INSPECTION REPORT

Sedimentation Structure

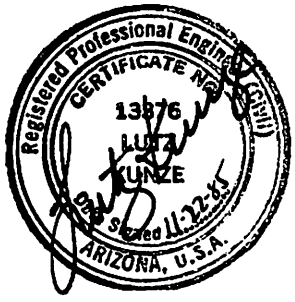
N14-Q

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N14-Q is a partially incised structure with an earthen embankment, designed and constructed in 1982 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure N14-Q is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N14-Q. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure N14-Q was inspected on September 10, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the N14-Q project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure N14-Q has a 44.4-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 67% disturbed and 33% Pinion/Juniper.

EMBANKMENT

Structure N14-Q is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure N14-Q

Embankment	Alluvium
Foundation	Alluvium
Right Abutment	Sandstone
Left Abutment	Sandstone
Height	15.7 ft
Crest Width	12 ft
Upstream Slope	2.25 H : 1 V
Downstream Slope	3.1 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section N14-Q, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure N14-Q is a category C-1 embankment. A standard category C-1 embankment has static and seismic factors of safety equal to or greater than 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 20 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 4.0 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N14-Q embankment is lower in height; however, the downstream slope is steeper than the category standard; therefore, the embankment has factors of safety less than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure N14-Q is located downstream from Structure N14-E, an MSHA structure. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for N14-Q was analyzed using the 100-year, 6-hour storm. The 100-year storm was routed through N14-E, with the N14-E reservoir at the maximum water surface level at the start of the storm. The 100-year storm did not produce any spillway flow

from N14-E. Therefore, the spillway for N14-Q was designed for the 100-year, 6-hour flow produced by the tributary drainage area between Structures N14-E and N14-Q.

The storage capacity of Structure N14-Q was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.242	mi
2.	Elevation Difference, H	118	ft
3.	Time of Concentration, T_c	0.080	h
4.	Lag time, $0.6T_c$	0.048	h
5.	SCS Curve Number	90	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	100-year, 6-hour storm	2.4	in.
7.	Drainage Area	44.4	acres

HYDRAULICS

The HEC-1 program was 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.

N14-Q HYDRAULICS

	Units	10-year 24-hour Storm	100-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	105	195	
Volume	acre-ft	4.34*	5.22*	
Storage				
Peak Stage	ft	6600.74	6607.84	
Spillway Elevation . .	ft	6605.70	—	
Peak Storage	acre-ft	4.34	--	
Storage Capacity . . .	acre-ft	8.34	--	
Outflow				
Peak Flow	cfs	0	105	
Embankment Crest Elevation	ft	—	6610.00	
Peak Stage	ft	--	6607.84	
Freeboard	ft	—	2.16	
Spillway Channel				
Flow Depth	ft	—	2.16	
Critical Velocity. . .	fps	--	2.14	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	5	30
Normal Velocity. . . .	fps	--	6.8	12.4
Normal Depth	ft	--	0.86	0.52
Manning's "n"		--	0.040	0.040

*Inflow volume for tributary drainage are between Structures N14-Q and N14-E.

Spillway Channel

The existing spillway for N14-Q has a trapezoidal channel with the following dimensions:

Channel depth	5.6	ft
Channel width	30	ft
Channel length	35	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	3	percent

Rock provides erosion protection within the channel.

Outflow Channel

The existing outflow channel for N14-Q has a trapezoidal channel with the following dimensions:

Channel width	30	ft
Channel length	75	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	18	percent

The present rock size of D50 of 10 inches is not adequate for the calculated outflow velocity and therefore does not provide adequate erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic

maps available were used in developing Plate 3, Volume-Elevation Curve, N14-Q.

The calculations for the sediment load entering Structure N14-Q were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 4.97
4. Cover Factor, C 0.716
5. Erosion Control Factor, P 1.0

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The existing storage capacity of N14-Q and the results of the sediment inflow analysis are summarized in the following table.

N14-Q STORAGE

Total Storage Capacity	8.34	acre-ft
10-year, 24-hour Storm Inflow	4.34	acre-ft
Available Sediment Storage Capacity . .	4.00	acre-ft
Sediment Inflow Rate	0.645	acre-ft/yr
Sediment Storage Life	7	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N14-Q indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes and a

small sinkhole (3-foot in diameter and 18 inches deep) upstream of the embankment adjacent to the left abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope should be flattened to 4.0 horizontal to 1 vertical to meet stability requirements. The sinkhole should be excavated to determine the extent of the cavity and then backfilled with a cohesive material. Future inspections should note any changes in the condition of the bottom in the vicinity of the repaired section.

