

DESIGN REPORT

Sedimentation Structure

N11-G

Kayenta Mine

Navajo County, Arizona

PEABODY COAL COMPANY

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Introduction

Sedimentation Structure N11-G will be an earthen embankment, designed and constructed by Peabody Coal Company as a permanent impoundment structure to control runoff and sediment from the proposed N-11 surface mining area at the Kayenta Mine. The location of Structure N11-G and its watershed boundary is shown on Drawing No. 85400 (Sheet L-7), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to Structure N11-G located in series with upstream sedimentation structures N11-G1, N11-G2, and N11-G3. In addition, the spillway design for N11-G was evaluated using the 100-year, 6-hour storm assuming the upstream structures have been reclaimed. This will be the condition in approximately 2015 when N11-G1, N11-G2, and N11-G3 are reclaimed and N11-G remains as a permanent structure.

Prior to bond release by the regulatory authorities, Peabody Coal Company will utilize a qualified Registered Professional Engineer to review the performance standards required for N11-G. The engineer will recommend remedial work, if required, to modify or upgrade N11-G to assure compliance with the applicable permanent impoundment regulations, proposed postmining land use, and with the livestock and wildlife facility requirements in Chapter 23, Revegetation Plan, of the approved permit. The final permanent impoundment remedial plan for structure N11-G will be submitted to OSMRE approximately one year prior to final bond release.

Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody 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 Structure N11-G was inspected by a Registered Professional Engineer from Peabody Coal Company to ensure that the location was suitable and no adverse conditions existed to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6,

Attachment D was utilized for embankment design. A conservative embankment category of (B-3) with a 30-foot total embankment height was utilized for the design.

Site Description

Land Use

The four N11-G series structures have an 863.0-acre combined drainage area and is located on a tributary to Coal Mine Wash at the Kayenta Mine. The watershed is classified as 29 percent disturbed, 66 percent pinon-juniper, and 5 percent sagebrush-grass. Prior to the reclamation of the upstream structures, structure N11-G will have a 69.1-acre drainage area.

Design Analyses

General

Structure N11-G was designed by a Registered Professional Engineer from Peabody Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of the 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 1983 and was used in the analyses of the structure.

Stability

A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 20 feet wide on top will be constructed. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 5:1 were assumed. Based on a total embankment height of 30 feet, these slopes are equal to or flatter than the recommended slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 80-foot wide riprap-lined trapezoidal channel.

Hydrology

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). Structure N11-G is located downstream from structures N11-G1, N11-G2, and N11-G3. Structure N11-G is classified as a low hazard structure. No coal mining activities will occur downstream of the embankment. In addition, the mine area is sparsely populated with no one living in the downstream flood plain. The structure will

impound less than 20 acre-feet and be less than 20 feet in vertical height from the upstream toe of embankment of the natural stream elevation to the emergency spillway elevation. The four structures have a combined capacity that is greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm for a permanent impoundment and for the downstream ponds in series. Structures N11-G1, N11-G2, and N11-G3 were assumed to be reclaimed and structure N11-G was conservatively assumed to be full to the emergency spillway at the time of the 100-year storm. The storage capacity requirements of Structure N11-G was analyzed using the 10-year, 24-hour storm. The combined ponds in series were conservatively assumed to completely contain the 10-year, 24-hour storm without discharge downstream to Coal Mine Wash; plus, provide adequate sediment storage volume.

The following parameters were used in the hydrologic analysis:

	10-Year <u>24-Hr Storm</u>	100-Year <u>6-Hr. Storm</u>
1. Water Course Length, L	0.095 mi	1.686 mi
2. Elevation Difference, H	34.5 ft	392 ft
3. Time of Concentration, Tc	0.044 hr	0.476 hr
4. SCS Curve Number	86	83
5. Rainfall Depth	2.1 in	2.4 in
6. Drainage Area	69.11 ac	862.98 ac

Hydraulics

The SEDCAD⁺ and Dodson-Trapezoidal Channel computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure, and the resulting water surface elevations. The 10-year storm was routed through Structures N11-G3, N11-G2, and N11-G1 into Structure N11-G as will be the worst case scenario during mining and reclamation, and the 100-year storm was analyzed with Structures N11-G1, N11-G2, and N11-G3 reclaimed. The initial conditions and results of the analysis are summarized in the following N11-G hydraulics table:

N11-G HYDRAULICS TABLE

	Units	10-Yr, 24-Hr	100-Yr, 6-Hr
	Storm	Storm	Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway elevation
Inflow			
Peak Flow	cfs	316.7	811.7
Volume	ac-ft	5.3*	70.5
Storage			
Peak Stage	msl	N/A	6748.5
Emerg. Spillway Elev.	msl	6746.0	6746.0
Peak Storage	ac-ft	N/A	24.8
Storage Capacity	ac-ft	19.7	19.7
Outflow			
Peak Flow	cfs	N/A	777.4
Spillway Elevation	msl	6746.0	6746.0
Embankment Crest Elev.	msl	6752.0	6752.0
Peak Stage	msl	---	6748.5
Freeboard	ft	---	3.5
Emergency Spillway Channel			
Flow Depth	ft	---	2.5
Critical Velocity	fps	---	6.6
Mannings "n"	---	---	0.061
Width	ft	---	80
Outflow Channel			
Slope	%	---	17.0
Normal Velocity	fps	---	9.6
Normal Depth	ft	---	1.0
Mannings "n"	---	---	0.061

* Inflow volume for the drainage area between Structures N11-G and N11-G1.

Emergency Spillway and Outlet Channel

The emergency spillway and outlet channel for N11-G will be a trapezoidal channel. The alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

Minimum Channel Depth (Spillway) . . . 3.5 ft.

(Outflow) . . . 2.0 ft.

Channel Length (Spillway) 65 ft.

(Outflow) 190 ft.

Side Slopes (Horizontal to Vertical) . . 3:1 or flatter

Average Slope (Spillway) 0 %

Maximum Slope (Outflow) 17 %

Spillway Elevation 6746.0

A minimum 15-foot long riprapped channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

Storage Capacity

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Coal Company. The total storage capacity of Structure N11-G is designed to contain approximately 19.69 acre-feet.

The calculations for the sediment load entering Structure N11-G were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

- | | | | |
|----|----------------------------|-------|-------|
| 1. | Rainfall Factor, R | | 40 |
| 2. | Soil Erodibility Factor, K | | 0.36 |
| 3. | Slope Factor, LS | | 11.87 |
| 4. | Cover Factor, C | | 0.67 |
| 5. | Erosion Control Factor, P | | 0.39 |

The hydrologic analysis gives the storage volume required to treat the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Although Structure N11-G has sufficient storage by itself, the structures upstream from N11-G do not have sufficient storage and contribute excess runoff downstream to N11-G. Therefore, the combined sediment storage capacity was determined for the four structures in series. The results of the analysis are presented in the following table.

