

DESIGN REPORT

Temporary Sedimentation Structure

J7-R1

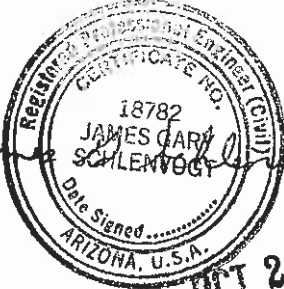
Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

James G. Schlenvogt



OCT 24 1997

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EXHIBIT #1	Proposed J7-R and J7-R1 Sedimentation Pond Design

INTRODUCTION

Sedimentation Structure J7-R1 will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure designed to control runoff and sediment from portions of J7 disturbed surface mining area at the Black Mesa Mine. The location of Structure J7-R1 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-11) 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 J7-R1 that is in series with sedimentation structure J7-R. 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 J7-R1 was inspected in August, 1997 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

SITE DESCRIPTION

LAND USE

The J7-R1 and J7-R Structures have a combined watershed of 260.1 acres and are located on a tributary upstream of Yucca Flat Wash at the Black Mesa Mine. The 244.6 acres watershed, which contributes directly to structure J7-R1 is classified as 35% spoil, 56% reclaimed and 9%, disturbed.

DESIGN ANALYSES

GENERAL

Structure J7-R1 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 1992 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J7-R1 is a Category A-3 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top will be constructed. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 4.25:1 were assumed. Based on the total embankment height of approximately 23 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 22-foot wide riprap-lined trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). Structure J7-R1 will be constructed in series with proposed Structure J7-R. Structure J7-R1 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 two structures have a combined capacity greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour event. Structures J7-R1 and J7-R were conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure J7-R1 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yucca Flat Wash.

The following parameters were used in the hydrologic analysis:

		<u>10yr-24hr Storm</u>	
1.	Water Course length, L	0.890	mi.
2.	Elevation Difference, H	180	ft
3.	Time of Concentration, T _c	0.307	hr
4.	SCS Curve Number	84	
5.	Rainfall Depth, 10-year, 24-hour storm	2.1	in
	100-year, 6-hour storm	2.4	in
6.	Drainage Area	244.6	acres

HYDRAULICS

The SEDCAD+ 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).

J7-R1 SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	cfs	163.2	294.7
Volume	ac-ft	16.6	21.2
Storage			
Peak Stage	msl	N/A	6322.0
Emerg. Spillway Elev.	msl	6319.5	6319.5
Peak Storage	ac-ft	N/A	10.9
Storage Capacity	ac-ft	8.1	8.1
Outflow			
Peak Flow	cfs	N/A	271.3
Spillway Elevation	msl	6319.5	6319.5
Embankment Crest Elev.	msl	6323	6323
Peak Stage	msl	--	6322.0
Freeboard	ft	--	1.0
Emergency Spillway Channel			
Flow Depth	ft	--	2.5
Critical Velocity	fps	--	6.5
Mannings "n"	--	--	.031
Width	ft	--	22
Outflow Channel			
Slope	%	--	5.0
Normal Velocity	fps	--	7.9
Normal Depth	ft	--	1.3
Mannings "n"	--	--	.046
Riprap D ₅₀	in	--	6

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J7-R1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.5	ft
	(Outflow)	2.5	ft
Channel Width		22	ft
Channel Length	(Spillway)	30	ft
	(Outflow)	250	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	5.0	%
Spillway Elevation		6319.5	ft

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1992 aerial topographic mapping conducted for Peabody Western Coal Company. Structure J7-R1 is designed to contain approximately 8.1 acre-feet.

The calculations for the sediment load entering structure J7-R1 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.28
3.	Slope Factor, LS	2.18
4.	Cover Factor, C	0.52
5.	Erosion Control Factor, P	0.59

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 J7-R1 does not have sufficient storage to contain the 10-year, 24-hour storm by itself; however, in series with structure J7-R, sufficient storage is achieved. The combined sediment storage capacity was determined for the two structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures J7-R1 and J7-R

	<u>J7-R1</u>	<u>J7-R</u>	<u>Combined</u>
Total Storage Capacity	8.1	14.9	23.0 acre-ft
10-Year, 24-Hour Storm Inflow	16.6	1.4	18.0 acre-ft
Available Sediment Storage Capacity	--	--	5.0 acre-ft
Sediment Inflow Rate/Year	0.80	0.17	0.97 acre-ft
Sediment Storage Life	--	-	5.2 years

* * *

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
- Exhibit #1 - Proposed J7-R and J7-R1 Sedimentation Pond Design

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J7-R1

TIME OF CONCENTRATION (Haul Road):

Start Elevation (ft) = 6480
End Elevation (ft) = 6300
Elevation Difference, E (ft) = 180

Watercourse Length (ft) = 4700
Watercourse Length, L (mi) = 0.890

$T_c = (11.9L^{0.385}/E) = \underline{\underline{0.307 \text{ hours}}}$

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Spoil	B	86	84.8	7292.8
Reclaimed	C	81	137.8	11161.8
Disturbed	D	91	22	2002
TOTAL:			244.6	20456.6

Weighted CN = Total CN*Area/ Total Area = 84

DRAINAGE BASIN AREA:

244.60 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J7-R1

SOIL ERODIBILITY FACTOR:

Soil Type	Soil Group	Erodibility Factor, K	Area (acres)	K*Area
Spoil	B	0.12	84.8	10.176
Reclaimed	C	0.38	137.8	52.364
Disturbed	D	0.22	22	4.84
TOTAL:			244.6	67.38
Erodibility factor average of spoil to reclaimed condition to simulate various stages of reclamation.				

