Stantec Consulting Services Inc.
11687 Lebanon Road, Cincinnati, OH 45241

October 11, 2016
File: 175534018
Revision 0

Indiana-Kentucky Electric Corporation
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

RE: Initial Inflow Design Flood Control System Plan
Landfill Runoff Collection Pond
EPA Final CCR Rule
Clifty Creek Station
Madison, Jefferson County, Indiana

1.0 PURPOSE

This letter documents Stantec's certification of the initial inflow design flood control system plan for the Clifty Creek Station's Landfill Runoff Collection Pond. Based on this assessment, the Landfill Runoff Collection Pond is in compliance with the initial inflow design flood control requirements in the EPA Final CCR Rule at 40 CFR 257.82(a)(3)(ii).

2.0 INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

As described in 40 CFR 257.82(c), documentation is required on how the inflow design flood control system has been designed and constructed to manage the design storm required by the hazard classification. The inflow design storm event was selected from §257.82(a)(3)(ii) as the 1000-year event based upon a hazard potential classification of significant. A rainfall amount for the 1000-year storm event (7.19 inches) was obtained from the "Precipitation Frequency Atlas of the United States, NOAA Atlas 14" using a precipitation event duration of 6 hours.

3.0 SUMMARY OF FINDINGS

The attached report presents the reservoir routing analysis of the Landfill Runoff Collection Pond for the Probable Maximum Precipitation (PMP) event (27.6 inches in 6 hours). The resulting water surface elevations are shown in the following table. The results show that the reservoir routing for the PMP event meets the criteria; therefore, the design is also acceptable for the 1000-year event and the requirements set forth in 40 CFR 257.82(a).

Station	Facility	Inflow Design Storm	Modeled Design Storm	Peak PMP Water Surface Elevation (feet)	Minimum Embankment Elevation (feet)
Clifty Creek	Landfill Runoff Collection Pond	1000-year storm	PMP	501.4	502.9

Re: **Initial Inflow Design Flood Control System Plan**
Landfill Runoff Collection Pond
EPA Final CCR Rule
Clifty Creek Station
Madison, Jefferson County, Indiana

4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stan A. Harris, being a Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;

2. that the information contained herein is accurate as of the date of my signature below; and

3. that, pursuant to 40 CRR 257.82(c)(5), the inflow design flood control system plan for the Clifty Creek Station's Landfill Runoff Collection Pond meets the requirements specified in 40 CFR 257.82(a) and (c)(1).

SIGNATURE _____ DATE 10/11/16

ADDRESS: Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio 45241

TELEPHONE: (513) 842-8200

ATTACHMENTS: Clifty Creek Station Landfill Runoff Collection Pond Inflow Design Flood Control System Plan

STAN A. HARRIS
REGISTERED
No. PE-19700150
STATE OF INDIANA
PROFESSIONAL ENGINEER

10/11/16

Reservoir Routing Analysis
Landfill Runoff Collection Pond

Clifty Creek Power Station
City of Madison
Jefferson County, Indiana

October 2016
Revision 1

Table of Contents

Appendices

1.0 Introduction and Summary

The Clifty Creek Power Station Landfill Runoff Collection Pond (LRCP), owned and operated by Indiana-Kentucky Electric Corp. (IKEC), is located in the City of Madison, Indiana along the northern bank of the Ohio River. The LRCP is being converted into a runoff collection pond for the proposed Coal Combustion Byproducts (CCB) Landfill. An approximately 508-acre area currently drains to the LRCP. Upon the completion of the CCB Landfill, the area draining to the LRCP will be reduced to approximately 443 acres. The pond is formed by natural grade to the north, east and west and a dam that runs along the bank of the Ohio River.

The LRCP Dam is a Significant Hazard Structure. As part of an evaluation of the dam, Stantec Consulting Services Inc. (Stantec) has been contracted to perform a reservoir routing analysis to determine the freeboard above the design storm for both existing and post CCB Landfill construction conditions. Stantec developed a hydrologic model of the existing and post CCB Landfill construction drainage areas to determine the expected runoff and routed the flows through the pond.

The results of the reservoir routing analysis indicate that the LRCP is capable of passing flows generated from the Probable Maximum Precipitation (PMP) event for both existing and final landfill conditions without overtopping.