HYDRAULICS

The storage capacity and spillway capacity of Structure N14-0 are adequate; however, the spillway outflow channel does not have adequate erosion protection. A trapezoidal outflow channel and a stilling basin should be constructed along the alignment B-B' shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5 and Plate 6. The outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

* * *

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

Plate 1 - Site Plan N14-Q

Plate 2 - Existing Maximum Cross Section N14-Q, A-A'

Plate 3 - Volume-Elevation Curve N14-Q

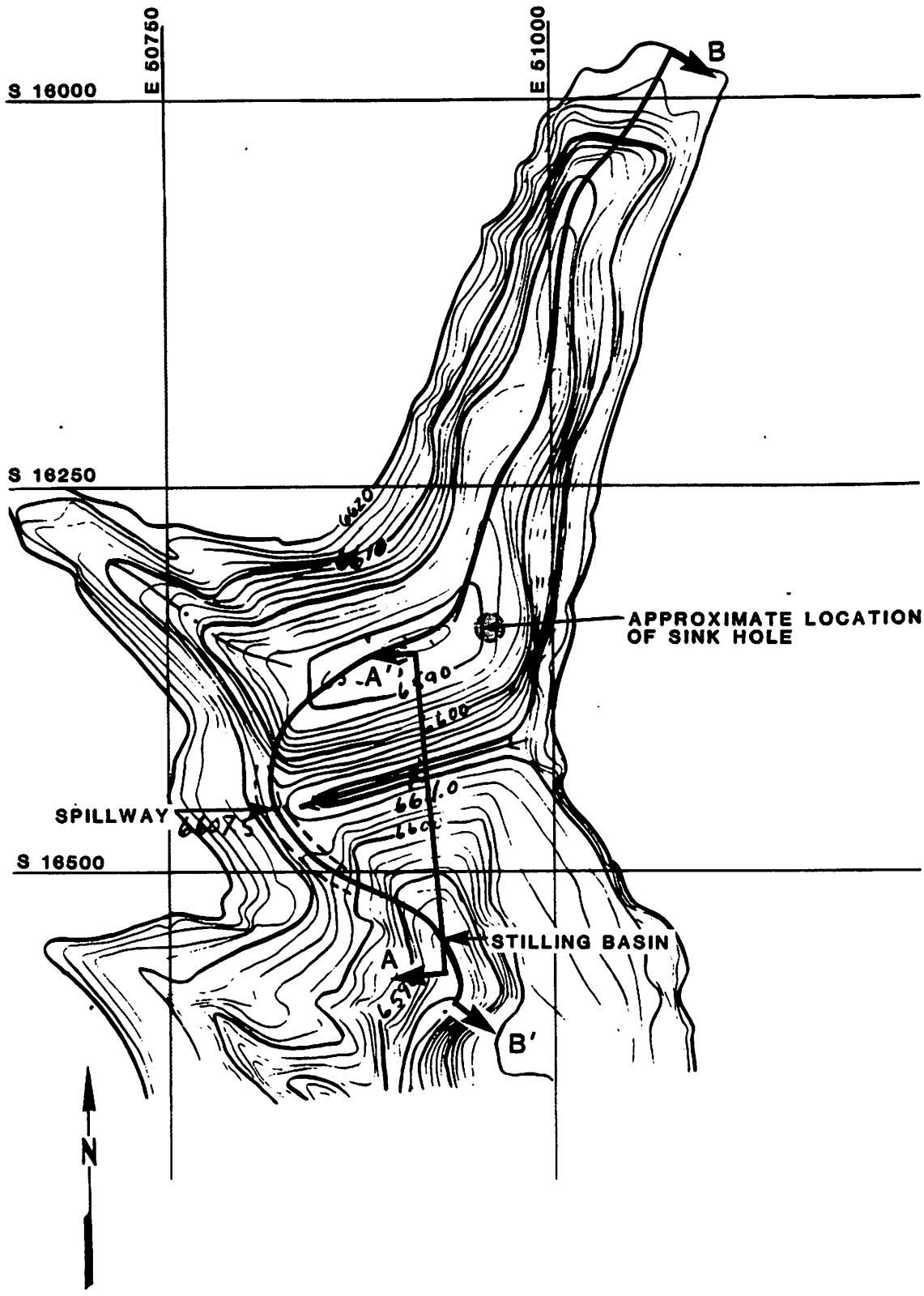
Plate 4 - Channel Profile N14-Q, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N14-Q