Combined Storage for Structures N11-G3, N11-G2, N11-G1, and N11-G

	N11-G3	N11-G2	N11-G1	N11-G	Combined
Total Storage Capacity	18.61	18.63	19.14	19.69	76.07 ac-ft
10-Year, 24-Hour Storm Inflow	42.58	5.09	0.76	5.33	53.76 ac-ft
Available Sediment					
Storage Capacity	---	---	7.95	14.36	22.31 ac-ft
Sediment Inflow Rate/Yr	5.14	0.89	0.21	1.43	7.67 ac-ft/yr
Sediment Storage Life	---	---	---	---	2.9 yrs

Diversions

Due to the topography and the location of the surface mining disturbance, it will be necessary to construct a temporary diversion (i.e., N11-G #1 Terrace). The location of this temporary diversion is shown on Exhibit 1 and Drawing 85400, Sheet L-7. The temporary diversion will receive the overland runoff from the N-11 mining and reclamation area and divert runoff within Sedimentation Pond N11-G's watershed. This diversion will be constructed in accordance with the enclosed design (see Appendix D) and the typical cross sections and construction specifications for terraces and downdrains found in Chapter 26.

N11-G #1 Terrace (Temporary Diversion) Summary

Purpose: To divert approximately 1.9 acres of N-11 mining and reclamation area runoff within the Sedimentation Pond N11-G's watershed (see Drawing No. 85400, Sheet L-7 and Exhibit 1 for location; see Appendix D for calculations).

10-Year, 6-Hour Precipitation	=	1.60 inches
Area	=	1.88 ac
CN	=	86
Time of Concentration	=	0.065 hr
Peak Discharge (100-yr, 6-hr)	=	3.37 cfs
Critical Slope	=	2.15 %
V-Ditch Design Depth w/freeboard	=	3.5 ft

Therefore, two alternative V-ditch designs are recommended:

A. Earth-lined V-ditch (subcritical flow)

Average slope = 1.0 %
n = 0.03 (graded silts)
 d_n = 0.82 ft
Velocity = 2.53 fps
Minimum freeboard = 1.0 ft

B. Riprap-lined Trapezoidal-ditch (supercritical flow)

Maximum slope = 15 %
n = 0.032 (riprap)
Width = 10 ft
 d_n = 0.06 ft
Velocity = 5.61 fps
Riprap D_{max} = 7.5 in
Riprap D₅₀ = 6.0 in
Minimum freeboard = 1.0 ft

Note: Minimum 20 ft. length of riprapped ditch as a transitional channel between the two alternative designs.

See Chapter 26 for construction specifications and typical cross sections for terraces and downdrains.

In conclusion, the earth-lined V-ditch design will be utilized in the subcritical slope channel sections and the riprap-lined V-ditch design will be utilized in the supercritical slope sections.

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

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

Appendix B - SEDCAD⁺ (Input and Output) 10-year, 24-hour Storm Event

Appendix C - SEDCAD⁺ (Input and Output) 100-year, 6-hour Storm Event

Appendix D - Temporary Diversion, N11-G #1 Terrace Calculations

Exhibit 1 - Proposed N11-G, N11-G1, N11-G2, and N11-G3 Sedimentation Ponds

APPENDIX A

HYDROLOGY, HYDRAULIC, AND SEDIMENTATION CALCULATIONS

N11-G

Project: N11-G Pond (In-Series)

Time of Concentration:

$$\text{Elevation Difference} = 6764.5 - 6730 = 34.5 \text{ ft.}$$

$$\text{Watercourse Length} = 500 \text{ ft.} = 0.095 \text{ mi.}$$

$$T_c = [11.9(W.L.)^3/(E.D.)]^{0.385} = 0.044 \text{ hr.}$$

SCS Curve Number:

Cover	Soil	Area		
Type	Group	CN	(Acres)	CN*Area
Disturbed	B	86	63.13	5429.2
Pinon-Juniper	D	83	<u>5.98</u>	<u>496.3</u>
			69.11	5925.5

$$\text{Weighted CN} = 5925.5/69.11 = 85.7 = \underline{\text{Use 86}}$$

Drainage Basin Area:

69.11 acres

0.11 sq. miles

SEDCAD Utility-Routing Parameters:

$$K = 0.053 \text{ hr}$$

$$X = 0.304 \text{ hr}$$

Project: N11-G Pond (Only)

Time of Concentration:

$$\text{Elevation Difference} = 7122 - 6730 = 392 \text{ ft.}$$

$$\text{Watercourse Length} = 8900 \text{ ft.} = 1.686 \text{ mi.}$$

$$T_c = \left[\frac{11.9 (\text{W.L.})^3}{ED} \right]^{0.385} = 0.476 \text{ hr.}$$

SCS Curve Number:

Cover	Soil	Area		
Type	Group	CN	(Acres)	CN x Area
Disturbed	B	86	249.84	21486.2
Sagebrush-Grass	B	60	41.48	2488.8
Pinon-Juniper	B	65	24.30	1579.5
Pinon-Juniper	D	83	<u>547.36</u>	<u>45430.9</u>
			862.98	70985.4

$$\text{Weighted CN} = 70985.4 / 862.98 = 82.3 = \underline{\text{Use 83}}$$

Drainage Basin Area:

862.98 acres

1.348 sq. miles

Revised USLE Calculations:

Project: N11-G Pond (In-Series)

Soil Erodibility Factor:

Soil Type	Group	K	Area (Acres)	K * Area
3E	D	0.15	3.99	0.599
42	D	0.16	1.99	0.318
Newly Reclaimed	B	0.38	<u>63.13</u>	<u>23.989</u>
			69.11	24.906

$$\text{Weighted k} = 24.906/69.11 = \underline{0.36}$$

Slope Factor:

Elev.	Slope	Theta	LS		
Length (ft)	Diff (ft)	(%)	M (Degrees)	$(L/72.6)^M[17.25\sin(\theta)-0.55]$	
700	195	27.86	0.6	15.57	15.84
450	90	20.00	0.6	11.31	8.44
850	150	17.65	0.6	10.01	10.68
850	172	20.24	0.6	11.44	12.52
<u>Avg. LS = 11.87</u>					

