INFLOW DESIGN FLOOD CONTROL PLAN
PERIODIC 5-YEAR REVIEW

OAC 252:517-13-3(c)

Bottom Ash Pond

Northeastern 3&4 Power Station
Oologah, Oklahoma

October, 2021

Prepared for: Public Service Company of Oklahoma

Oologah, Oklahoma

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

AMERICAN ELECTRIC POWER®
BOUNDLESS ENERGY™

Document ID: GERS-21-041

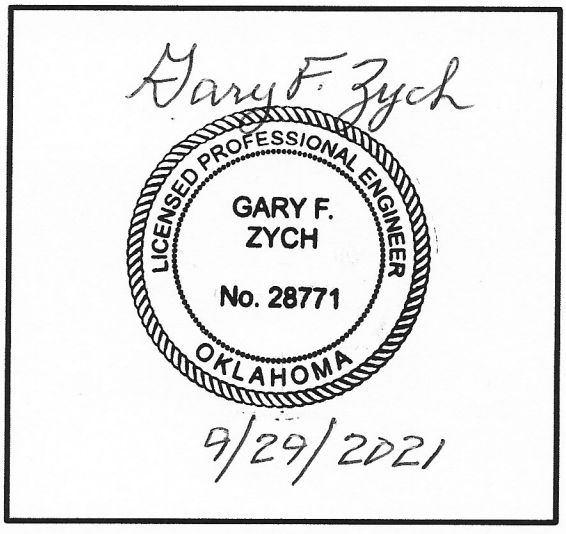
INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
OAC 252:517-13-3(c)
NORTHEASTERN 3&4 POWER STATION
BOTTOM ASH POND

Document ID: GERS-21-041

PREPARED BY: _____ DATE: 09-27-2021
Shah S. Baig, P.E.

REVIEWED BY: Brett A. Dreger DATE: 9/27/2021
Brett A. Dreger, P.E.

APPROVED BY: Gary F. Zych DATE: 9/29/2021
Gary F. Zych, P.E.
Section Manager – AEP Geotechnical Engineering



I certify to the best of my knowledge, information, and belief that the information contained in this Inflow Design Flood Control System Plan meets the requirements of OAC 252:517-13-3.

INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
NORTHEASTERN 3&4 POWER STATION
BOTTOM ASH POND

Table of Contents

Attachments

Attachment A – Hydrology and Hydraulics Analysis (Report Title: Hydrologic Analysis of Northeastern 3&4 Power Station Bottom Ash Pond)

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of OAC 252:517-13-3(c) for the Inflow Design Flood Control System Plan. This report is a summary of the first periodic 5-year review of the initial evaluation.

2.0 DESCRIPTIONS OF THE CCR IMPOUNDMENT

The Northeastern 3&4 Power Station is located near the City of Oologah, Rogers County, Oklahoma. It is owned and operated by Public Service Company of Oklahoma (PSO). The facility operates one surface impoundment for storing CCR called the Bottom Ash Pond.

The embankment is about 4,200 feet long, encompassing about 72 acres with about 34 acres of surface water. The dam crest gradually increases in elevation from about 630 feet-msl at the north berm east of the auxiliary spillway, to about elevation 639 feet-msl at the south berm where it meets the coal storage area on the east side. The embankment was constructed across a first order tributary to Fourmile Creek leaving the site to the south where the embankment is at its highest, 38 feet from the crest to the toe of the dam. A railroad track extends the length of the crest, typically used to remove empty coal cars from the site.

3.0 DESCRIPTION OF THE DESIGN FLOOD

The Bottom Ash Pond has been determined to be a Low Hazard potential CCR impoundment. This classification has not changed since the initial evaluation. Based on this hazard classification the design flood as determined by section OAC 252:517-13-3(a)(3) to be the 100-year storm which corresponds to 8.85 inches in 24 hours for this site. An analysis was performed for the 40% PMF (Probable Maximum Flood), which looks at 40% of the runoff from PMP storm of 45.87 inches in 72 hours. This produces significantly more runoff than the 100-year storm and therefore exceeds the requirements of section OAC 252:517-13-3(a)(3). The complete analysis is included in Attachment A.

4.0 DESCRIPTION OF INFLOW DESIGN FLOOD CONTROL SYSTEM

The embankment of the Bottom Ash Pond is approximately 4,200 feet long, encompassing about 72 acres with about 34 acres surface water. The total tributary area is approximately 199 acres which is primarily runoff from the plant area and coal yard. There is no principal spillway at the bottom ash pond. The water level is controlled by pumping and recirculating water through the power plant for reuse. The auxiliary spillway is a broad-crested weir, with a concrete chute and stilling basin. The overflow crest is 25-feet wide with a design invert elevation of 625.0 ft msl. The auxiliary spillway is located on the west side of the north embankment. Overflow from the spillway discharges to a low area on site. The low area is drained by two culverts under the adjacent railroad track, which discharge off site into a tributary to Fourmile Creek on the northeast side of the ash pond. Areas adjacent to the embankments are diverted around the Bottom Ash Pond by natural drainage channels and grass lined ditches.

There has not been any changes to the spillway system, flood storage capacity or rainfall estimates that would change the results presented in Attachment A. The calculations show that the facility has the capacity to manage all flood events up to and including the 40% PMF.

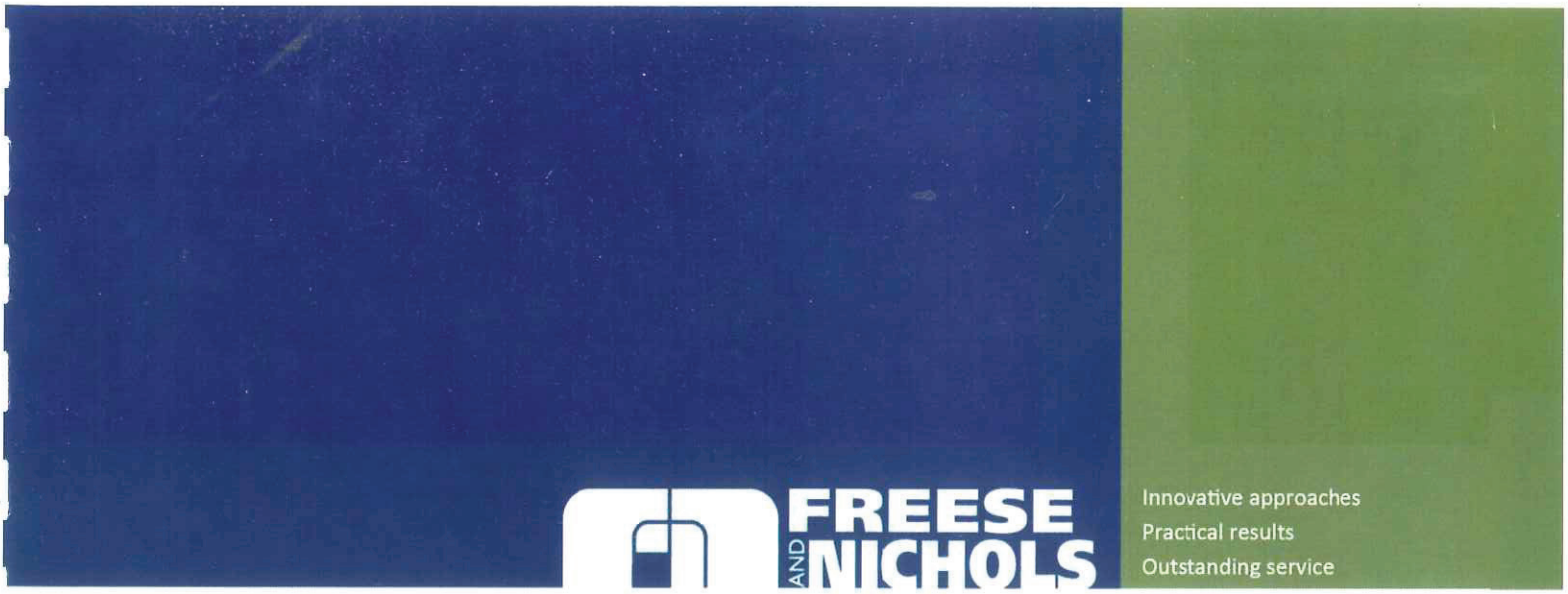
5.0 SUMMARY OF INFLOWS, OUTFLOWS AND FLOOD ELEVATIONS

The following table provides the maximum inflows, outflows and flood elevations for the Bottom Ash Pond. See the analysis include in Attachment A for detailed calculations.

Bottom Ash Pond	
Storm Event	0.40 PMF
Peak Inflow	1,490 cfs
Peak Outflow	396 cfs
Maximum Pool Elevation	628.15 ft.
Crest Elevation	630 ft

ATTACHMENT A

HYDROLOGY AND HYDRAULICS ANALYSIS



Hydrologic Analysis of Northeastern 3 &4 Power Station Bottom Ash Pond

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

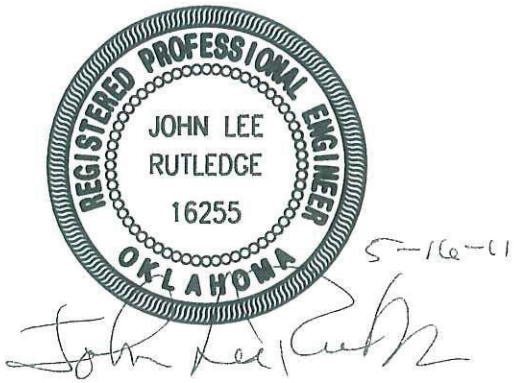
AEP11201

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Hydrologic Analysis of Northeastern 3 &4 Power Station Bottom Ash Pond

American Electric Power Company



Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP11201

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

In April of 2011, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Bottom Ash Pond for the Northeastern 3 & 4 Power Station located near Oologah, Oklahoma. This report summarizes the results of the analysis for the 10-year, 100-year, and 40% PMF events.

The Ash Pond is situated immediately southwest of the Power Plant and west of Oologah Dam. The general location of the power plant and associated reservoirs is shown in Figure 1.

FN PROJECT NO.	AEP11201
FILE NAME	H:\WR_DESIGN\FIGURES\Figure1_LocationMap.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE OKLAHOMA NORTH (FT)
DATE CREATED	APRIL 2011
PREPARED BY	JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 0.5 1 2 Miles