2.0 Hydrology

SEDCAD 4 (Reference 1) models were developed to estimate the hydrologic response, or runoff from a rainfall event, of the LRCP for existing and final conditions watershed configurations. The Natural Resources Conservation Service (NRCS) National Engineering Handbook (NEH) Part 630 – Hydrology methodology was selected to determine rainfall-runoff relationships in the model (Reference 2). For each hydrology model the watershed contributing to the LRCP was delineated and divided into sub-watersheds. The hydrologic properties of the modeled sub-watersheds, including curve numbers, times of concentration and lag times, were determined using the methodology outlined in TR-55 (Reference 3). Hydrologic properties of the watershed are listed in Table 1.

Table 1. Hydrologic Model Parameters

Sub-Watershed No.	Area (Acres)	Curve Number	Time of Concentration (minutes)	Lag Time (minutes)
SB6(E,F)	30.10	72	24.6	14.7
SB7(E,F)	95.00	75	101.7	61.0
SB8(E, F)	70.40	76	24.7	14.8
SB9(E,F)	20.60	72	23.0	13.8
SB10(E,F)	36.60	72	33.0	19.8
SB11(E,F)	41.30	71	58.4	35.0
SB16(F)	4.95	86	14.0	8.4
SB17(F)	3.77	86	8.0	4.8
SB18(F)	13.28	86	8.2	4.9
SB19(F)	16.19	86	8.0	4.8
SB20(F)	17.35	86	8.0	4.8
SB21(F)	11.83	86	8.3	5.0
SB22(F)	8.47	73	17.0	10.2
SB-A(F)	15.31	73	16.6	9.9
SB-B(F)	12.51	86	8.0	4.8
SB-C(E)	9.05	73	16.6	9.9
SB-D(E)	71.86	73	42.8	25.7
SB-E(E)	81.30	86	38.5	23.1
Ash Pond(E)	51.64	99	-	-
Ash Pond(F)	44.96	99	-	-

Key: (E) = Existing Condition, (F) = Final Condition

A PMP event was used as the design storm for the hydrologic models in accordance with the IDNR *General Guidelines for New Dams and Improvements to Existing Dams in Indiana* (Reference 4). A 6-hour Soil Conservation Service (SCS) Type B distribution was used based on IDNR's recommendations (Reference 4). The 6-hour rainfall depth (27.6 inches) for the PMP

storm event was obtained from the National Weather Service (Reference 5). Drawings of the existing and final conditions watershed layout are provided in Appendix A. The resultant watershed runoff hydrographs are presented in Appendix B.

3.0 Reservoir Routing

Following the development of runoff parameters, the subsequent flows were routed through the reservoir. The LRCP storage, principal spillway and embankment characteristics were input into the SEDCAD 4 models to perform the reservoir routing analyses. The normal pool elevation of 485 was assumed to be the starting water surface elevation for the existing and proposed conditions reservoir routing models.

3.1 STAGE-STORAGE INFORMATION

The stage-storage information input into the model was used in the determination of the water level in the reservoir. The stage-storage data was calculated from 2005 topographic mapping, soil borings performed for the landfill design, and the proposed landfill permit drawings (References 6, 7 and 8). Tables 2 and 3 provide the cumulative storage volume for a given elevation.

Table 2. LRCP Stage-Storage – Existing Conditions

Elevation (feet)	LRCP Storage (acre-feet)
440	0.0
445	14.7
450	62.7
455	170.5
460	353.0
465	590.2
470	871.9
475	1,198.0
480	1,491.9
485	1,549.2
490	1,737.5
495	1,965.0
500	2,248.9
504	2,560.8

Table 3. LRCP Stage-Storage – Final Conditions

Elevation (feet)	Pond Storage (acre-feet)
440	0.0
445	14.7
450	62.7
455	167.4
460	330.1
465	521.1
470	730.2
475	955.4
480	1,146.9
485	1,196.7
490	1,362.8
495	1,550.9
500	1,754.8
504	1,942.5