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (Acres)	C	C * Area	P	P * Area
Pinon-Juniper	40	25	5.98	0.14	0.84	1.0	5.98
Newly Reclaimed	--	--	<u>63.13</u>	0.725	<u>45.77</u>	0.336	<u>21.21</u>
			69.11		46.61		27.19

$$\text{Weighted C} = 46.61/69.11 = \underline{0.67}$$

$$\text{Weighted P} = 27.19/69.11 = \underline{0.39}$$

Rainfall Factor: R = 40

Revised USLE Calculations:

$$A = R * K * LS * C * P$$

$$A = 40 * 0.36 * 11.87 * 0.67 * 0.39 = 44.66 \text{ tons/acre}$$

Sediment Inflow Rate:

$$DA = 69.11$$

$$SDR = 0.95$$

$$SI = (A * DA * SDR * 94) / 192,400 = \underline{1.43} \text{ ac-ft/yr}$$

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

August 19, 1993
N11-G POND SPILLWAY 100-YR., 6-HR. STORM

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PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	777.4
Manning's Roughness Coefficient (n-value).....	0.0610
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	80.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	1.41
Critical Slope (feet per foot).....	0.0496
Flow Velocity (feet per second).....	6.57
Froude Number.....	1.000
Velocity Head (feet).....	0.67
Energy Head (feet).....	2.08
Cross-Sectional Area of Flow (square feet).....	118.40
Top Width of Flow (feet).....	88.44

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-G POND SPILLWAY 100-YR., 6-HR. STORM

INPUT VALUES:

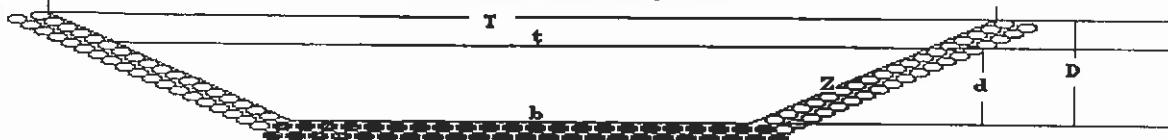
Shape	TRAPEZOIDAL
Discharge	777.41 cfs
Slope	17.00 %
Sideslopes (L and R)	3.00:1 3.00:1
Bottom Width	80.00 feet
Freeboard	1 ft

RESULTS:

Steep Slope Design - PADER Method

Depth	0.97 ft
with Freeboard	1.97 ft
Top Width	85.84 ft
with Freeboard	91.84 ft
Velocity	9.64 fps
Cross Sectional Area	80.66 sq ft
Hydraulic Radius	0.94 ft
Manning's n	0.061
Froude Number	1.75
Dmax	0.938 ft (11.25 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEDCAD+ CHANNEL DESIGN
N11-G POND SPILLWAY 100-YR., 6-HR. STORM



Riprap - Steep Slope Design - PADER Method

Discharge	= 777.41 cfs	Depth (d)	= 0.97 (w/ Freeboard: D = 1.97) ft
Bottom (b)	= 80.00 ft	Top width (t)	= 85.84 (T = 91.84) ft
Side slopes (Z)	= 3.0:1(L) 3.0:1(R)	Velocity	= 9.64 fps
Bed slope	= 17.00 %	Hydraulic Radius	= 0.94 ft
Manning's n	= 0.061	Froude number	= 1.75
	D _{max} = 0.94 ft (11.25 in)		
	D ₅₀ = 0.75 ft (9.00 in)		
	D ₁₀ = 0.25 ft (3.00 in)		

APPENDIX B

N11-G SEDCAD+ (INPUT AND OUTPUT)

10-YEAR, 24-HOUR STORM EVENT

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-G SERIES PONDS 10-YR., 24-HR. STORM

by

Name: JGS

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11GR5A

Date: 08-19-1993

Civil Software Design -- SEDCAD+ Version 3.1
 Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
 Filename: C:\SEDCAD3\K-MINE\N11GR5A User: JGS
 Date: 08-19-1993 Time: 08:40:16
 N11-G SERIES PONDS 10-YR., 24-HR. STORM
 Storm: 2.10 inches, 10 year-24 hour, SCS Type II
 Hydrograph Convolution Interval: 0.1 hr

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 SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE
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-Hydrology-

JBS SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111 1	714.23	82	F	0.422	0.000	0.000	0.0	42.58	362.87
		Type: Pond			Label: N11-G3 POND				
111 Structure	714.23							42.58	
111 Total IN	714.23							42.58	362.87
111 Total OUT								42.58	324.42
112 1	66.06	86	F	0.029	0.000	0.000	0.0	5.09	65.05
		Type: Pond			Label: N11-G2 POND				
2 Structure	66.06							47.68	
112 Total IN	780.29							47.68	337.61
112 Total OUT								47.68	317.80
111 to 112 Routing					0.031	0.307			
113 1	13.58	81	F	0.036	0.000	0.000	0.0	0.76	10.02
		Type: Pond			Label: N11-G1 POND				
113 Structure	13.58							48.43	
113 Total IN	793.87							48.43	319.94
113 Total OUT								48.44	308.90
112 to 113 Routing					0.040	0.309			
114 1	69.11	86	F	0.044	0.000	0.000	0.0	5.33	68.06
		Type: Null			Label: N11-G POND				
114 Structure	69.11							53.76	
114 Total IN/OUT	862.98							53.76	316.71
113 to 114 Routing					0.053	0.304			

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR5A User: JGS
Date: 08-19-1993 Time: 08:40:16
N11-G SERIES PONDS 10-YR., 24-HR. STORM
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
LAST POND ONLY TABLE
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J1, B1, S3
N11-G1 POND

Drainage Area from J1, B1, S3, SWS(s)1: 13.6 acres
Total Contributing Drainage Area: 793.9 acres

DISCHARGE OPTIONS:

Emergency
Spillway

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6764.0
Crest Length (ft)	65.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	70.0

POND RESULTS:

Permanent
Pool
(ac-ft)
=====

19.1

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	48.43	319.94
OUT	48.44	308.90

Elevation	Peak Hydrograph Detention Time (hrs)
6765.5	0.12

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR5A User: JGS
Date: 08-19-1993 Time: 08:40:16
N11-G SERIES PONDS 10-YR., 24-HR. STORM
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====

POND INPUT/OUTPUT TABLE

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J1, B1, S1
N11-G3 POND

Drainage Area from J1, B1, S1, SWS(s)1: 714.2 acres
Total Contributing Drainage Area: 714.2 acres

DISCHARGE OPTIONS:

Emergency
Spillway

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6787.0
Crest Length (ft)	60.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	70.0

POND RESULTS:

Permanent
Pool
(ac-ft)

=====

18.6

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	42.58	362.87
OUT	42.58	324.42

