

STORM WATER MANAGEMENT SUMMARY

NOVEMBER 14, 2016

PREPARED FOR:
DAYTON FREIGHT
6450 POE AVENUE, SUITE 311
DAYTON, OHIO

RECEIVED BY THE
VANDERBURGH COUNTY
SURVEYOR'S OFFICE
11/16/16 CA



STORM WATER MANAGEMENT SUMMARY

11160 GREEN RIVER ROAD
EVANSVILLE, INDIANA

NOVEMBER 14, 2016



*PREPARED BY:

Mark J. Mathe

MARK J. MATHE, PE

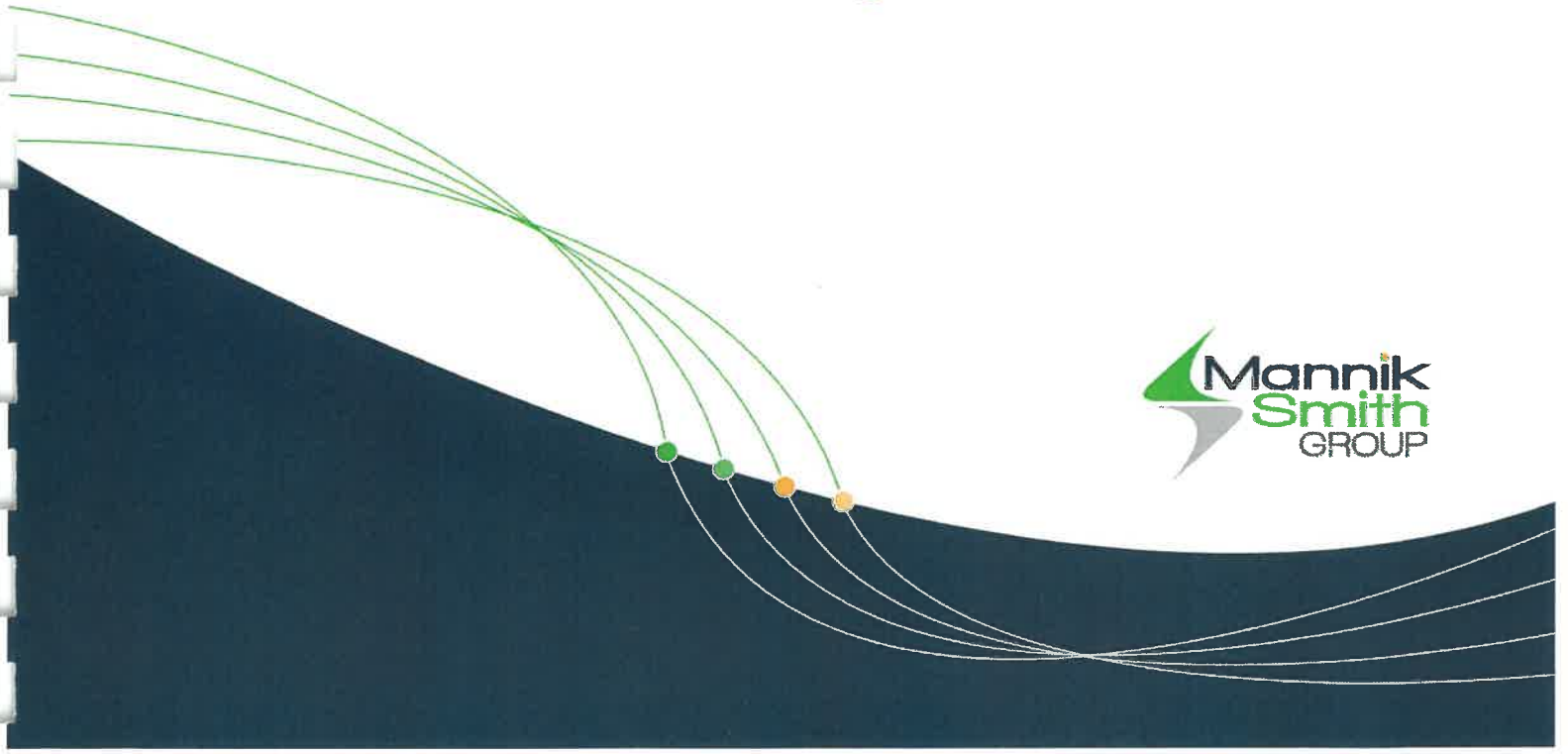


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1.0 INTRODUCTION

Dayton Freight is proposing modifications to their existing site located at 11160 Green River Road, which would include the addition of a concrete pavement area and an additional gravel area. A larger pavement area and additional buildings are planned for the future which this storm design has accounted for. The project site is located in Vanderburgh County, Indiana.

2.0 METHODOLOGY

The Hydrological design for this project was based on controlling the sites post-developed 25 year storm event back to the outflow rate for the pre-developed 10-year storm event. Both Pre-Development and Post-Development runoff and peak discharge amounts were calculated using the rational method as described in the Stormwater Drainage Control section (chapter 13.04) of the Vanderburgh County Code.

3.0 EXISTING CONDITIONS

Currently, the site consists of an existing building, a parking lot area, and drive aisles located primarily in the western portion of the site with the eastern portion of the site consisting primarily of open greenspace. Drainage ditches are located on both the north and south side of the site and a stream runs along the eastern end of the site. The site is bordered by North Green River Road and commercial storage buildings to the west, a residential building and wooded area to the north, farm fields to the east, and commercial buildings and farm fields to the south.

The site hydrology primarily consists of a relatively flat area, which mostly drains into the drainage ditches to the north and south, or towards an existing pond to the east, all of which ultimately outlet into the stream located on the eastern side of the site. An existing runoff coefficient of 0.25 and 0.26, respectively, was calculated for the north and south drainage areas as shown on the calculation references sheet in the appendix.

3.1 Hydrologic Soil Group

According to the Custom Soil Resource Report, generated by The USDA - Natural Resources Conservation Service (NRCS) Soil Survey, the site is situated on a combination of Birds silt loam (Bd), Evansville silt loam (Ev) and Henshaw silt loam (He). Birds silt loam and Evansville silt loam both have a hydrologic soil group rating of B/D with Henshaw silt loam having a rating of C/D.

4.0 PROPOSED CONDITIONS

The post-developed condition of the site consists of an expansion of the concrete pavement and gravel areas with a further expansion of the pavement areas and the construction of additional buildings planned for the future. Runoff for the developed portions of the site will either be directed into detention basins located on the north or the south side of the site. Both the north and south detention basins will utilize weir walls to control release rates down to allowable values. Runoff from an existing detention basin will route through the proposed north detention basin. The weir wall for the north detention basin has been designed to account for this additional runoff and will allow it to pass through at its existing release rate. A developed runoff coefficient of 0.61 and 0.56, respectively, were calculated for the north and south drainage areas as shown on the calculation references sheet in the appendix.

1.0 INTRODUCTION

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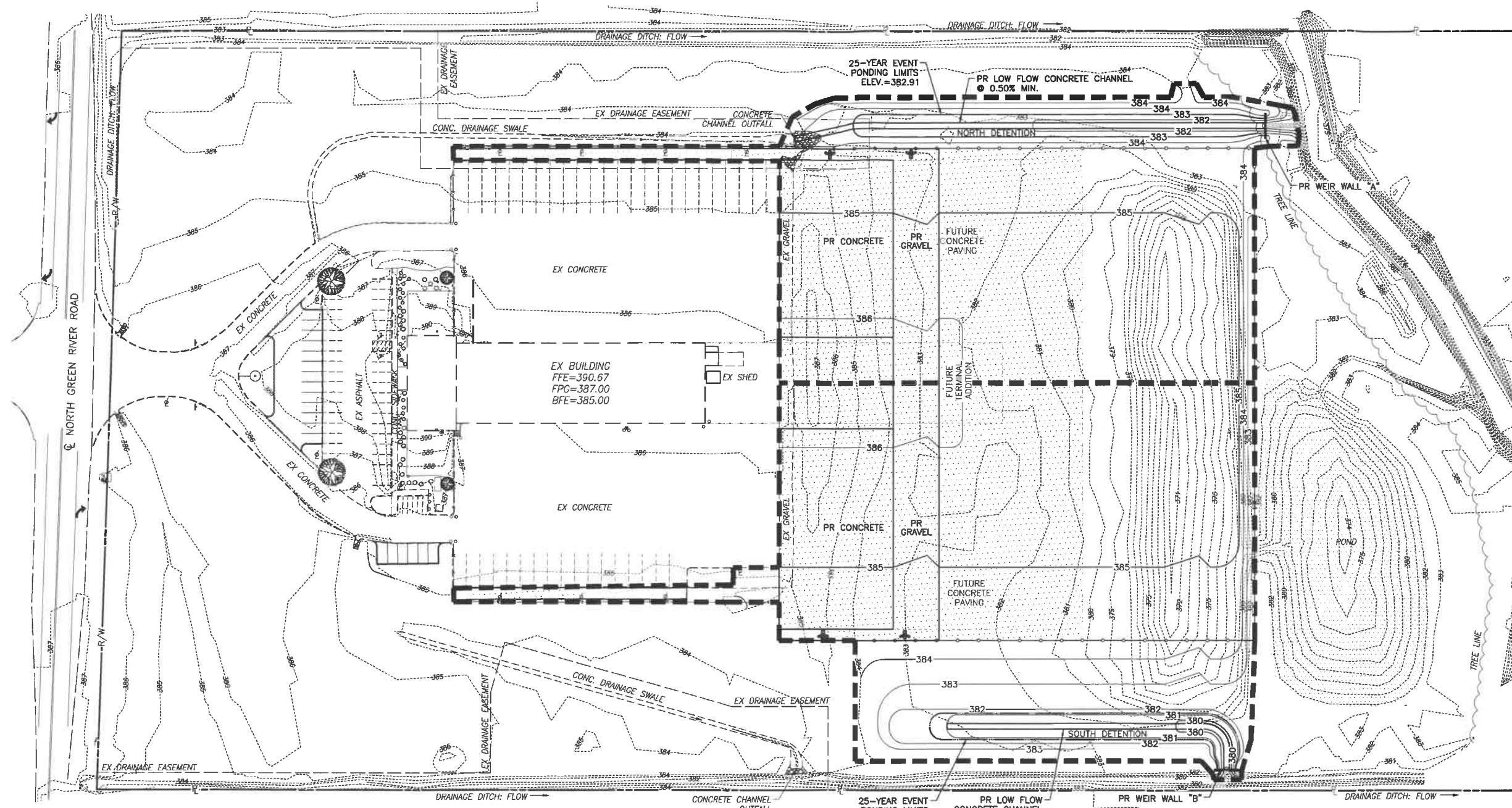
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APPENDIX A
PRE AND POST CONDITIONS DRAINAGE MAPS