NORTHEASTERN 3 & 4 ASH POND

LOCATION MAP

N

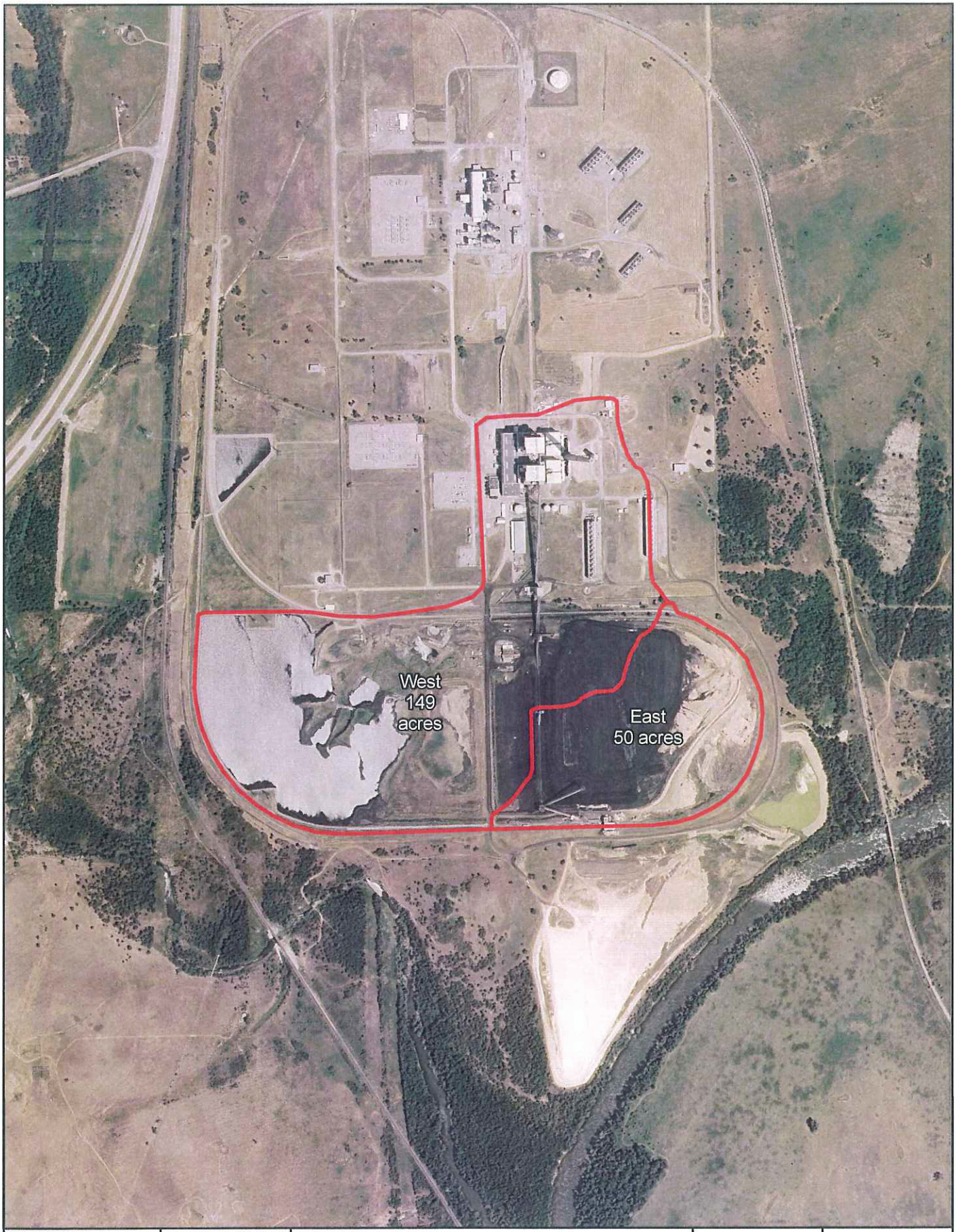
FIGURE 1

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Northeastern 3 & 4 Power Station Bottom Ash Pond was created in HEC-HMS[1] and consisted of two total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.31 square miles, or 199 acres. One basin represents the area that includes most of the power plant facilities and the Bottom Ash Pond itself, while the other represents the area that includes the coal pile and the area east of the coal pile, which is connected to the Bottom Ash Pond via a small channel. The basins were delineated from one-foot contours generated from a March 2010 survey[2] of the area and supplemented with the National Elevation Dataset (NED) 10-meter resolution Digital Elevation Model (DEM).

The Northeastern 3 & 4 Power Station Bottom Ash Pond is connected to multiple segments of the overall plant system and has several inflows and outflows that are assumed to be constant. Stormwater from a retention basin at the fly ash landfill, known as Basin C, is pumped to the bottom ash pond at a maximum rate of 4,000 gpm or 8.91 cfs. Inflow from pumping operations at Basin C, as well as from drains at Units 1, 2, 3, and 4, contribute a combined 6.3 MGD, or 9.75 cfs. The on-site wastewater treatment facility has capacity to pump approximately 1000 gpm, or 2.23 cfs. This capacity is used to regulate the normal pool elevation. Additionally, during emergency or high flood situations, flow may be diverted to the plant's cooling towers at a rate of 2.0 MGD, or 3.09 cfs.



FN PROJECT NO.	AEP10431
FILE NAME	H:\WR_DESIGN\FIGURES\Figure2_Basins.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE OKLAHOMA NORTH (FT)
DATE CREATED	APRIL 2011
PREPARED BY	JPM

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000 Feet

N

NORTHEASTERN 3&4 ASH POND

DRAINAGE BASIN MAP

FIGURE 2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[3] (SSURGO), and land use classification was determined from National Agriculture Imagery Program[4] (NAIP) 2010 aerial imagery of the site. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. All soils in the basin are in Hydrologic Soil Group D. The curve numbers shown in Table 1 represent only these soils and are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 10-year storm event. For the PMP events, a higher curve number with AMC III was used to simulate a worst-case scenario with the ground fully saturated.

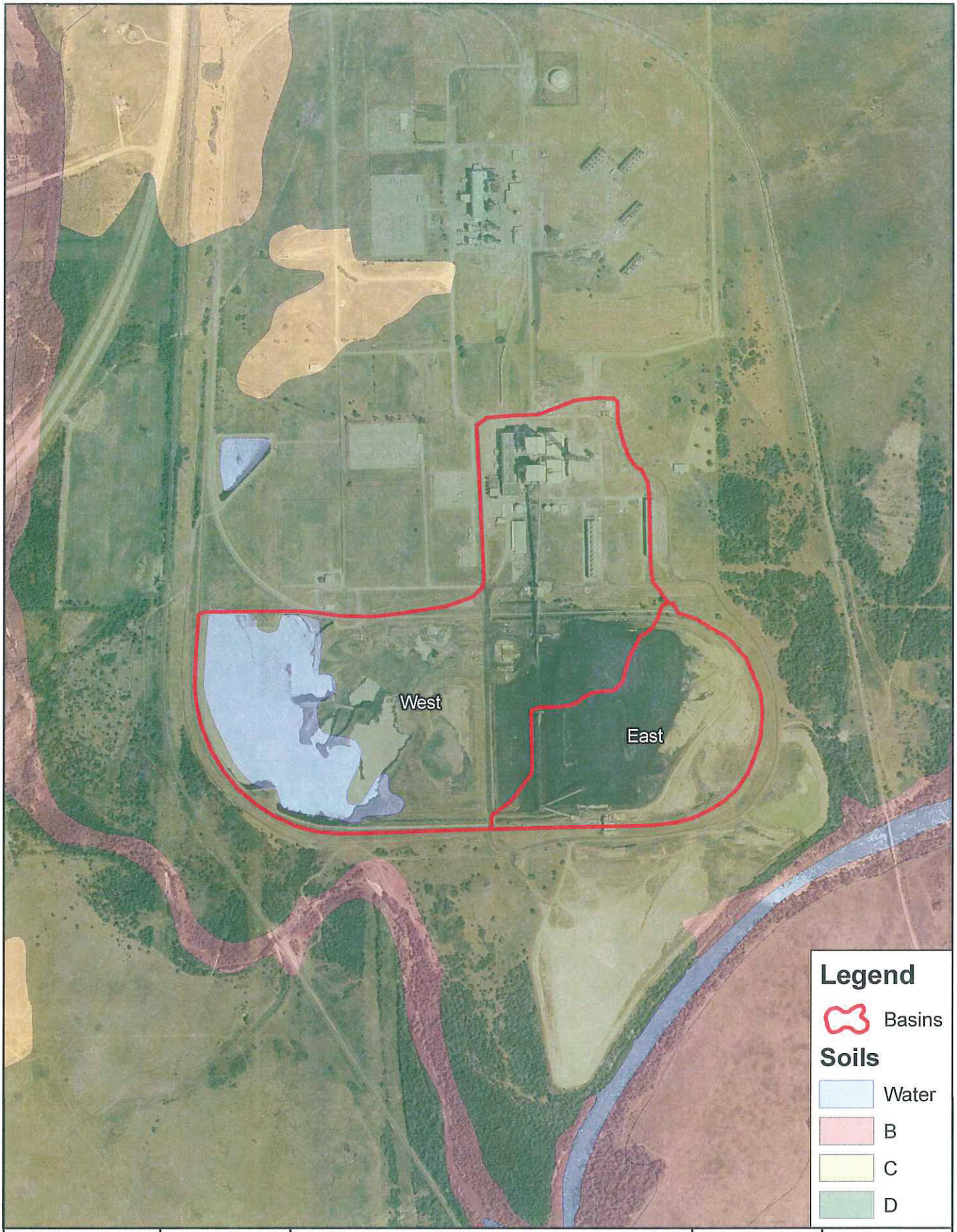
Table 1 – Curve Number Calculation Matrix

Land Use Classification	Curve Number (AMC II)
Water	100
Open Space	89
Industrial	93
Coal Pile	94

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
West	0.246	14.75	94.1	97.4
East	0.078	11.99	92.7	96.7



FN PROJECT NO.	AEP11201
FILE NAME	H:\WR_DESIGN\FIGURES\Figure3_Soils.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE OKLAHOMA NORTH (FT)
DATE CREATED	APRIL 2011
PREPARED BY	JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

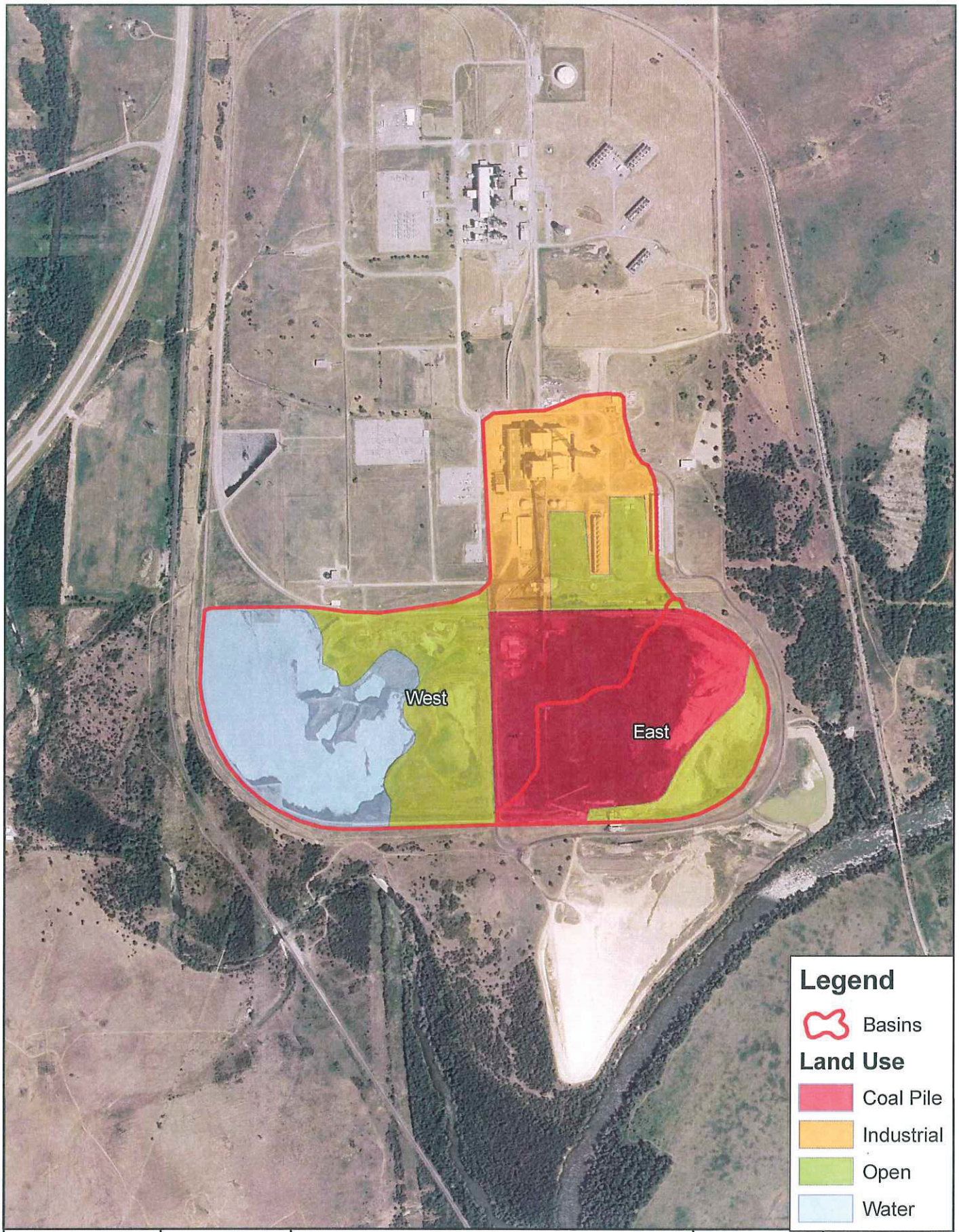
0 500 1,000 2,000 Feet

N

NORTHEASTERN 3&4 ASH POND

HYDROLOGIC SOIL CLASSIFICATIONS

FIGURE 3



FN PROJECT NO.	AEP11201
FILE NAME	H:\WR_DESIGN\FIGURES\Figure4_LandCover.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE OKLAHOMA NORTH (FT)
DATE CREATED	APRIL 2011
PREPARED BY	JPM

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000 Feet

N

NORTHEASTERN 3&4 ASH POND

LAND COVER DATA

FIGURE 4

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for the reservoir was approximated with the NED 10-meter DEM to calculate the available storage up to the nominal top of dam elevation of 630.0 ft-msl. This data is considered an approximation based on the best available information because the general topography of the reservoir has changed, and continues to change, with both sedimentation and excavation and grading of the bottom ash material. The elevation-storage relationship was used in the hydrologic model for routing both the frequency storm events and the PMF and is shown in Table 3 below.

