RUN-ON/RUN-OFF CONTROL SYSTEM PLAN

RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

Lakeland Electric – C.D. McIntosh Power Plant Byproduct Storage Area

Submitted to: Lakeland Electric
C.D. McIntosh Power Plant
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October 2016

15-45454.1

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1.0 INTRODUCTION

This Run-On and Run-Off Control System (ROROCS) Plan was prepared for the Byproduct Storage Area (BSA) at the C.D. McIntosh Power Plant (MPP) owned and operated by Lakeland Electric (LE) in Polk County, Florida, in accordance with the requirements of the federal coal combustion residual (CCR) rule[1]. This ROROCS plan documents how the BSA's run-on and run-off control systems have been designed and constructed to meet the requirements of §257.81 and is supported by appropriate engineering calculations and modeling analysis that is included herein. This Plan will be included in the facility's operating records in accordance with §257.105(g)(3).

2.0 REGULATORY REQUIREMENTS

2.1 Federal CCR Rule

The federal CCR Rule requires that the owner or operator of an existing CCR landfill must prepare an initial ROROCS which documents how the run-on and run-off control systems meet the following requirements as outlined in §257.81(a):

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from the 25-year, 24-hour storm event.
- A run-off control system from the active portion of the CCR unit to collect and control the peak discharge from the 25-year, 24-hour storm event.

The active portion is defined in §257.53 as the part of the CCR unit that has received or is receiving CCR or non-CCR waste and has not completed closure in accordance with §257.102. The entire BSA is considered active.

3.0 DESIGN METHODOLOGIES

3.1 Design Storm

The existing run-on and run-off control systems were designed for hydraulic capacity for at least the 25-year, 24-hour storm event as required by local and federal regulations. Site-specific precipitation estimates were obtained from Natural Resource Conservation Service (NRCS) 24-hour rainfall maps and the Soil Conservation Service (SCS) Florida Modified (FLMOD) Type II Rainfall Distribution was used. The 25-year, 24-hour storm event generates approximately 7.5 inches of precipitation at MPP.

3.2 Hydrologic Calculation and Stormwater Routing Methods

Hydrology calculations were completed using NRCS methods. Time of concentration values were calculated for each basin by dividing the flow paths into sheet flow and shallow concentration segments.

[1] 40 Code of Federal Regulations (CFR) Part 257, Subtitle D

The time of concentration calculations are for the contact water and non-contact water models are presented in Appendix A and B, respectively.

Composite curve numbers were calculated for each basin within the contact and non-contact water models (see Appendix A and B, respectively). CCR material was assumed to perform hydrologically consistent with bare soil conditions. Final cover material was assumed to perform hydrologically consistent with open space with good vegetative condition. Hydrologic soil group B was assumed for curve number computations.

Stormwater discharge and flow routing calculations were performed using the Streamline Technologies Interconnected Pond Routing (ICPR) stormwater modeling software. The ICPR model operates using three key elements that include basins, nodes and links. The basins represent the hydrological information for each drainage basin. Stage-area data (or depressional storage areas) within each drainage basin was input into nodes. The nodal warning stages correlate to the maximum stage that can be reached within the depressional storage areas before overtopping occurs (e.g. top of bank elevation). The nodal warning stages vary for each drainage basin node. Nodes are interconnected by links and the links represent the existing or proposed culverts/pipes and pumps for flow routing.

4.0 RUN-ON CONTROL

Run-on is defined as stormwater that may flow towards the active portion of the BSA. Based on the topography of the BSA and surrounding topography, run-on potential is low. The BSA is topographically higher than surrounding areas and is surrounded by berms and a network of stormwater collection areas. The perimeter berms and stormwater collection areas (ditches, swales, and ponds) would intercept run-on flows. The BSA topography and surrounding area topography are shown on Figure 1.

5.0 RUN-OFF CONTROL

Run-off is defined as stormwater that falls on and flows off of the BSA. This includes run-off from the active ash placement areas and intermediate cover areas. There are two-types of stormwater run-off at BSA:

- Contact water (stormwater run-off that has contacted CCR); and
- Non-contact stormwater (run-off that has not contacted CCR).

Contact and non-contact stormwater is separated through the use of diversion berms, swales, and ditches. Contact water run-off and non-contact stormwater run-off are managed separately as addressed in the following sections:

5.1 Contact Water Run-Off

Contact water is collected by a series of interconnected ditches and eventually conveyed to the South Sedimentation Pond adjacent to the temporary byproduct staging area. Contact water from the active

portion of the BSA is routed to a soil cement lined perimeter ditch where it collects and is discharged via culverts to the south sedimentation basin. The South Sedimentation Basin is constructed with a soil cement liner which acts to contain water and facilitate regular clean out by LE. Contact water entering the sedimentation basin is pumped to the existing process water ponds.

The current configuration of the BSA was analyzed for contact water management (see Figure 2). As the BSA develops further, the area producing contact water run-off will decrease. The current contact water management system for the BSA was modeled in ICPR. The ICPR nodal diagram model inputs and results for the contact water configuration are provided in Appendix A.

The modeling results indicate that the existing BSA contact water management system has adequate capacity to collect, manage and route flows from the 25-year, 24-hour return period as warning stages were not exceeded for the basin nodes (no overtopping occurs). The nodal peak staging results and available freeboard for each basin node are summarized below:

Node	Description	Peak Stage (feet)	Warning Stage (feet)	Freeboard 25-year, 24-hour Storm (feet)
1	Ramp Ditch	137.4	140.0	2.6
2	Perimeter Ditch	135.0	136.0	1.0
3	South Sedimentation Basin	134.5	135.0	0.5

5.2 Non-Contact Stormwater Run-Off

The final cover configuration of the BSA was analyzed for non-contact stormwater run-off management as it would generate the highest volume of stormwater run-off. As the BSA development progresses, the exterior side-slopes will be covered with intermediate soil cover. At 25 to 30-foot (vertical) intervals, 25-foot wide benches with backwardly inclined channels will be constructed to convey stormwater to grout filled fabric revetment lined slope drain channels. The slope drain channel will convey stormwater to the perimeter ditch system which will be graded to convey stormwater to Fish Lake via culverts. Non-contact stormwater will eventually discharge via infiltration to the water table.

The final cover configuration of the BSA was modeled in ICPR as one drainage basin using the depressional storage capacity of Fish Lake. The ICPR nodal diagram, model inputs, and results for the non-contact stormwater run-off configuration are presented in Appendix B.

The modeling results indicate that Fish Lake has adequate capacity to collect, manage and route flows from the 25-year, 24-hour return period as warning stages were not exceeded at any of the basin nodes (no overtopping). The nodal peak staging result and available freeboard are summarized below:

Node	Description	Peak Stage (feet)	Warning Stage (feet)	Freeboard 25-year, 24-hour Storm (feet)
1	Fish Lake	133.1	135.0	1.9

6.0 CLOSING

As required by §257.81, the BSA run-on control system has the capacity to prevent flow onto the active portion of the CCR unit during the peak discharge from a 25-year, 24-hour storm, and the run-off control system has the capacity to collect, manage and route flows resulting from a 25-year, 24-hour storm.

GOLDER ASSOCIATES, INC.