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CALCULATED AREAS

NORTH AREA		
GREENSPACE (C=0.24):	1.175 AC	52.7%
IMPERVIOUS (C=0.94):	1.312 AC	47.3%
TOTAL	2.487 AC	100.0%

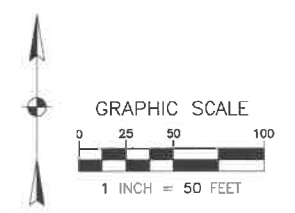
SOUTH AREA		
GREENSPACE (C=0.24):	1.664 AC	46.3%
IMPERVIOUS (C=0.94):	1.432 AC	53.7%
TOTAL	3.096 AC	100.0%

LEGEND

IMPERVIOUS AREA
 DRAINAGE AREA

ABBREVIATIONS

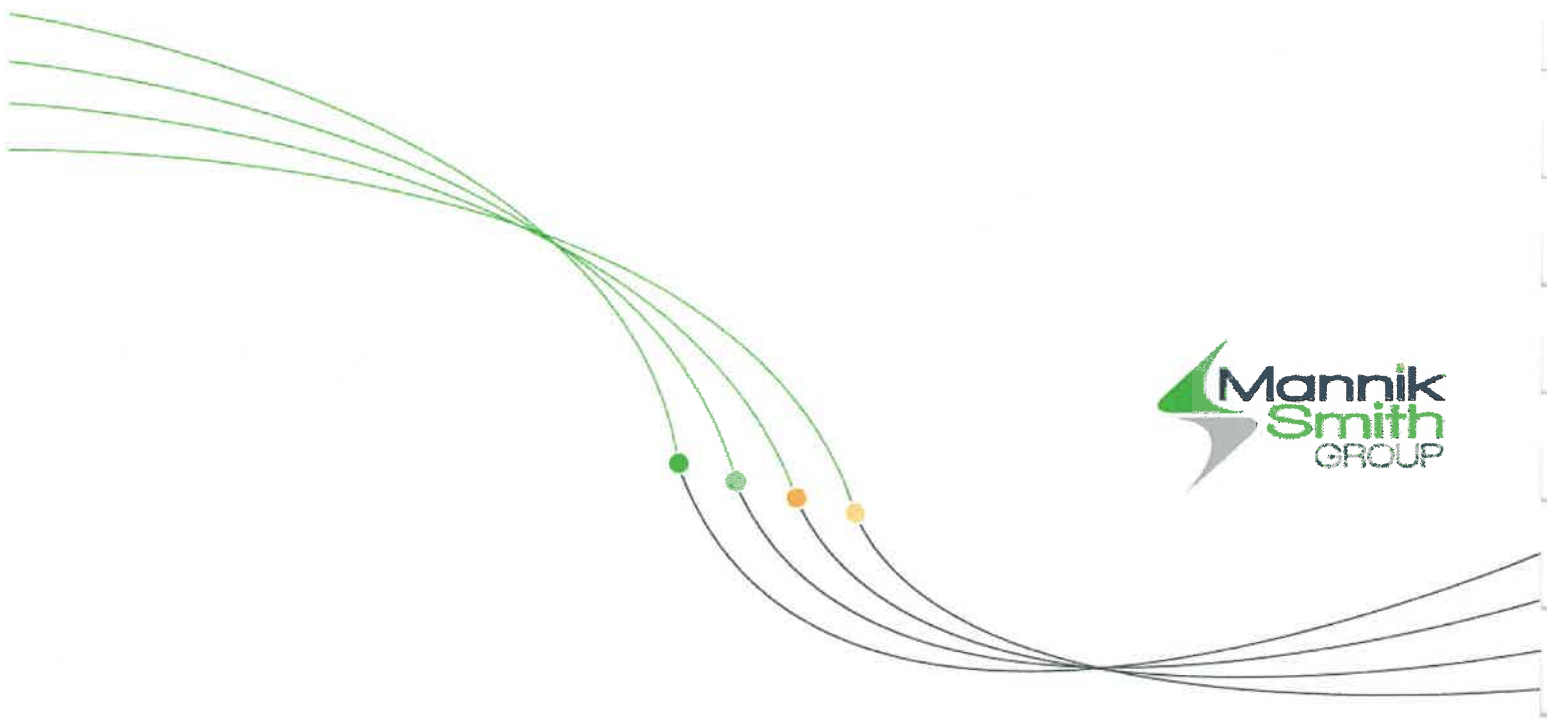
FFE FINISH FLOOR ELEVATION
 FPG FLOOD PROTECTION GRADE
 BFE BASE FLOOD ELEVATION



	NO.	DATE	BY	DESCRIPTION
616 GRANDVIEW AVENUE SUITE 600 COLUMBUS, OH 43215 TEL: 614.441.4222 FAX: 614.441.4222 PROJECT DATE: 10/31/2016 PROJECT NO.: JT-40008 DRAWN BY: JPB CHECKED BY: JMB				
 TECHNICAL DRAFTER CHELSEA BRILL				
PREPARED FOR: JH ARCHITECTS 5120 B NINE DRIVE COLUMBUS, OHIO				
CITY OF EVANSVILLE, VANDERBURGH COUNTY, INDIANA SITE IMPROVEMENT PLAN DAYTON FREIGHT 11160 GREEN RIVER ROAD				
POST DEVELOPED CONDITIONS				
2 OF 2				

**APPENDIX B
DETENTION CALCULATIONS**





Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
North Drainage Area - Calculation References

Allowable Discharge, $Q_a = C * i_{10} * A = 0.25 * 4.48 \text{ in/hr} * 2.487 \text{ AC} = 2.84 \text{ cfs}$

Allowable Discharge, $Q_a = C_{ex} * i_{10-Tc} * A$

C = Runoff coefficient dictated by Vanderburgh County

A (AC) = Tributary area

i_{10-Tc} (in/hr) = Rainfall intensity of a 10 year storm at time T_c

Allowable Discharge, Q_a (cfs) = 2.84

A (AC) = 2.487

Time of Concentration, T_c (min) = 15.36

i_{10-Tc} (in/hr) = 4.48

Existing Runoff Coefficient, C_{ex} = 0.25

Proposed Runoff Coefficient, C_{pr} = 0.61

C, Runoff Coefficients	
Pavement, Roofs, etc.	0.94
Open Space	0.24

Proposed Conditions	
Impervious Area (AC)	1.312
Pervious Area (AC)	1.175

Existing Conditions	
Impervious Area (AC)	0.053
Pervious Area (AC)	2.434

Utilized Equations

$$Q_{in-25(t)} \text{ (cfs)} = C_p * i_{(t)} * A$$

$Q_{in-25(t)}$ (cfs) = Proposed 25-Year inflow rate at time (t)

C_p = PR conditions runoff coefficient

$i_{(t)}$ (in/hr) = Rainfall intensity at time (t)

A (AC) = Drainage area

$$V_{rs} \text{ (ft}^3\text{)} = (Q_{in-25(t)} - Q_a) * (T_d * 60)$$

V_{rs} (ft³) = Required storage volume

$Q_{in-25(t)}$ (cfs) = Proposed 25-Year inflow rate at time (t)

Q_a (cfs) = Allowable discharge

T_d (min) = Storm duration

Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
Time of Concentration Calculation

Sheet Flow

Manning's roughness coefficient, n =	0.24
Flow length, L (ft) =	100
2-year 24-hour rainfall, P ₂ (in) =	3.25
Land Slope, s (ft/ft) =	0.0229
Sheet Flow, T _t (min) =	13.41

Shallow Concentrated Flow

	Segment	1st	2nd
Flow length, L (ft) =		210	55
Land Slope, s (ft/ft) =		0.016	0.055
Average velocity, V (ft/s) =		2.055	3.768
Shallow Concentrated Time, T _s (min) =		1.70	0.24

Time of concentration, T_c (min) = 15.36

Utilized Equations

$$\text{Unpaved, } V = 16.1345 * (s)^{0.5}$$

$$\text{Paved, } V = 20.3282 * (s)^{0.5}$$

$$T_t \text{ (hr)} = \frac{0.007 * (n * L)^{0.8}}{P_2^{0.5} * s^{0.4}}$$

$$T_s \text{ (hr)} = L / (3600 * V)$$

Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
North Drainage Area - Detention Calculations

Allowable Discharge, $Q_a = C_{ex} * i_{10-Tc} * A$

Drainage Area, A (AC) = 2.487
 Proposed Runoff Coefficient, C_{pr} = 0.61
 $C_{pr} * A$ (AC) = 1.52
 Existing Tc (min) = 15.36
 Proposed Tc (min) = 10.00
 10 YR Rainfall Intensity at time Tc, i_{10-Tc} (in/hr) = 4.48
 Existing Runoff Coefficient, C_{ex} = 0.25
 Allowable Discharge, Q_a (CFS) = 2.84

T_d , Storm Duration (min)	$i_{25-(t)}$, Rainfall Intensity (in/hr)	Q_{in-25} , Inflow Rate (cfs)	$Q_{in-25} - Q_a$	V_{rs} , Storage Volume Required (ft ³)
5	7.208	10.92	8.08	2,424.11
10	5.925	8.98	6.14	3,681.88
15	5.033	7.63	4.78	4,306.50
20	4.571	6.93	4.08	4,901.41
30	3.646	5.52	2.68	4,830.37
40	3.123	4.73	1.89	4,539.95
50	2.601	3.94	1.10	3,299.25
60	2.078	3.15	0.31	1,108.27
70	1.965	2.98	0.14	573.91
80	1.852	2.81	0.00	0.00
90	1.739	2.63	0.00	0.00
100	1.626	2.46	0.00	0.00
110	1.513	2.29	0.00	0.00
120	1.400	2.12	0.00	0.00
130	1.337	2.02	0.00	0.00
140	1.273	1.93	0.00	0.00
150	1.210	1.83	0.00	0.00
160	1.146	1.74	0.00	0.00
170	1.083	1.64	0.00	0.00
180	1.019	1.54	0.00	0.00