3.2 DAM EMBANKMENT

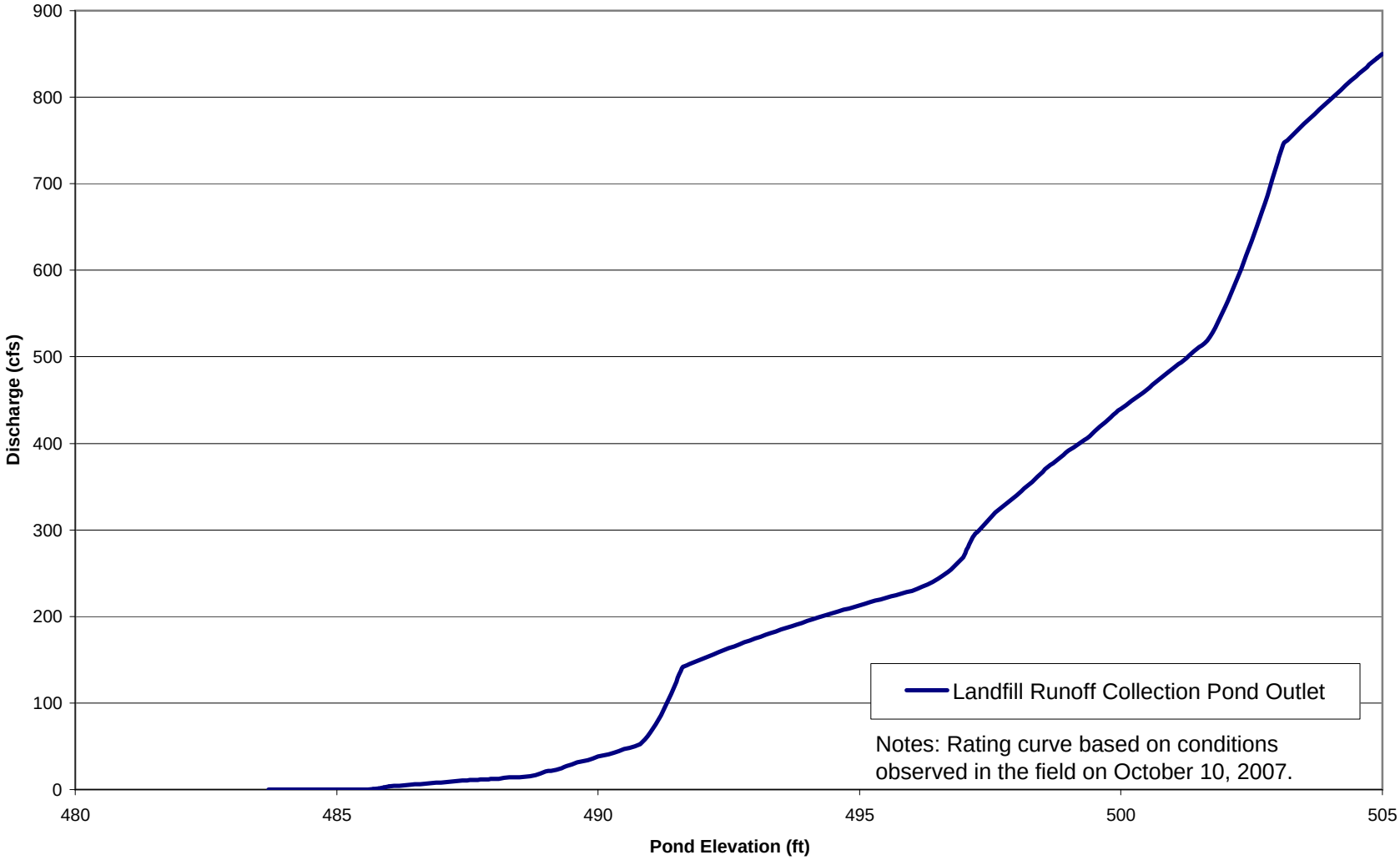
The two foot contour interval topographic data (Reference 6) provided by American Electric Power (AEP) indicates that the crest elevation of the dam is approximately 504 feet. A recent dam assessment report dated September 14, 2009 prepared by GZA GeoEnvironmental Inc. stated that the low spot on the dam crest is at an elevation of 502.9 feet (Reference 9).

3.3 PRINCIPAL SPILLWAY

The LRCP primary spillway consists of an inclined 6-foot by 3-foot reinforced concrete box culvert with a riser box structure containing grated inlets located at every 11 feet in elevation. Currently, the two uppermost sections of riser box structure are above the pond level and the lower riser section is the active outlet for the pond. The inclined box is connected to a 400-foot long, 72-inch diameter concrete pipe that discharges to the Ohio River. The rating curve of the principal spillway used in the reservoir routing models, provided in Figure 1, assumes a normal high water depth on the Ohio River.