Blake T. Holcomb, PE
Florida Professional Engineer No. 72381
Certificate of Authorization No. 1670

Date: 11/2/16

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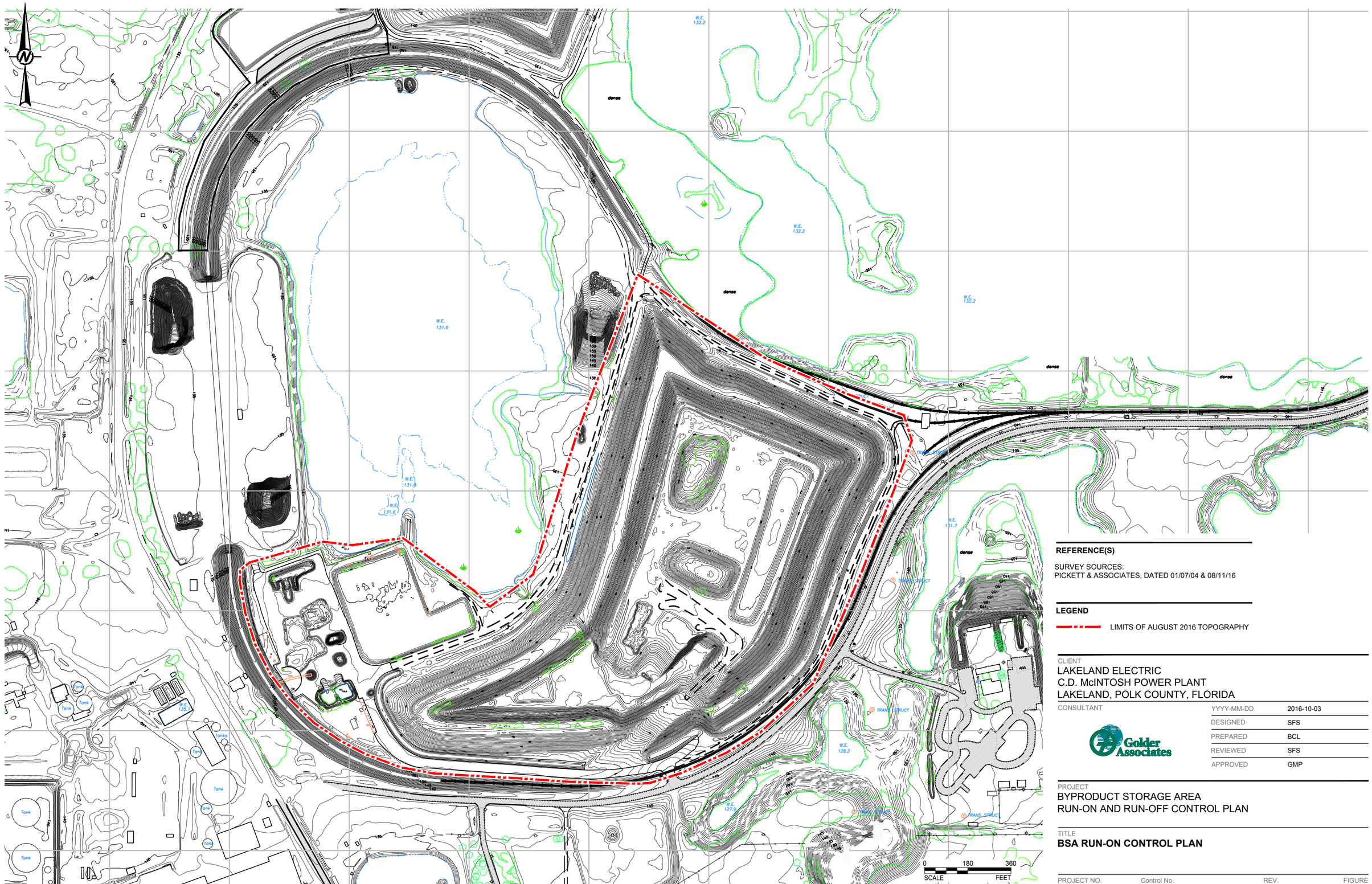
FN: G:\Projects\15-\15-45454.1\Report\Final\LE MPP BSA ROROCS Plan.docx

FIGURES



REFERENCE(S)

SURVEY SOURCES:
PICKETT & ASSOCIATES, DATED 01/07/04 & 08/11/16

LEGEND

LIMITS OF AUGUST 2016 TOPOGRAPHY

CLIENT
LAKELAND ELECTRIC
C.D. McINTOSH POWER PLANT
LAKELAND, POLK COUNTY, FLORIDA

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-10-03
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	GMP

PROJECT
BYPRODUCT STORAGE AREA
RUN-ON AND RUN-OFF CONTROL PLAN

TITLE
BSA RUN-ON CONTROL PLAN

PROJECT NO.	Control No.	REV.	FIGURE
15-45454.1	1545454-H001		1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in
0

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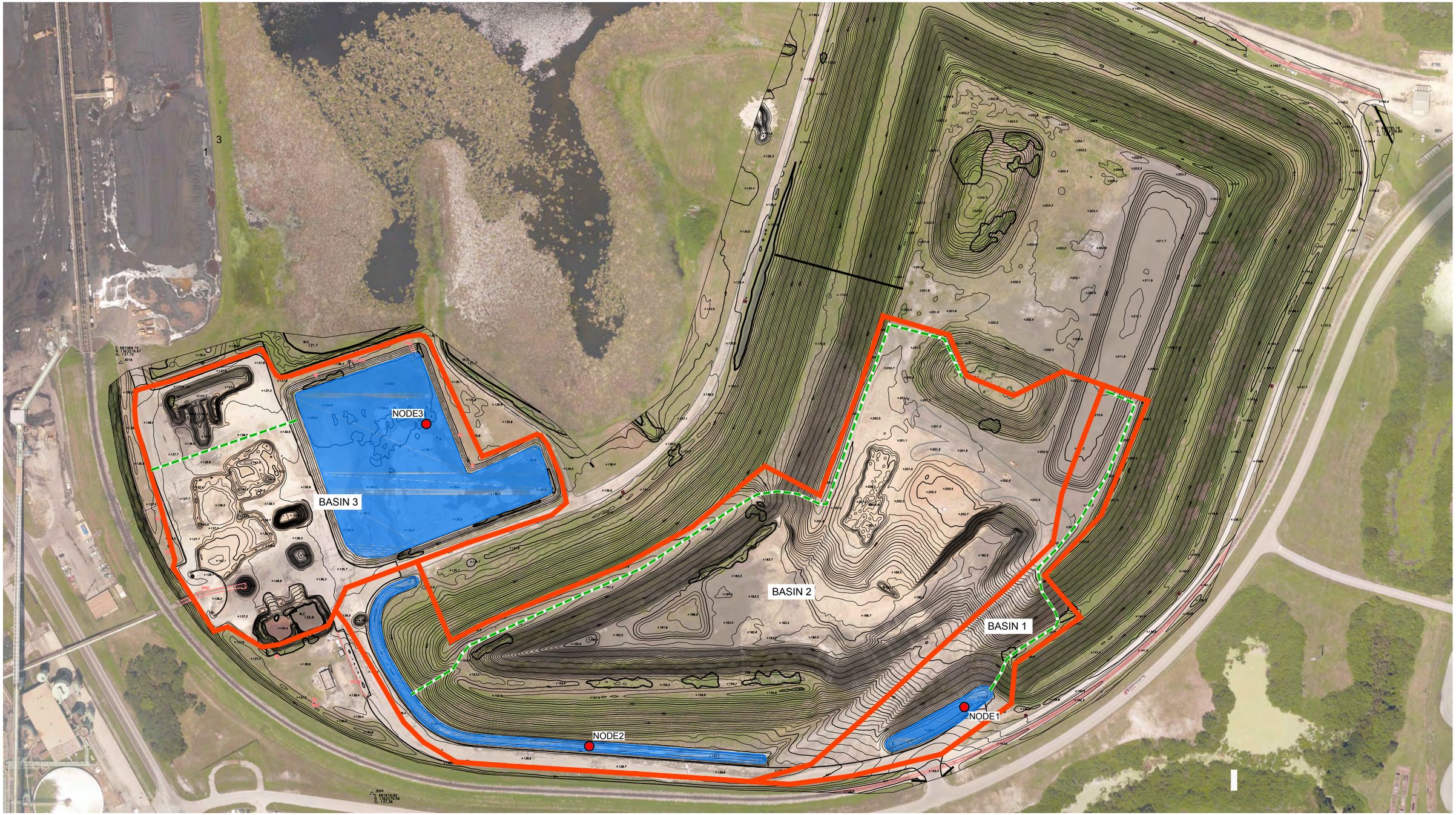