Weir Report

North Weir

Rectangular Weir

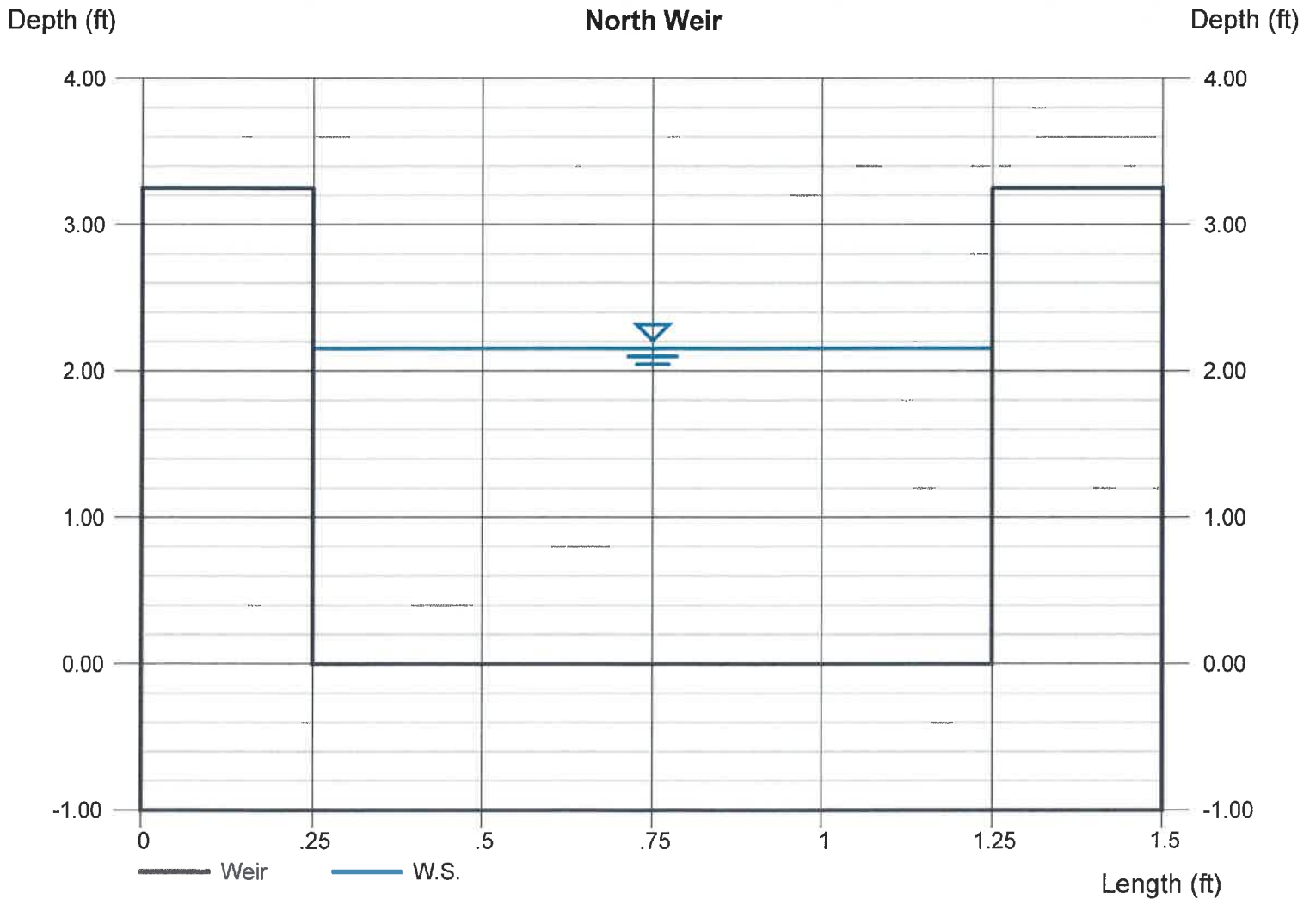
Crest = Sharp
Bottom Length (ft) = 1.00
Total Depth (ft) = 3.25

Highlighted

Depth (ft) = 2.15
Q (cfs) = 10.51
Area (sqft) = 2.15
Velocity (ft/s) = 4.88
Top Width (ft) = 1.00

Calculations

Weir Coeff. C_w = 3.33
Compute by: Known Q
Known Q (cfs) = 10.51



Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
South Drainage Area - Calculation References

Allowable Discharge, $Q_a = C * i_{10} * A = 0.26 * 4.76 \text{ in/hr} * 3.096 \text{ AC} = 3.76 \text{ cfs}$
 Allowable Discharge, $Q_a = C_{ex} * i_{10-T_c} * A$

C = Runoff coefficient dictated by Vanderburgh County
 A (AC) = Tributary area
 i_{10-T_c} (in/hr) = Rainfall intensity of a 10 year storm at time T_c

Allowable Discharge, Q_a (cfs) = 3.76
 A (AC) = 3.096
 Time of Concentration, T_c (min) = 13.58
 i_{10-T_c} (in/hr) = 4.76
 Existing Runoff Coefficient, C_{ex} = 0.26
 Proposed Runoff Coefficient, C_{pr} = 0.56

C, Runoff Coefficients	
Pavement, Roofs, etc.	0.94
Open Space	0.24

Proposed Conditions	
Impervious Area (AC)	1.432
Pervious Area (AC)	1.664

Existing Conditions	
Impervious Area (AC)	0.067
Pervious Area (AC)	3.029

Utilized Equations

$Q_{in-25(t)} \text{ (cfs)} = C_p * i_{(t)} * A$
 $Q_{in-25(t)} \text{ (cfs)}$ = Proposed 25-Year inflow rate at time (t)
 C_p = PR conditions runoff coefficient
 $i_{(t)}$ (in/hr) = Rainfall intensity at time (t)
 A (AC) = Drainage area

$V_{rs} \text{ (ft}^3\text{)} = (Q_{in-25(t)} - Q_a) * (T_d * 60)$
 $V_{rs} \text{ (ft}^3\text{)}$ = Required storage volume
 $Q_{in-25(t)} \text{ (cfs)}$ = Proposed 25-Year inflow rate at time (t)
 $Q_a \text{ (cfs)}$ = Allowable discharge
 $T_d \text{ (min)}$ = Storm duration

Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
Time of Concentration Calculation

Sheet Flow

Manning's roughness coefficient, n = 0.24
 Flow length, L (ft) = 100
 2-year 24-hour rainfall, P₂ (in) = 3.25
 Land Slope, s (ft/ft) = 0.0317
 Sheet Flow, T_t (min) = 11.77

Shallow Concentrated Flow

	Segment	1st	2nd
Flow length, L (ft) =		190	53
Land Slope, s (ft/ft) =		0.015	0.057
Average velocity, V (ft/s) =		2.000	3.839
Shallow Concentrated Time, T _s (min) =		1.58	0.23

Time of concentration, T_c (min) = 13.58

Utilized Equations

$$\text{Unpaved, } V = 16.1345 * (s)^{0.5}$$

$$\text{Paved, } V = 20.3282 * (s)^{0.5}$$

$$T_t \text{ (hr)} = \frac{0.007 * (n * L)^{0.8}}{P_2^{0.5} * s^{0.4}}$$

$$T_s \text{ (hr)} = L / (3600 * V)$$

Project: Dayton Freight - Evansville, IN
Project Number: J1340008
11601 N. Green River Road, Evansville, IN
South Drainage Area - Detention Calculations

Allowable Discharge, $Q_a = C_{ex} * i_{10-Tc} * A$

Drainage Area, A (AC) = 3.096
Proposed Runoff Coefficient, C_{pr} = 0.56
 $C_{pr} * A$ (AC) = 1.75
Existing Tc (min) = 13.58
Proposed Tc (min) = 10.00
10 YR Rainfall Intensity at time Tc, i_{10-Tc} (in/hr) = 4.76
Existing Runoff Coefficient, C_{ex} = 0.26
Allowable Discharge, Q_a (CFS) = 3.76

T_d , Storm Duration (min)	$i_{25-(t)}$, Rainfall Intensity (in/hr)	Q_{in-25} , Inflow Rate (cfs)	$Q_{in-25} - Q_a$	V_{rs} , Storage Volume Required (ft ³)
5	7.208	12.58	8.82	2,646.17
10	5.925	10.34	6.58	3,948.75
15	5.033	8.78	5.02	4,521.93
20	4.571	7.98	4.22	5,060.91
30	3.646	6.36	2.60	4,686.35
40	3.123	5.45	1.69	4,059.07
50	2.601	4.54	0.78	2,337.09
60	2.078	3.63	0.00	0.00
70	1.965	3.43	0.00	0.00
80	1.852	3.23	0.00	0.00
90	1.739	3.04	0.00	0.00
100	1.626	2.84	0.00	0.00
110	1.513	2.64	0.00	0.00
120	1.400	2.44	0.00	0.00
130	1.337	2.33	0.00	0.00
140	1.273	2.22	0.00	0.00
150	1.210	2.11	0.00	0.00
160	1.146	2.00	0.00	0.00
170	1.083	1.89	0.00	0.00
180	1.019	1.78	0.00	0.00

Weir Report

South Weir

Rectangular Weir

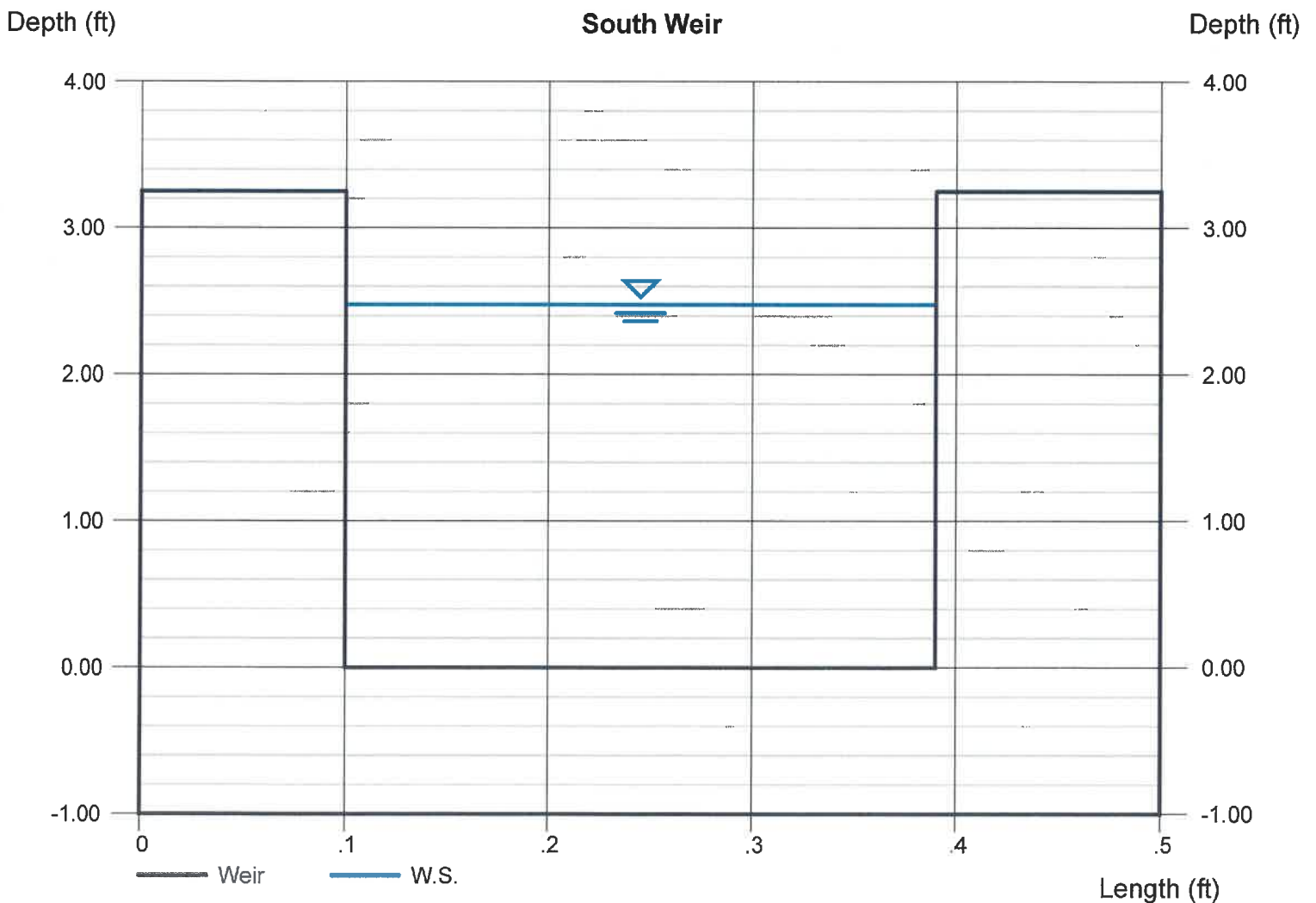
Crest = Sharp
Bottom Length (ft) = 0.29
Total Depth (ft) = 3.25