Plate 6 - Spillway Stilling Basin Plan N14-Q

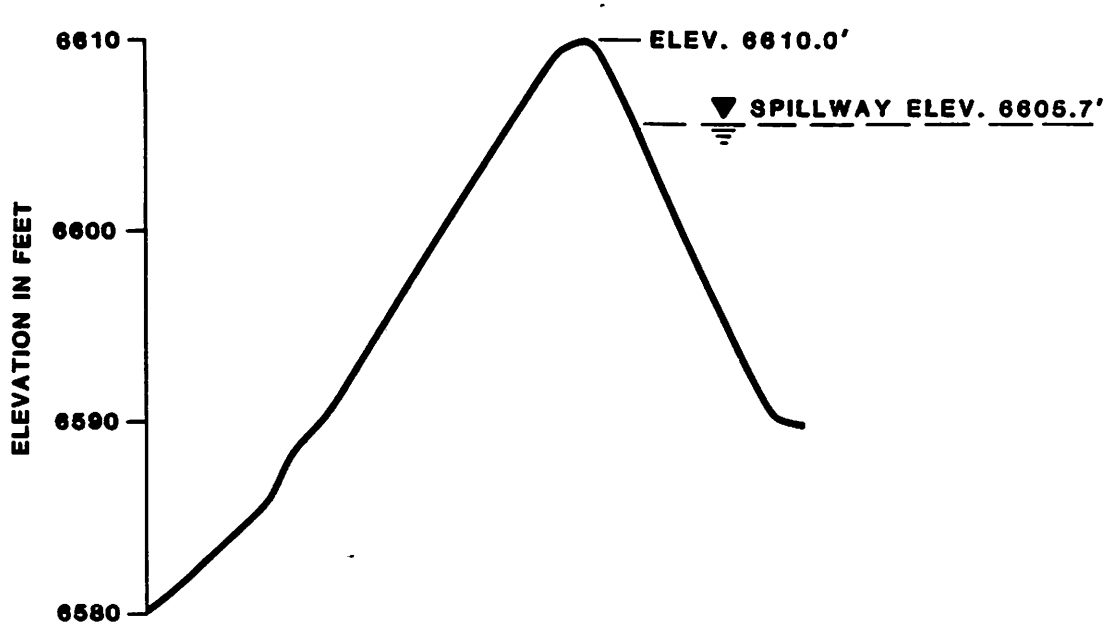
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N14-Q