LEGEND

- TIME OF CONCENTRATION
- DEPRESSIONAL STORAGE AREA
- BASIN BOUNDARY

REFERENCE(S)

1. TOPOGRAPHIC SURVEY AND AERIAL PHOTOGRAPH BY PICKETT AND ASSOCIATES DATED 8/11/2016.

0 100 200
SCALE FEET

CLIENT
LAKELAND ELECTRIC
C.D. McINTOSH POWER PLANT
LAKELAND, POLK COUNTY, FLORIDA

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YYYY-MM-DD	2016-10-03
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	GMP

PROJECT
BYPRODUCT STORAGE AREA
RUN-ON AND RUN-OFF CONTROL PLAN

TITLE
BSA RUN-OFF CONTROL PLAN
CONTACT STORMWATER

PROJECT NO.	Control No.	REV.	FIGURE
15-45454.1	1545454-H002		2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in
0

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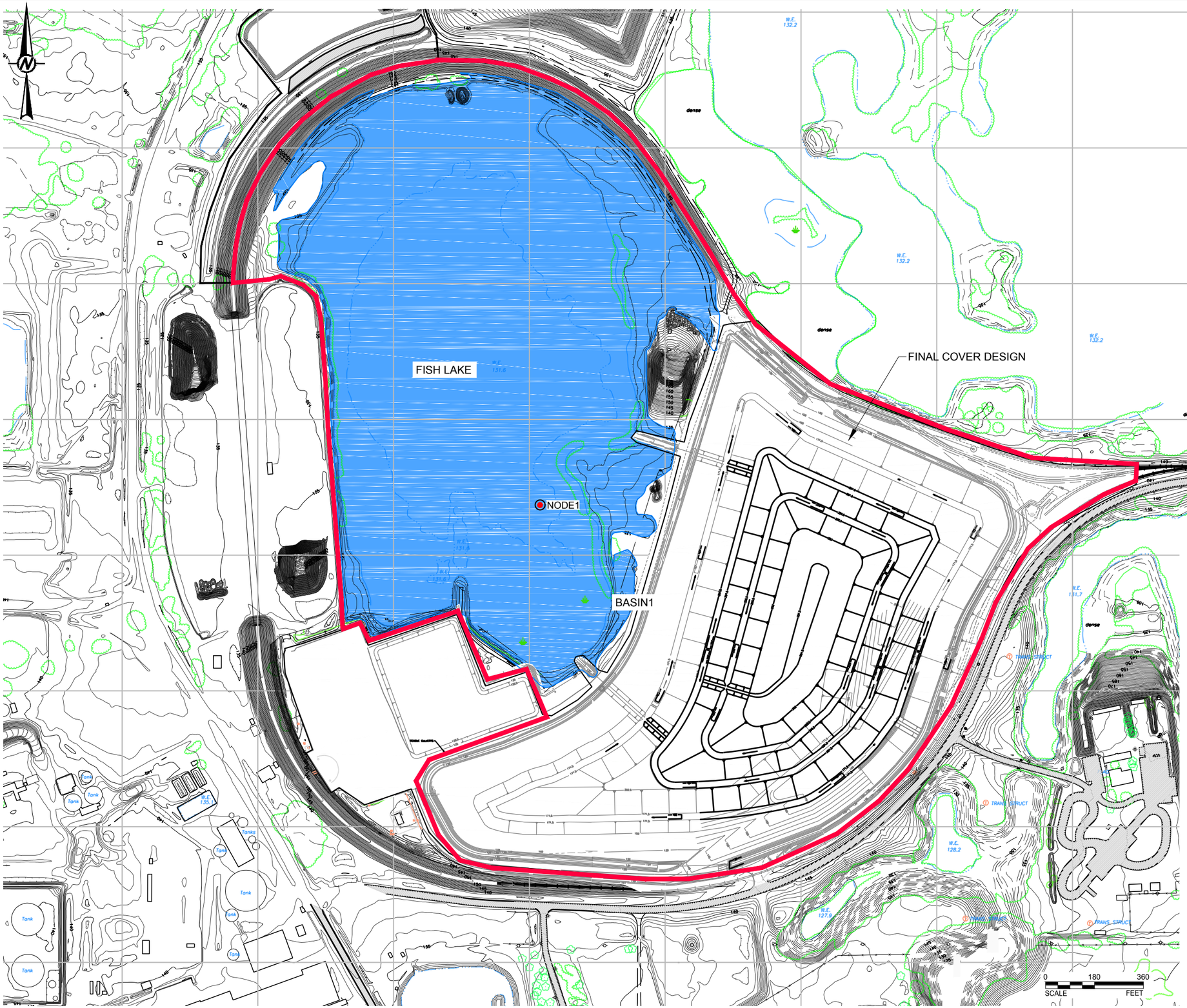

LEGEND

- TIME OF CONCENTRATION
- DEPRESSIONAL STORAGE AREA
- BASIN BOUNDARY

REFERENCE(S)

1. SURVEY SOURCES:
   PICKETT & ASSOCIATES, DATED 01/07/04 & 08/11/16
2. FINAL COVER DESIGN FROM BLACK & VEATCH, DATED 5/17/2004.

CLIENT
LAKELAND ELECTRIC
C.D. McINTOSH POWER PLANT
LAKELAND, POLK COUNTY, FLORIDA

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-10-03
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	GMP

PROJECT
BYPRODUCT STORAGE AREA
RUN-ON AND RUN-OFF CONTROL PLAN

TITLE
BSA RUN-ON CONTROL PLAN
NON-CONTACT STORMWATER

PROJECT NO.	Control No.	REV.	FIGURE
15-45454.1	1545454-H003		3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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APPENDIX A
CONTACT WATER RUN-OFF CALCULATIONS AND MODEL

Time of Concentration Calculations

Hydrology calculations were completed using NRCS methods. Time of concentration values were calculated for each basin by dividing the flow paths into different segments based on overland flow characteristics. The travel times for each flow path were summed to get a time of concentration. The flow paths were divided into the following categories:

Sheet Flow – the maximum sheet flow distance used was 300 feet. The SCS equation for overland flow using Manning's equation was used and is shown below:

$$T_t = \frac{(0.007)(n*L)^{0.8}}{P_2^{0.5}(S)^{0.4}}$$, where:

T_t = Travel Time (min.)
n = Manning's n
L = Flow path length (ft.)
P_2 = 2-year, 24-hour rainfall (in.)
S = Flow path slope (ft./ft.)

Shallow Concentrated Flow –concentrated overland flow towards channels. The equation for shallow concentrated flow is shown below:

$$T_t = \frac{L}{V} * \frac{1}{60}$$, where:

T_t = Travel Time (min.)
L = Flow path length (ft.)
v = Flow velocity (feet/second)

Time of concentration calculations are presented in Table 1.