Highlighted

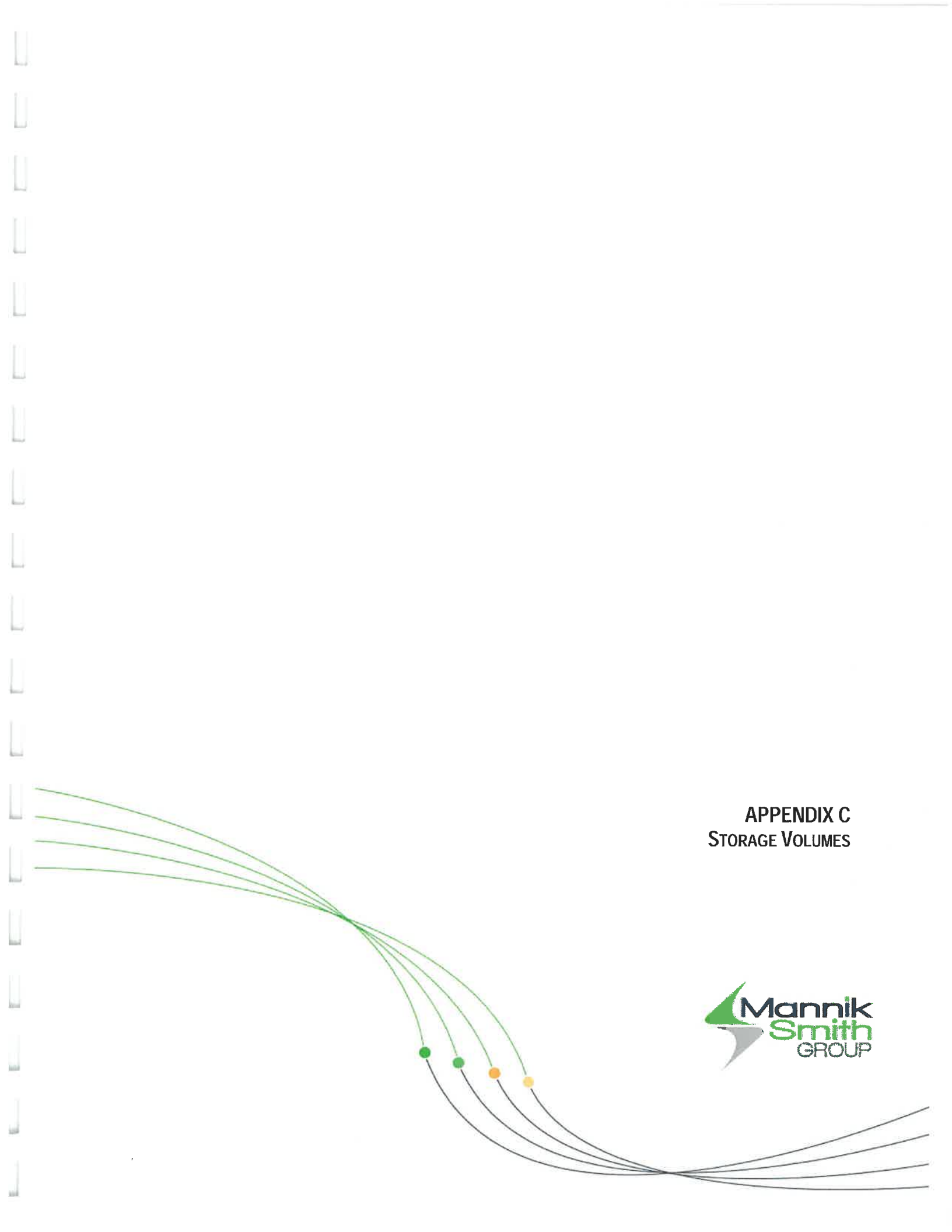
Depth (ft) = 2.48
Q (cfs) = 3.760
Area (sqft) = 0.72
Velocity (ft/s) = 5.24
Top Width (ft) = 0.29

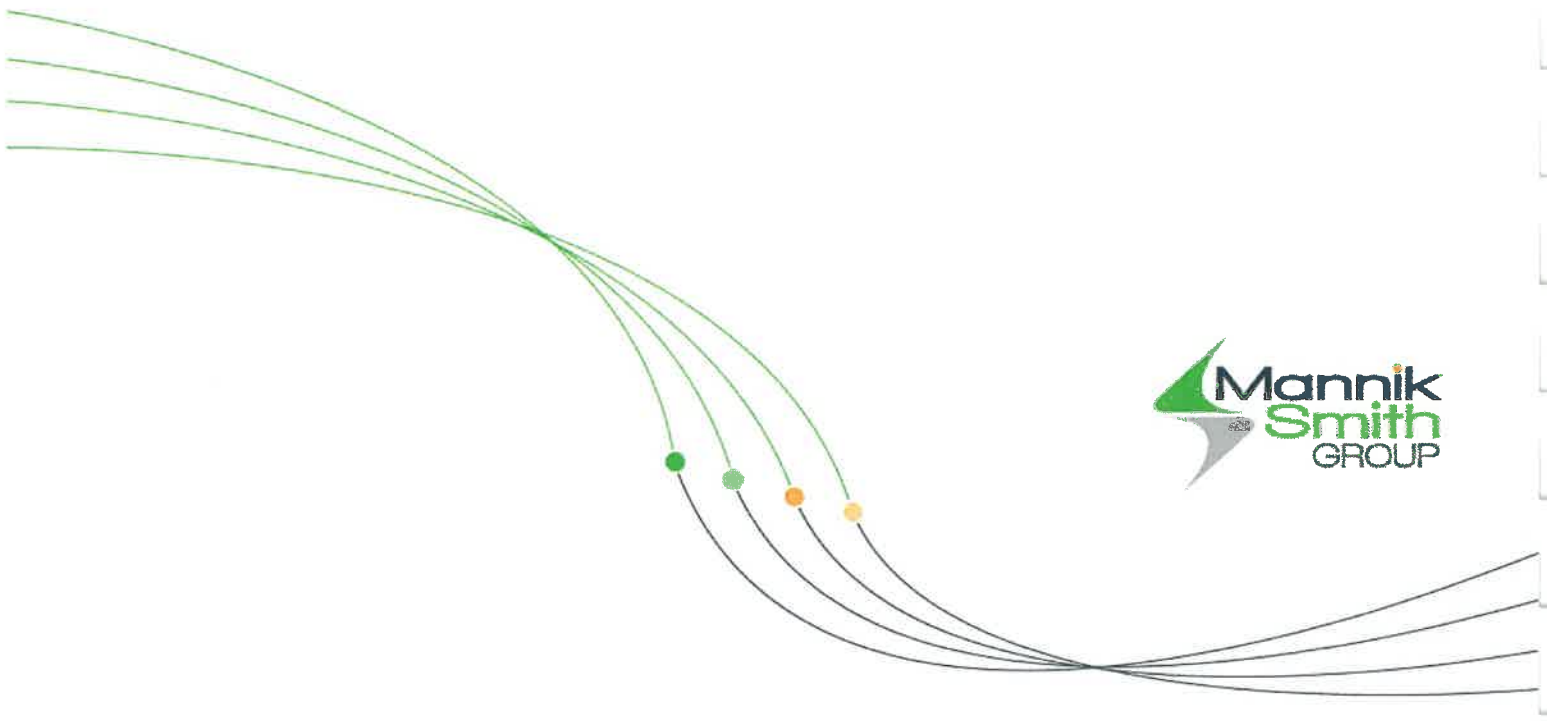
Calculations

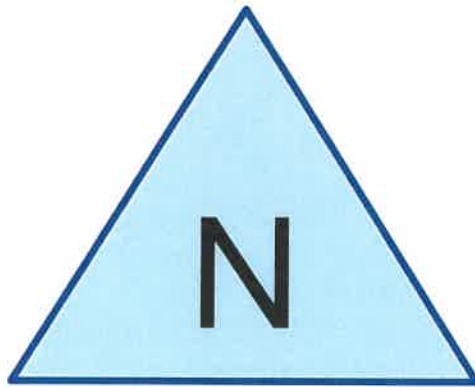
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 3.76



APPENDIX C
STORAGE VOLUMES







North Basin



Routing Diagram for J1340008 - Detention Time
Prepared by The Mannik & Smith Group, Printed 11/14/2016
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J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

Prepared by The Mannik & Smith Group

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Page 2

Summary for Pond N: North Basin

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 10.40 cfs @ 0.00 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.0 min
 Primary = 10.40 cfs @ 0.00 hrs, Volume= 0.136 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.05 hrs
 Starting Elev= 382.91' Surf.Area= 6,600 sf Storage= 4,921 cf
 Peak Elev= 382.91' @ 0.00 hrs Surf.Area= 6,600 sf Storage= 4,921 cf

Plug-Flow detention time= (not calculated: no plugs found)

Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	380.75'	14,984 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
380.75	4	0	0
381.00	8	2	2
382.00	2,002	1,005	1,007
383.00	7,055	4,529	5,535
384.00	11,843	9,449	14,984

Device	Routing	Invert	Outlet Devices
#1	Primary	380.75'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 3.25 Width (feet) 1.00 1.00

Primary OutFlow Max=10.40 cfs @ 0.00 hrs HW=382.91' (Free Discharge)

↑1=Custom Weir/Orifice (Weir Controls 10.40 cfs @ 4.81 fps)