Weighted K = Total K*Area/ Total Area = 0.275

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
500	30	6.0%	0.5	3.4	1.78
700	40	5.7%	0.5	3.3	2.01
200	30	15.0%	0.6	8.5	3.66
600	30	5.0%	0.5	2.9	1.64
600	50	8.3%	0.5	4.8	2.66
400	20	5.0%	0.5	2.9	1.34
500	40	8.0%	0.5	4.6	2.34
400	30	7.5%	0.5	4.3	1.97
600	30	5.0%	0.5	2.9	1.64
400	40	10.0%	0.5	5.7	2.75

Average LS = 2.18

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 > or = 9%

Where:

- Slope < or = 3% m = 0.3
- Slope = 4% m = 0.4
- 5% > Slope < 10% m = 0.5
- Slope > 10% m = 0.6

l:

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT J7-R1 POND

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Spoil	0%	0%	84.8	1	84.8	0.80	67.84
Reclaimed	40%	0%	137.8	0.15	20.67	0.40	55.12
Disturbed	0%	0%	22	1.00	22	1.00	22
TOTAL:			244.6		127.47		144.96

Weighted C = Total C*Area/ Total Area = 0.52

Weighted P = Total P*Area/ Total Area = 0.59

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J7-R1

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

<u>PARAMETER DESCRIPTION</u>	<u>VALUE</u>
Annual Rainfall Factor	40.00
Soil Erodibility Factor	0.28
Length Slope Factor	2.18
Cover Factor	0.52
Practice Factor	0.59
Gross Annual Sediment Yield	7.41 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0036 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0033 acre-feet/acre/year
Watershed Area	244.6 acres
Watershed Annual Sediment Yield	0.7968 acre-feet/year
Number of years	1 years
Required Pond Sediment Storage	0.797 acre-feet

SEDCAD+ RIPRAP CHANNEL DESIGN

J7-R1 OUTFLOW

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	271.33 cfs	
Slope	5.00 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	22.00 feet	
Freeboard	.3 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	1.33 ft
with Freeboard	1.63 ft
Top Width	29.96 ft
with Freeboard	31.76 ft
Velocity	7.88 fps
Cross Sectional Area	34.45 sq ft
Hydraulic Radius	1.13 ft
Manning's n	0.046
Froude Number	1.29
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

J7-R1 SPILLWAY
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	j7
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.013023 ft/ft	
Left Side Slope	3.000000 H : V	
Right Side Slope	3.000000 H : V	
Bottom Width	22.00	ft
Discharge	271.30	cfs

Results		
Depth	1.56	ft
Flow Area	41.55	ft ²
Wetted Perimeter	31.85	ft
Top Width	31.35	ft
Critical Depth	1.56	ft
Critical Slope	0.013023 ft/ft	
Velocity	6.53	ft/s
Velocity Head	0.66	ft
Specific Energy	2.22	ft
Froude Number	1.00	
Flow is subcritical.		

APPENDIX B

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (10-YR, 24-HR)

by

Name: TEL

Company Name: ACZ, INC.
File Name: J:\861\0350\SEDCAD\J7R-R1

Date: 10-18-1997

Company Name: ACZ, INC.

Filename: J:\861\0350\SEDCAD\J7R-R1 User: TEL

Date: 10-18-1997 Time: 08:58:58

PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (10-YR, 24-HR)

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	244.60	84	F	0.307	0.000	0.000	0.0	16.62	163.15
			Type: Null		Label: POND J7-R1					
111	Structure	244.60							16.62	
111	Total IN/OUT	244.60							16.62	163.15
112	1	15.50	88	F	0.087	0.000	0.000	0.0	1.35	16.90
			Type: Null		Label: POND J7-R					
112	Structure	15.50							17.97	
112	Total IN/OUT	260.10							17.97	166.47
111 to 112	Routing					0.015	0.381			

APPENDIX C

SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (100-YR, 6-HR)

by

Name: TEL

Company Name: ACZ, INC.
File Name: J:\861\0350\SEDCAD\J7R25

Date: 10-18-1997

Company Name: ACZ, INC.