Composite Curve Number Calculations

CCR material was assumed to perform hydrologically consistent with bare soil conditions, which correlates to runoff curve number values ranging from 77 to 94 depending on the hydrologic soil group. Final cover material was assumed to perform hydrologically consistent with Open Space, Good Condition (grass cover > 75%), which correlates to runoff curve number values ranging from 39 to 80 depending on the hydrologic soil group. Hydrologic soil group B was assumed for curve number computations.

Composite curve number calculations are presented in Table 1.

TABLE 1
McIntosh Power Plant - Byproduct Storage Area
Run-on and Run-off Control System Plan
CURVE NUMBER & TIME OF CONCENTRATION SUMMARY
CONTACT WATER

Basin Description 1 8.90 ac.

CN:

Ac.	Land Cover	Soil Type	SCS CN	%	Weight %
8.15	Impervious	B	98	91.5%	90
0.76	Grass	B	69	8.5%	6
0.00	CCR (Bare Soil)	B	86	0.0%	0
Total: 8.90	**OK**		Weighted SCS CN =		96

Tc:

*First Time of Concentration segment less than 300-ft was calculated using the TR-55 formula for sheet flow (cultivated soils - residue cover ≤ 20%)

*The remaining segments were calculated using the TR-55 velocity vs. slope criteria for shallow concentrated flow or pipe flow (if applicable)

*Pipe flow travel times were negligible and not included in the Tc computations

Mannings n	$P_{2\text{-yr},24\text{-hr}}$ (in.)	Slope (ft./ft.)
0.06	5	0.02

Segment	Dist. (ft)		Slope	Vel. (fps)	Time (min.)
1	300	Sheet Flow	2%		9.1
2	100	Shallow concentrated flow	2%	3.00	0.6
Total:	400				

Time of Concentration = 9.6 min.

Basin Description 2 17.75 ac.

CN:

Ac.	Land Cover	Soil Type	SCS CN	%	Weight %
1.81	Impervious	B	98	10.2%	10
6.58	Grass	B	69	37.1%	26
9.36	CCR (Bare Soil)	B	86	52.8%	45
Total: 17.75	**OK**		Weighted SCS CN =		81

Tc:

*First Time of Concentration segment less than 300-ft was calculated using the TR-55 formula for sheet flow (cultivated soils - residue cover ≤ 20%)

*The remaining segments were calculated using the TR-55 velocity vs. slope criteria for shallow concentrated flow or pipe flow (if applicable)

*Pipe flow travel times were negligible and not included in the Tc computations

Mannings n	$P_{2\text{-yr},24\text{-hr}}$ (in.)	Slope (ft./ft.)
0.06	5	0.02

Segment	Dist. (ft)		Slope	Vel. (fps)	Time (min.)
1	225	Sheet Flow	2%		7.2
2	100	Shallow concentrated flow	3H:1V	9.25	0.2
3	1135	Shallow concentrated flow	0.50%	1.15	16.4
4	120	Shallow concentrated flow	3H:1V	9.25	0.2
Total:	1580				

Time of Concentration = 24.1 min.

TABLE 1
McIntosh Power Plant - Byproduct Storage Area
Run-on and Run-off Control System Plan
CURVE NUMBER & TIME OF CONCENTRATION SUMMARY
CONTACT WATER

Basin Description 3 3.10 ac.

CN:

Ac.	Land Cover	Soil Type	SCS CN	%	Weight %
0.54	Impervious	B	98	17.6%	17
0.97	Grass	B	69	31.2%	22
1.59	CCR (Bare Soil)	B	86	51.2%	44
Total: 3.10	**OK**		Weighted SCS CN =		83

Tc:

*First Time of Concentration segment less than 300-ft was calculated using the TR-55 formula for sheet flow (cultivated soils - residue cover ≤ 20%)

*The remaining segments were calculated using the TR-55 velocity vs. slope criteria for shallow concentrated flow or pipe flow (if applicable)

*Pipe flow travel times were neglible and not included in the Tc computations

Mannings n	$P_{2\text{-yr},24\text{-hr}}$ (in.)	Slope (ft./ft.)
0.06	5	0.1

Segment	Dist. (ft)		Slope	Vel. (fps)	Time (min.)
1	300	Sheet Flow	10%		4.8
2	150	Shallow concentrated flow	10%	5.00	0.5
3	100	Shallow concentrated flow	3H:1V	9.25	0.2
Total:	550				
				Time of Concentration =	5.4 min.

*The minimum TR-55 Time of Concentration of 0.1 hours (6 minutes) was used for this basin.

CONTACT WATER ICPR MODEL INPUT

```
================================================================================
==== Basins ====================================================================
================================================================================

         Name: Basin 1                 Node: South Sed Basin        Status: Onsite
        Group: 25-24                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Flmod              Storm Duration(hrs): 24.00
    Rainfall Amount(in): 7.500                Time of Conc(min): 9.60
            Area(ac): 8.900                     Time Shift(hrs): 0.00
         Curve Number: 96.00                Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

--------------------------------------------------------------------------------
         Name: Basin 2                 Node: CCR Perim Ditch        Status: Onsite
        Group: 25-24                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Flmod              Storm Duration(hrs): 24.00
    Rainfall Amount(in): 7.500                Time of Conc(min): 24.10
            Area(ac): 17.750                    Time Shift(hrs): 0.00
         Curve Number: 81.00                Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

--------------------------------------------------------------------------------
         Name: Basin 3                 Node: CCR Ramp Ditch         Status: Onsite
        Group: 25-24                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Flmod              Storm Duration(hrs): 24.00
    Rainfall Amount(in): 7.500                Time of Conc(min): 6.00
            Area(ac): 3.100                     Time Shift(hrs): 0.00
         Curve Number: 83.00                Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

================================================================================
==== Nodes =====================================================================
================================================================================

      Name: CCR Perim Ditch     Base Flow(cfs): 0.000          Init Stage(ft): 133.000
     Group: 25-24                                             Warn Stage(ft): 136.000
      Type: Stage/Area

      Stage(ft)        Area(ac)
--------------- ---------------
        133.000          0.0300
        134.000          0.3000
        135.000          0.5000
        136.000          0.7000

--------------------------------------------------------------------------------
      Name: CCR Ramp Ditch      Base Flow(cfs): 0.000          Init Stage(ft): 136.000
     Group: 25-24                                             Warn Stage(ft): 140.000
      Type: Stage/Area

      Stage(ft)        Area(ac)
--------------- ---------------
        136.000          0.0100
        137.000          0.1000
        138.000          0.1000
        139.000          0.2000
        140.000          0.2400
```

Name: South SB BC Base Flow(cfs): 0.000 Init Stage(ft): 134.000
Group: 25-24 Warn Stage(ft): 134.000
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	134.000
30.00	134.000

Name: South Sed Basin Base Flow(cfs): 0.000 Init Stage(ft): 130.000
Group: 25-24 Warn Stage(ft): 135.000
Type: Stage/Area

Stage(ft)	Area(ac)
130.000	1.0000
131.000	3.2000
132.000	3.3000
133.000	3.5000
134.000	3.6000
135.000	3.8000

==========

Cross Sections

==========

Name: Weir SSB-BC Group: 25-24
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
0.000	135.000	0.060000
100.000	135.000	0.060000

==========

Operating Tables

==========

Name: SSB Pump Group: 25-24
Type: Rating Curve
Function: US Stage vs. Discharge

US Stage(ft)	Discharge(cfs)
130.000	1.78
131.000	1.78
132.000	1.78
133.000	1.78
134.000	1.78
135.000	1.78

==========

Pipes

==========

Name: CCR PD Culvert From Node: CCR Perim Ditch Length(ft): 50.00
Group: 25-24 To Node: South Sed Basin Count: 3
Friction Equation: Automatic
Solution Algorithm: Most Restrictive
Flow: Both