Table 3 – Elevation-Storage Data

Elevation (ft-msl)	Storage (acre-ft)
600.0	0
620.0	72
621.0	93
622.0	117
623.0	147
624.0	183
625.0	223
626.0	266
627.0	311
628.0	360
629.0	412
630.0	469

2.4 DISCHARGE RATING CURVES

The dam has a single spillway structure located on the northwest corner of the embankment. Information regarding the dimensions and elevations of the spillway was taken from a combination of original construction drawings and detailed descriptions from AEP personnel. The principal spillway for the Bottom Ash Pond consists of a broad-crested weir with a total length of 24 feet and crest elevation of 625.0 ft-msl. There is also a 1-foot square notch with crest elevation of 624.0 ft-msl; however, this notch has been filled with concrete and no longer contributes to the discharge capacity of the spillway. A 10-foot section of the spillway is covered by a concrete lid. The spillway discharges down a chute with a slope of 2.5:1 and into a stilling basin with chute blocks. Immediately downstream of the stilling basin is a small

depressed area contained by the railroad embankment. Two 48-inch HDPE culverts run under the railroad embankment. The original culverts were 60-inch corrugated metal pipe (CMP) culverts, but HDPE slip-liners were recently installed. The overall spillway system, including these downstream culverts, was modeled with a steady-state HEC-RAS[5] model. The HEC-RAS model accounts for submergence of the tailwater from the downstream culverts, which will significantly restrict flow through the spillway. The discharge rating curve for the spillway is shown in Table 4. A photograph of the spillway is shown in Figure 5, along with a photograph of the downstream stilling basin and culverts in Figure 6. Detailed calculations for the discharge rating curve are included in Appendix B.

Table 4 – Discharge Rating Curve

Elevation (ft-msl)	Total Discharge (cfs)
625.0	0
625.5	25
626.0	71
626.5	131
627.0	199
627.5	279
628.0	367
628.5	462
629.0	507
629.5	518
630.0	529

Figure 5 – Bottom Ash Pond Spillway

Figure 6 – Downstream Basin with Culverts

2.5 FREQUENCY MODEL RESULTS

The 10-year frequency – or 10% annual chance – storm event was analyzed for the Northeastern 3 & 4 Power Station Ash Pond. The hydrologic model described in the preceding sections was implemented in analyzing this event. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to a storm event of this nature. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[6] and Technical Paper 40.[7] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.39	0.81	1.50	1.77	1.96	2.27	2.76	3.22
5	0.56	1.19	2.34	2.88	3.17	3.76	4.52	5.17
10	0.62	1.32	2.72	3.26	3.67	4.39	5.22	6.09
25	0.71	1.52	3.17	3.81	4.25	5.12	6.10	7.08
50	0.79	1.68	3.56	4.20	4.77	5.71	6.84	7.92
100	0.86	1.84	4.04	4.71	5.35	6.41	7.63	8.85

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. Normal engineering assumptions would assume that flood routings were started at the lowest spillway crest elevation. However, the power plant operation policy calls for the normal pool of the reservoir to be maintained at elevation 623.0 ft-msl. This water level is regulated with pumping to the on-site wastewater treatment facility, and, in emergency situations, flow may be diverted to the plant's cooling towers. For comparison, the 10-year storm event was computed with initial elevations at both the normal pool and spillway crest. The results of the 10-year storm are shown in Table 6.

Table 6 – 10-Year Frequency Model Results

Initial Elevation (ft-msl)	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
623.0	625.28	798	14
625.0	626.28	798	104

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[8] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[9] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 7 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, the same rainfall depths were applied to both basins.HMR-52 also produces a 72-hour, critically stacked temporal distribution by arranging the incremental rainfall depths to produce the rainfall hyetograph shown in Figure 7.

Table 7 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	15.58
2	19.55
3	22.66
6	28.56
12	34.52
24	39.21
48	43.47
72	45.87

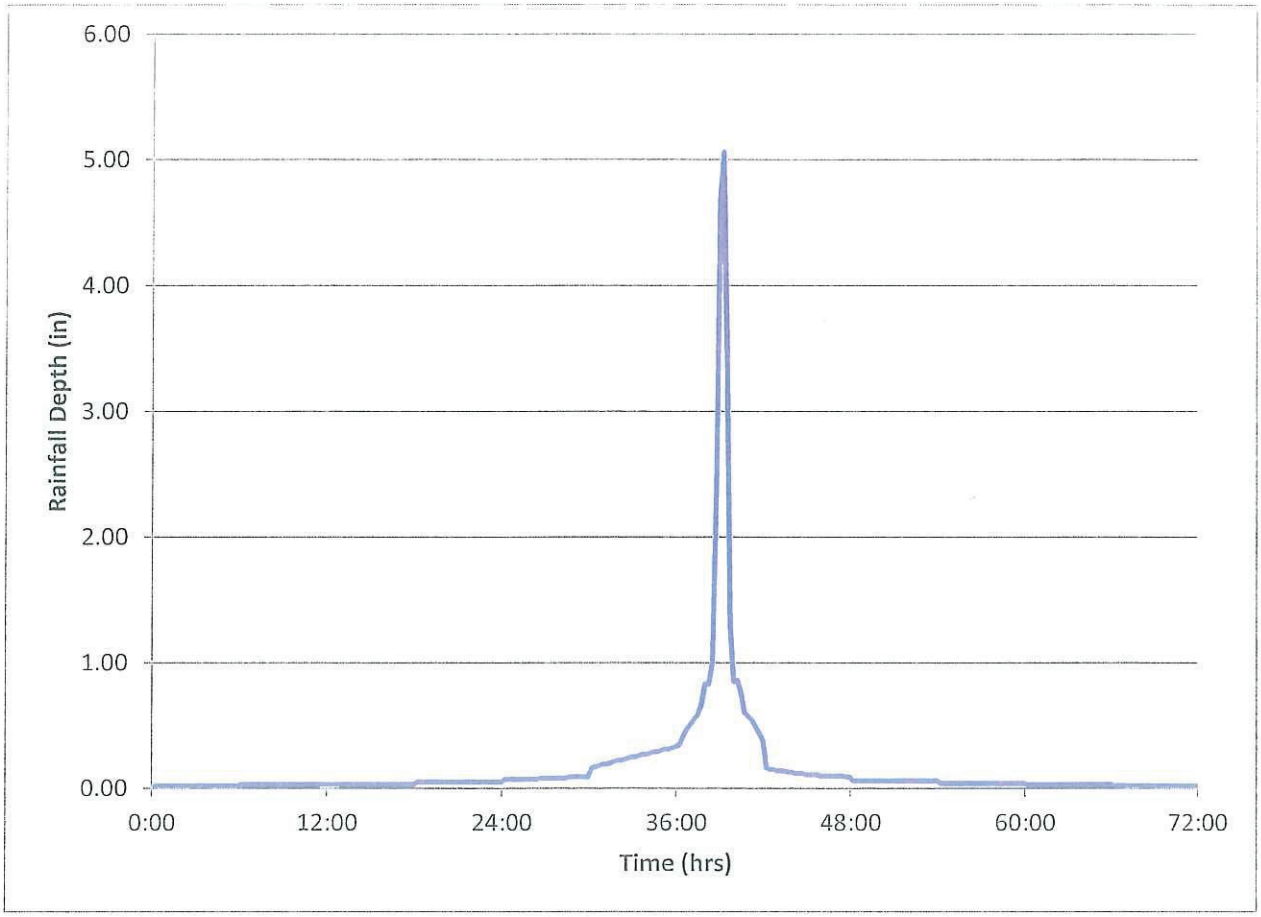


Figure 7 – PMP Rainfall Hyetograph

The PMF was modeled, as described previously, with flood routing started at both elevation 623.0 ft-msl and elevation 625.0 ft-msl. According to the Oklahoma Water Resources Board (OWRB) [10] regulations, the Bottom Ash Pond dam is classified as a small-size dam. The hazard classification may be either low or significant depending on the effects of a dam breach on a railroad bridge downstream. For this analysis, the hazard classification was assumed to be significant. This assumption will be evaluated upon completion of the breach analysis. A dam with a hazard classification of significant is required to pass 40% of the PMF to be in compliance with the OWRB regulations. Table 8 contains the results of these PMF model runs.

Table 8 – 0.4 PMF Model Results

Initial Elevation (ft-msl)	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
623.0	627.87	1,490	344
625.0	628.15	1,490	396

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydrologic analysis, the Bottom Ash Pond Dam is hydraulically adequate for the 40% PMF event. Table 9 lists the pertinent elevation data for the dam, including the top of dam elevation and spillway crest elevation. Comparing these elevations to the maximum water surface elevations shown in Table 10 indicates that the dam would safely contain all flood events up to, and including, the 40% PMF. Additionally, while the normal pool elevation is maintained at elevation 623.0 ft-msl by pumping operations, the spillway is engaged during the 10-year storm event.

Table 9 – Pertinent Dam Information

Top of Dam (ft-msl)	Spillway Crest (ft-msl)	Operating Level (ft-msl)
630.0	625.0	623.0

Table 10 – Summary of Results

Initial Elevation (ft-msl)	10-year	0.4 PMF
623.0	625.28	627.87
625.0	626.28	628.15

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to the reservoir. The assumptions in this analysis represent average reservoir conditions. In its current condition, the Bottom Ash Pond associated with the Northeastern 3 & 4 Power Station is deemed to be hydraulically adequate for any storm event up to, and including, the 40% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *Hydrologic Modeling System HEC-HMS - User's Manual Version 3.5*, Davis, California, August 2010.

2. Henderson Aerial Survey, Inc. *Northeastern Plant*. [computer map]. 1"=50'. Grove City, Ohio, March 31, 2010.

3. "Soil Data Mart." *NRCS Soil Survey Geographic (SSURGO) Database*. <http://soildatamart.nrcs.usda.gov>.

4. U.S. Department of Agriculture, Aerial Photography Field Office: *National Agriculture Imagery Program*, Salt Lake City, UT, 2010. <http://gis.apfo.usda.gov/arcgis/services>.

5. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *River Analysis System - User's Manual Version 4.1*, Davis, California, January 2010.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration: *Technical Memorandum NWS HYDRO-35, Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States*, Silver Spring, MD, June 1977.

7. U.S. Department of Commerce, Weather Bureau: *Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*, Washington, D.C., May 1961.

8. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

9. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

10. Oklahoma Water Resources Board, Dam Safety Program: *Hazard Potential Classification: Guidelines for Dams in Oklahoma*. January 2011.