Elevation	Peak Hydrograph Detention Time (hrs)
6788.6	0.20

**J1, B1, S2
 N11-G2 POND**

Drainage Area from J1, B1, S2, SWS(s)1: 66.1 acres
Total Contributing Drainage Area: 780.3 acres

DISCHARGE OPTIONS:

Emergency
 Spillway

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6775.5
Crest Length (ft)	55.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	70.0

POND RESULTS:

Permanent
 Pool
 (ac-ft)

=====

18.6

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	47.68	337.61
OUT	47.68	317.80

Elevation	Peak Hydrograph Detention Time (hrs)
6777.1	0.17

J1, B1, S3
N11-G1 POND

Drainage Area from J1, B1, S3, SWS(s)1: 13.6 acres
Total Contributing Drainage Area: 793.9 acres

DISCHARGE OPTIONS:

Emergency
Spillway

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6764.0
Crest Length (ft)	65.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	70.0

POND RESULTS:

Permanent

Pool
(ac-ft)
=====

19.1

Runoff Peak
Volume Discharge
(ac-ft) (cfs)
=====

IN 48.43 319.94
OUT 48.44 308.90

Peak Hydrograph
Elevation Detention Time
(hrs)
=====

6765.5 0.12

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR5A User: JGS
Date: 08-19-1993 Time: 08:40:16
N11-G SERIES PONDS 10-YR., 24-HR. STORM
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
ELEVATION-DISCHARGE TABLE
=====

J1, B1, S1
N11-G3 POND

Drainage Area from J1, B1, S1, SWS(s)1: 714.2 acres
Total Contributing Drainage Area: 714.2 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
6775.00	0.0	0.0
6775.50	0.0	0.0
6776.00	0.0	0.0
6776.50	0.0	0.0
6777.00	0.0	0.
6777.50	0.0	0.0
6778.00	0.0	0.0
6778.50	0.0	0.0
6779.00	0.0	0.0
6779.50	0.0	0.0
6780.00	0.0	0.0
6780.50	0.0	0.0
6781.00	0.0	0.0
6781.50	0.0	0.0
6782.00	0.0	0.0
6782.50	0.0	0.0
6783.00	0.0	0.0
6783.50	0.0	0.0
6784.00	0.0	0.0
6784.50	0.0	0.0
6785.00	0.0	0.0
6785.50	0.0	0.0
6786.00	0.0	0.0
6786.50	0.0	0.0
6787.00	0.0	0.0
6787.50	51.4	51.4
6787.80	82.3	82.3
6787.90	102.2	102.2
6788.00	123.6	123.6
6788.50	294.0	294.0
6789.00	468.8	468.8
6789.50	690.1	690.1
6790.00	945.3	945.3
6790.50	1253.4	1253.4
6791.00	1595.1	1595.1

6791.50	1969.6	1969.6
6792.00	2376.3	2376.3

J1, B1, S2
N11-G2 POND

Drainage Area from J1, B1, S2, SWS(s)1: 66.1 acres
Total Contributing Drainage Area: 780.3 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
6765.00	0.0	0.0
6765.50	0.0	0.0
6766.00	0.0	0.0
6766.50	0.0	0.0
6767.00	0.0	0.0
6767.50	0.0	0.0
6768.00	0.0	0.0
6768.50	0.0	0.0
6769.00	0.0	0.0
6769.50	0.0	0.0
6770.00	0.0	0.0
6770.50	0.0	0.0
6771.00	0.0	0.0
6771.50	0.0	0.0
6772.00	0.0	0.0
6772.50	0.0	0.0
6773.00	0.0	0.0
6773.50	0.0	0.0
6774.00	0.0	0.0
6774.50	0.0	0.0
6775.00	0.0	0.0
6775.50	0.0	0.0
6776.00	52.9	52.9
6776.30	84.7	84.7
6776.40	104.8	104.8
6776.50	126.4	126.4
6777.00	295.9	295.9
6777.50	474.4	474.4
6778.00	699.1	699.1
6778.50	959.9	959.9
6779.00	1269.7	1269.7
6779.50	1613.0	1613.0
6780.00	1989.2	1989.2

J1, B1, S3
N11-G1 POND

Drainage Area from J1, B1, S3, SWS(s)1: 13.6 acres
Total Contributing Drainage Area: 793.9 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
-----------	--------------------------	-----------------------

6745.00	0.0	0.0
6745.50	0.0	0.0
6746.00	0.0	0
6746.50	0.0	0.
6747.00	0.0	0.0
6747.50	0.0	0.0
6748.00	0.0	0.0
6748.50	0.0	0.0
6749.00	0.0	0.0
6749.50	0.0	0.0
6750.00	0.0	0.0
6750.50	0.0	0.0
6751.00	0.0	0.0
6751.50	0.0	0.0
6752.00	0.0	0.0
6752.50	0.0	0.0
6753.00	0.0	0.0
6753.50	0.0	0.0
6754.00	0.0	0.0
6754.50	0.0	0.0
6755.00	0.0	0.0
6755.50	0.0	0.0
6756.00	0.0	0.0
6756.50	0.0	0.0
6757.00	0.0	0.0
6757.50	0.0	0.0
6758.00	0.0	0.0
6758.50	0.0	0.0
6759.00	0.0	0.
6759.50	0.0	0.0
6760.00	0.0	0.0
6760.50	0.0	0.0
6761.00	0.0	0.0
6761.50	0.0	0.0
6762.00	0.0	0.0
6762.50	0.0	0.0
6763.00	0.0	0.0
6763.50	0.0	0.0
6764.00	0.0	0.0
6764.50	49.9	49.9
6764.80	79.9	79.9
6764.90	99.6	99.6
6765.00	120.9	120.9
6765.50	292.1	292.1
6766.00	463.3	463.3
6766.50	681.1	681.1
6767.00	930.8	930.8
6767.50	1237.2	1237.2
6768.00	1577.2	1577.2
6768.50	1950.1	1950.1
6769.00	2355.2	2355.2
6769.50	2792.2	2792.2
6770.00	3260.8	3260.8

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR5A User: JGS
Date: 08-19-1993 Time: 08:40:16
N11-G SERIES PONDS 10-YR., 24-HR. STORM
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
=====

J1, B1, S1
N11-G3 POND

Drainage Area from J1, B1, S1, SWS(s)1: 714.2 acres
Total Contributing Drainage Area: 714.2 acres