	UPSTREAM	DOWNSTREAM
Geometry:	Circular	Circular
Span(in):	30.00	30.00
Rise(in):	30.00	30.00
Invert(ft):	133.000	130.700
Manning's N:	0.012000	0.012000
Top Clip(in):	0.000	0.000
Bot Clip(in):	0.000	0.000

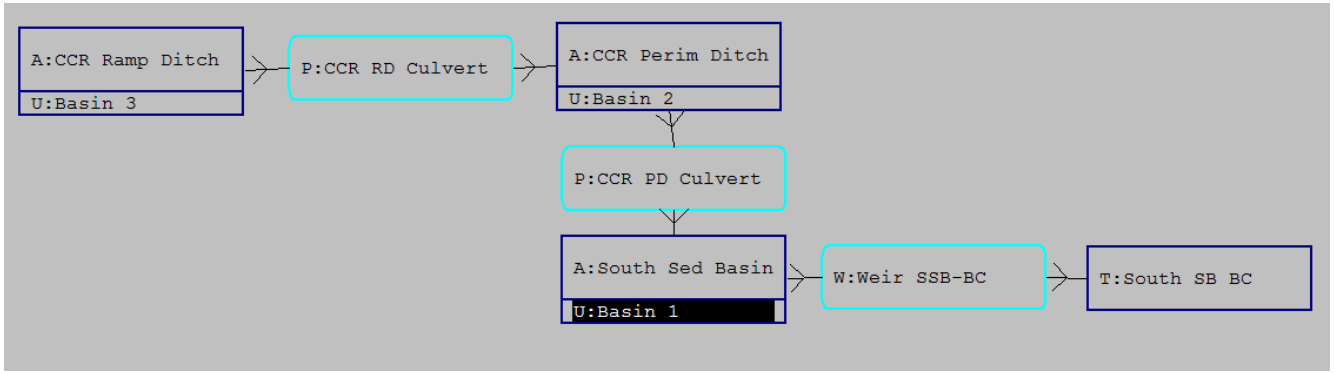
Entrance Loss Coef: 0.00
Exit Loss Coef: 1.00
Bend Loss Coef: 0.00
Outlet Ctrl Spec: Use dc or tw
Inlet Ctrl Spec: Use dc
Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Groove end projecting

Downstream FHWA Inlet Edge Description:
Circular Concrete: Groove end projecting

```
---------------------------------------------------------------------------------------------------
         Name: CCR RD Culvert      From Node: CCR Ramp Ditch     Length(ft): 280.00
        Group: 25-24                 To Node: CCR Perim Ditch         Count: 1
                                                                Friction Equation: Automatic
               UPSTREAM       DOWNSTREAM                 Solution Algorithm: Most Restrictive
     Geometry: Circular       Circular                                 Flow: Both
     Span(in): 36.00          36.00                     Entrance Loss Coef: 0.00
     Rise(in): 36.00          36.00                         Exit Loss Coef: 1.00
   Invert(ft): 135.900        133.900                       Bend Loss Coef: 0.00
  Manning's N: 0.012000       0.012000                    Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000          0.000                        Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000          0.000                     Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Groove end projecting

Downstream FHWA Inlet Edge Description:
Circular Concrete: Groove end projecting

===================================================================================================
==== Weirs ========================================================================================
===================================================================================================

         Name: Weir SSB-BC         From Node: South Sed Basin
        Group: 25-24                 To Node: South SB BC
         Flow: Both                    Count: 1
         Type: Vertical: Fread      Geometry: Irregular

                      XSec: Weir SSB-BC
                Invert(ft): 135.000
      Control Elevation(ft): 135.000
     Struct Opening Dim(ft): 9999.00
                                        TABLE
            Bottom Clip(ft): 0.000
               Top Clip(ft): 0.000
      Weir Discharge Coef: 3.200
     Orifice Discharge Coef: 0.600

===================================================================================================
==== Hydrology Simulations ========================================================================
===================================================================================================

         Name: 25-24
     Filename: G:\Projects\15-\15-45454.1\Calculations\Initial Draft\25-24.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Flmod
    Rainfall Amount(in): 7.50

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

===================================================================================================
==== Routing Simulations ==========================================================================
===================================================================================================
         Name: 25-24               Hydrology Sim: 25-24
     Filename: G:\Projects\15-\15-45454.1\Calculations\Initial Draft\25-24.I32
      Execute: Yes         Restart: No            Patch: No     Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 30.00
     Min Calc Time(sec): 0.5000              Max Calc Time(sec): 60.0000
        Boundary Stages:                         Boundary Flows:

Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
25-24           Yes
```

CONTACT WATER ICPR MODEL NODAL DIAGRAM



CONTACT WATER ICPR MODEL MAXIMUM CONDITIONS REPORT

Name	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
CCR Perim Ditch	25-24	12.32	134.94	136.00	0.0050	21796	12.17	54.61	12.31	50.27
CCR Ramp Ditch	25-24	12.06	137.42	140.00	0.0049	4767	12.00	13.71	12.06	12.13
South SB BC	25-24	0.00	134.00	134.00	0.0000	0	0.00	0.00	0.00	0.00
South Sed Basin	25-24	26.92	134.48	135.00	0.0045	161090	12.12	79.26	0.00	0.00