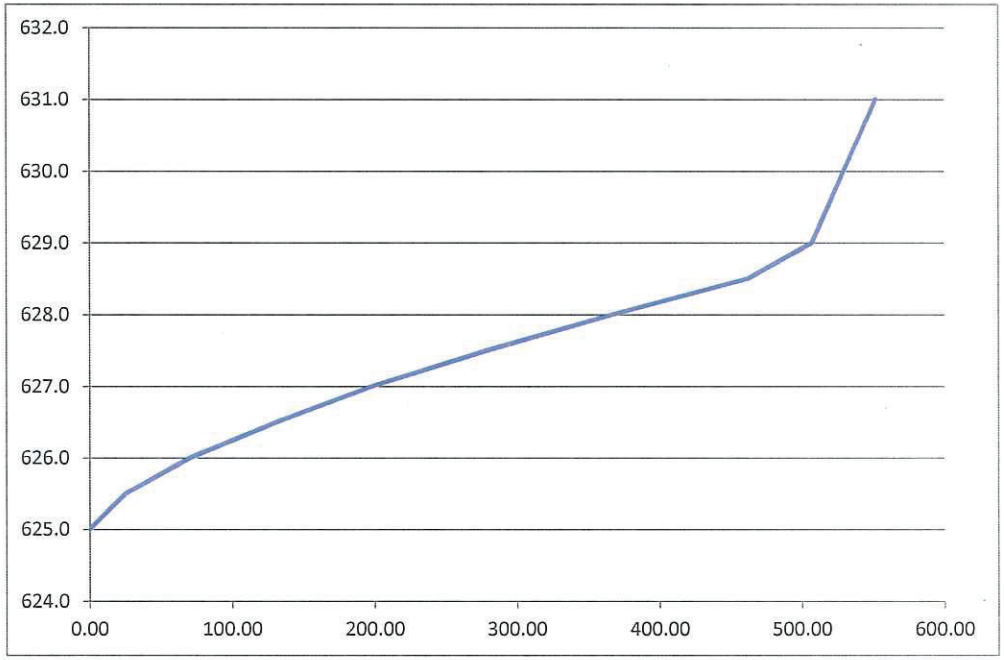
Appendix B
Discharge Rating Curve Calculations and Hydrologic Parameters

Discharge Rating Curve
Overflow Structure

Elevation [ft-msl]	Discharge [cfs]
625.0	0.00
625.5	24.86
626.0	70.65
626.5	131.08
627.0	198.65
627.5	279.03
628.0	367.27
628.5	461.54
629.0	506.74
629.5	517.98
630.0	529.21
630.5	540.45
631.0	551.69
631.5	562.92

RAS Results	
Elevation [ft-msl]	Discharge [cfs]
625	0
625.07	1
625.2	10
625.44	20
625.81	50
626.27	100
627.01	200
627.63	300
628.18	400
628.7	500
633.15	600
640.02	700

**Accounts for Discharge in DS Culverts*

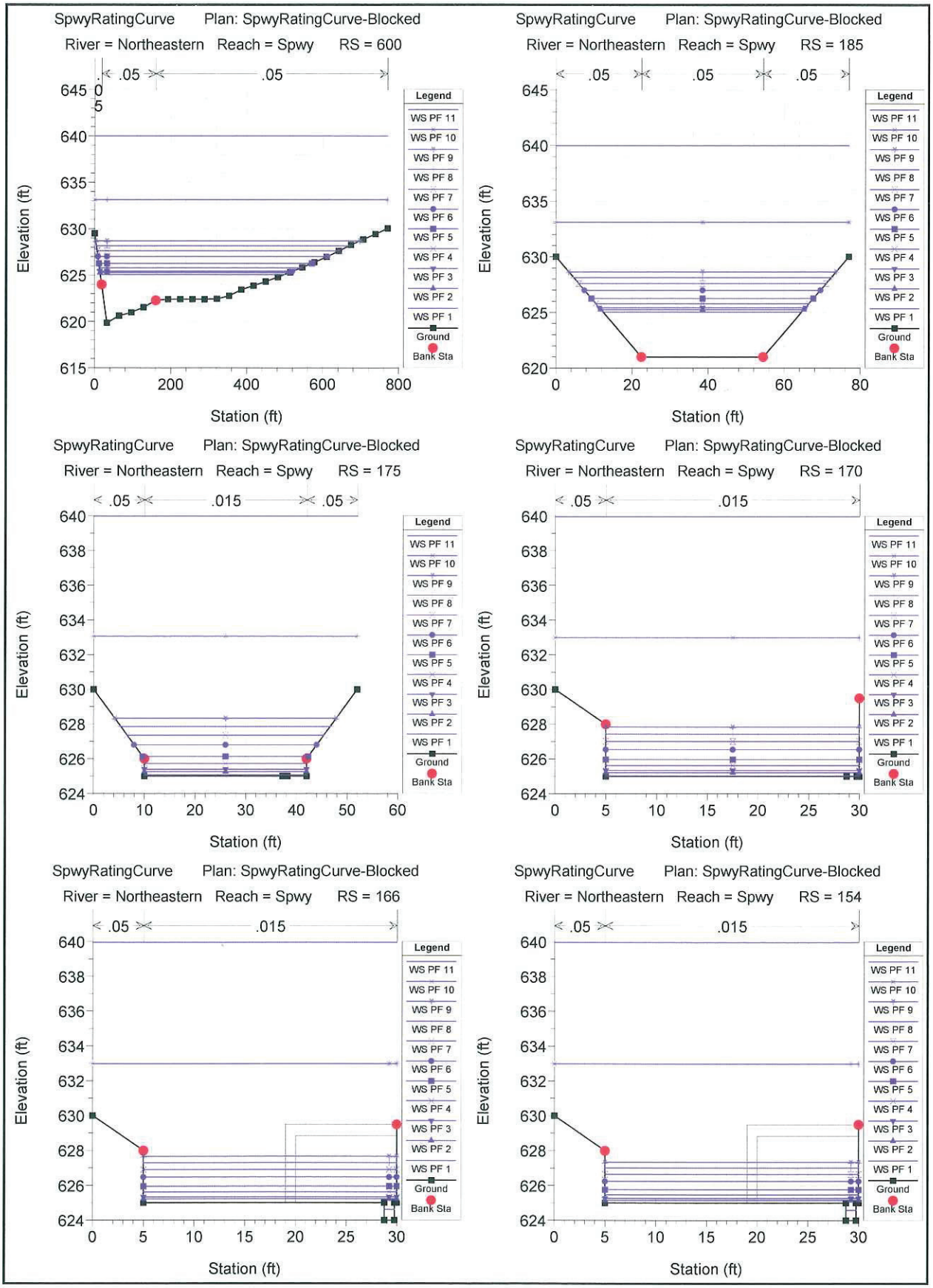


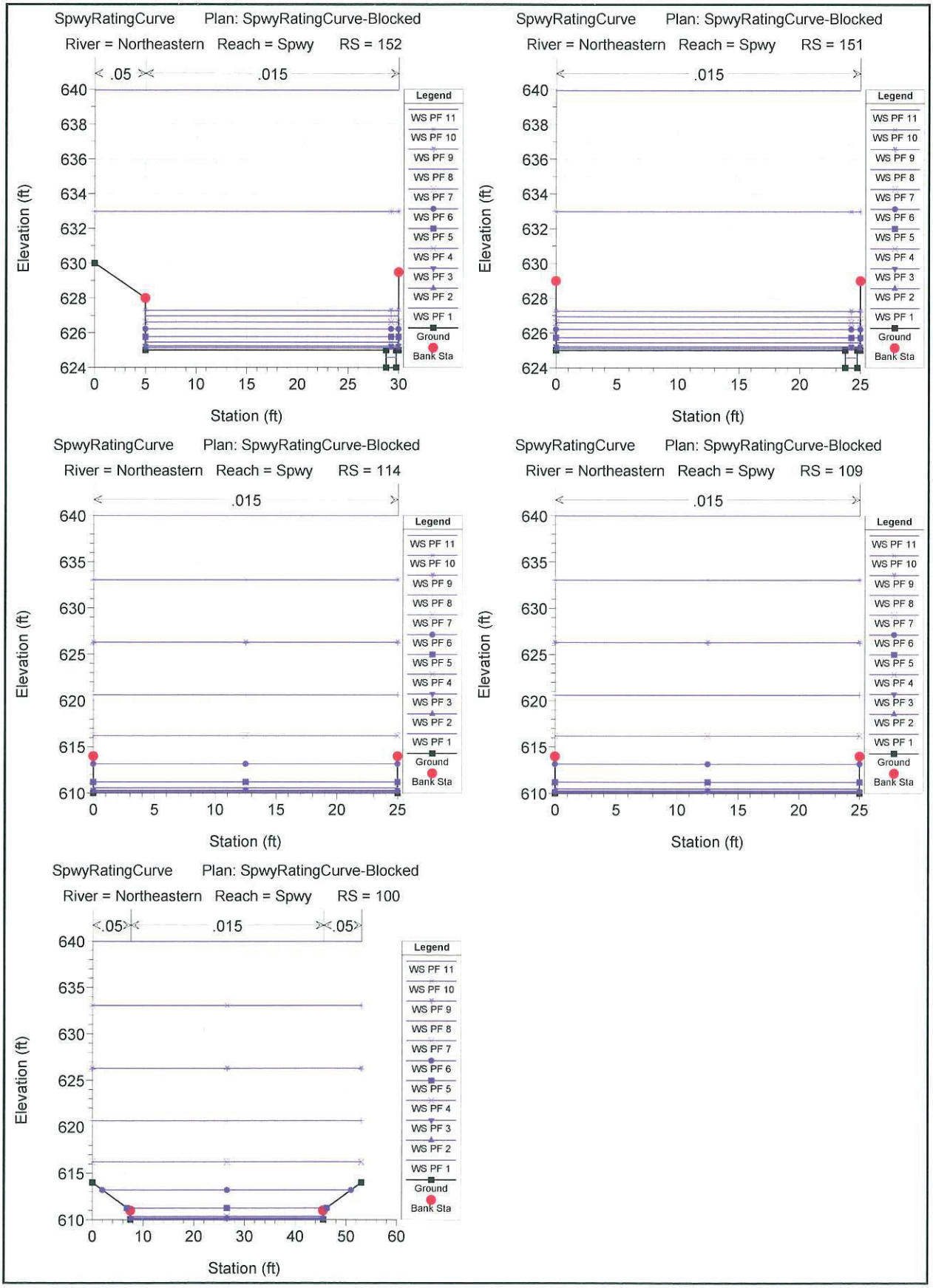
HEC-RAS Plan: SPRC_BL River: Northeastern Reach: Spwy