SW#1: Emergency Spillway

Elev	Stage	Area	Capacity	Discharge
	(ft)	(ac)	(ac-ft)	(cfs)
6775.00	0.00	0.65	0.00	0.00
6775.50	0.50	0.70	0.34	0.00
6776.00	1.00	0.75	0.70	0.00
6776.50	1.50	0.81	1.09	0.00
6777.00	2.00	0.87	1.51	0.00
6777.50	2.50	0.93	1.96	0.00
6778.00	3.00	0.99	2.44	0.00
6778.50	3.50	1.05	2.95	0.00
6779.00	4.00	1.11	3.49	0.00
6779.50	4.50	1.18	4.06	0.00
6780.00	5.00	1.25	4.67	0.00
6780.50	5.50	1.34	5.32	0.00
6781.00	6.00	1.44	6.01	0.00
6781.50	6.50	1.53	6.75	0.00
6782.00	7.00	1.64	7.55	0.00
6782.50	7.50	1.74	8.39	0.00
6783.00	8.00	1.85	9.29	0.00
6783.50	8.50	1.96	10.24	0.00
6784.00	9.00	2.07	11.25	0.00
6784.50	9.50	2.19	12.31	0.00
6785.00	10.00	2.31	13.44	0.00
6785.50	10.50	2.44	14.62	0.00
6786.00	11.00	2.58	15.88	0.00
6786.50	11.50	2.72	17.21	0.00
6787.00	12.00	2.87	18.61	0.00
6787.50	12.50	3.02	20.08	51.43
6787.80	12.80	3.11	21.00	82.28
6787.90	12.90	3.14	21.31	102.22
6788.00	13.00	3.17	21.62	123.60
6788.50	13.50	3.33	23.25	294.02
6788.59	13.59	3.33	23.55	324.42
6789.00	14.00	3.49	24.95	468.83
6789.50	14.50	3.65	26.74	690.08
6790.00	15.00	3.82	28.61	945.29
6790.50	15.50	4.00	30.56	1253.36

Stage of SW#1

Peak Stage

6791.00	16.00	4.18	32.61	1595.08
6791.50	16.50	4.37	34.74	1969.59
6792.00	17.00	4.56	36.98	2376.33

J1, B1, S2
N11-G2 POND

Drainage Area from J1, B1, S2, SWS(s)1: 66.1 acres
Total Contributing Drainage Area: 780.3 acres

SW#1: Emergency Spillway

Elev	Stage	Area	Capacity	Discharge
(ft)	(ac)	(ac-ft)		(cfs)

6765.00	0.00	1.26	0.00	0.00
6765.50	0.50	1.30	0.64	0.00
6766.00	1.00	1.35	1.30	0.00
6766.50	1.50	1.39	1.99	0.00
6767.00	2.00	1.44	2.69	0.00
6767.50	2.50	1.48	3.42	0.00
6768.00	3.00	1.53	4.17	0.00
6768.50	3.50	1.57	4.95	0.00
6769.00	4.00	1.62	5.75	0.00
6769.50	4.50	1.67	6.57	0.00
6770.00	5.00	1.72	7.42	0.00
6770.50	5.50	1.78	8.29	0.00
6771.00	6.00	1.83	9.20	0.00
6771.50	6.50	1.89	10.13	0.00
6772.00	7.00	1.95	11.08	0.00
6772.50	7.50	2.00	12.07	0.00
6773.00	8.00	2.06	13.09	0.00
6773.50	8.50	2.12	14.13	0.00
6774.00	9.00	2.19	15.21	0.00
6774.50	9.50	2.25	16.32	0.00
6775.00	10.00	2.31	17.46	0.00
6775.50	10.50	2.38	18.63	0.00 Stage of SW#1
6776.00	11.00	2.45	19.84	52.93
6776.30	11.30	2.49	20.58	84.69
6776.40	11.40	2.50	20.83	104.81
6776.50	11.50	2.51	21.08	126.38
6777.00	12.00	2.58	22.35	295.90
6777.06	12.06	2.58	22.51	317.80 Peak Stage
6777.50	12.50	2.65	23.66	474.42
6778.00	13.00	2.72	25.00	699.12
6778.50	13.50	2.79	26.38	959.88
6779.00	14.00	2.86	27.80	1269.66
6779.50	14.50	2.94	29.25	1613.03
6780.00	15.00	3.01	30.73	1989.17

J1, B1, S3
N11-G1 POND

Drainage Area from J1, B1, S3, SWS(s)1: 13.6 acres
Total Contributing Drainage Area: 793.9 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6745.00	0.00	0.46	0.00	0.00
15.50	0.50	0.48	0.24	0.00
6746.00	1.00	0.50	0.48	0.00
6746.50	1.50	0.53	0.74	0.00
6747.00	2.00	0.55	1.01	0.00
6747.50	2.50	0.57	1.29	0.00
6748.00	3.00	0.60	1.58	0.00
6748.50	3.50	0.62	1.89	0.00
6749.00	4.00	0.65	2.21	0.00
6749.50	4.50	0.67	2.54	0.00
6750.00	5.00	0.70	2.88	0.00
6750.50	5.50	0.73	3.24	0.00
6751.00	6.00	0.75	3.61	0.00
6751.50	6.50	0.78	3.99	0.00
6752.00	7.00	0.81	4.39	0.00
6752.50	7.50	0.84	4.80	0.00
6753.00	8.00	0.87	5.23	0.00
6753.50	8.50	0.90	5.67	0.00
6754.00	9.00	0.93	6.12	0.00
6754.50	9.50	0.96	6.60	0.00
6755.00	10.00	0.99	7.08	0.00
6755.50	10.50	1.02	7.59	0.00
6756.00	11.00	1.06	8.11	0.00
6756.50	11.50	1.09	8.65	0.00
6757.00	12.00	1.13	9.20	0.00
6757.50	12.50	1.17	9.78	0.00
6758.00	13.00	1.20	10.37	0.00
6758.50	13.50	1.24	10.98	0.00
6759.00	14.00	1.28	11.61	0.00
6759.50	14.50	1.32	12.26	0.00
6760.00	15.00	1.36	12.93	0.00
6760.50	15.50	1.41	13.63	0.00
6761.00	16.00	1.45	14.34	0.00
6761.50	16.50	1.50	15.08	0.00
6762.00	17.00	1.55	15.84	0.00
6762.50	17.50	1.60	16.63	0.00
6763.00	18.00	1.65	17.44	0.00
6763.50	18.50	1.70	18.28	0.00
6764.00	19.00	1.75	19.14	0.00
6764.50	19.50	1.80	20.03	49.94
6764.80	19.80	1.83	20.57	79.90
6764.90	19.90	1.84	20.75	99.64
6765.00	20.00	1.85	20.94	120.85
6765.50	20.50	1.91	21.88	292.14
6765.55	20.55	1.91	21.97	308.90
6766.00	21.00	1.97	22.85	463.27
6766.50	21.50	2.04	23.85	681.09
6767.00	22.00	2.10	24.89	930.79
6767.50	22.50	2.17	25.95	1237.15
6768.00	23.00	2.23	27.05	1577.21
6768.50	23.50	2.30	28.19	1950.10
6769.00	24.00	2.37	29.36	2355.23
6769.50	24.50	2.44	30.56	2792.22
6770.00	25.00	2.51	31.80	3260.82