FIGURE 1

Composite Rating Curve



4.0 Results

The reservoir routing model indicates that the LRCP existing and proposed conditions peak PMP water surface elevations are 500.4 and 501.4 feet respectively. Based on a minimum crest elevation of 502.9 feet, as indicated by the GZA dam assessment report (Reference 9), the results of the reservoir routing analysis indicate that the LRCP dam is currently capable of passing flows generated from the PMP event while maintaining a minimum freeboard of 2.5 feet. Once the CCB Landfill construction is completed, slightly reducing the storage capacity of the LRCP, the peak water surface elevation will rise about a foot from that of its current configuration reducing the estimated PMP freeboard to 1.5 feet.

The model results presented above are predicated on the current configuration of the LRCP spillway facility and a normal pool elevation of 485 feet. Modifications to the spillway and normal pool will require an update of the freeboard analysis.

5.0 Bibliography and References

1. Warner, Richard C., Pamela J. Scwab, and Dennis j. Marshall. SEDCAD 4 for Windows (computer software), 1998.

2. Natural Resources Conservation Service, National Engineering Handbook (NEH) Section 4: Hydrology, September 1997.

3. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, January 1975.

4. Indiana Department of Natural Resources, General Guidelines for New Dams and Improvements to Existing Dams in Indiana, 2001.

5. National Oceanic and Atmospheric Administration, Office of Hydrology, National Weather Service, Hydrometeorlogical Report No. 51, Maximum Precipitation Estimates, United States East of the 105th Meridian, June 1978. Reprinted August 1980.

6. Henderson Aerial Surveys Inc., Clifty Creek East Pond NAVD 27/NAVD88 in South, (2 foot contours), aerial photography exposed on 4/16/2005.

7. Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM),"Permit Drawings, Indiana Kentucky Electric Corporation, Clifty Creek Coal Ash Landfill Modification", Drawings 16-30500- 07 through 29, November 15, 2006.

8. Fuller, Mossbarger, Scott, and May Engineers, Inc. (FMSM),"Phase 1 Construction Drawings, Indiana Kentucky Electric Corporation, Clifty Creek Coal Ash Landfill Modification," Drawings 16-30870- 01 through 29 November 15, 2006.

9. GZA GeoEnvironmental, Inc. (GZA)," Dam Assessment Report, Clifty Creek Station, South Fly Ash Pond," Inspection Date: June 11, 2009, Report Date: September 14, 2009.

Appendix A

Watershed Layout

Notes:

1. Aerial photography provided by the USDA's Farm Service Agency (FSA).
2. Topographic data developed from Madison West, USGS, 7 1/2 -minute topographic Quadrangle and supplemented by data provided by I.K.E.C.

CLIFTY CREEK POWER STATION

CLIFTY CREEK

OHIO RIVER

WEST BOTTOM ASH POND

PRINCIPAL SPILLWAY

SB7

SB6

SB8

SB-E

SB-D

SB9

SB10

SB11

SB-C

Ash Pond

LANDFILL RUNOFF COLLECTION POND

PRINCIPAL SPILLWAY

Legend

Drainage Channels

Drainage Areas

LRCP Watershed

WBAP Watershed

Topography

Proposed Contours

Existing Contours

N

0 600 1,200 Feet

STANTEC CONSULTING SERVICES INC.
11687 Lebanon Road
Cincinnati, Ohio
45241-2012
(513) 842-8200

Stantec

EXISTING CONDITIONS WATERSHED

APPENDIX A
LANDFILL RUNOFF COLLECTION POND
CLIFTY CREEK POWER STATION
MADISON, INDIANA

PROJECT NO.	175539021
DATE	FEBRUARY, 2010
DRAWN BY	KAS
CHECKED BY	JRM
CHECKED BY	
SCALE	1" = 600'
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

Notes:

1. Aerial photography provided by the USDA's Farm Service Agency (FSA).
2. Topographic data developed from Madison West, USGS, 7 1/2 -minute topographic Quadrangle and supplemented by data provided by I.K.E.C.

CLIFTY CREEK POWER STATION

CLIFTY CREEK

WEST BOTTOM ASH POND

OHIO RIVER

PRINCIPAL SPILLWAY

SB7

SB6

SB17

SB16

SB18

SB8

SB19

SB20

SB9

SB21

SB10

SB22

SB-B

SB-A

LANDFILL RUNOFF COLLECTION POND

Ash Pond

SB11

PRINCIPAL SPILLWAY

Legend

Drainage Channels

Drainage Areas

LRCP Watershed

WBAP Watershed

Topography

Proposed Contours

Existing Contours

N

0 600 1,200 Feet

STANTEC CONSULTING SERVICES INC.
11687 Lebanon Road
Cincinnati, Ohio
45241-2012
(513) 842-8200