CONTACT WATER ICPR MODEL MB REPORT

SIMULATION	TIME HRS	INFLOW VOLUME FT3	OUTFLOW VOLUME FT3	CHANGE IN SYS STORAGE FT3	DIFFERENCE FT3	ERROR %
25-24	0.00	0.0	0.0	0.0	0.0	0.00
25-24	0.26	0.0	0.0	-0.0	0.0	9999.99
25-24	0.51	0.0	0.0	-0.0	0.0	9999.99
25-24	0.76	0.0	0.0	-0.0	0.0	9999.99
25-24	1.01	0.2	0.0	0.2	0.0	0.00
25-24	1.26	18.6	0.0	18.6	0.0	0.00
25-24	1.51	92.9	0.0	92.9	0.0	0.00
25-24	1.76	232.8	0.0	232.8	0.0	0.00
25-24	2.01	435.3	0.0	435.3	0.0	0.00
25-24	2.26	699.4	0.0	699.4	0.0	0.00
25-24	2.51	1023.3	0.0	1023.3	0.0	0.00
25-24	2.76	1396.2	0.0	1396.2	0.0	0.00
25-24	3.01	1810.8	0.0	1810.8	-0.0	-0.00
25-24	3.26	2273.9	0.0	2273.9	-0.0	-0.00
25-24	3.51	2790.6	0.0	2790.6	-0.0	-0.00
25-24	3.76	3346.0	0.0	3346.0	-0.0	-0.00
25-24	4.01	3932.4	0.0	3932.4	-0.0	-0.00
25-24	4.26	4570.5	0.0	4570.5	-0.0	-0.00
25-24	4.51	5277.2	0.0	5277.2	0.0	0.00
25-24	4.76	6032.3	0.0	6032.3	0.0	0.00
25-24	5.01	6836.0	0.0	6836.0	0.0	0.00
25-24	5.26	7713.5	0.0	7713.5	0.0	0.00
25-24	5.51	8681.3	0.0	8681.3	0.0	0.00
25-24	5.76	9729.2	0.0	9729.2	-0.0	-0.00
25-24	6.01	10852.9	0.0	10852.9	-0.0	-0.00
25-24	6.26	12108.4	0.0	12108.4	-0.0	-0.00
25-24	6.51	13534.3	0.0	13534.3	-0.0	-0.00
25-24	6.76	15081.9	0.0	15081.9	0.0	0.00
25-24	7.01	16729.0	0.0	16729.0	0.0	0.00
25-24	7.26	18530.7	0.0	18530.7	0.0	0.00
25-24	7.51	20531.1	0.0	20531.1	0.0	0.00
25-24	7.76	22671.5	0.0	22671.5	0.0	0.00
25-24	8.01	24923.0	0.0	24923.0	0.0	0.00
25-24	8.26	27368.2	0.0	27368.2	0.0	0.00
25-24	8.51	30073.9	0.0	30073.9	0.0	0.00
25-24	8.76	33058.7	0.0	33058.7	0.0	0.00
25-24	9.01	36358.8	0.0	36358.8	0.0	0.00
25-24	9.26	39920.3	0.0	39920.3	0.0	0.00
25-24	9.51	43735.1	0.0	43735.1	0.0	0.00
25-24	9.76	47900.1	0.0	47900.1	0.0	0.00
25-24	10.01	52513.2	0.0	52513.2	0.0	0.00
25-24	10.26	57709.1	0.0	57709.1	0.0	0.00
25-24	10.51	63640.9	0.0	63640.9	0.0	0.00
25-24	10.76	70450.0	0.0	70450.0	0.0	0.00
25-24	11.01	78342.7	0.0	78342.7	0.0	0.00
25-24	11.26	87027.6	0.0	87027.6	0.0	0.00
25-24	11.50	98114.5	0.0	98114.5	0.0	0.00
25-24	11.75	124134.9	0.0	124134.9	0.0	0.00
25-24	12.00	183012.4	0.0	183012.4	0.0	0.00
25-24	12.25	261053.3	0.0	261053.3	-0.0	-0.00
25-24	12.50	321983.0	0.0	321983.0	-0.0	-0.00
25-24	12.75	363896.0	0.0	363896.0	0.0	0.00
25-24	13.00	393221.9	0.0	393221.9	0.0	0.00
25-24	13.25	415800.5	0.0	415800.5	0.0	0.00
25-24	13.50	434259.3	0.0	434259.3	0.0	0.00
25-24	13.75	449250.5	0.0	449250.5	0.0	0.00
25-24	14.01	461469.6	0.0	461469.6	-0.0	-0.00
25-24	14.26	471530.5	0.0	471530.5	0.0	0.00
25-24	14.50	479803.7	0.0	479803.7	0.0	0.00
25-24	14.75	487556.3	0.0	487556.3	0.0	0.00
25-24	15.01	494575.1	0.0	494575.1	0.0	0.00
25-24	15.26	501055.5	0.0	501055.5	0.0	0.00
25-24	15.51	507202.2	0.0	507202.2	0.0	0.00
25-24	15.76	513018.4	0.0	513018.4	0.0	0.00
25-24	16.01	518453.7	0.0	518453.7	0.0	0.00
25-24	16.26	523608.2	0.0	523608.2	0.0	0.00
25-24	16.51	528514.8	0.0	528514.8	0.0	0.00
25-24	16.76	533214.5	0.0	533214.5	0.0	0.00
25-24	17.01	537701.3	0.0	537701.3	0.0	0.00
25-24	17.26	542071.5	0.0	542071.5	-0.0	-0.00
25-24	17.51	546377.1	0.0	546377.1	0.0	0.00
25-24	17.76	550497.3	0.0	550497.3	0.0	0.00
25-24	18.01	554317.1	0.0	554317.1	-0.0	-0.00
25-24	18.26	558050.8	0.0	558050.8	-0.0	-0.00
25-24	18.51	561842.5	0.0	561842.5	-0.0	-0.00
25-24	18.76	565515.5	0.0	565515.5	-0.0	-0.00
25-24	19.01	568918.2	0.0	568918.2	-0.0	-0.00
25-24	19.26	572247.2	0.0	572247.2	-0.0	-0.00

25-24	19.51	575643.5	0.0	575643.5	-0.0	-0.00
25-24	19.76	579003.8	0.0	579003.8	-0.0	-0.00
25-24	20.01	582237.9	0.0	582237.9	-0.0	-0.00
25-24	20.26	585325.2	0.0	585325.2	-0.0	-0.00
25-24	20.51	588237.6	0.0	588237.6	-0.0	-0.00
25-24	20.76	591058.8	0.0	591058.8	0.0	0.00
25-24	21.01	593832.8	0.0	593832.8	-0.0	-0.00
25-24	21.26	596580.3	0.0	596580.3	-0.0	-0.00
25-24	21.51	599309.4	0.0	599309.4	-0.0	-0.00
25-24	21.76	602025.4	0.0	602025.4	-0.0	-0.00
25-24	22.01	604733.9	0.0	604733.9	-0.0	-0.00
25-24	22.26	607439.6	0.0	607439.6	-0.0	-0.00
25-24	22.51	610144.9	0.0	610144.9	-0.0	-0.00
25-24	22.76	612776.1	0.0	612776.1	0.0	0.00
25-24	23.01	615268.3	0.0	615268.3	0.0	0.00
25-24	23.26	617684.8	0.0	617684.8	-0.0	-0.00
25-24	23.51	620061.1	0.0	620061.1	-0.0	-0.00
25-24	23.76	622341.3	0.0	622341.3	-0.0	-0.00
25-24	24.01	624466.9	0.0	624466.9	-0.0	-0.00
25-24	24.26	626137.1	0.0	626137.1	-0.0	-0.00
25-24	24.50	627008.7	0.0	627008.7	-0.0	-0.00
25-24	24.75	627519.1	0.0	627519.1	0.0	0.00
25-24	25.00	627822.5	0.0	627822.5	0.0	0.00
25-24	25.25	628013.8	0.0	628013.8	0.0	0.00
25-24	25.50	628126.4	0.0	628126.4	0.0	0.00
25-24	25.75	628184.3	0.0	628184.3	0.0	0.00
25-24	26.00	628208.8	0.0	628208.8	0.0	0.00
25-24	26.25	628216.0	0.0	628216.0	0.0	0.00
25-24	26.50	628216.4	0.0	628216.4	0.0	0.00
25-24	26.75	628216.4	0.0	628216.4	0.0	0.00
25-24	27.00	628216.4	0.0	628216.4	0.0	0.00
25-24	27.25	628216.4	0.0	628216.4	0.0	0.00
25-24	27.50	628216.4	0.0	628216.4	0.0	0.00
25-24	27.75	628216.4	0.0	628216.4	0.0	0.00
25-24	28.00	628216.4	0.0	628216.4	0.0	0.00
25-24	28.25	628216.4	0.0	628216.4	0.0	0.00
25-24	28.50	628216.4	0.0	628216.4	0.0	0.00
25-24	28.75	628216.4	0.0	628216.4	0.0	0.00
25-24	29.00	628216.4	0.0	628216.4	0.0	0.00
25-24	29.26	628216.4	0.0	628216.4	0.0	0.00
25-24	29.50	628216.4	0.0	628216.4	0.0	0.00
25-24	29.75	628216.4	0.0	628216.4	0.0	0.00
25-24	30.00	628216.4	0.0	628216.4	0.0	0.00
25-24	30.01	628216.4	0.0	628216.4	0.0	0.00

APPENDIX B
NON-CONTACT WATER RUN-OFF CALCULATIONS AND MODEL

Time of Concentration Calculations

Hydrology calculations were completed using NRCS methods. Time of concentration values were calculated for each basin by dividing the flow paths into different segments based on overland flow characteristics. The travel times for each flow path were summed to get a time of concentration. The flow paths were divided into the following categories:

Sheet Flow – the maximum sheet flow distance used was 300 feet. The SCS equation for overland flow using Manning's equation was used and is shown below:

$$T_t = \frac{(0.007)(n*L)^{0.8}}{P_2^{0.5}(S)^{0.4}}$$, where:

T_t = Travel Time (min.)
n = Manning's n
L = Flow path length (ft.)
P_2 = 2-year, 24-hour rainfall (in.)
S = Flow path slope (ft./ft.)