APPENDIX C

N11-G SEDCAD+ (INPUT AND OUTPUT)

100-YEAR, 6-HOUR STORM EVENT

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-G POND (ONLY) 100-YR., 6-HR. STORM

by

Name: JGS

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11GR4A

Date: 08-19-1993

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR4A User: JGS
Date: 08-19-1993 Time: 08:40:04
N11-G POND (ONLY) 100-YR.,6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE
=====

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	862.98	83	F	0.476	0.000	0.000	0.0	70.54	811.74
			Type:	Pond		Label:	N11-G POND			
111	Structure	862.98							70.54	
111	Total IN	862.98							70.54	811.74
111	Total OUT								70.54	777.41
112	1	0.00	0	F	0.000	0.000	0.000	0.0	0.00	0.00
			Type:	Null		Label:	NULL			
112	Structure	0.00							70.54	
112	Total IN/OUT	862.98							70.54	777.41
111	to 112 Routing				0.000	0.000				

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR4A User: JGS
Date: 08-19-1993 Time: 08:40:04
N11-G POND (ONLY) 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
LAST POND ONLY TABLE
=====

J1, B1, S1
N11-G POND

Drainage Area from J1, B1, S1, SWS(s)1: 863.0 acres
Total Contributing Drainage Area: 863.0 acres

DISCHARGE OPTIONS:

Emergency
Spillway

=====

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6746.0
Crest Length (ft)	65.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	80.0

POND RESULTS:

Permanent
Pool
(ac-ft)
=====

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	70.54	811.74
OUT	70.54	777.41

Elevation	Peak Hydrograph Detention Time (hrs)
6748.5	0.10

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR4A User: JGS
Date: 08-19-1993 Time: 08:40:04
N11-G POND (ONLY) 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====

POND INPUT/OUTPUT TABLE

=====

J1, B1, S1
N11-G POND

Drainage Area from J1, B1, S1, SWS(s)1: 863.0 acres
Total Contributing Drainage Area: 863.0 acres

DISCHARGE OPTIONS:

Emergency
Spillway

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6746.0
Crest Length (ft)	65.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	80.0

POND RESULTS:

Permanent
Pool
(ac-ft)

=====

19.7

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	70.54	811.74
OUT	70.54	777.41

Elevation	Peak Hydrograph Detention Time (hrs)
6748.5	0.10

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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR4A User: JGS
Date: 08-19-1993 Time: 08:40:04
N11-G POND (ONLY) 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====

ELEVATION-DISCHARGE TABLE

=====

J1, B1, S1
N11-G POND

Drainage Area from J1, B1, S1, SWS(s)1: 863.0 acres
Total Contributing Drainage Area: 863.0 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
6730.00	0.0	0.0
6730.50	0.0	0.0
6731.00	0.0	0.0
6731.50	0.0	0.0
6732.00	0.0	0.
6732.50	0.0	0..
6733.00	0.0	0.0
6733.50	0.0	0.0
6734.00	0.0	0.0
6734.50	0.0	0.0
6735.00	0.0	0.0
6735.50	0.0	0.0
6736.00	0.0	0.0
6736.50	0.0	0.0
6737.00	0.0	0.0
6737.50	0.0	0.0
6738.00	0.0	0.0
6738.50	0.0	0.0
6739.00	0.0	0.0
6739.50	0.0	0.0
6740.00	0.0	0.0
6740.50	0.0	0.0
6741.00	0.0	0.0
6741.50	0.0	0.0
6742.00	0.0	0.0
6742.50	0.0	0.0
6743.00	0.0	0.0
6743.50	0.0	0.0
6744.00	0.0	0.0
6744.50	0.0	0..
6745.00	0.0	0.
6745.50	0.0	0.0
6746.00	0.0	0.0
6746.50	57.0	57.0
6746.80	91.1	91.1

6746.90	113.6	113.6
6747.00	137.8	137.8
6747.50	332.5	332.5
6748.00	526.5	526.5
748.50	772.9	772.9
o749.00	1054.6	1054.6
6749.50	1399.5	1399.5
6750.00	1781.4	1781.4
6750.50	2199.2	2199.2
6751.00	2652.0	2652.0
6751.50	3139.4	3139.4
6752.00	3660.9	3660.9

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11GR4A User: JGS
Date: 08-19-1993 Time: 08:40:04
N11-G POND (ONLY) 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
=====

J1, B1, S1
N11-G POND

Drainage Area from J1, B1, S1, SWS(s)1: 863.0 acres
Total Contributing Drainage Area: 863.0 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6730.00	0.00	0.56	0.00	0.00
6730.50	0.50	0.60	0.29	0.00
6731.00	1.00	0.65	0.60	0.00
6731.50	1.50	0.70	0.94	0.00
6732.00	2.00	0.75	1.30	0.00
6732.50	2.50	0.80	1.69	0.00
6733.00	3.00	0.85	2.10	0.00
6733.50	3.50	0.91	2.54	0.00
6734.00	4.00	0.96	3.01	0.00
6734.50	4.50	1.02	3.50	0.00
6735.00	5.00	1.08	4.03	0.00
6735.50	5.50	1.10	4.58	0.00
6736.00	6.00	1.13	5.13	0.00
6736.50	6.50	1.15	5.70	0.00
6737.00	7.00	1.18	6.29	0.00
6737.50	7.50	1.20	6.88	0.00
6738.00	8.00	1.23	7.49	0.00
6738.50	8.50	1.25	8.11	0.00
6739.00	9.00	1.28	8.74	0.00
6739.50	9.50	1.30	9.39	0.00
6740.00	10.00	1.33	10.04	0.00
6740.50	10.50	1.37	10.72	0.00
6741.00	11.00	1.42	11.42	0.00
6741.50	11.50	1.46	12.14	0.00
6742.00	12.00	1.51	12.88	0.00
6742.50	12.50	1.56	13.65	0.00
6743.00	13.00	1.60	14.44	0.00
6743.50	13.50	1.65	15.25	0.00
6744.00	14.00	1.70	16.09	0.00
6744.50	14.50	1.75	16.95	0.00
6745.00	15.00	1.80	17.84	0.00
6745.50	15.50	1.85	18.75	0.00
6746.00	16.00	1.91	19.69	0.00
6746.50	16.50	1.96	20.66	56.97
6746.80	16.80	2.00	21.26	91.15