Stantec

FINAL CONDITIONS WATERSHED

APPENDIX A
LANDFILL RUNOFF COLLECTION POND
CLIFTY CREEK POWER STATION
MADISON, INDIANA

PROJECT NO.	175539021
DATE	FEBRUARY, 2010
DRAWN BY	KAS
CHECKED BY	JRM
CHECKED BY	
SCALE	1" = 600'
REVISED	
1.	
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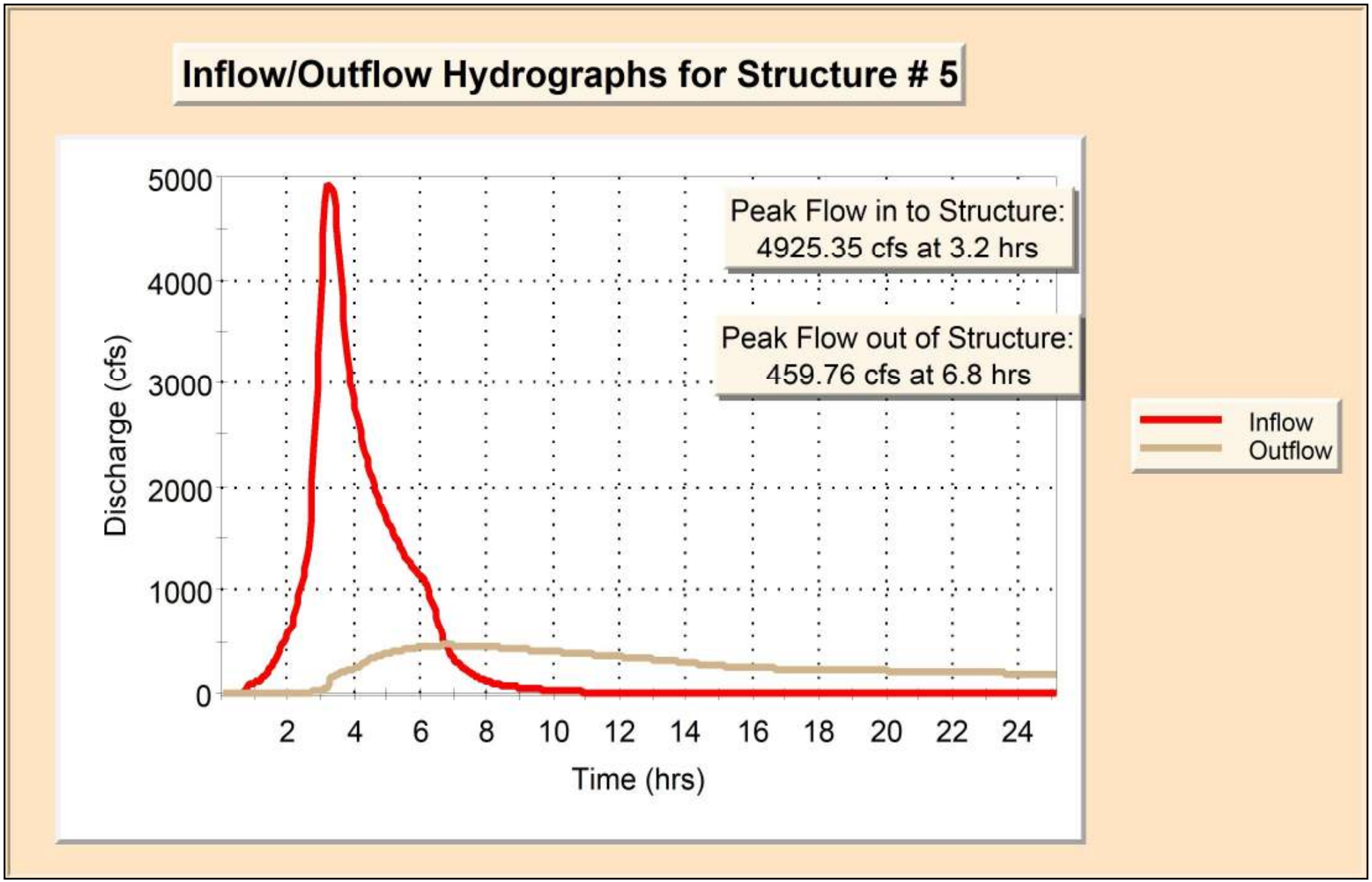
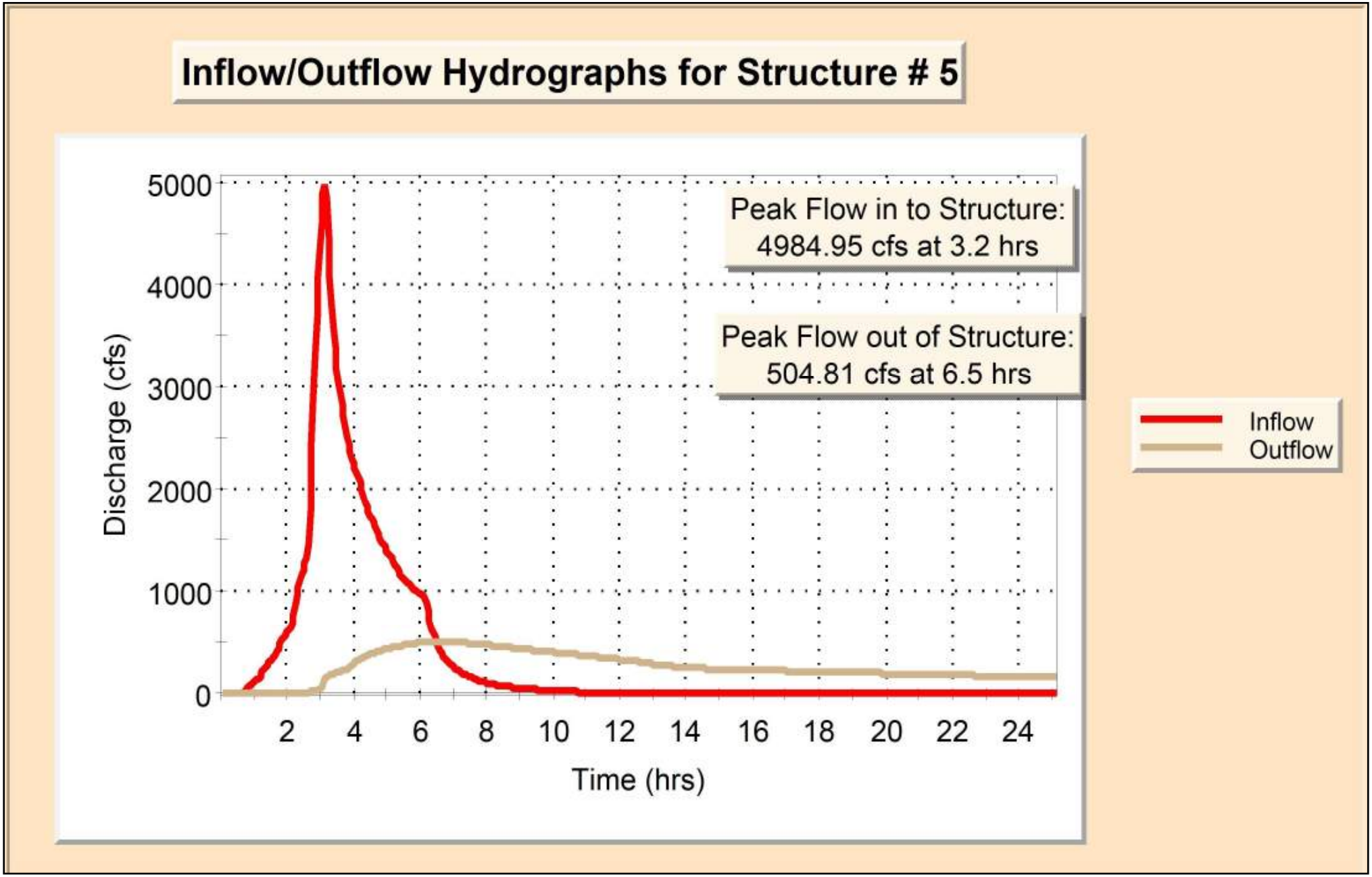
SHEET

Appendix B

Hydrographs



***Appendix B* – SEDCAD 4 Existing Conditions LRCP Inflow Outflow Hydrographs**


Inflow/Outflow Hydrographs for Structure # 5
Peak Flow in to Structure:
4984.95 cfs at 3.2 hrs
Peak Flow out of Structure:
504.81 cfs at 6.5 hrs
Inflow
Outflow
Discharge (cfs)
5000
4000
3000
2000
1000
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hrs)