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Spwy	600	PF 1	1.00	619.86	625.07		625.07	0.000000	0.00	1231.66	484.24	0.00
Spwy	600	PF 2	10.00	619.86	625.28		625.28	0.000000	0.01	1336.14	498.46	0.00
Spwy	600	PF 3	20.00	619.86	625.44		625.44	0.000000	0.02	1416.77	508.75	0.00
Spwy	600	PF 4	50.00	619.86	625.81		625.81	0.000000	0.04	1606.45	532.03	0.00
Spwy	600	PF 5	100.00	619.86	626.27		626.27	0.000001	0.07	1859.02	560.46	0.01
Spwy	600	PF 6	200.00	619.86	627.01		627.01	0.000001	0.11	2290.88	603.90	0.01
Spwy	600	PF 7	300.00	619.86	627.63		627.63	0.000002	0.14	2674.13	637.24	0.01
Spwy	600	PF 8	400.00	619.86	628.18		628.19	0.000002	0.17	3035.76	666.36	0.01
Spwy	600	PF 9	500.00	619.86	628.70		628.70	0.000003	0.19	3386.70	695.48	0.01
Spwy	600	PF 10	600.00	619.86	633.15		633.15	0.000000	0.11	6765.67	770.65	0.01
Spwy	600	PF 11	700.00	619.86	640.02		640.02	0.000000	0.07	12057.71	770.65	0.00
Spwy	185	PF 1	1.00	621.00	625.07		625.07	0.000000	0.01	171.72	52.36	0.00
Spwy	185	PF 2	10.00	621.00	625.28		625.28	0.000001	0.06	182.96	53.42	0.01
Spwy	185	PF 3	20.00	621.00	625.44		625.44	0.000002	0.12	191.57	54.22	0.01
Spwy	185	PF 4	50.00	621.00	625.81		625.81	0.000010	0.27	211.60	56.04	0.02
Spwy	185	PF 5	100.00	621.00	626.27		626.27	0.000028	0.48	237.89	58.33	0.04
Spwy	185	PF 6	200.00	621.00	627.00		627.01	0.000069	0.81	282.07	62.01	0.06
Spwy	185	PF 7	300.00	621.00	627.61		627.63	0.000107	1.08	320.80	65.05	0.07
Spwy	185	PF 8	400.00	621.00	628.16		628.18	0.000140	1.31	357.11	67.79	0.09
Spwy	185	PF 9	500.00	621.00	628.67		628.69	0.000169	1.50	392.17	70.33	0.10
Spwy	185	PF 10	600.00	621.00	633.13		633.15	0.000039	0.98	731.89	77.00	0.05
Spwy	185	PF 11	700.00	621.00	640.01		640.01	0.000011	0.69	1261.22	77.00	0.03
Spwy	175	PF 1	1.00	625.00	625.07		625.07	0.000792	0.46	2.17	32.00	0.31
Spwy	175	PF 2	10.00	625.00	625.26		625.28	0.000917	1.21	8.29	32.00	0.42
Spwy	175	PF 3	20.00	625.00	625.40		625.44	0.000852	1.55	12.89	32.00	0.43
Spwy	175	PF 4	50.00	625.00	625.73		625.80	0.000755	2.14	23.35	32.00	0.44
Spwy	175	PF 5	100.00	625.00	626.14		626.26	0.000694	2.74	36.58	32.71	0.45
Spwy	175	PF 6	200.00	625.00	626.81		626.99	0.000597	3.45	59.45	36.03	0.45
Spwy	175	PF 7	300.00	625.00	627.36		627.60	0.000544	3.94	80.27	38.82	0.45
Spwy	175	PF 8	400.00	625.00	627.87		628.15	0.000502	4.30	100.48	41.34	0.45
Spwy	175	PF 9	500.00	625.00	628.34		628.66	0.000466	4.59	120.62	43.71	0.44
Spwy	175	PF 10	600.00	625.00	633.07		633.14	0.000032	2.17	359.78	52.00	0.13
Spwy	175	PF 11	700.00	625.00	639.99		640.01	0.000005	1.35	719.30	52.00	0.06
Spwy	170	PF 1	1.00	625.00	625.03	625.03	625.06	0.020524	1.35	0.74	25.00	1.39
Spwy	170	PF 2	10.00	625.00	625.22		625.27	0.002461	1.79	5.59	25.00	0.67
Spwy	170	PF 3	20.00	625.00	625.35		625.43	0.002331	2.31	8.64	25.00	0.69
Spwy	170	PF 4	50.00	625.00	625.63		625.79	0.002041	3.18	15.73	25.00	0.71
Spwy	170	PF 5	100.00	625.00	625.98		626.24	0.001952	4.10	24.41	25.00	0.73
Spwy	170	PF 6	200.00	625.00	626.54		626.96	0.001790	5.18	38.60	25.00	0.73
Spwy	170	PF 7	300.00	625.00	627.02		627.57	0.001730	5.95	50.41	25.00	0.74
Spwy	170	PF 8	400.00	625.00	627.44		628.11	0.001686	6.55	61.06	25.00	0.74
Spwy	170	PF 9	500.00	625.00	627.85		628.61	0.001636	7.02	71.21	25.00	0.73
Spwy	170	PF 10	600.00	625.00	633.00		633.13	0.000090	2.95	220.04	30.00	0.18
Spwy	170	PF 11	700.00	625.00	639.96		640.01	0.000019	1.83	428.79	30.00	0.08
Spwy	166	PF 1	1.00	624.00	624.62	624.32	624.66	0.001489	1.62	0.62	1.00	0.36
Spwy	166	PF 2	10.00	624.00	625.22	625.13	625.26	0.001714	1.58	6.35	24.00	0.54
Spwy	166	PF 3	20.00	624.00	625.34	625.24	625.42	0.001992	2.16	9.25	24.00	0.61
Spwy	166	PF 4	50.00	624.00	625.62	625.47	625.78	0.002088	3.13	16.00	24.00	0.67
Spwy	166	PF 5	100.00	624.00	625.95	625.77	626.23	0.002305	4.19	23.87	24.00	0.74
Spwy	166	PF 6	200.00	624.00	626.48	626.25	626.95	0.002386	5.47	36.57	24.00	0.78
Spwy	166	PF 7	300.00	624.00	626.92	626.65	627.55	0.002464	6.39	46.98	24.00	0.80
Spwy	166	PF 8	400.00	624.00	627.31	627.01	628.09	0.002509	7.10	56.34	24.00	0.82
Spwy	166	PF 9	500.00	624.00	627.67	627.34	628.59	0.002546	7.70	64.96	24.00	0.82
Spwy	166	PF 10	600.00	624.00	632.99	627.64	633.13	0.000235	3.08	209.47	30.00	0.18
Spwy	166	PF 11	700.00	624.00	639.96	627.94	640.01	0.000041	1.86	418.55	30.00	0.08
Spwy	154	PF 1	1.00	624.00	624.60	624.32	624.64	0.001636	1.68	0.60	1.00	0.38
Spwy	154	PF 2	10.00	624.00	625.17	625.13	625.23	0.003413	1.94	5.15	24.00	0.74
Spwy	154	PF 3	20.00	624.00	625.27	625.24	625.38	0.003801	2.63	7.59	24.00	0.82
Spwy	154	PF 4	50.00	624.00	625.48	625.47	625.73	0.004764	4.03	12.41	24.00	0.99
Spwy	154	PF 5	100.00	624.00	625.77	625.77	626.18	0.004351	5.11	19.58	24.00	1.00
Spwy	154	PF 6	200.00	624.00	626.25	626.25	626.90	0.004034	6.46	30.95	24.00	1.00
Spwy	154	PF 7	300.00	624.00	626.65	626.65	627.50	0.003873	7.39	40.61	24.00	1.00
Spwy	154	PF 8	400.00	624.00	627.01	627.01	628.03	0.003766	8.11	49.34	24.00	1.00
Spwy	154	PF 9	500.00	624.00	627.34	627.34	628.53	0.003732	8.73	57.26	24.00	1.00
Spwy	154	PF 10	600.00	624.00	632.99	627.64	633.13	0.000236	3.08	209.38	30.00	0.18
Spwy	154	PF 11	700.00	624.00	639.96	627.94	640.01	0.000041	1.86	418.53	30.00	0.08
Spwy	152	PF 1	1.00	624.00	624.59		624.64	0.001663	1.69	0.59	1.00	0.39
Spwy	152	PF 2	10.00	624.00	625.15	625.12	625.22	0.004604	2.10	4.76	25.00	0.85
Spwy	152	PF 3	20.00	624.00	625.24	625.23	625.37	0.004957	2.82	7.08	25.00	0.94
Spwy	152	PF 4	50.00	624.00	625.47	625.46	625.71	0.004456	3.92	12.75	25.00	0.97
Spwy	152	PF 5	100.00	624.00	625.78	625.74	626.15	0.003840	4.90	20.39	25.00	0.96
Spwy	152	PF 6	200.00	624.00	626.23	626.22	626.85	0.003684	6.31	31.68	25.00	0.99

HEC-RAS Plan: SPRC_BL River: Northeastern Reach: Spwy (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Spwy	152	PF 7	300.00	624.00	626.63	626.60	627.43	0.003411	7.18	41.81	25.00	0.98
Spwy	152	PF 8	400.00	624.00	626.98	626.94	627.95	0.003332	7.92	50.49	25.00	0.98
Spwy	152	PF 9	500.00	624.00	627.29	627.26	628.43	0.003299	8.57	58.36	25.00	0.99
Spwy	152	PF 10	600.00	624.00	632.99		633.13	0.000095	2.94	220.82	30.00	0.18
Spwy	152	PF 11	700.00	624.00	639.96		640.01	0.000020	1.82	429.76	30.00	0.08
Spwy	151	PF 1	1.00	624.00	624.59		624.63	0.001680	1.70	0.59	1.00	0.39
Spwy	151	PF 2	10.00	624.00	625.12	625.12	625.22	0.007571	2.44	4.10	25.00	1.06
Spwy	151	PF 3	20.00	624.00	625.23	625.23	625.37	0.006126	3.01	6.64	25.00	1.03
Spwy	151	PF 4	50.00	624.00	625.46	625.46	625.71	0.004890	4.03	12.40	25.00	1.01
Spwy	151	PF 5	100.00	624.00	625.74	625.74	626.15	0.004453	5.13	19.48	25.00	1.02
Spwy	151	PF 6	200.00	624.00	626.22	626.22	626.85	0.003789	6.37	31.41	25.00	1.00
Spwy	151	PF 7	300.00	624.00	626.59	626.59	627.43	0.003686	7.35	40.80	25.00	1.01
Spwy	151	PF 8	400.00	624.00	626.94	626.94	627.95	0.003540	8.08	49.53	25.00	1.01
Spwy	151	PF 9	500.00	624.00	627.26	627.26	628.43	0.003449	8.69	57.54	25.00	1.01
Spwy	151	PF 10	600.00	624.00	632.99		633.12	0.000117	2.99	200.65	25.00	0.19
Spwy	151	PF 11	700.00	624.00	639.95		640.01	0.000029	1.87	374.86	25.00	0.08
Spwy	114	PF 1	1.00	610.00	610.08		610.08	0.000854	0.52	1.92	25.00	0.33
Spwy	114	PF 2	10.00	610.00	610.22		610.27	0.002417	1.78	5.62	25.00	0.66
Spwy	114	PF 3	20.00	610.00	610.34		610.43	0.002505	2.36	8.46	25.00	0.72
Spwy	114	PF 4	50.00	610.00	610.59	610.49	610.77	0.002574	3.41	14.65	25.00	0.79
Spwy	114	PF 5	100.00	610.00	611.22		611.39	0.000952	3.28	30.49	25.00	0.52
Spwy	114	PF 6	200.00	610.00	613.17		613.27	0.000189	2.52	79.22	25.00	0.25
Spwy	114	PF 7	300.00	610.00	616.21		616.27	0.000057	1.93	155.31	25.00	0.14
Spwy	114	PF 8	400.00	610.00	620.63		620.67	0.000022	1.51	265.76	25.00	0.08
Spwy	114	PF 9	500.00	610.00	626.30		626.33	0.000011	1.23	407.61	25.00	0.05
Spwy	114	PF 10	600.00	610.00	633.07		633.09	0.000007	1.04	576.75	25.00	0.04
Spwy	114	PF 11	700.00	610.00	639.98		640.00	0.000005	0.93	749.56	25.00	0.03
Spwy	109	PF 1	1.00	610.00	610.07	610.03	610.08	0.001103	0.56	1.78	25.00	0.37
Spwy	109	PF 2	10.00	610.00	610.17	610.17	610.26	0.005799	2.32	4.32	25.00	0.98
Spwy	109	PF 3	20.00	610.00	610.27	610.27	610.41	0.005192	2.95	6.78	25.00	1.00
Spwy	109	PF 4	50.00	610.00	610.49	610.49	610.75	0.004480	4.04	12.37	25.00	1.01
Spwy	109	PF 5	100.00	610.00	611.21		611.38	0.000967	3.29	30.35	25.00	0.53
Spwy	109	PF 6	200.00	610.00	613.17		613.27	0.000189	2.53	79.19	25.00	0.25
Spwy	109	PF 7	300.00	610.00	616.21		616.27	0.000057	1.93	155.31	25.00	0.14
Spwy	109	PF 8	400.00	610.00	620.63		620.67	0.000022	1.51	265.76	25.00	0.08
Spwy	109	PF 9	500.00	610.00	626.30		626.33	0.000011	1.23	407.60	25.00	0.05
Spwy	109	PF 10	600.00	610.00	633.07		633.09	0.000007	1.04	576.75	25.00	0.04
Spwy	109	PF 11	700.00	610.00	639.98		640.00	0.000005	0.93	749.56	25.00	0.03
Spwy	100	PF 1	1.00	610.00	610.03	610.03	610.04	0.014233	1.03	0.97	38.00	1.13
Spwy	100	PF 2	10.00	610.00	610.13	610.13	610.19	0.006803	2.06	4.85	38.00	1.02
Spwy	100	PF 3	20.00	610.00	610.21	610.21	610.31	0.005602	2.56	7.80	38.00	1.00
Spwy	100	PF 4	50.00	610.00	610.38	610.38	610.57	0.004696	3.49	14.31	38.00	1.00
Spwy	100	PF 5	100.00	610.00	611.28	610.60	611.35	0.000330	2.05	48.89	39.41	0.32
Spwy	100	PF 6	200.00	610.00	613.21	610.95	613.25	0.000060	1.62	134.10	49.04	0.16
Spwy	100	PF 7	300.00	610.00	616.24	611.24	616.26	0.000014	1.21	293.06	53.00	0.09
Spwy	100	PF 8	400.00	610.00	620.65	611.51	620.66	0.000004	0.94	526.73	53.00	0.05
Spwy	100	PF 9	500.00	610.00	626.31	611.75	626.32	0.000002	0.77	827.16	53.00	0.03
Spwy	100	PF 10	600.00	610.00	633.08	611.98	633.08	0.000001	0.66	1185.60	53.00	0.02
Spwy	100	PF 11	700.00	610.00	639.99	612.19	639.99	0.000000	0.59	1551.88	53.00	0.02


SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 600
.05 .05
Elevation (ft)
Station (ft)
Legend
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground
Bank Sta
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 185
.05 .05 .05
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 175
.05 .015 .05
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 170
.05 .015
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 166
.05 .015
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 154
.05 .015
Elevation (ft)
Station (ft)


SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 152
.05
.015
Elevation (ft)
Station (ft)
Legend
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground
Bank Sta
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 151
.015
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 114
.015
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 109
.015
Elevation (ft)
Station (ft)
SpwyRatingCurve Plan: SpwyRatingCurve-Blocked
River = Northeastern Reach = Spwy RS = 100
.05
.015
.05
Elevation (ft)
Station (ft)

BASIN LAG TIME CALCULATION (Existing)

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	Northeastern Station	
LOCATION	Oologah, OK	
DATE	Apr-11	
BASIN COND.		
BY:	JPM	
WSHED NAME	West	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0

based on information for imperviousness from Corps of Engineers

Land Use	% Conc	% Grass	n value	% Land Use	Inc n
Low D. Residential (1+ Acres)	25	75	0.21375	0	0
Med. D. Residential (1/3 Acres)	41	59	0.17135	0	0
High D. Residential (1/4 Acres)	47	53	0.15545	0	0
Multifamily	70	30	0.0945	0	0
Mobile Home Parks	20	80	0.227	0	0
C.B.D.	95	5	0.02825	0	0
Strip Commercial	90	10	0.0415	0	0
Shopping Center	95	5	0.02825	0	0
Instutional-Schools	40	60	0.174	0	0
Industrial	90	10	0.0415	100	0.0415
Highway ROW	35	65	0.18725	0	0
Public Utilities	60	40	0.121	0	0
Vacant urban land and	6	84	0.2361	0	0
Parks	0	0	0	0	
Other	0	0	0	0	0
		TOTAL		100	0.0415

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.02	IN.		
SLOPE	0.01	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	1010.04	FT		
SLOPE	0.0050	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	1.131			

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	40
XSECT AREA=	125.000	SQ FT	BOTTOM	10
			DEPTH	5
WETTED PERIMETER	41.623	FT		
SLOPE	0.0063	FT/FT		
MANNINGS N	0.04			
COMPUTED VELOCITY	6.159	FT/S		
LENGTH	2060.49	FT		

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	West	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	4.13	4.13
SHALLOW CONCENTRATED FLOW			14.88	14.88
CHANNEL FLOW			5.58	5.58
TOTAL			24.59	24.59
			Lag (Hrs) =	0.25

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag (min) = 14.75

BASIN LAG TIME CALCULATION (Existing)

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	Northeastern Station	
LOCATION	Oologah, OK	
DATE	Apr-11	
BASIN COND.		
BY:	JPM	
WSHED NAME	East	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	100	0.15
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0

based on information for imperviousness from Corps of Engineers

Land Use	% Conc	% Grass	n value	% Land Use	Inc n
Low D. Residential (1+ Acres)	25	75	0.21375	0	0
Med. D. Residential (1/3 Acres)	41	59	0.17135	0	0
High D. Residential (1/4 Acres)	47	53	0.15545	0	0
Multifamily	70	30	0.0945	0	0
Mobile Home Parks	20	80	0.227	0	0
C.B.D.	95	5	0.02825	0	0
Strip Commercial	90	10	0.0415	0	0
Shopping Center	95	5	0.02825	0	0
Instutional-Schools	40	60	0.174	0	0
Industrial	90	10	0.0415	0	0
Highway ROW	35	65	0.18725	0	0
Public Utilities	60	40	0.121	0	0
Vacant urban land and	6	84	0.2361	0	0
Parks	0	0	0	0	
Other	0	0	0	0	0
		TOTAL		100	0.15

LENGTH	100	FT.	MAX 100'
2 YR. 24 HOUR PRECIP	4.02	IN.	
SLOPE	0.2	FT/FT	

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

CHANNEL FLOW -- 1

XSECT AREA=	60.000	SQ FT	TOPWIDTH = 30
			BOTTOM = 10
			DEPTH = 3
WETTED PERIMETER	30.881	FT	
SLOPE	0.0018	FT/FT	
MANNINGS N	0.04		
COMPUTED VELOCITY	2.478	FT/S	
LENGTH	1643.35	FT	

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{60 \times L}{60 \times V}$$

CHANNEL FLOW -- 2

XSECT AREA=	137.500	SQ FT	TOPWIDTH = 40
			BOTTOM = 15
			DEPTH = 5
WETTED PERIMETER	41.926	FT	
SLOPE	0.0052	FT/FT	
MANNINGS N	0.04		
COMPUTED VELOCITY	5.912	FT/S	
LENGTH	1934.24	FT	

$$V = \frac{1.49 \times \left(\frac{a}{p_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	East	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	3.48	3.48
CHANNEL FLOW -- 1			11.05	11.05
CHANNEL FLOW -- 2			5.45	5.45
TOTAL			19.98	19.98
			Lag (Hrs) =	0.20

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag (min) = 11.99

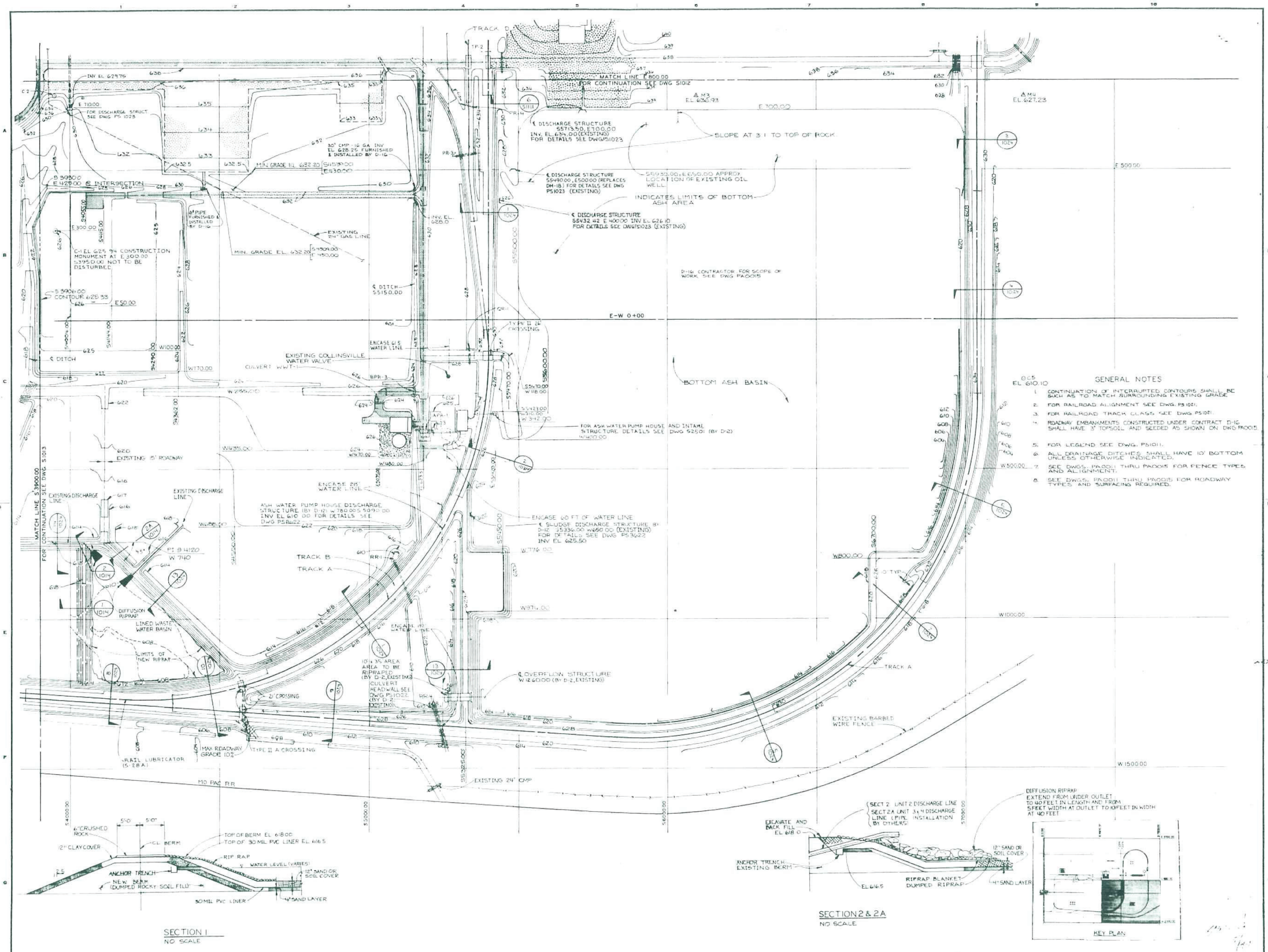
Curve Number

Basin	Land Use	CN	Area (ac)	Inc. CN	
West	Water	100	46.86	31.40	
West	Open Space - Poor	89	46.38	27.66	
West	Industrial	93	32.50	20.25	
West	Coal Pile	94	23.51	14.80	
					AMC III
		Total	**149.25**	**94.11**	**97.35**

Basin	Land Use	CN	Area (ac)	Inc. CN	
East	Open Space - Poor	89	12.68	22.63	
East	Coal Pile	94	37.19	70.10	
					AMC III
		Total	**49.87**	**92.73**	**96.70**

** All soils are Hydrologic Soil Group D*

Appendix C
Pertinent Drawings



11-12-76	REVISED AS CIRCLED
10-8-76	REVISED AS CIRCLED
8-11-76	REVISED AS CIRCLED
5-14-76	REVISED AS CIRCLED
6-8-76	REVISED AS CIRCLED

SCALE: 1" = 100'