Shallow Concentrated Flow –concentrated overland flow towards channels. The equation for shallow concentrated flow is shown below:

$$T_t = \frac{L}{V} * \frac{1}{60}$$, where:

T_t = Travel Time (min.)
L = Flow path length (ft.)
v = Flow velocity (feet/second)

Time of concentration calculations are presented in Table 2.

Composite Curve Number Calculations

CCR material was assumed to perform hydrologically consistent with bare soil conditions, which correlates to runoff curve number values ranging from 77 to 94 depending on the hydrologic soil group. Final cover material was assumed to perform hydrologically consistent with Open Space, Good Condition (grass cover > 75%), which correlates to runoff curve number values ranging from 39 to 80 depending on the hydrologic soil group. Hydrologic soil group B was assumed for curve number computations.

Composite curve number calculations are presented in Table 2.

TABLE 2
McIntosh Power Plant - Byproduct Storage Area
Run-on and Run-off Control System Plan
CURVE NUMBER & TIME OF CONCENTRATION SUMMARY
NON-CONTACT WATER

Basin Description 1 124.30 ac.

CN:

Ac.	Land Cover	Soil Type	SCS CN	%	Weight %
5.10	Impervious	B	98	4.1%	4
73.40	Grass	B	69	59.1%	41
45.80	Pond	B	98	36.8%	36
Total: 124.30	**OK**		Weighted SCS CN =		81

Tc:

*First Time of Concentration segment less than 300-ft was calculated using the TR-55 formula for sheet flow (gravel)

*The remaining segments were calculated using the TR-55 velocity vs. slope criteria for shallow concentrated flow or pipe flow (if applicable)

*Pipe flow travel times were negligible and not included in the Tc computations

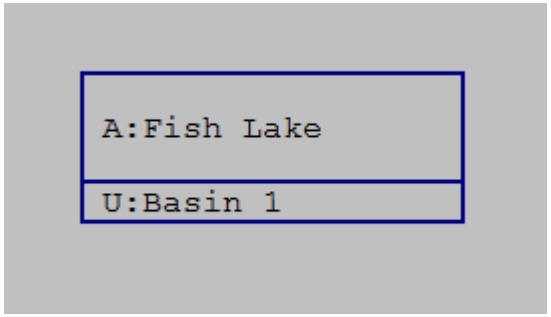
Mannings n	$P_{2\text{-yr},24\text{-hr}}$ (in.)	Slope (ft./ft.)
0.011	5	0.33

Segment	Dist. (ft)		Slope	Vel. (fps)	Time (min.)
1	100	Sheet Flow	2%		0.3
2	2500	Shallow concentrated flow	0.2%	2.20	18.9
Total:	2600				
				Time of Concentration =	19.3 min.

NON-CONTACT WATER ICPR MODEL INPUT

```
================================================================================
==== Basins ====================================================================
================================================================================

         Name: Basin 1                 Node: Fish Lake              Status: Onsite
        Group: 25-24                   Type: SCS Unit Hydrograph CN

        Unit Hydrograph: Uh256                  Peaking Factor: 256.0
          Rainfall File: Flmod              Storm Duration(hrs): 24.00
    Rainfall Amount(in): 7.500                Time of Conc(min): 19.30
             Area(ac): 124.300                  Time Shift(hrs): 0.00
         Curve Number: 81.00               Max Allowable Q(cfs): 999999.000
              DCIA(%): 0.00

================================================================================
==== Nodes =====================================================================
================================================================================

      Name: Fish Lake           Base Flow(cfs): 0.000          Init Stage(ft): 132.000
     Group: 25-24                                            Warn Stage(ft): 135.000
      Type: Stage/Area

      Stage(ft)        Area(ac)
--------------- ---------------
        124.700          0.3000
        125.000         15.6000
        131.600         44.1000
        132.000         45.8000
        133.000         50.5000
        134.000         54.0000
        135.000         57.1000

================================================================================
==== Hydrology Simulations =====================================================
================================================================================

         Name: 25-24
     Filename: G:\Projects\15-\15-45454.1\Calculations\Initial Draft\25-24.R32

      Override Defaults: Yes
    Storm Duration(hrs): 24.00
          Rainfall File: Flmod
    Rainfall Amount(in): 7.50

Time(hrs)       Print Inc(min)
--------------- ---------------
30.000          5.00

================================================================================
==== Routing Simulations =======================================================
================================================================================

         Name: 25-24              Hydrology Sim: 25-24
     Filename: G:\Projects\15-\15-45454.1\Calculations\Initial Draft\25-24.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 10.000
        Start Time(hrs): 0.000                    End Time(hrs): 30.00
     Min Calc Time(sec): 0.5000               Max Calc Time(sec): 60.0000
        Boundary Stages:                         Boundary Flows:

Time(hrs)       Print Inc(min)
--------------- ---------------
999.000         15.000

Group           Run
--------------- -----
25-24           Yes
```

NON-CONTACT WATER ICPR MODEL NODAL DIAGRAM



NON-CONTACT WATER ICPR MODEL MAXIMUM CONDITIONS REPORT

Name	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
Fish Lake	25-24	25.92	133.13	135.00	0.0050	2219075	12.16	339.95	0.00	0.00