J1340008 - Detention Time

Prepared by The Mannik & Smith Group

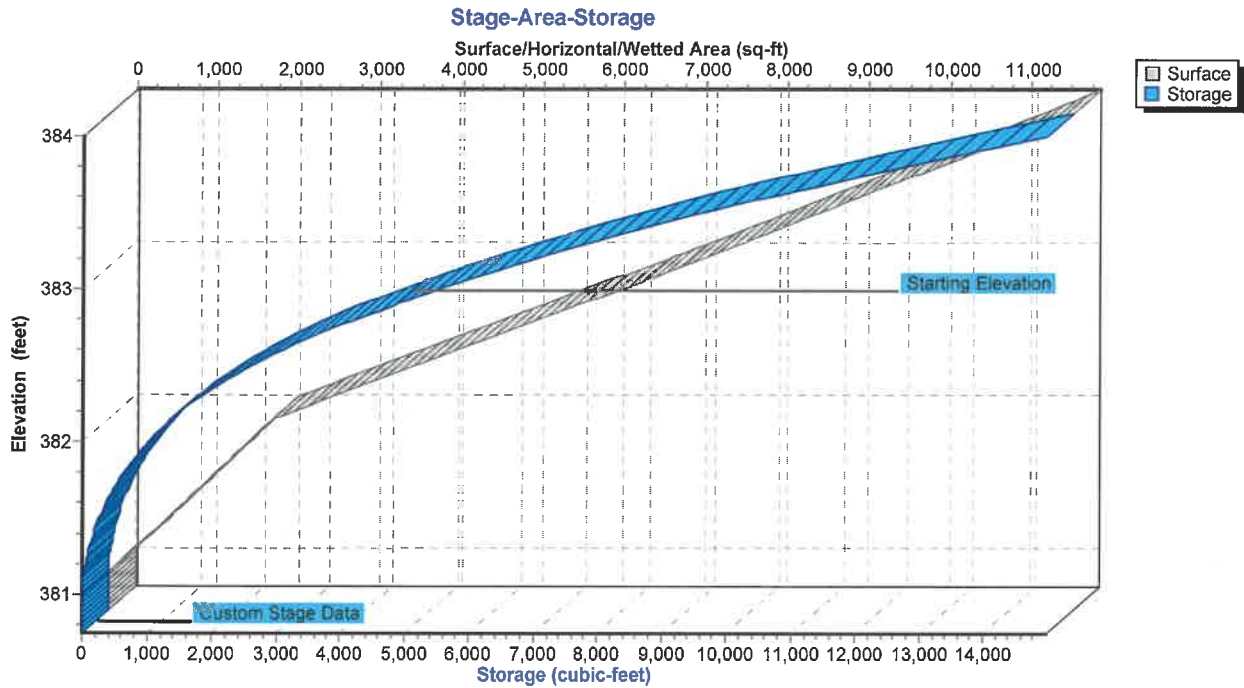
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Type II 24-hr 10-Year Rainfall=4.70"

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Pond N: North Basin



J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

Prepared by The Mannik & Smith Group

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Hydrograph for Pond N: North Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	4,921	382.91	10.40
0.05	0.00	3,230	382.62	8.39
0.10	0.00	1,897	382.32	6.43
0.15	0.00	926	381.96	4.35
0.20	0.00	319	381.56	2.39
0.25	0.00	28	381.16	0.85
0.30	0.00	0	380.75	0.00
0.35	0.00	0	380.75	0.00
0.40	0.00	0	380.75	0.00
0.45	0.00	0	380.75	0.00
0.50	0.00	0	380.75	0.00
0.55	0.00	0	380.75	0.00
0.60	0.00	0	380.75	0.00
0.65	0.00	0	380.75	0.00
0.70	0.00	0	380.75	0.00
0.75	0.00	0	380.75	0.00
0.80	0.00	0	380.75	0.00
0.85	0.00	0	380.75	0.00
0.90	0.00	0	380.75	0.00
0.95	0.00	0	380.75	0.00
1.00	0.00	0	380.75	0.00
1.05	0.00	0	380.75	0.00
1.10	0.00	0	380.75	0.00
1.15	0.00	0	380.75	0.00
1.20	0.00	0	380.75	0.00
1.25	0.00	0	380.75	0.00
1.30	0.00	0	380.75	0.00
1.35	0.00	0	380.75	0.00
1.40	0.00	0	380.75	0.00
1.45	0.00	0	380.75	0.00
1.50	0.00	0	380.75	0.00
1.55	0.00	0	380.75	0.00
1.60	0.00	0	380.75	0.00
1.65	0.00	0	380.75	0.00
1.70	0.00	0	380.75	0.00
1.75	0.00	0	380.75	0.00
1.80	0.00	0	380.75	0.00
1.85	0.00	0	380.75	0.00
1.90	0.00	0	380.75	0.00
1.95	0.00	0	380.75	0.00
2.00	0.00	0	380.75	0.00

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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Stage-Area-Storage for Pond N: North Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
380.75	4	0	381.28	566	82
380.76	4	0	381.29	586	88
380.77	4	0	381.30	606	94
380.78	4	0	381.31	626	100
380.79	5	0	381.32	646	106
380.80	5	0	381.33	666	113
380.81	5	0	381.34	686	119
380.82	5	0	381.35	706	126
380.83	5	0	381.36	726	134
380.84	5	0	381.37	746	141
380.85	6	0	381.38	766	149
380.86	6	1	381.39	786	156
380.87	6	1	381.40	806	164
380.88	6	1	381.41	826	172
380.89	6	1	381.42	845	181
380.90	6	1	381.43	865	189
380.91	7	1	381.44	885	198
380.92	7	1	381.45	905	207
380.93	7	1	381.46	925	216
380.94	7	1	381.47	945	225
380.95	7	1	381.48	965	235
380.96	7	1	381.49	985	245
380.97	8	1	381.50	1,005	255
380.98	8	1	381.51	1,025	265
380.99	8	1	381.52	1,045	275
381.00	8	2	381.53	1,065	286
381.01	28	2	381.54	1,085	297
381.02	48	2	381.55	1,105	307
381.03	68	3	381.56	1,125	319
381.04	88	3	381.57	1,145	330
381.05	108	4	381.58	1,165	342
381.06	128	6	381.59	1,184	353
381.07	148	7	381.60	1,204	365
381.08	168	9	381.61	1,224	377
381.09	187	10	381.62	1,244	390
381.10	207	12	381.63	1,264	402
381.11	227	14	381.64	1,284	415
381.12	247	17	381.65	1,304	428
381.13	267	19	381.66	1,324	441
381.14	287	22	381.67	1,344	454
381.15	307	25	381.68	1,364	468
381.16	327	28	381.69	1,384	482
381.17	347	32	381.70	1,404	496
381.18	367	35	381.71	1,424	510
381.19	387	39	381.72	1,444	524
381.20	407	43	381.73	1,464	539
381.21	427	47	381.74	1,484	553
381.22	447	52	381.75	1,504	568
381.23	467	56	381.76	1,523	583
381.24	487	61	381.77	1,543	599
381.25	507	66	381.78	1,563	614
381.26	526	71	381.79	1,583	630
381.27	546	76	381.80	1,603	646

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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Stage-Area-Storage for Pond N: North Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
381.81	1,623	662	382.34	3,720	1,979
381.82	1,643	678	382.35	3,771	2,017
381.83	1,663	695	382.36	3,821	2,055
381.84	1,683	712	382.37	3,872	2,093
381.85	1,703	729	382.38	3,922	2,132
381.86	1,723	746	382.39	3,973	2,172
381.87	1,743	763	382.40	4,023	2,212
381.88	1,763	781	382.41	4,074	2,252
381.89	1,783	798	382.42	4,124	2,293
381.90	1,803	816	382.43	4,175	2,335
381.91	1,823	834	382.44	4,225	2,377
381.92	1,842	853	382.45	4,276	2,419
381.93	1,862	871	382.46	4,326	2,462
381.94	1,882	890	382.47	4,377	2,506
381.95	1,902	909	382.48	4,427	2,550
381.96	1,922	928	382.49	4,478	2,594
381.97	1,942	947	382.50	4,529	2,639
381.98	1,962	967	382.51	4,579	2,685
381.99	1,982	987	382.52	4,630	2,731
382.00	2,002	1,007	382.53	4,680	2,777
382.01	2,053	1,027	382.54	4,731	2,824
382.02	2,103	1,048	382.55	4,781	2,872
382.03	2,154	1,069	382.56	4,832	2,920
382.04	2,204	1,091	382.57	4,882	2,968
382.05	2,255	1,113	382.58	4,933	3,018
382.06	2,305	1,136	382.59	4,983	3,067
382.07	2,356	1,159	382.60	5,034	3,117
382.08	2,406	1,183	382.61	5,084	3,168
382.09	2,457	1,207	382.62	5,135	3,219
382.10	2,507	1,232	382.63	5,185	3,271
382.11	2,558	1,257	382.64	5,236	3,323
382.12	2,608	1,283	382.65	5,286	3,375
382.13	2,659	1,309	382.66	5,337	3,428
382.14	2,709	1,336	382.67	5,388	3,482
382.15	2,760	1,364	382.68	5,438	3,536
382.16	2,810	1,391	382.69	5,489	3,591
382.17	2,861	1,420	382.70	5,539	3,646
382.18	2,912	1,449	382.71	5,590	3,702
382.19	2,962	1,478	382.72	5,640	3,758
382.20	3,013	1,508	382.73	5,691	3,814
382.21	3,063	1,538	382.74	5,741	3,871
382.22	3,114	1,569	382.75	5,792	3,929
382.23	3,164	1,601	382.76	5,842	3,987
382.24	3,215	1,633	382.77	5,893	4,046
382.25	3,265	1,665	382.78	5,943	4,105
382.26	3,316	1,698	382.79	5,994	4,165
382.27	3,366	1,731	382.80	6,044	4,225
382.28	3,417	1,765	382.81	6,095	4,286
382.29	3,467	1,800	382.82	6,145	4,347
382.30	3,518	1,834	382.83	6,196	4,409
382.31	3,568	1,870	382.84	6,247	4,471
382.32	3,619	1,906	382.85	6,297	4,534
382.33	3,669	1,942	382.86	6,348	4,597