Stage of SW#1

6746.90	16.90	2.01	21.46	113.64
6747.00	17.00	2.02	21.66	137.79
6747.50	17.50	2.07	22.68	332.49
6748.00	18.00	2.13	23.73	526.50
6748.50	18.50	2.19	24.81	772.87
6748.51	18.51	2.19	24.83	777.41 Peak Stage
6749.00	19.00	2.24	25.92	1054.65
6749.50	19.50	2.30	27.05	1399.52
6750.00	20.00	2.36	28.22	1781.39
6750.50	20.50	2.43	29.42	2199.15
6751.00	21.00	2.50	30.65	2652.01
6751.50	21.50	2.58	31.92	3139.41
6752.00	22.00	2.65	33.23	3660.94

APPENDIX D

TEMPORARY DIVERSION
N11-G #1 TERRACE CALCULATIONS

Project: N11-G #1 Terrace (Temporary Diversion)

Time of Concentration

$$\text{Elevation Difference} = 6950 - 6890 = 60 \text{ ft.}$$

$$\text{Watercourse Length} = 850 \text{ ft} = 0.161 \text{ mi.}$$

$$T_c = [11.9(W.L)^3/(E.D.)]^{0.385} = 0.065 \text{ hr.}$$

SCS Curve Number

Cover Type	Soil Group	CN	Area (Acres)	CN * Area
Disturbed	B	86	1.88	161.68

$$\text{Weighted CN} = 161.68/1.88 = 86.000 = \underline{\underline{86}}$$

Drainage Basin Area

1.88 acres 0.00294 sq. miles

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-G #1 TERRACE (TEMPORARY DIVERSION) 10-YR., 6-HR. STORM

by

Name: J.G.S

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\11GDIV

Date: 09-02-1993

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\11GDIV User: J.G.S
Date: 09-02-1993 Time: 08:05:41
N11-G #1 TERRACE (TEMPORARY DIVERSION) 10-YR., 6-HR. STORM
Storm: 1.60 inches, 10 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	1.88	86	F	0.065	0.000	0.000	0.0	0.09	1.74
Type: Null Label: N11-G #1 TERRACE										
111	Structure	1.88							0.09	
111 Total IN/OUT		1.88							0.09	1.74

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 2, 1993
N11-G #1 TERRACE 10-YR., 6-HR. STORM

=====

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	1.7
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.54
Critical Slope (feet per foot).....	0.0235
Flow Velocity (feet per second).....	2.5
Froude Number.....	1.0
Velocity Head (feet).....	0.14
Energy Head (feet).....	0.68
Cross-Sectional Area of Flow (square feet).....	0.59
Top Width of Flow (feet).....	2.17

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-G #1 TERRACE (TEMPORARY DIVERSION)

Limiting Velocity Technique
Sediment-laden Water

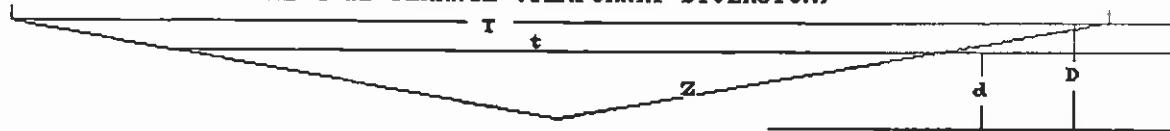
INPUT VALUES:

Shape	TRIANGULAR
Discharge	1.74 cfs
Slope	1.00 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.030
Max. Velocity	5.50 fps
Material	GRADED SILTS - COBBLES COLLOIDAL
Freeboard	1.0 ft

RESULTS:

Actual Discharge	1.74 cfs
Depth	0.64 ft
with Freeboard	1.64 ft
Top Width	2.54 ft
with Freeboard	6.54 ft
Velocity	2.15 fps
Cross Sectional Area	0.81 sq ft
Hydraulic Radius	0.28 ft
Froude Number	0.67

**SEDCAD+ CHANNEL DESIGN
N11-G #1 TERRACE (TEMPORARY DIVERSION)**



MATERIAL: GRADED SILTS - CORBLES COLLOIDAL
Limiting Variable: Velocity = 5.500 fps
 Sediment-laden Water

Discharge	=	1.74 cfs	Depth (d)	=	0.64 (D = 1.64) ft	w/ Freeboard:
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	2.54 (T = 6.54) ft	
Bed Slope	=	1.00%	Velocity	=	2.15 fps	
Manning's n	=	0.030	Hydraulic Radius	=	0.28 ft	
			Froude number	=	0.67	

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 2, 1993
N11-G #1 TERRACE 10-YR., 6-HR. STORM
RI普RAP TRANSITION

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	1.7
Manning's Roughness Coefficient (n-value).....	0.0320
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	10.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.10
Critical Slope (feet per foot).....	0.0329
Flow Velocity (feet per second).....	1.74
Froude Number.....	1.000
Velocity Head (feet).....	0.05
Energy Head (feet).....	0.14
Cross-Sectional Area of Flow (square feet).....	1.00
Top Width of Flow (feet).....	10.58

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-G #1 TERRACE TRANSITION 10-YR., 6-HR.

INPUT VALUES:

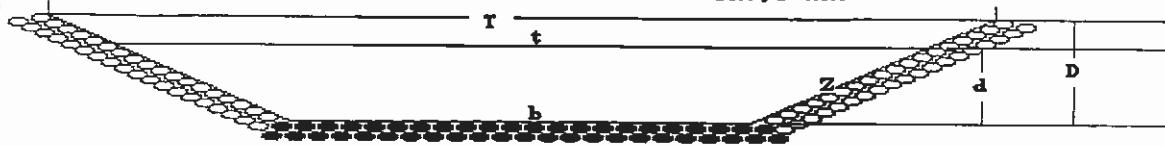
Shape	TRAPEZOIDAL
Discharge	1.74 cfs
Slope	15.00 %
Sideslopes (L and R)	3.00:1 3.00:1
Bottom Width	10.00 feet
Freeboard	1 ft

RESULTS:

Steep Slope Design - Simons/OSM Method

Depth	0.05 ft
with Freeboard	1.05 ft
Top Width	10.27 ft
with Freeboard	16.27 ft
Velocity	3.75 fps
Cross Sectional Area	0.46 sq ft
Hydraulic Radius	0.05 ft
Manning's n	0.032
Froude Number	3.11
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