NON-CONTACT WATER ICPR MODEL MB REPORT

SIMULATION	TIME HRS	INFLOW VOLUME FT3	OUTFLOW VOLUME FT3	CHANGE IN SYS STORAGE FT3	DIFFERENCE FT3	ERROR %
25-24	0.00	0.0	0.0	0.0	0.0	0.00
25-24	0.26	0.0	0.0	0.0	0.0	0.00
25-24	0.50	0.0	0.0	0.0	0.0	0.00
25-24	0.77	0.0	0.0	0.0	0.0	0.00
25-24	1.02	0.0	0.0	0.0	0.0	0.00
25-24	1.27	0.0	0.0	0.0	0.0	0.00
25-24	1.52	0.0	0.0	0.0	0.0	0.00
25-24	1.77	0.0	0.0	0.0	0.0	0.00
25-24	2.02	0.0	0.0	0.0	0.0	0.00
25-24	2.27	0.0	0.0	0.0	0.0	0.00
25-24	2.52	0.0	0.0	0.0	0.0	0.00
25-24	2.77	0.0	0.0	0.0	0.0	0.00
25-24	3.02	0.0	0.0	0.0	0.0	0.00
25-24	3.27	0.0	0.0	0.0	0.0	0.00
25-24	3.52	0.0	0.0	0.0	0.0	0.00
25-24	3.77	0.0	0.0	0.0	0.0	0.00
25-24	4.02	0.0	0.0	0.0	0.0	0.00
25-24	4.27	0.0	0.0	0.0	0.0	0.00
25-24	4.52	0.0	0.0	0.0	-0.0	-0.00
25-24	4.77	14.7	0.0	14.7	-0.0	-0.00
25-24	5.02	149.3	0.0	149.3	-0.0	-0.00
25-24	5.27	521.1	0.0	521.1	-0.0	-0.00
25-24	5.52	1205.7	0.0	1205.7	0.0	0.00
25-24	5.77	2235.1	0.0	2235.1	0.0	0.00
25-24	6.02	3623.1	0.0	3623.1	0.0	0.00
25-24	6.27	5427.5	0.0	5427.5	0.0	0.00
25-24	6.52	7761.6	0.0	7761.6	0.0	0.00
25-24	6.77	10593.4	0.0	10593.4	0.0	0.00
25-24	7.02	13888.2	0.0	13888.2	0.0	0.00
25-24	7.27	17710.7	0.0	17710.7	0.0	0.00
25-24	7.52	22217.4	0.0	22217.4	-0.0	-0.00
25-24	7.77	27329.6	0.0	27329.6	0.0	0.00
25-24	8.02	32980.0	0.0	32980.0	0.0	0.00
25-24	8.27	39284.9	0.0	39284.9	0.0	0.00
25-24	8.52	46509.9	0.0	46509.9	0.0	0.00
25-24	8.77	54683.6	0.0	54683.6	0.0	0.00
25-24	9.02	64023.4	0.0	64023.4	-0.0	-0.00
25-24	9.27	74419.8	0.0	74419.8	-0.0	-0.00
25-24	9.52	85904.1	0.0	85904.1	-0.0	-0.00
25-24	9.77	98624.7	0.0	98624.7	0.0	0.00
25-24	10.02	113049.1	0.0	113049.1	-0.0	-0.00
25-24	10.27	129403.1	0.0	129403.1	-0.0	-0.00
25-24	10.52	148522.7	0.0	148522.7	-0.0	-0.00
25-24	10.77	170646.6	0.0	170646.6	-0.0	-0.00
25-24	11.02	196965.6	0.0	196965.6	0.0	0.00
25-24	11.27	226714.2	0.0	226714.2	0.0	0.00
25-24	11.52	264468.2	0.0	264468.2	0.0	0.00
25-24	11.77	344061.3	0.0	344061.3	0.0	0.00
25-24	12.00	524313.8	0.0	524313.8	0.0	0.00
25-24	12.25	820290.5	0.0	820290.5	0.0	0.00
25-24	12.51	1081310.6	0.0	1081310.6	0.0	0.00
25-24	12.76	1273179.9	0.0	1273179.9	0.0	0.00
25-24	13.01	1411709.9	0.0	1411709.9	0.0	0.00
25-24	13.25	1515263.1	0.0	1515263.1	0.0	0.00
25-24	13.50	1593425.3	0.0	1593425.3	0.0	0.00
25-24	13.75	1651947.2	0.0	1651947.2	0.0	0.00
25-24	14.00	1696606.3	0.0	1696606.3	0.0	0.00
25-24	14.25	1734559.7	0.0	1734559.7	0.0	0.00
25-24	14.50	1768375.7	0.0	1768375.7	0.0	0.00
25-24	14.75	1799509.6	0.0	1799509.6	0.0	0.00
25-24	15.00	1827846.1	0.0	1827846.1	0.0	0.00
25-24	15.25	1854360.3	0.0	1854360.3	0.0	0.00
25-24	15.50	1879429.8	0.0	1879429.8	0.0	0.00
25-24	15.75	1903310.4	0.0	1903310.4	0.0	0.00
25-24	16.00	1925608.4	0.0	1925608.4	0.0	0.00
25-24	16.25	1946786.3	0.0	1946786.3	0.0	0.00
25-24	16.50	1966902.8	0.0	1966902.8	0.0	0.00
25-24	16.75	1986209.1	0.0	1986209.1	0.0	0.00
25-24	17.00	2004596.4	0.0	2004596.4	0.0	0.00
25-24	17.25	2022430.9	0.0	2022430.9	0.0	0.00
25-24	17.50	2039966.1	0.0	2039966.1	0.0	0.00
25-24	17.75	2056987.5	0.0	2056987.5	0.0	0.00
25-24	18.00	2072790.0	0.0	2072790.0	0.0	0.00
25-24	18.25	2088026.6	0.0	2088026.6	0.0	0.00
25-24	18.50	2103428.2	0.0	2103428.2	0.0	0.00
25-24	18.75	2118583.6	0.0	2118583.6	0.0	0.00
25-24	19.00	2132647.4	0.0	2132647.4	0.0	0.00
25-24	19.25	2146220.2	0.0	2146220.2	0.0	0.00

25-24	19.50	2160027.4	0.0	2160027.4	0.0	0.00
25-24	19.75	2173809.2	0.0	2173809.2	0.0	0.00
25-24	20.00	2187080.9	0.0	2187080.9	0.0	0.00
25-24	20.25	2199858.7	0.0	2199858.7	0.0	0.00
25-24	20.50	2211924.9	0.0	2211924.9	0.0	0.00
25-24	20.75	2223550.8	0.0	2223550.8	0.0	0.00
25-24	21.00	2234920.5	0.0	2234920.5	0.0	0.00
25-24	21.25	2246128.9	0.0	2246128.9	0.0	0.00
25-24	21.50	2257242.8	0.0	2257242.8	0.0	0.00
25-24	21.75	2268316.3	0.0	2268316.3	0.0	0.00
25-24	22.00	2279375.8	0.0	2279375.8	0.0	0.00
25-24	22.25	2290437.6	0.0	2290437.6	0.0	0.00
25-24	22.50	2301504.4	0.0	2301504.4	0.0	0.00
25-24	22.75	2312395.1	0.0	2312395.1	0.0	0.00
25-24	23.00	2322726.5	0.0	2322726.5	0.0	0.00
25-24	23.25	2332699.5	0.0	2332699.5	0.0	0.00
25-24	23.50	2342468.0	0.0	2342468.0	0.0	0.00
25-24	23.75	2351928.9	0.0	2351928.9	0.0	0.00
25-24	24.00	2360730.2	0.0	2360730.2	0.0	0.00
25-24	24.25	2367975.1	0.0	2367975.1	0.0	0.00
25-24	24.50	2372152.7	0.0	2372152.7	0.0	0.00
25-24	24.75	2374511.3	0.0	2374511.3	0.0	0.00
25-24	25.00	2375851.4	0.0	2375851.4	0.0	0.00
25-24	25.25	2376541.1	0.0	2376541.1	0.0	0.00
25-24	25.50	2376821.0	0.0	2376821.0	0.0	0.00
25-24	25.75	2376900.1	0.0	2376900.1	0.0	0.00
25-24	26.00	2376905.2	0.0	2376905.2	0.0	0.00
25-24	26.25	2376905.2	0.0	2376905.2	0.0	0.00
25-24	26.50	2376905.2	0.0	2376905.2	0.0	0.00
25-24	26.75	2376905.2	0.0	2376905.2	0.0	0.00
25-24	27.00	2376905.2	0.0	2376905.2	0.0	0.00
25-24	27.25	2376905.2	0.0	2376905.2	0.0	0.00
25-24	27.50	2376905.2	0.0	2376905.2	0.0	0.00
25-24	27.75	2376905.2	0.0	2376905.2	0.0	0.00
25-24	28.00	2376905.2	0.0	2376905.2	0.0	0.00
25-24	28.25	2376905.2	0.0	2376905.2	0.0	0.00
25-24	28.50	2376905.2	0.0	2376905.2	0.0	0.00
25-24	28.75	2376905.2	0.0	2376905.2	0.0	0.00
25-24	29.00	2376905.2	0.0	2376905.2	0.0	0.00
25-24	29.25	2376905.2	0.0	2376905.2	0.0	0.00
25-24	29.50	2376905.2	0.0	2376905.2	0.0	0.00
25-24	29.75	2376905.2	0.0	2376905.2	0.0	0.00
25-24	30.00	2376905.2	0.0	2376905.2	0.0	0.00
25-24	30.01	2376905.2	0.0	2376905.2	0.0	0.00