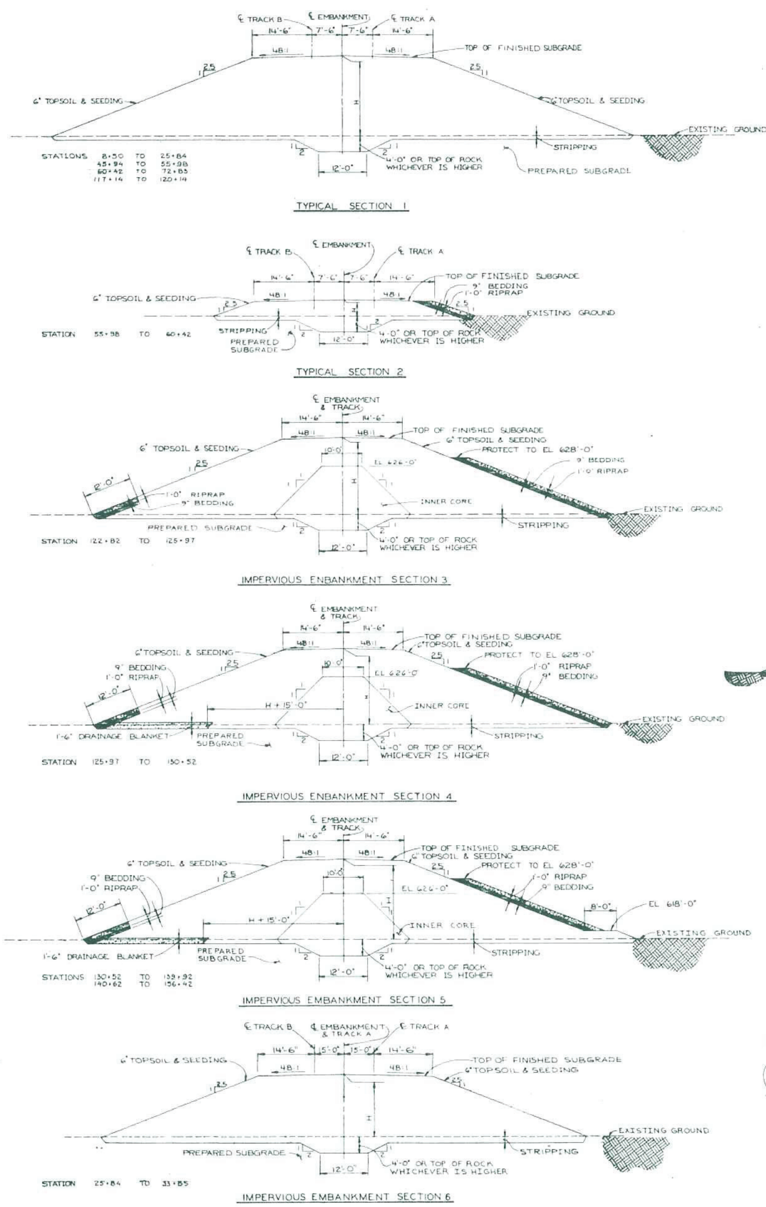
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OKLAHOMA

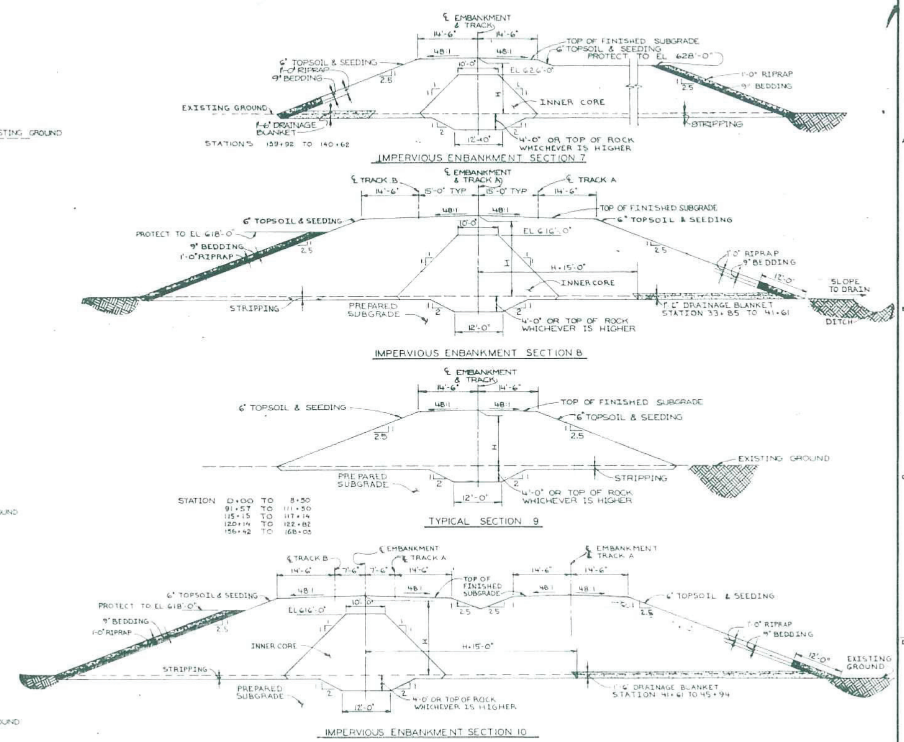
DATE 2/29/75 REG. NO. 8892

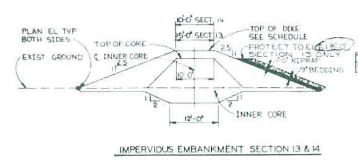
BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6571/6572

PUBLIC SERVICE COMPANY OF OKLAHOMA
NORTHEASTERN STATION - UNITS 3 & 4
SITE GRADING
PLANT SITE AREA IV

PS1C14
REV 21
85127-E


TYPICAL SECTION 1
STATIONS 8+50 TO 25+84
45+94 TO 55+98
60+42 TO 72+85
117+14 TO 120+14
TYPICAL SECTION 2
STATION 55+98 TO 60+42
IMPERVIOUS EMBANKMENT SECTION 3
STATION 122+82 TO 125+97
IMPERVIOUS EMBANKMENT SECTION 4
STATION 125+97 TO 130+52
IMPERVIOUS EMBANKMENT SECTION 5
STATIONS 130+52 TO 139+92
140+62 TO 156+42
IMPERVIOUS EMBANKMENT SECTION 6
STATION 25+84 TO 33+85
TOP OF FINISHED SUBGRADE
6" TOPSOIL & SEEDING
EXISTING GROUND
STRIPPING
PREPARED SUBGRADE
4'-0" OR TOP OF ROCK WHICHEVER IS HIGHER
INNER CORE
PROTECT TO EL 628'-0"
9" BEDDING
1'-0" RIPRAP
1'-6" DRAINAGE BLANKET
EL 618'-0"


IMPERVIOUS EMBANKMENT SECTION 7
STATIONS 139+92 TO 140+62
IMPERVIOUS EMBANKMENT SECTION 8
1'-6" DRAINAGE BLANKET STATION 33+85 TO 41+61
SLOPE TO DRAIN
DITCH
TYPICAL SECTION 9
STATION 0+00 TO 8+50
91+57 TO 111+50
115+15 TO 117+14
120+14 TO 122+82
156+42 TO 168+05
IMPERVIOUS EMBANKMENT SECTION 10
1'-6" DRAINAGE BLANKET STATION 41+61 TO 45+94
PROTECT TO EL 618'-0"
INNER CORE
EXISTING GROUND
STRIPPING
PREPARED SUBGRADE



	SECTION 13 & 14 SCHEDULE	
	WASTE WATER POND	BOTTOM ASH POND
TOP DIKE	EL 618.0	EL 629.0
TOP CORE	EL 616.0	EL 626.0

GENERAL NOTES

1. EACH SECTION IS FACING TOWARD INCREASING STATION NUMBER.
2. FINISHED AND PREPARED SUBGRADE SHALL BE CONSTRUCTED AS REQUIRED BY SPECIFICATION D-2.

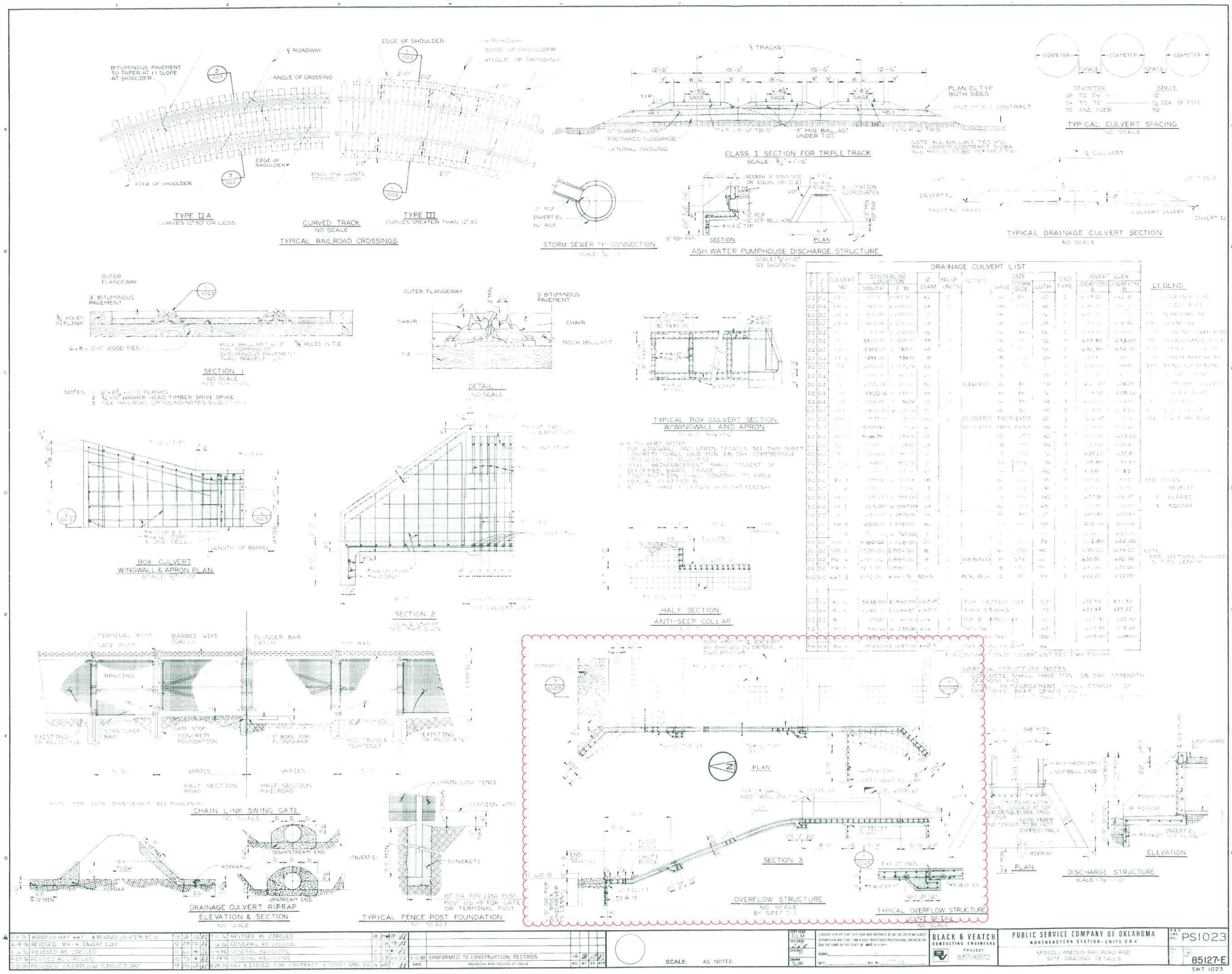
NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY
8	2-12-82	CONFORMED TO CONSTRUCTION RECORDS	JR
7	6-1-76	REVISED EMBANKMENT SECTION 7	RH
6	3-12-76	GENERAL REVISIONS	TD
5	1-16-76	GENERAL REVISIONS	CB
4	9-29-75	GENERAL REVISIONS	JR
3	8-29-75	REV & ISSUED FOR CONTRACT & CONST. SPEC D-2	NH
2	7-17-75	REVISED & ISSUED FOR ADDENDUM 1-SPEC D-2	TD
1	6-13-75	REVISED & ISSUED FOR BIDS, SPEC D-2	TD
0	5-8-75	ISSUED FOR PSO REVIEW	TD