Filename: J:\861\0350\SEDCAD\J7R25 User: TEL

Date: 10-18-1997 Time: 12:02:38

PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (100-YR, 6-HR)

Storm: 2.40 inches, 100 year- 6 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

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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	244.60	84	F	0.307	0.000	0.000	0.0	21.18	294.73
			Type: Pond		Label: POND J7-R1					
111	Structure	244.60							21.18	

111	Total IN	244.60							21.18	294.73
111	Total OUT								21.18	271.33
=====										
112	1	15.50	88	F	0.087	0.000	0.000	0.0	1.67	30.12
			Type: Pond		Label: POND J7-R					
112	Structure	15.50							22.85	

112	Total IN	260.10							22.85	277.30
112	Total OUT								22.85	234.90
=====										
111 to 112 Routing					0.015	0.381				
=====										

Company Name: ACZ, INC.
 Filename: J:\861\0350\SEDCAD\J7R25 User: TEL
 Date: 10-18-1997 Time: 12:02:38
 PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (100-YR, 6-HR)
 Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
 Hydrograph Convolution Interval: 0.1 hr

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 POND INPUT/OUTPUT TABLE
 =====

J1, B1, S1
 POND J7-R1

Drainage Area from J1, B1, S1, SWS(s)1: 244.6 acres
 Total Contributing Drainage Area: 244.6 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 6319.5
 Crest Length (ft) 30.0
 Z:1 (Left and Right) 3 3
 Bottom Width (ft) 22.0

RESULTS:

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

8.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	21.18	294.73
OUT	21.18	271.33

Peak Elevation	Hydrograph Detention Time (hrs)
6322.0	0.16

J1, B1, S2
POND J7-R

Drainage Area from J1, B1, S2, SWS(s)1: 15.5 acres
Total Contributing Drainage Area: 260.1 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	6317.0
Crest Length (ft)	30.0
3:1 (Left and Right)	3 3
Bottom Width (ft)	30.0

POND RESULTS:

Permanent
Pool
(ac-ft)

=====
14.9

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	22.85	277.30
OUT	22.85	234.90

Peak Elevation	Hydrograph Detention Time (hrs)
6319.0	0.16

Company Name: ACZ, INC.

Filename: J:\861\0350\SEDCAD\J7R25 User: TEL

Date: 10-18-1997 Time: 12:02:38

PEABODY WESTERN COAL COMPANY: POND J7-R AND R1 (100-YR, 6-HR)

Storm: 2.40 inches, 100 year- 6 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

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 ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
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J1, B1, S1
 POND J7-R1

Drainage Area from J1, B1, S1, SWS(s)1: 244.6 acres
 Total Contributing Drainage Area: 244.6 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6302.00	0.00	0.02	0.00	0.00	
6303.00	1.00	0.04	0.03	0.00	
6304.00	2.00	0.07	0.08	0.00	
6305.00	3.00	0.11	0.17	0.00	
6306.00	4.00	0.15	0.30	0.00	
6307.00	5.00	0.20	0.48	0.00	
6308.00	6.00	0.24	0.70	0.00	
6309.00	7.00	0.32	0.98	0.00	
6310.00	8.00	0.40	1.34	0.00	
6311.00	9.00	0.45	1.77	0.00	
6312.00	10.00	0.51	2.25	0.00	
6313.00	11.00	0.57	2.78	0.00	
6314.00	12.00	0.63	3.38	0.00	
6315.00	13.00	0.72	4.06	0.00	
6316.00	14.00	0.81	4.82	0.00	
6317.00	15.00	0.87	5.66	0.00	
6318.00	16.00	0.94	6.56	0.00	
6319.00	17.00	1.01	7.53	0.00	
6319.50	17.50	1.05	8.05	0.00	Stage of SW#1
6320.00	18.00	1.09	8.58	17.95	
6320.20	18.20	1.10	8.80	25.13	
6320.30	18.30	1.11	8.91	32.46	
6320.40	18.40	1.12	9.02	40.48	
6320.50	18.50	1.13	9.14	49.16	
6321.00	19.00	1.17	9.71	108.67	
6321.50	19.50	1.21	10.30	177.77	
6322.00	20.00	1.25	10.92	267.25	
6322.02	20.02	1.26	10.94	271.33	Peak Stage
6322.50	20.50	1.30	11.55	377.75	
6323.00	21.00	1.36	12.22	506.08	

J1, B1, S2
 POND J7-R

Drainage Area from J1, B1, S2, SWS(s)1: 15.5 acres
 Total Contributing Drainage Area: 260.1 acres

SW#1: Emergency Spillway

Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6306.00	0.00	0.90	0.00	
6307.00	1.00	1.01	0.96	
6308.00	2.00	1.13	2.03	
6309.00	3.00	1.15	3.17	
6310.00	4.00	1.18	4.34	
6311.00	5.00	1.27	5.56	
6312.00	6.00	1.36	6.87	
6313.00	7.00	1.45	8.28	
6314.00	8.00	1.55	9.78	
6315.00	9.00	1.65	11.38	
6316.00	10.00	1.75	13.08	
6317.00	11.00	1.86	14.88	
6317.70	11.70	1.94	16.21	33.86
6317.80	11.80	1.95	16.41	43.66
6317.90	11.90	1.96	16.60	54.33
6318.00	12.00	1.97	16.80	65.85
6318.50	12.50	2.04	17.80	143.99
6319.00	13.00	2.11	18.84	233.39
6319.01	13.01	2.11	18.85	234.90
6319.50	13.50	2.18	19.91	347.63
6320.00	14.00	2.26	21.02	486.90

Stage of SW#1

Peak Stage