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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Stage-Area-Storage for Pond N: North Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
382.87	6,398	4,661	383.40	8,970	8,740
382.88	6,449	4,725	383.41	9,018	8,830
382.89	6,499	4,790	383.42	9,066	8,920
382.90	6,550	4,855	383.43	9,114	9,011
382.91	6,600	4,921	383.44	9,162	9,103
382.92	6,651	4,987	383.45	9,210	9,195
382.93	6,701	5,054	383.46	9,257	9,287
382.94	6,752	5,121	383.47	9,305	9,380
382.95	6,802	5,189	383.48	9,353	9,473
382.96	6,853	5,257	383.49	9,401	9,567
382.97	6,903	5,326	383.50	9,449	9,661
382.98	6,954	5,395	383.51	9,497	9,756
382.99	7,004	5,465	383.52	9,545	9,851
383.00	7,055	5,535	383.53	9,593	9,947
383.01	7,103	5,606	383.54	9,641	10,043
383.02	7,151	5,677	383.55	9,688	10,139
383.03	7,199	5,749	383.56	9,736	10,237
383.04	7,247	5,821	383.57	9,784	10,334
383.05	7,294	5,894	383.58	9,832	10,432
383.06	7,342	5,967	383.59	9,880	10,531
383.07	7,390	6,041	383.60	9,928	10,630
383.08	7,438	6,115	383.61	9,976	10,729
383.09	7,486	6,189	383.62	10,024	10,829
383.10	7,534	6,264	383.63	10,071	10,930
383.11	7,582	6,340	383.64	10,119	11,031
383.12	7,630	6,416	383.65	10,167	11,132
383.13	7,677	6,493	383.66	10,215	11,234
383.14	7,725	6,570	383.67	10,263	11,337
383.15	7,773	6,647	383.68	10,311	11,439
383.16	7,821	6,725	383.69	10,359	11,543
383.17	7,869	6,804	383.70	10,407	11,647
383.18	7,917	6,882	383.71	10,454	11,751
383.19	7,965	6,962	383.72	10,502	11,856
383.20	8,013	7,042	383.73	10,550	11,961
383.21	8,060	7,122	383.74	10,598	12,067
383.22	8,108	7,203	383.75	10,646	12,173
383.23	8,156	7,284	383.76	10,694	12,280
383.24	8,204	7,366	383.77	10,742	12,387
383.25	8,252	7,448	383.78	10,790	12,494
383.26	8,300	7,531	383.79	10,838	12,603
383.27	8,348	7,614	383.80	10,885	12,711
383.28	8,396	7,698	383.81	10,933	12,820
383.29	8,444	7,782	383.82	10,981	12,930
383.30	8,491	7,867	383.83	11,029	13,040
383.31	8,539	7,952	383.84	11,077	13,150
383.32	8,587	8,038	383.85	11,125	13,261
383.33	8,635	8,124	383.86	11,173	13,373
383.34	8,683	8,210	383.87	11,221	13,485
383.35	8,731	8,298	383.88	11,268	13,597
383.36	8,779	8,385	383.89	11,316	13,710
383.37	8,827	8,473	383.90	11,364	13,824
383.38	8,874	8,562	383.91	11,412	13,938
383.39	8,922	8,651	383.92	11,460	14,052

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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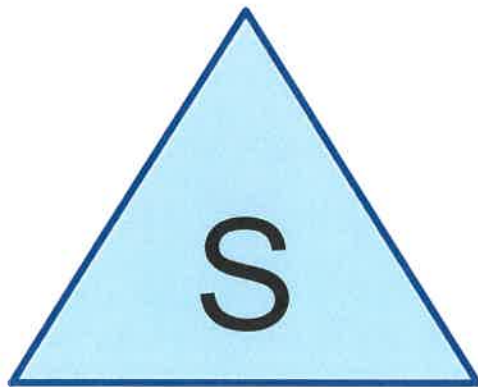
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Stage-Area-Storage for Pond N: North Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
383.93	11,508	14,167
383.94	11,556	14,282
383.95	11,604	14,398
383.96	11,651	14,514
383.97	11,699	14,631
383.98	11,747	14,748
383.99	11,795	14,866
384.00	11,843	14,984



South Basin



J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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Summary for Pond S: South Basin

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 3.82 cfs @ 0.00 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min
 Primary = 3.82 cfs @ 0.00 hrs, Volume= 0.124 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.05 hrs
 Starting Elev= 381.28' Surf.Area= 6,522 sf Storage= 5,069 cf
 Peak Elev= 381.28' @ 0.00 hrs Surf.Area= 6,522 sf Storage= 5,069 cf

Plug-Flow detention time= (not calculated: no plugs found)
 Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	378.75'	10,834 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
378.75	2	0	0
379.00	5	1	1
380.00	718	362	362
381.00	5,366	3,042	3,404
382.00	9,493	7,430	10,834

Device	Routing	Invert	Outlet Devices
#1	Primary	378.75'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 3.25 Width (feet) 0.29 0.29

Primary OutFlow Max=3.82 cfs @ 0.00 hrs HW=381.28' (Free Discharge)
 ↳1=Custom Weir/Orifice (Weir Controls 3.82 cfs @ 5.21 fps)

J1340008 - Detention Time

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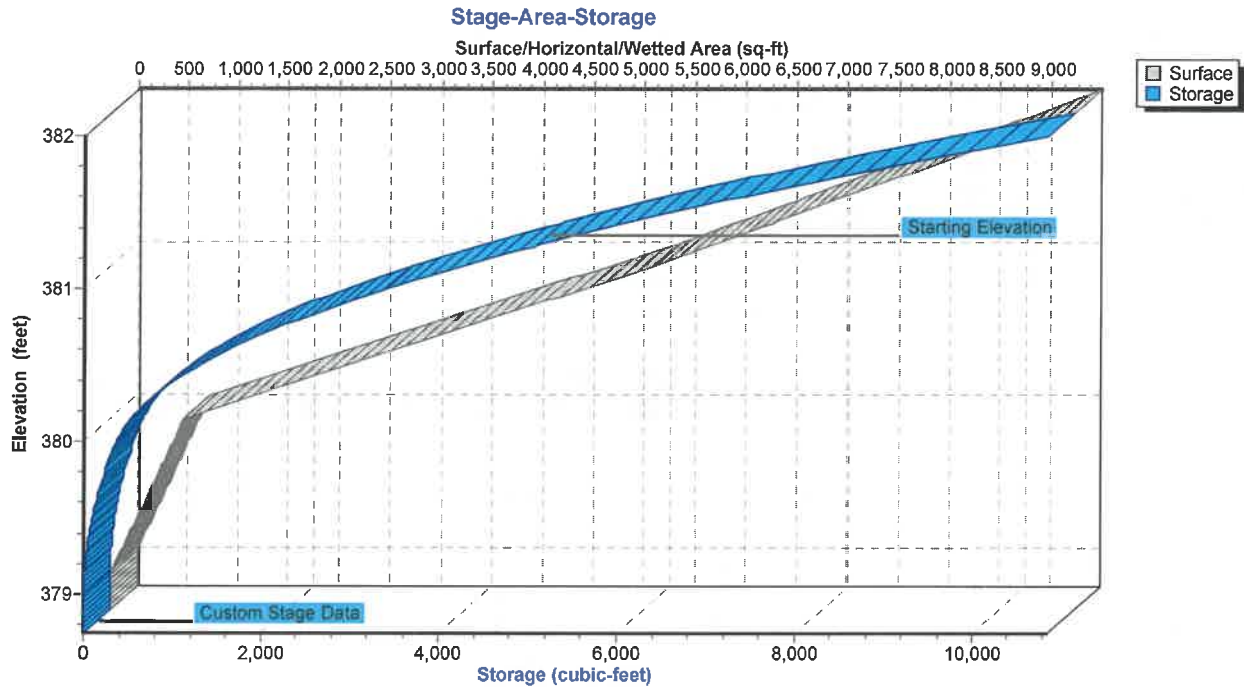
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Pond S: South Basin



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Hydrograph for Pond S: South Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	5,069	381.28	3.82
0.05	0.00	4,402	381.17	3.58
0.10	0.00	3,778	381.07	3.35
0.15	0.00	3,195	380.96	3.12
0.20	0.00	2,654	380.85	2.89
0.25	0.00	2,155	380.74	2.66
0.30	0.00	1,697	380.62	2.43
0.35	0.00	1,282	380.49	2.19
0.40	0.00	911	380.36	1.93
0.45	0.00	589	380.19	1.65
0.50	0.00	328	379.95	1.25
0.55	0.00	145	379.63	0.78
0.60	0.00	38	379.32	0.41
0.65	0.00	0	378.82	0.02
0.70	0.00	0	378.75	0.00
0.75	0.00	0	378.75	0.00
0.80	0.00	0	378.75	0.00
0.85	0.00	0	378.75	0.00
0.90	0.00	0	378.75	0.00
0.95	0.00	0	378.75	0.00
1.00	0.00	0	378.75	0.00
1.05	0.00	0	378.75	0.00
1.10	0.00	0	378.75	0.00
1.15	0.00	0	378.75	0.00
1.20	0.00	0	378.75	0.00
1.25	0.00	0	378.75	0.00
1.30	0.00	0	378.75	0.00
1.35	0.00	0	378.75	0.00
1.40	0.00	0	378.75	0.00
1.45	0.00	0	378.75	0.00
1.50	0.00	0	378.75	0.00
1.55	0.00	0	378.75	0.00
1.60	0.00	0	378.75	0.00
1.65	0.00	0	378.75	0.00
1.70	0.00	0	378.75	0.00
1.75	0.00	0	378.75	0.00
1.80	0.00	0	378.75	0.00
1.85	0.00	0	378.75	0.00
1.90	0.00	0	378.75	0.00
1.95	0.00	0	378.75	0.00
2.00	0.00	0	378.75	0.00

J1340008 - Detention Time

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Stage-Area-Storage for Pond S: South Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
378.75	2	0	379.28	205	30
378.76	2	0	379.29	212	32
378.77	2	0	379.30	219	34
378.78	2	0	379.31	226	37
378.79	2	0	379.32	233	39
378.80	3	0	379.33	240	41
378.81	3	0	379.34	247	44
378.82	3	0	379.35	255	46
378.83	3	0	379.36	262	49
378.84	3	0	379.37	269	52
378.85	3	0	379.38	276	54
378.86	3	0	379.39	283	57
378.87	3	0	379.40	290	60
378.88	4	0	379.41	297	63
378.89	4	0	379.42	304	66
378.90	4	0	379.43	312	69
378.91	4	0	379.44	319	72
378.92	4	1	379.45	326	75
378.93	4	1	379.46	333	79
378.94	4	1	379.47	340	82
378.95	4	1	379.48	347	85
378.96	5	1	379.49	354	89
378.97	5	1	379.50	362	93
378.98	5	1	379.51	369	96
378.99	5	1	379.52	376	100
379.00	5	1	379.53	383	104
379.01	12	1	379.54	390	108
379.02	19	1	379.55	397	111
379.03	26	1	379.56	404	115
379.04	34	2	379.57	411	120
379.05	41	2	379.58	419	124
379.06	48	2	379.59	426	128
379.07	55	3	379.60	433	132
379.08	62	4	379.61	440	137
379.09	69	4	379.62	447	141
379.10	76	5	379.63	454	146
379.11	83	6	379.64	461	150
379.12	91	7	379.65	468	155
379.13	98	8	379.66	476	159
379.14	105	9	379.67	483	164
379.15	112	10	379.68	490	169
379.16	119	11	379.69	497	174
379.17	126	12	379.70	504	179
379.18	133	13	379.71	511	184
379.19	140	15	379.72	518	189
379.20	148	16	379.73	525	195
379.21	155	18	379.74	533	200
379.22	162	19	379.75	540	205
379.23	169	21	379.76	547	211
379.24	176	23	379.77	554	216
379.25	183	24	379.78	561	222
379.26	190	26	379.79	568	227
379.27	198	28	379.80	575	233