NII-G #1 TERRACE TRANSITION 10-YR., 6-HR.
SEDCAD+ CHANNEL DESIGN



Riprap - Steep Slope Design - Simons/OSM Method

Discharge	=	1.74 cfs	Depth (d)	=	0.85 ft	w/ Freeboard:
Bottom (b)	=	10.00 ft	Top width (t)	=	10.27 ft	(D = 1.05) ft
Side slopes (Z)	=	3.0:1(L) 3.0:1(R)	Velocity	=	3.75 fps	(T = 16.27) ft
Bed Slope	=	15.00 %	Hydraulic Radius	=	0.05 ft	
Manning's n	=	0.032	Froude number	=	3.11	
Dmax = 0.63 ft (7.50 in)						
DS0 = 0.50 ft (6.00 in)						
DI0 = 0.17 ft (2.00 in)						

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-G #1 TERRACE (TEMPORARY DIVERSION) 100-YR., 6-HR. STORM

by

Name: J.G.S

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\11GDIVA

Date: 09-02-1993

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\11GDIVA User: J.G.S
Date: 09-02-1993 Time: 08:05:45
N11-G #1 TERRACE (TEMPORARY DIVERSION) 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE
=====

-Hydrology-

JBS SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)	
111 1		1.88	86	F	0.065	0.000	0.000	0.0	0.18	3.37
		Type: Null			Label: N11-G #1 TERRACE					
111 Structure		1.88						0.18		
111 Total IN/OUT		1.88						0.18	3.37	

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 2, 1993
N11-G #1 TERRACE 100-YR., 6-HR. STORM

=====

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	3.4
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.7
Critical Slope (feet per foot).....	0.0 .5
Flow Velocity (feet per second).....	3.37
Froude Number.....	1.000
Velocity Head (feet).....	0.18
Energy Head (feet).....	0.88
Cross-Sectional Area of Flow (square feet).....	1.00
Top Width of Flow (feet).....	2.83

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-G #1 TERRACE (TEMPORARY DIVERSION)

Limiting Velocity Technique
Sediment-laden Water

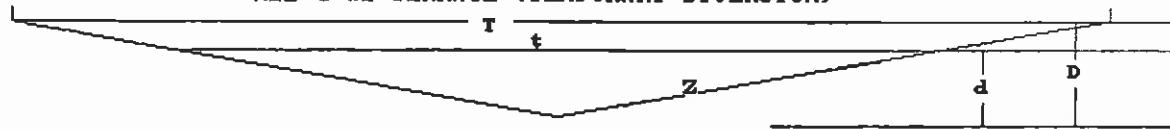
INPUT VALUES:

Shape	TRIANGULAR
Discharge	3.37 cfs
Slope	1.00 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.030
Max. Velocity	5.50 fps
Material	GRADED SILTS - COBBLES COLLOIDAL
Freeboard	1.0 ft

RESULTS:

Actual Discharge	3.37 cfs
Depth	0.82 ft
with Freeboard	1.82 ft
Top Width	3.26 ft
with Freeboard	7.26 ft
Velocity	2.53 fps
Cross Sectional Area	1.33 sq ft
Hydraulic Radius	0.36 ft
Froude Number	0.70

**SEDCAD+ CHANNEL DESIGN
N11-G #1 TERRACE (TEMPORARY DIVERSION)**



**MATERIAL: GRADED SILTS - COBBLES COLLOIDAL
Limiting Variable: Velocity = 5.500 fps
Sediment-laden Water**

Discharge	=	3.37 cfs	Depth (d)	=	0.82 { D = 1.82 } ft	w/ Freeboard:
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	3.26 { T = 7.26 } ft	
Bed Slope	=	1.00 %	Velocity	=	2.53 fps	
Manning's n	=	0.030	Hydraulic Radius	=	0.38 ft	
			Froude number	=	0.70	

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 2, 1993
N11-G #1 TERRACE 100-YR., 6-HR. STORM
RIPRAP TRANSITION

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	3.4
Manning's Roughness Coefficient (n-value).....	0.0320
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	10.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.15
Critical Slope (feet per foot).....	0.0287
Flow Velocity (feet per second).....	2.15
Froude Number.....	1.000
Velocity Head (feet).....	0.07
Energy Head (feet).....	0.22
Cross-Sectional Area of Flow (square feet).....	1.57
Top Width of Flow (feet).....	10.90

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-G #1 TERRACE TRANSITION 100-YR., 6-HR

INPUT VALUES:

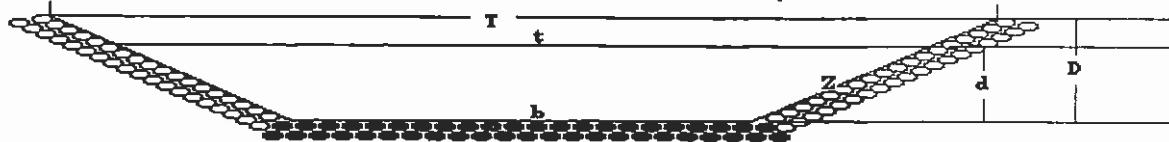
Shape	TRAPEZOIDAL
Discharge	3.37 cfs
Slope	15.00 %
Sideslopes (L and R)	3.00:1 3.00:1
Bottom Width	10.00 feet
Freeboard	1 ft

RESULTS:

Steep Slope Design - Simons/OSM Method

Depth	0.06 ft
with Freeboard	1.06 ft
Top Width	10.35 ft
with Freeboard	16.35 ft
Velocity	5.61 fps
Cross Sectional Area	0.60 sq ft
Hydraulic Radius	0.06 ft
Manning's n	0.032
Froude Number	4.10
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

N11-G #1 SEDCAD+ CHANNEL DESIGN
TERRACE TRANSITION 100-YR., 6-HR



Riprap - Steep Slope Design - Simons/OSM Method

Discharge	=	3.37 cfs	Depth (d)	=	0.06 (w/ Freeboard: $D = 1.06$) ft
Bottom (b)	=	10.00 ft	Top width (t)	=	10.35 ($T = 16.35$) ft
Side slopes (Z)	=	3.0:1(L) 3.0:1(R)	Velocity	=	5.61 fps
Bed Slope	=	15.00 %	Hydraulic Radius	=	0.06 ft
Manning's n	=	0.032	Froude number	=	4.10
			$D_{max} = 0.63 \text{ ft } (7.50 \text{ in})$		
			$D_{50} = 0.50 \text{ ft } (6.00 \text{ in})$		
			$D_{10} = 0.17 \text{ ft } (2.00 \text{ in})$		