BY **Dames & Moore** Plate 1

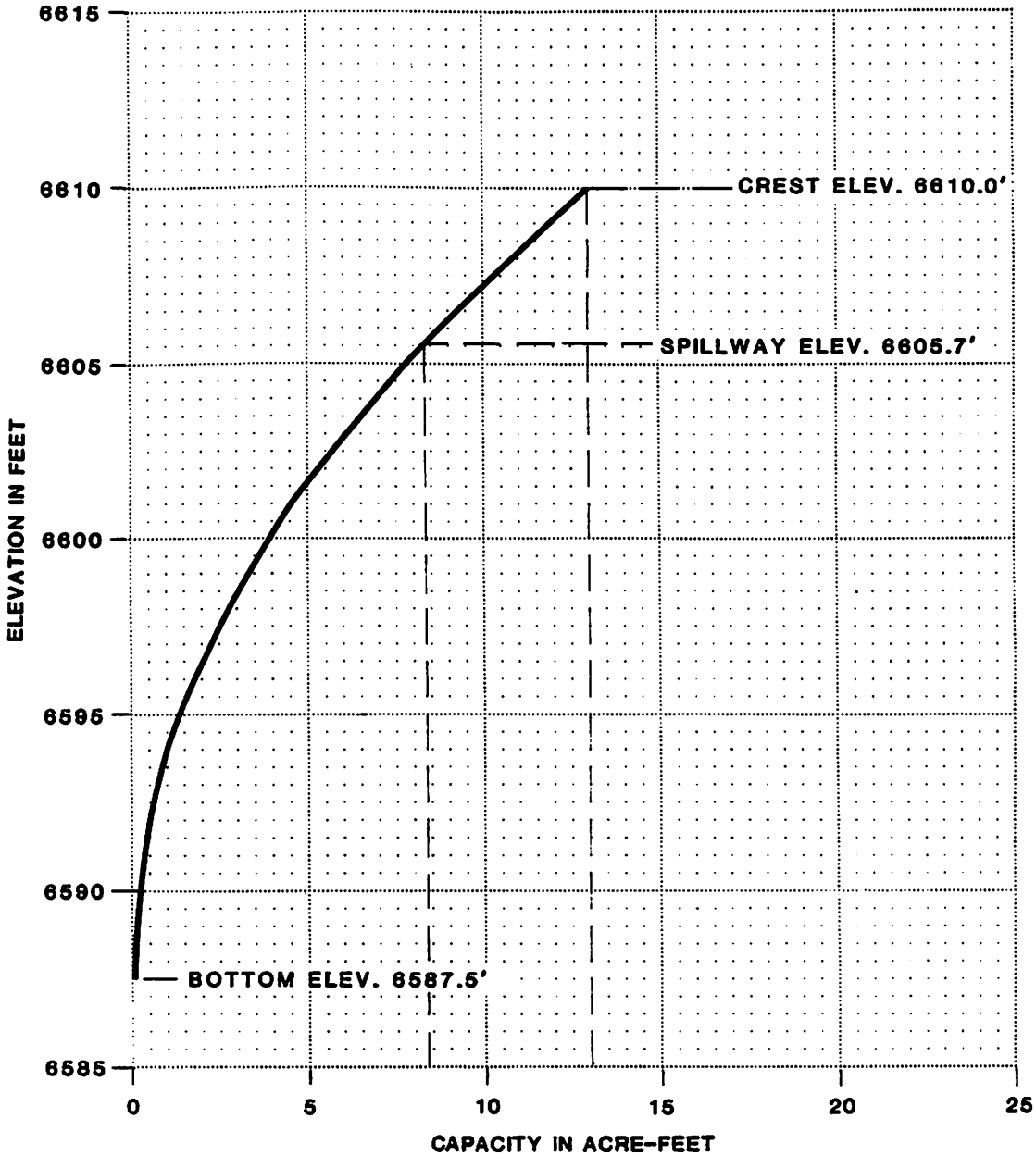


SCALE
0 50 100
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' N14-Q

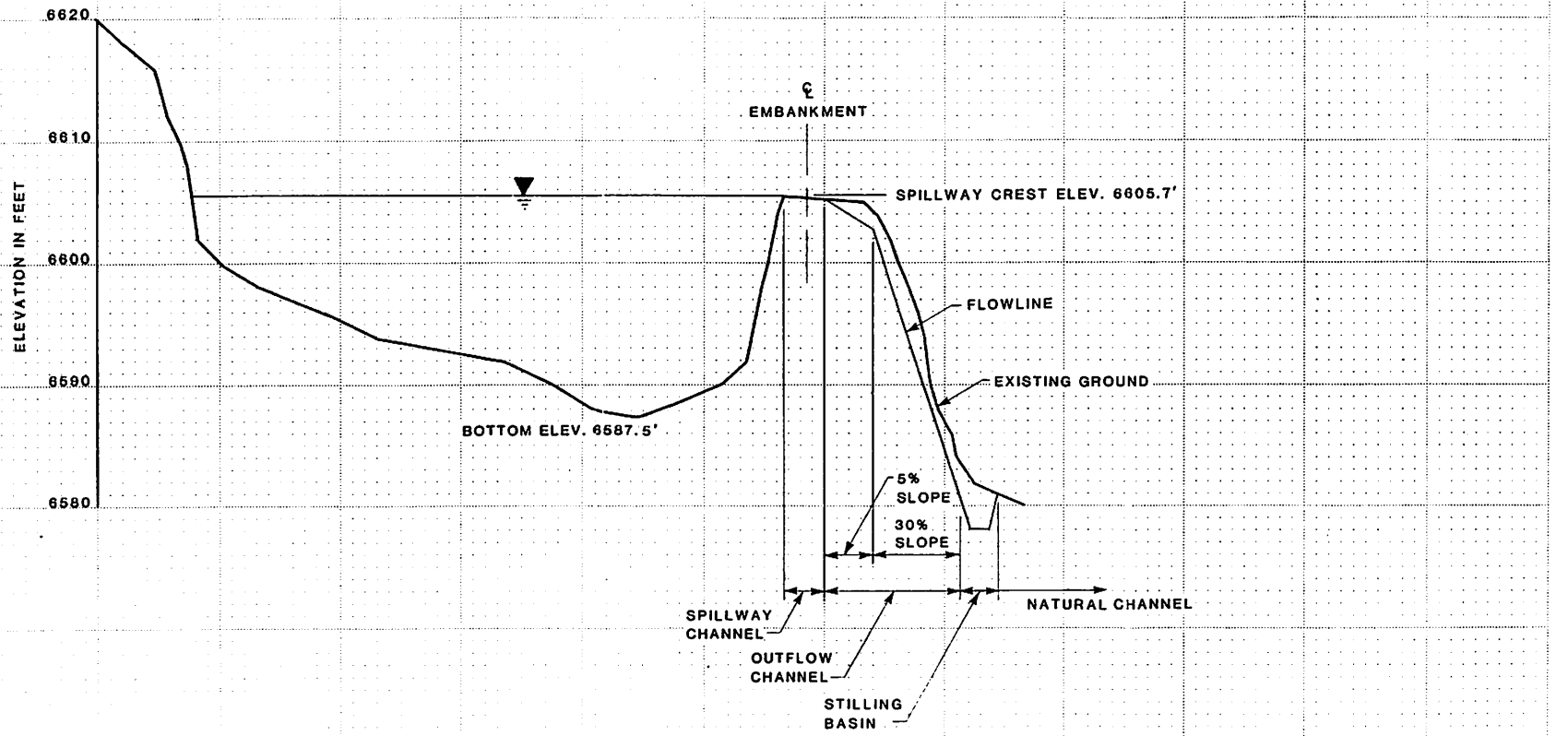
FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

N14-Q

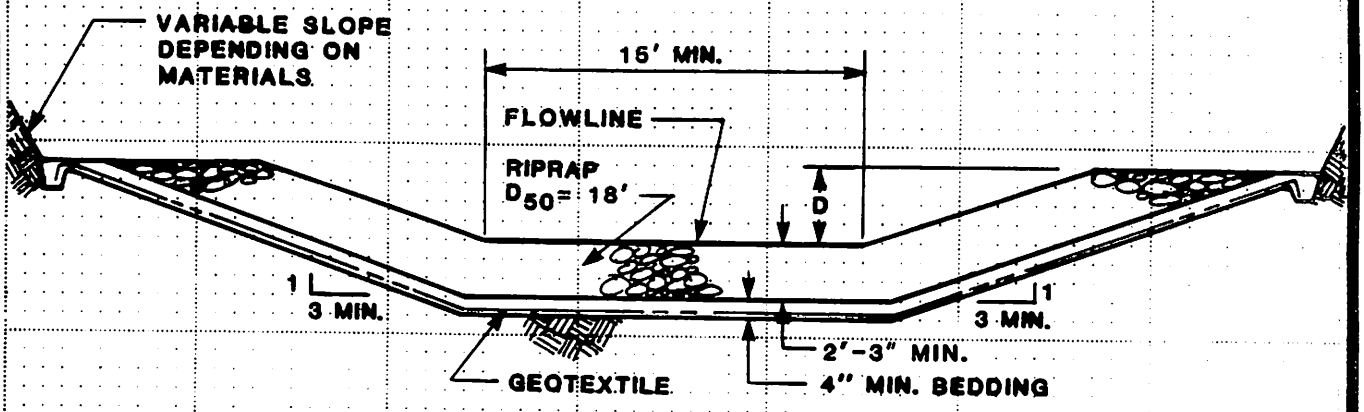


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N14-Q

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 3.2'

LENGTH = 30'