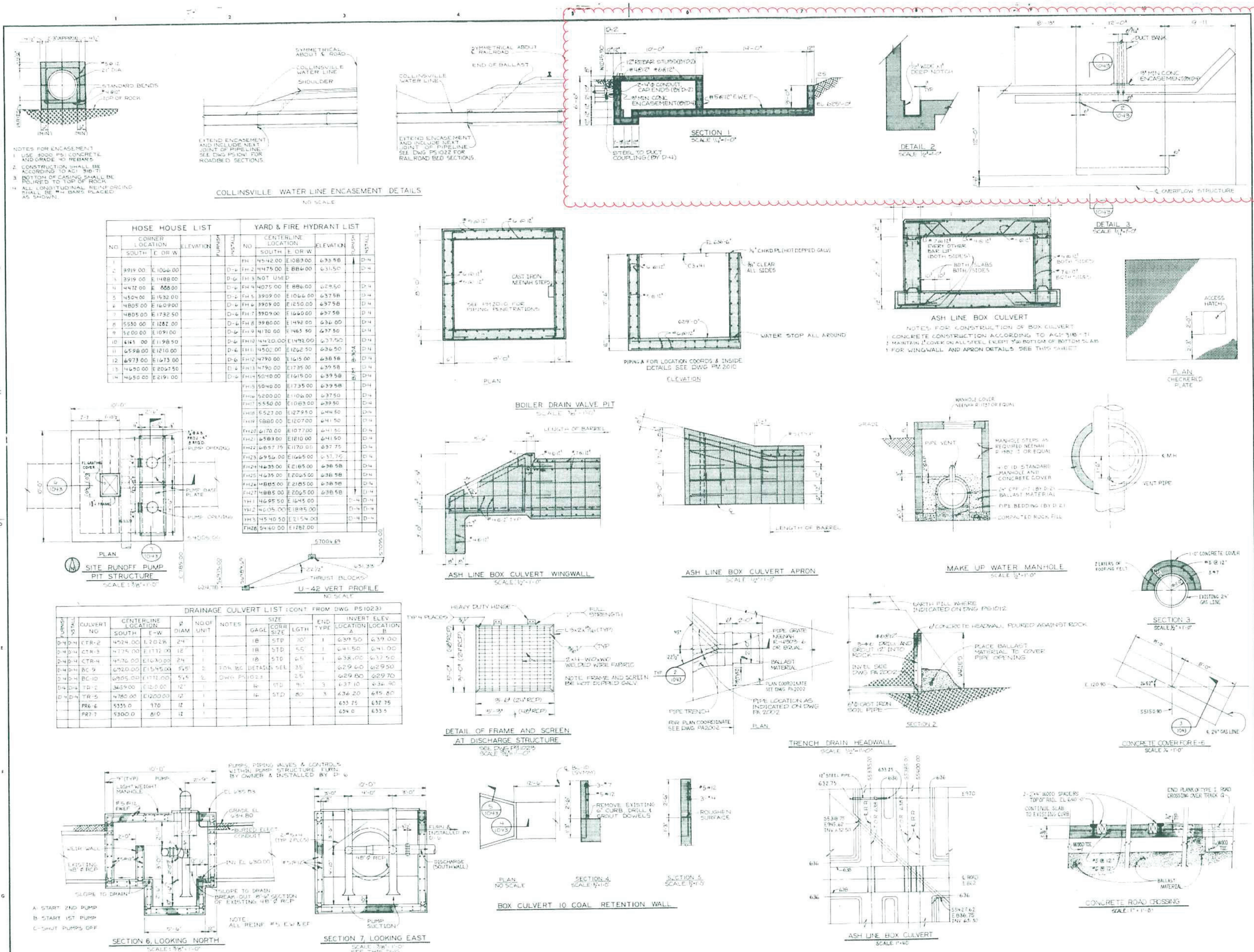
SCALE: 1" = 10'

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 6571/6572

PUBLIC SERVICE COMPANY OF OKLAHOMA
NORTHEASTERN STATION - UNITS 3 & 4
EMBANKMENT DETAILS

DWG NO. PS1024
REV NO. 8
85127-E


TYPE II A
CURVES 12°30' OR LESS
CURVED TRACK
NO SCALE
TYPE III
CURVES GREATER THAN 12°30'
TYPICAL RAILROAD CROSSINGS
STORM SEWER "Y" CONNECTION
CLASS I SECTION FOR TRIPLE TRACK
ASH WATER PUMPHOUSE DISCHARGE STRUCTURE
TYPICAL CULVERT SPACING
NO SCALE
TYPICAL DRAINAGE CULVERT SECTION
NO SCALE
DRAINAGE CULVERT LIST
LEGEND
SECTION I
NO SCALE
DETAIL I
NO SCALE
TYPICAL BOX CULVERT SECTION W/WINGWALL AND APRON
BOX CULVERT WINGWALL & APRON PLAN
SECTION 2
HALF SECTION
ANTI-SEEP COLLAR
CHAIN LINK SWING GATE
DRAINAGE CULVERT RIPRAP
ELEVATION & SECTION
NO SCALE
TYPICAL FENCE POST FOUNDATION
PLAN
SECTION 3
OVERFLOW STRUCTURE
NO SCALE
TYPICAL OVERFLOW STRUCTURE JOINT DETAIL
NO SCALE
OVERFLOW STRUCTURE NOTES
DISCHARGE STRUCTURE
ELEVATION
CONFORMED TO CONSTRUCTION RECORDS
SCALE: AS NOTED
BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6571/6572
PUBLIC SERVICE COMPANY OF OKLAHOMA
NORTHEASTERN STATION - UNITS 3 & 4
MISCELLANEOUS RAILROAD AND SITE GRADING DETAILS
PS1023
85127-E
SHT 1023



COLLINSVILLE WATER LINE ENCASEMENT DETAILS
NO SCALE
NOTES FOR ENCASEMENT
1. USE 4000 PSI CONCRETE AND GRADE 40 REBARS
2. CONSTRUCTION SHALL BE ACCORDING TO ACI 318-71
3. BOTTOM OF CASING SHALL BE POURED TO TOP OF ROCK
4. ALL LONGITUDINAL REINFORCING SHALL BE #4 BARS PLACED AS SHOWN.
SECTION 1
DETAIL 2
DETAIL 3
SITE RUNOFF PUMP PIT STRUCTURE
U-42 VERT PROFILE
BOILER DRAIN VALVE PIT
ASH LINE BOX CULVERT
ASH LINE BOX CULVERT WINGWALL
ASH LINE BOX CULVERT APRON
MAKE UP WATER MANHOLE
DETAIL OF FRAME AND SCREEN AT DISCHARGE STRUCTURE
TRENCH DRAIN HEADWALL
CONCRETE COVER FOR E-6
SECTION 6, LOOKING NORTH
SECTION 7, LOOKING EAST
BOX CULVERT 10 COAL RETENTION WALL
CONCRETE ROAD CROSSING
PUMPS, PIPING VALVES & CONTROLS WITHIN PUMP STRUCTURE FURN. BY OWNER & INSTALLED BY D-6
NOTE: ALL REINF. #5 E.W. & E.F.

HOSE HOUSE LIST					
NO.	CORNER LOCATION SOUTH	CORNER LOCATION E OR W	ELEVATION	FURNISH	INSTALL
1					
2	3919.00	E 1066.00			D-6
3	3919.00	E 1488.00			D-6
4	4472.00	E 888.00			D-6
5	4504.00	E 1532.00			D-6
6	4805.00	E 1609.00			D-6
7	4805.00	E 1732.50			D-6
8	5530.00	E 1282.00			D-6
9	5200.00	E 1091.00			D-6
10	6163.00	E 1198.50			D-6
11	6598.00	E 1210.00			D-6
12	6973.00	E 1673.00			D-6
13	4650.00	E 2067.50			D-6
14	4650.00	E 2191.00			D-6

YARD & FIRE HYDRANT LIST					
NO.	CENTERLINE LOCATION SOUTH	CENTERLINE LOCATION E OR W	ELEVATION	FURNISH	INSTALL
FH 1	4542.00	E 1083.00	633.58	B/M B-30A	D-4
FH 2	4475.00	E 886.00	631.50	B/M B-30A	D-4
FH 3	NOT USED				
FH 4	4075.00	E 886.00	629.50	B/M B-30A	D-4
FH 5	3909.00	E 1066.00	637.58	B/M B-30A	D-4
FH 6	3909.00	E 1250.00	637.58	B/M B-30A	D-4
FH 7	3909.00	E 1660.00	637.58	B/M B-30A	D-4
FH 8	3980.00	E 1492.00	636.00	B/M B-30A	D-4
FH 9	4170.00	E 1463.50	637.50	B/M B-30A	D-4
FH 10	4420.00	E 1492.00	637.50	B/M B-30A	D-4
FH 11	4502.00	E 1262.50	636.50	B/M B-30A	D-4
FH 12	4790.00	E 1615.00	638.58	B/M B-30A	D-4
FH 13	4790.00	E 1735.00	639.58	B/M B-30A	D-4
FH 14	5040.00	E 1615.00	639.58	B/M B-30A	D-4
FH 15	5040.00	E 1735.00	639.58	B/M B-30A	D-4
FH 16	5200.00	E 1106.00	637.50	B/M B-30A	D-4
FH 17	5550.00	E 1083.00	639.50	B/M B-30A	D-4
FH 18	5527.00	E 1279.50	644.50	B/M B-30A	D-4
FH 19	5880.00	E 1207.00	641.50	B/M B-30A	D-4
FH 20	6170.00	E 1077.00	641.50	B/M B-30A	D-4
FH 21	6583.00	E 1210.00	641.50	B/M B-30A	D-4
FH 22	6857.75	E 1170.00	637.75	B/M B-30A	D-4
FH 23	6956.00	E 1665.00	637.75	B/M B-30A	D-4
FH 24	4635.00	E 2185.00	638.58	B/M B-30A	D-4
FH 25	4635.00	E 2065.00	638.58	B/M B-30A	D-4
FH 26	4885.00	E 2185.00	638.58	B/M B-30A	D-4
FH 27	4885.00	E 2065.00	638.58	B/M B-30A	D-4
YH 1	4695.50	E 1645.00		D-4	D-4
YH 2	4605.00	E 1895.00		D-4	D-4
YH 3	4540.50	E 2154.00		D-4	D-4
FH 28	5460.00	E 1282.00			

DRAINAGE CULVERT LIST (CONT. FROM DWG PS1023)

FURNISH	INSTALL	CULVERT NO.	CENTERLINE LOCATION SOUTH	CENTERLINE LOCATION E-W	Ø DIAM	NO. OF UNIT	NOTES	SIZE GAGE	SIZE CORR SIZE	SIZE LGTH	END TYPE	INVERT ELEV LOCATION A	INVERT ELEV LOCATION B
D-4	D-4	CTR-2	4524.00	E 2028	24"	1		18	STD	70'	1	639.50	639.00
D-4	D-4	CTR-3	4775.00	E 1712.00	12"	1		18	STD	55'	1	641.50	641.00
D-4	D-4	CTR-4	4576.00	E 1630.00	24"	1		18	STD	65'	1	638.00	637.50
D-4	D-4	BC-9	6920.00	E 1545.00	5'x5'	2	FOR BC DETAILS SEE DWG PS1023			35'		629.60	629.50
D-4	D-4	BC-10	6905.00	E 1712.00	5'x5'	2				25'		629.80	629.70
D-4	D-4	TR-2	3659.00	E 1200.00	12"	1		16	STD	91'	3	637.10	636.90
D-4	D-4	TR-5	4780.00	E 1200.00	12"	1		16	STD	80'	3	636.20	635.80
		PR6-6	5335.0	970	12	1						633.75	632.75
		PR7-7	5300.0	810	12	1						634.0	633.5

2-11-82	CONFORMED TO CONSTRUCTION RECORDS	13	10-8-76	REVISED AS CIRCLED	8
4-14-80	REVISED STORM WATER PUMP PIT	12	6-25-76	REVISED AS CIRCLED	7
3-6-80	ADDED STORM WATER PUMP PIT	11	6-1-76	REVISED AS CIRCLED	6
1-21-77	REVISED AS CIRCLED	10	5-14-76	REVISED AS CIRCLED	5
11-12-76	REVISED AS CIRCLED	9	4-29-76	REVISED AS CIRCLED	4

DATE	REVISIONS AND RECORD OF ISSUE	NO.
4-5-76	REVISED AS CIRCLED	3
3-3-76	REVISED OVERFLOW STRUCTURE	2
3-12-76	REVISED AS CIRCLED	1
1-16-76	ISSUED FOR CONSTRUCTION	0

SCALE AS NOTED

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF OKLAHOMA

DATE 1/6/76 REG. NO. 10238

BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6571/6572

PUBLIC SERVICE COMPANY OF OKLAHOMA
NORTHEASTERN STATION - UNITS 3 & 4
MISCELLANEOUS SECTIONS AND DETAILS

PS1043
13
85127-E
SHT. 1043