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

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Stage-Area-Storage for Pond S: South Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
379.81	583	239	380.34	2,298	875
379.82	590	245	380.35	2,345	898
379.83	597	251	380.36	2,391	922
379.84	604	257	380.37	2,438	946
379.85	611	263	380.38	2,484	971
379.86	618	269	380.39	2,531	996
379.87	625	275	380.40	2,577	1,021
379.88	632	281	380.41	2,624	1,047
379.89	640	288	380.42	2,670	1,074
379.90	647	294	380.43	2,717	1,101
379.91	654	301	380.44	2,763	1,128
379.92	661	307	380.45	2,810	1,156
379.93	668	314	380.46	2,856	1,184
379.94	675	321	380.47	2,903	1,213
379.95	682	327	380.48	2,949	1,242
379.96	689	334	380.49	2,996	1,272
379.97	697	341	380.50	3,042	1,302
379.98	704	348	380.51	3,088	1,333
379.99	711	355	380.52	3,135	1,364
380.00	718	362	380.53	3,181	1,396
380.01	764	370	380.54	3,228	1,428
380.02	811	378	380.55	3,274	1,460
380.03	857	386	380.56	3,321	1,493
380.04	904	395	380.57	3,367	1,527
380.05	950	404	380.58	3,414	1,561
380.06	997	414	380.59	3,460	1,595
380.07	1,043	424	380.60	3,507	1,630
380.08	1,090	435	380.61	3,553	1,665
380.09	1,136	446	380.62	3,600	1,701
380.10	1,183	457	380.63	3,646	1,737
380.11	1,229	469	380.64	3,693	1,774
380.12	1,276	482	380.65	3,739	1,811
380.13	1,322	495	380.66	3,786	1,849
380.14	1,369	508	380.67	3,832	1,887
380.15	1,415	522	380.68	3,879	1,925
380.16	1,462	537	380.69	3,925	1,964
380.17	1,508	552	380.70	3,972	2,004
380.18	1,555	567	380.71	4,018	2,044
380.19	1,601	583	380.72	4,065	2,084
380.20	1,648	599	380.73	4,111	2,125
380.21	1,694	616	380.74	4,158	2,166
380.22	1,741	633	380.75	4,204	2,208
380.23	1,787	650	380.76	4,250	2,250
380.24	1,834	669	380.77	4,297	2,293
380.25	1,880	687	380.78	4,343	2,336
380.26	1,926	706	380.79	4,390	2,380
380.27	1,973	726	380.80	4,436	2,424
380.28	2,019	746	380.81	4,483	2,469
380.29	2,066	766	380.82	4,529	2,514
380.30	2,112	787	380.83	4,576	2,559
380.31	2,159	808	380.84	4,622	2,605
380.32	2,205	830	380.85	4,669	2,652
380.33	2,252	852	380.86	4,715	2,699

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

Prepared by The Mannik & Smith Group

Printed 11/14/2016

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Page 7

Stage-Area-Storage for Pond S: South Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
380.87	4,762	2,746	381.40	7,017	5,881
380.88	4,808	2,794	381.41	7,058	5,951
380.89	4,855	2,842	381.42	7,099	6,022
380.90	4,901	2,891	381.43	7,141	6,093
380.91	4,948	2,940	381.44	7,182	6,165
380.92	4,994	2,990	381.45	7,223	6,237
380.93	5,041	3,040	381.46	7,264	6,309
380.94	5,087	3,091	381.47	7,306	6,382
380.95	5,134	3,142	381.48	7,347	6,455
380.96	5,180	3,193	381.49	7,388	6,529
380.97	5,227	3,245	381.50	7,430	6,603
380.98	5,273	3,298	381.51	7,471	6,678
380.99	5,320	3,351	381.52	7,512	6,753
381.00	5,366	3,404	381.53	7,553	6,828
381.01	5,407	3,458	381.54	7,595	6,904
381.02	5,449	3,513	381.55	7,636	6,980
381.03	5,490	3,567	381.56	7,677	7,056
381.04	5,531	3,622	381.57	7,718	7,133
381.05	5,572	3,678	381.58	7,760	7,211
381.06	5,614	3,734	381.59	7,801	7,289
381.07	5,655	3,790	381.60	7,842	7,367
381.08	5,696	3,847	381.61	7,883	7,445
381.09	5,737	3,904	381.62	7,925	7,525
381.10	5,779	3,962	381.63	7,966	7,604
381.11	5,820	4,020	381.64	8,007	7,684
381.12	5,861	4,078	381.65	8,049	7,764
381.13	5,903	4,137	381.66	8,090	7,845
381.14	5,944	4,196	381.67	8,131	7,926
381.15	5,985	4,256	381.68	8,172	8,007
381.16	6,026	4,316	381.69	8,214	8,089
381.17	6,068	4,376	381.70	8,255	8,172
381.18	6,109	4,437	381.71	8,296	8,254
381.19	6,150	4,498	381.72	8,337	8,338
381.20	6,191	4,560	381.73	8,379	8,421
381.21	6,233	4,622	381.74	8,420	8,505
381.22	6,274	4,685	381.75	8,461	8,590
381.23	6,315	4,748	381.76	8,503	8,674
381.24	6,356	4,811	381.77	8,544	8,760
381.25	6,398	4,875	381.78	8,585	8,845
381.26	6,439	4,939	381.79	8,626	8,931
381.27	6,480	5,004	381.80	8,668	9,018
381.28	6,522	5,069	381.81	8,709	9,105
381.29	6,563	5,134	381.82	8,750	9,192
381.30	6,604	5,200	381.83	8,791	9,280
381.31	6,645	5,266	381.84	8,833	9,368
381.32	6,687	5,333	381.85	8,874	9,456
381.33	6,728	5,400	381.86	8,915	9,545
381.34	6,769	5,467	381.87	8,956	9,635
381.35	6,810	5,535	381.88	8,998	9,724
381.36	6,852	5,604	381.89	9,039	9,815
381.37	6,893	5,672	381.90	9,080	9,905
381.38	6,934	5,741	381.91	9,122	9,996
381.39	6,976	5,811	381.92	9,163	10,088

J1340008 - Detention Time

Type II 24-hr 10-Year Rainfall=4.70"

Prepared by The Mannik & Smith Group

Printed 11/14/2016

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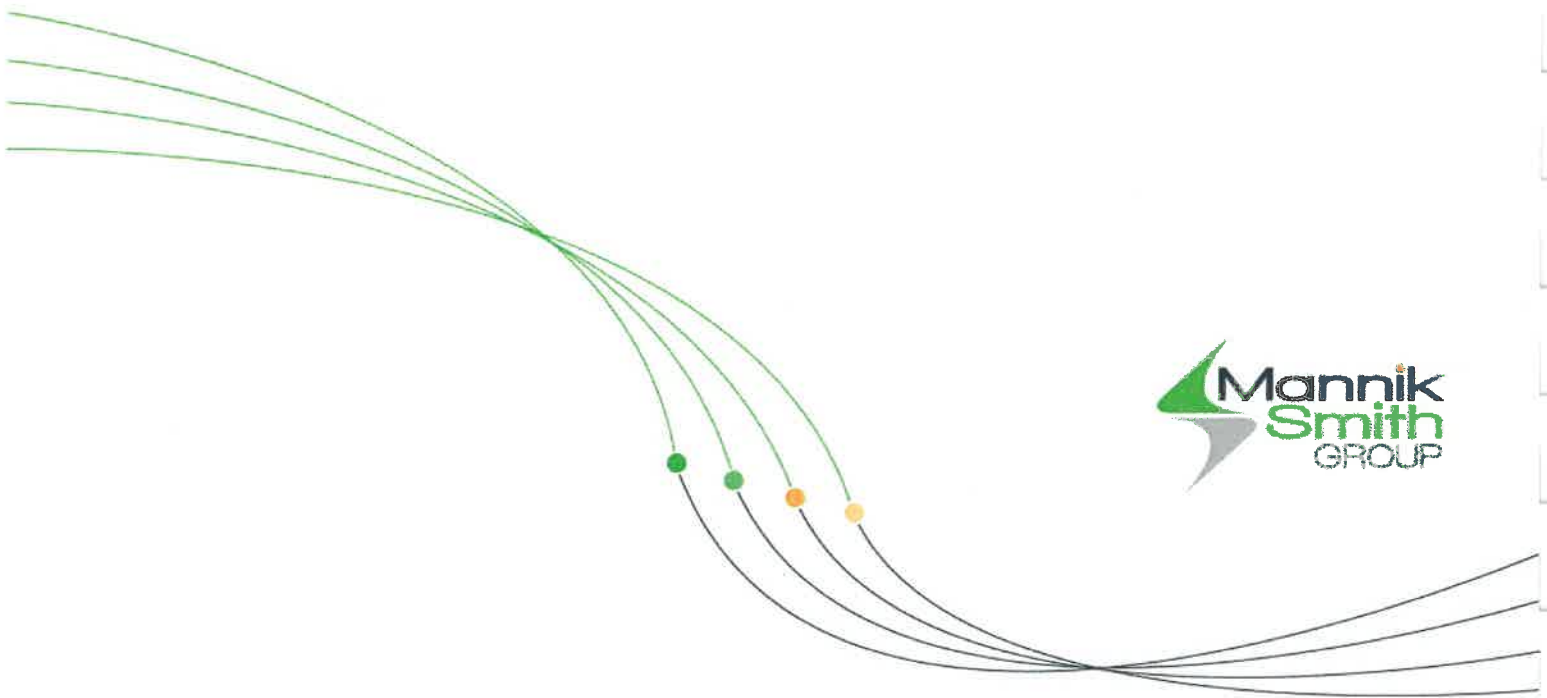
Page 8

Stage-Area-Storage for Pond S: South Basin (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
381.93	9,204	10,179
381.94	9,245	10,272
381.95	9,287	10,364
381.96	9,328	10,457
381.97	9,369	10,551
381.98	9,410	10,645
381.99	9,452	10,739
382.00	9,493	10,834

APPENDIX D
2005 DEVELOPMENT DETENTION CALCULATIONS REFERENCE







Transmittal

If enclosures are not received as noted below,
please call sender or Woolpert at 614.476.6000

Date: January 19, 2005

Re: Dayton Freight- Evansville, IN

To: Bill Jeffers, LS
Vanderburgh County Surveyor
Civic Center, Room 325
1 NW ML King Jr. Blvd
Evansville, IN 47708
PH: 812.435.5210

Order Number: 62918.06.083

Shipped Via: UPS Ground

We are sending you

- Shop Drawings
 Samples
 Specifications
 Plans
 Change Order
 Other

Copies	Date	No.	Description
3 sets	1-18-05		Final Construction Dwgs for Drain Commission review.
5 shts	1-18-05		Storm Detention Calculations

Remarks:

For your review and approval.