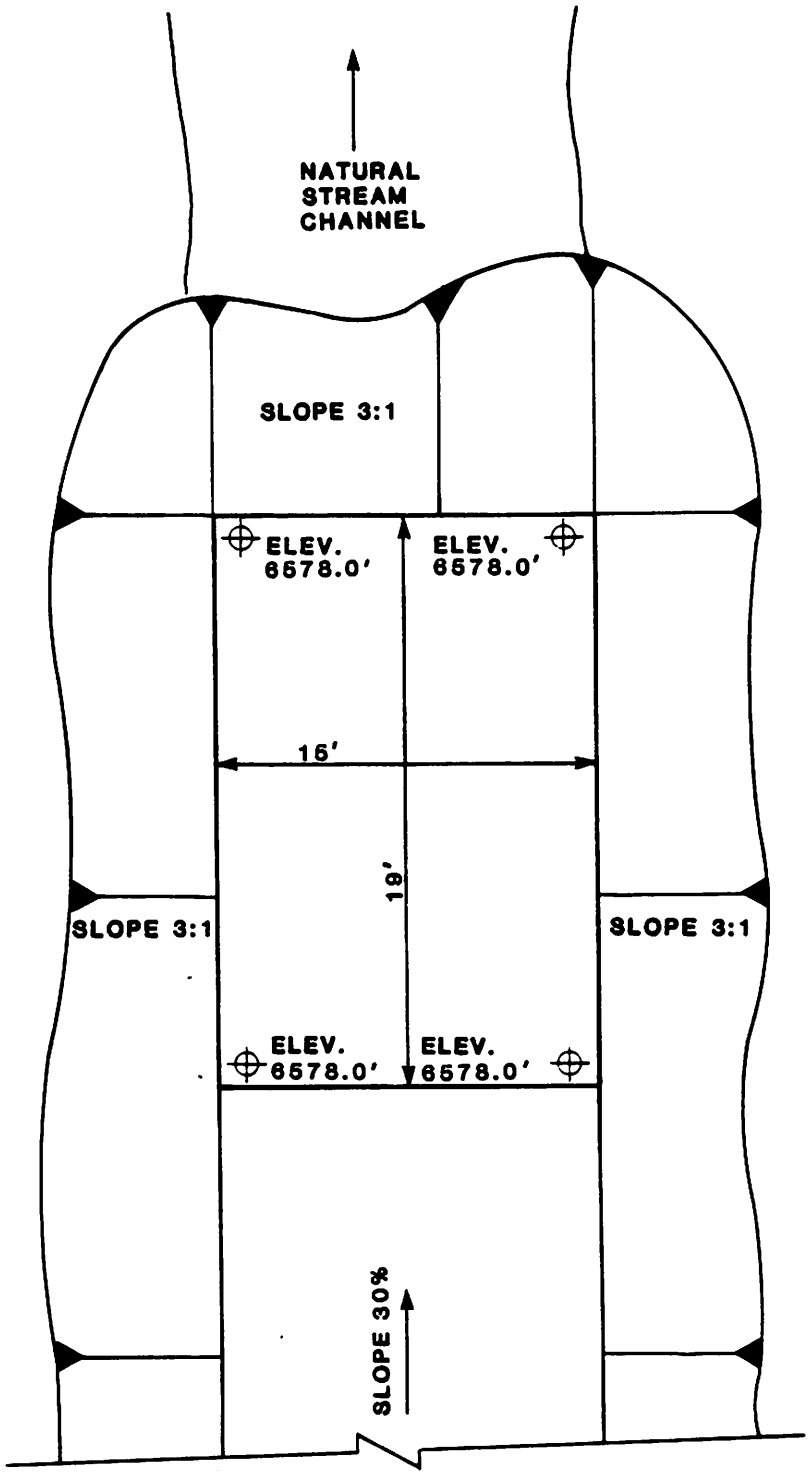
FLOWLINE ELEV. = 6605.70'

OUTFLOW CHANNEL

D = 2.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N14-Q

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 5.3'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED = 2.9'

SPILLWAY STILLING BASIN PLAN N14-Q

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N14-Q
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			12' w - Rounded
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			24°
a. Adequate grass cover?	X		40%
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			18°
a. Adequate grass cover?	X		
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?			
k. Is seepage present?			
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		5.6' below Crest. ≈30' W ≈35' L
Are side slopes eroding?		X	3% Slope
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		D50 - 10"
d. Outflow Channel:	X		≈30 W, ≈75' L 10° slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	Note: 20' berm between outlet
Bottom of channel eroding?		X	channel & dam.
Obstructed?		X	
Erosion protection?	X		D50 - 10"
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			
a. Location:			NA
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?	X		(Elev.) SEE Comments feet
b. Water present?		X	(Elev.) But Bottom wet & muddy feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

1. Potential sinkhole in pond near L.A. approx. 50' back from dam u.s. toe 3' dia. 18" deep with debris

Found No evidence below d.s. toe of seepage

Canopy Cover 5 %

Ground Cover 10 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
N14-Q SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6724 − 6606 = 118 ft.

WATER COURSE LENGTH = 3.2(400) = 1280 = 0.242 mi.

$$T_c = \left(\frac{11.9\,(0.242)^3}{118}\right)^{0.385} = 0.080 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.048 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
14.5	P-J	average	D	83 (.33)
25.0	disturbed	—	D	94 (.56)
4.9	road	—	D	89 (.11)
				89.8

1007, #25

use 90

DRAINAGE BASIN AREA

44.4 ACRES 0.069 SQ. MILES

BY S. DOLAN DATE 10-2-85
CHECKED BY
COPY TO EO

FILE PEABODY COAL CO 1039-011-22
SUBJECT SEDIMENT INFLOW
N14-Q SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH # 25 = .22

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
600	65	10.8	3.78 (.7)
300	40	13.3	3.63 (.2)
400	120	30.0	15.71 (.1)
			= 4.97

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
33%	P-J	40	25	.33(.14)
67%	disturbed	—	—	.67(1.0)
				C = .716

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.22)(4.97)(.716)(1.0) = 31.31$ ton/acre/year

$A = (31.31)\left(\frac{1}{2047}\right)(44.4)(.95) = .645$ acre-feet/year

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Dames & Moore

MSHA → [illegible]
LOCATED JUST UPSTREAM
FROM N14-Q

FILE FEARBEY COAL CO 10139-01-02
SUBJECT SEDIMENT POND HYDROLOGY
N14-E SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6845 − 6680 = 165 ft.

WATER COURSE LENGTH = 7.2(400) = 2880 ft. = 0.545 mi.

$$T_c = \left(\frac{11.9\,(0.545)^3}{165}\right)^{0.385} = 0.190 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.108 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
95% RECLAIMED				
5% HAUL RD				

USE CN = 94
for Jim Schlenvogt

DRAINAGE BASIN AREA

155.4 ACRE 0.243 SQ MILE

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

10/13/85

N14-E.

Max. Pool Elev.- 6672 CN=84 per JS

Spillway Elev.- 6686.2

Spillway Dim. → 1.25 ft x 150 ft ∴ DAM CREST = 6687.45'

Watershed = 157 ac.

89

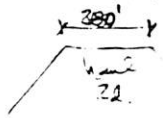
N14-D

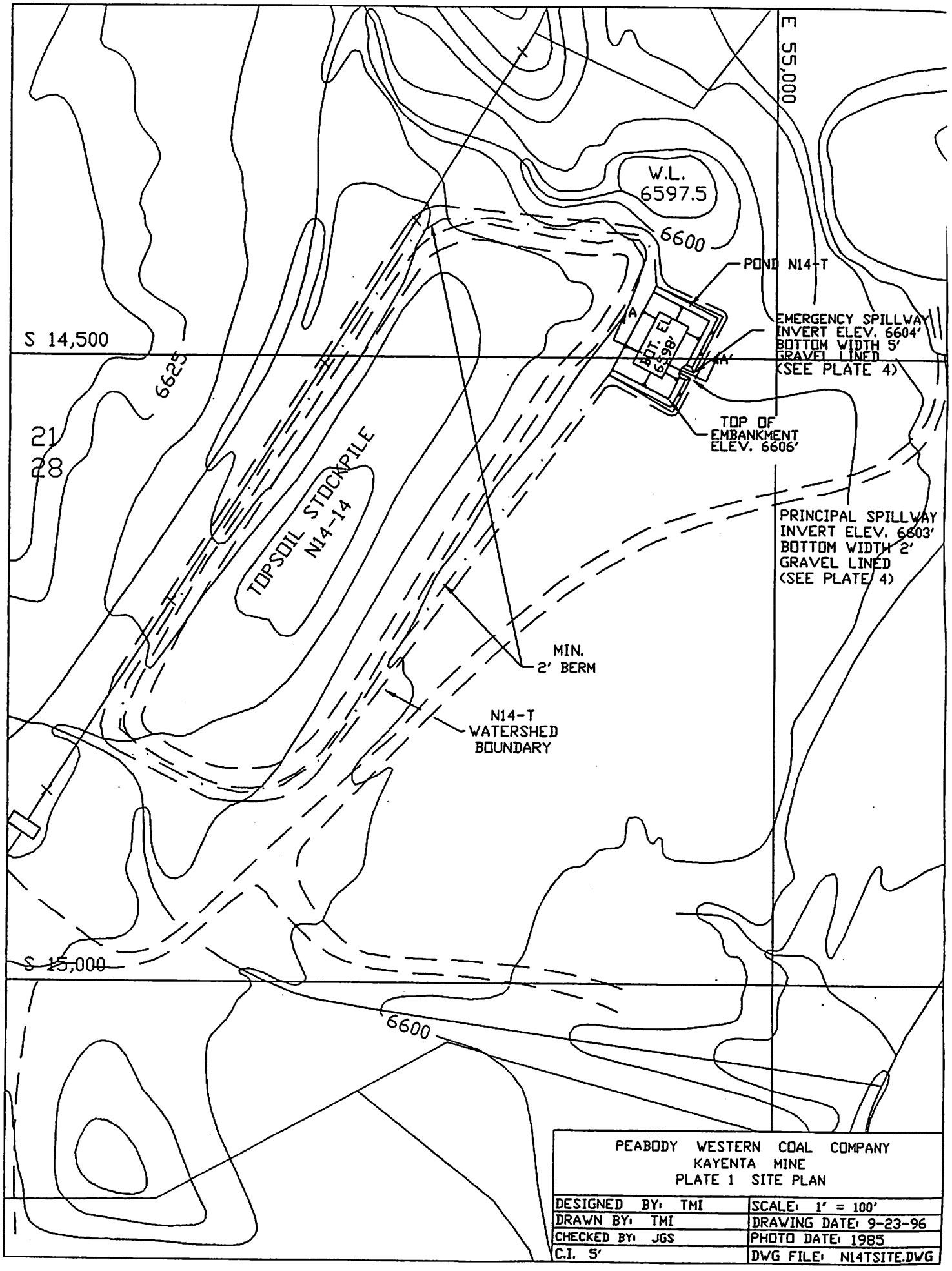
Max Pool Elev. - 6647

Spillway Elev. - 6653.3

Spillway Dim. → 2 ft x 1000 ft ∴ DAM CREST = 6655.3

Watershed = 1836 ac.




E 55,000
W.L.
6597.5
6600
POND N14-T
A
A'
BOT. EL
6598'
EMERGENCY SPILLWAY
INVERT ELEV. 6604'
BOTTOM WIDTH 5'
GRAVEL LINED
(SEE PLATE 4)
S 14,500
6625
21
28
TOP OF
EMBANKMENT
ELEV. 6606'
TOPSOIL STOCKPILE
N14-14
PRINCIPAL SPILLWAY
INVERT ELEV. 6603'
BOTTOM WIDTH 2'
GRAVEL LINED
(SEE PLATE 4)
MIN.
2' BERM
N14-T
WATERSHED
BOUNDARY
S 15,000
6600
PEABODY WESTERN COAL COMPANY
KAYENTA MINE
PLATE 1 SITE PLAN
DESIGNED BY: TMI
DRAWN BY: TMI
CHECKED BY: JGS
C.I. 5'
SCALE: 1" = 100'
DRAWING DATE: 9-23-96
PHOTO DATE: 1985
DWG FILE: N14TSITE.DWG

PEABODY WESTERN
KAYENTA AND BLACK MESA MINES
POND N14-T STAGE STORAGE

Project N 808-0100
Calculate *TEL*
Checked by:
Date: 23-Sep-96

Stage (ft)	Area (sqft)	Avg. Area (sqft)	Depth (ft)	Volume (cft)	Cum. Vol. (cft)	Cum. Vol. (ac-ft)	Description
6598	1196					0	Bottom of Pond
6599	1500	1348	1	1348	1348	0.03	
6600	1836	1668	1	1668	3016	0.07	
6601	2204	2020	1	2020	5036	0.12	
6602	2604	2404	1	2404	7440	0.17	
6603	3036	2820	1	2820	10260	0.24	Principal Spillway Invert
6604	3500	3268	1	3268	13528	0.31	Emergency Spillway Invert
6605	3996	3748	1	3748	17276	0.4	
6606	4524	4260	1	4260	21536	0.49	Top of Embankment

STAGE-CAPACITY CHART

PLATE 2