Copy To:

File

RECEIVED BY THE
VANDERBURGH COUNTY
SURVEYOR'S OFFICE
1/20/05 9:30 am pjp

Signature: _____

Steven C. Hermiller, PE

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	7.31	1	10	4,385	---	-----	---	Pre Developed
2	Rational	12.79	1	10	7,674	---	-----	---	Post Developed
3	Reservoir	6.43	1	15	7,672	2	383.89	4,360	Route 25 thru 10 Yr <u>South Pond</u>
5	Rational	8.64	1	10	5,182	---	-----	-----	Pre Developed
6	Rational	15.55	1	10	9,328	---	-----	-----	Post Developed
7	Reservoir	7.67	1	15	9,327	6	384.46	4,154	Route 25 thru 10 Yr <u>North Pond</u>

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Rational	-----	-----	-----	-----	-----	6.48	7.31	-----	-----	Pre Developed
2	Rational	-----	-----	-----	-----	-----	11.34	12.79	-----	-----	Post Developed
3	Reservoir	2	-----	-----	-----	-----	5.54	6.43	-----	-----	Route 25 thru 10 Yr <i>South Pond</i>
5	Rational	-----	-----	-----	-----	-----	7.66	8.64	-----	-----	Pre Developed
6	Rational	-----	-----	-----	-----	-----	13.79	15.55	-----	-----	Post Developed
7	Reservoir	6	-----	-----	-----	-----	7.04	7.67	-----	-----	Route 25 thru 10 Yr <i>North Pond</i>

Reservoir Report

Reservoir No. 2 - North Pond Storage

Hydraflow Hydrographs by Intelisolve

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	383.60	100	0	0
0.10	383.70	500	30	30
0.20	383.80	1,000	75	105
0.30	383.90	2,000	150	255
0.40	384.00	2,500	225	480
0.50	384.10	4,000	325	805
0.60	384.20	8,000	600	1,405
0.70	384.30	10,000	900	2,305
0.80	384.40	12,000	1,100	3,405
0.90	384.50	14,000	1,300	4,705

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 0.0	0.0	0.0	0.0
Span in	= 0.0	0.0	0.0	0.0
No. Barrels	= 0	0	0	0
Invert El. ft	= 0.00	0.00	0.00	0.00
Length ft	= 0.0	0.0	0.0	0.0
Slope %	= 0.00	0.00	0.00	0.00
N-Value	= .000	.000	.000	.000
Orif. Coeff.	= 0.00	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 2.90	0.00	0.00	0.00
Crest El. ft	= 383.60	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Cippli	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	Civ D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	383.60	---	---	---	---	0.00	---	---	---	---	0.00
0.10	30	383.70	---	---	---	---	0.31	---	---	---	---	0.31
0.20	105	383.80	---	---	---	---	0.86	---	---	---	---	0.86
0.30	255	383.90	---	---	---	---	1.59	---	---	---	---	1.59
0.40	480	384.00	---	---	---	---	2.44	---	---	---	---	2.44
0.50	805	384.10	---	---	---	---	3.41	---	---	---	---	3.41
0.60	1,405	384.20	---	---	---	---	4.49	---	---	---	---	4.49
0.70	2,305	384.30	---	---	---	---	5.66	---	---	---	---	5.66
0.80	3,405	384.40	---	---	---	---	6.91	---	---	---	---	6.91
0.90	4,705	384.50	---	---	---	---	8.25	---	---	---	---	8.25

Reservoir Report

Reservoir No. 1 - South Pond Storage

Hydraflow Hydrographs by Intelisolve

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	383.00	600	0	0
1.00	384.00	9,200	4,900	4,900

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 0.0	0.0	0.0	0.0
Span in	= 0.0	0.0	0.0	0.0
No. Barrels	= 0	0	0	0
Invert El. ft	= 0.00	0.00	0.00	0.00
Length ft	= 0.0	0.0	0.0	0.0
Slope %	= 0.00	0.00	0.00	0.00
N-Value	= .013	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 2.30	0.00	0.00	0.00
Crest El. ft	= 383.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Cipiti	---	---	---
Multi-Stage	= No	No	No	No

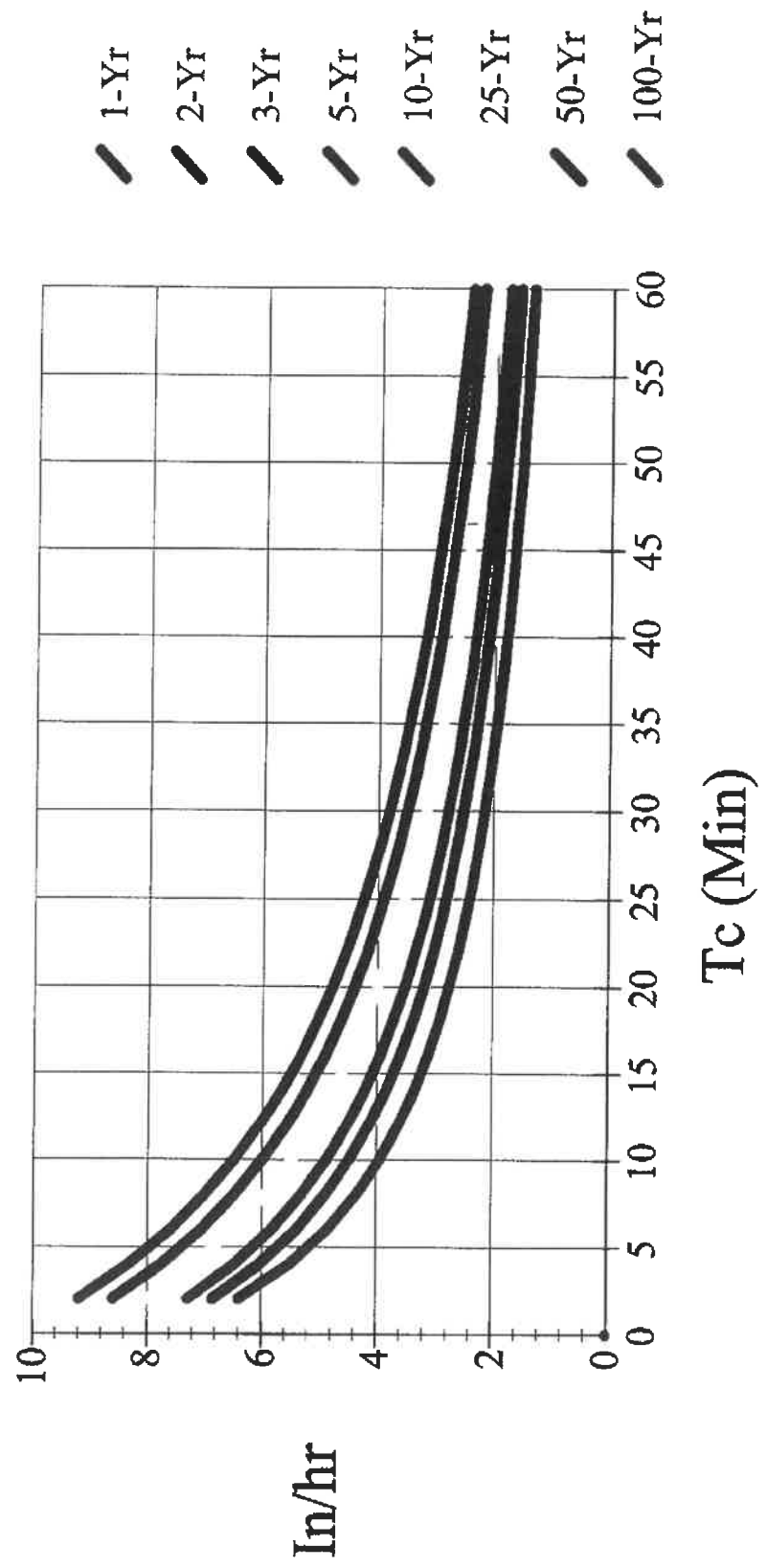
Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	Civ D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	383.00	---	---	---	---	0.00	---	---	---	---	0.00
1.00	4,900	384.00	---	---	---	---	7.66	---	---	---	---	7.66

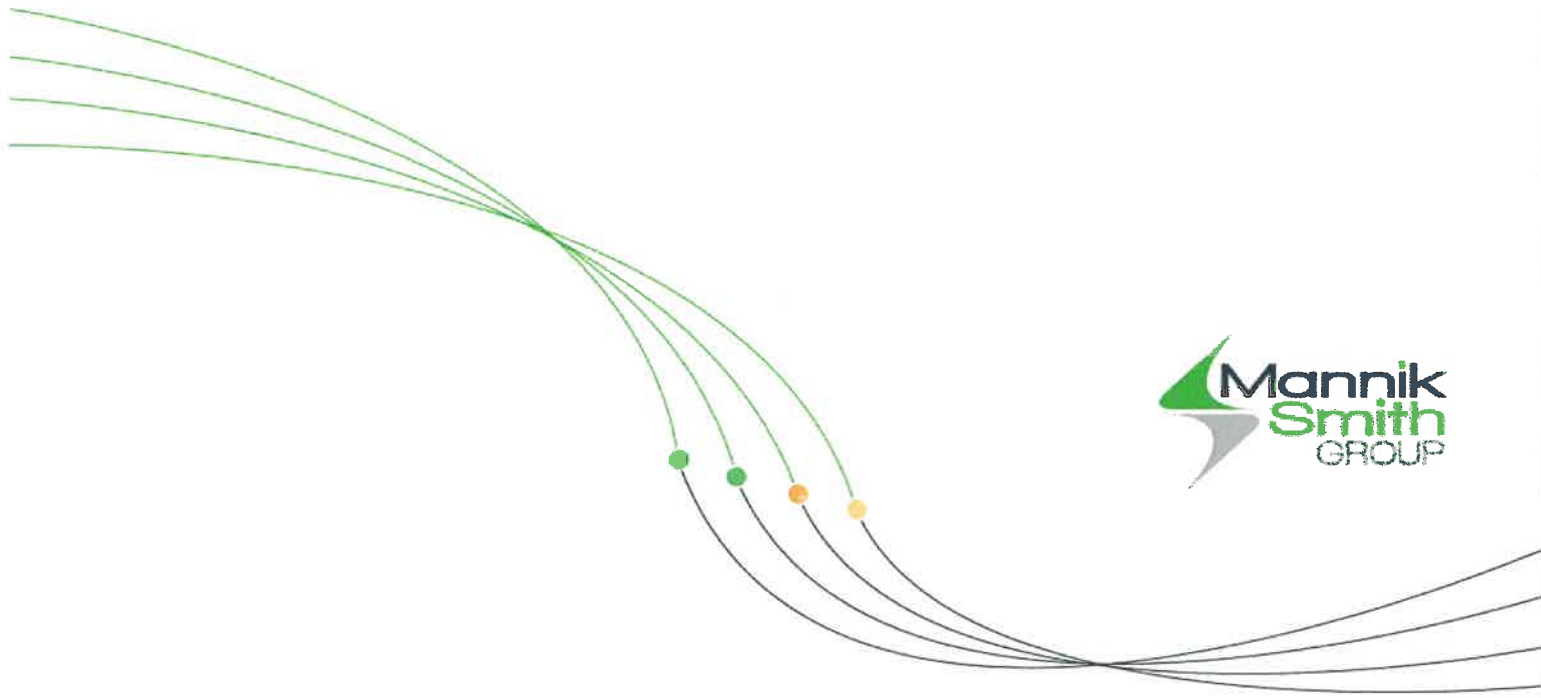
I-D-F Curve - EvansvilleIN.IDF



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**APPENDIX F
NRCS SOILS REPORT**





Custom Soil Resource Report for Vanderburgh County, Indiana



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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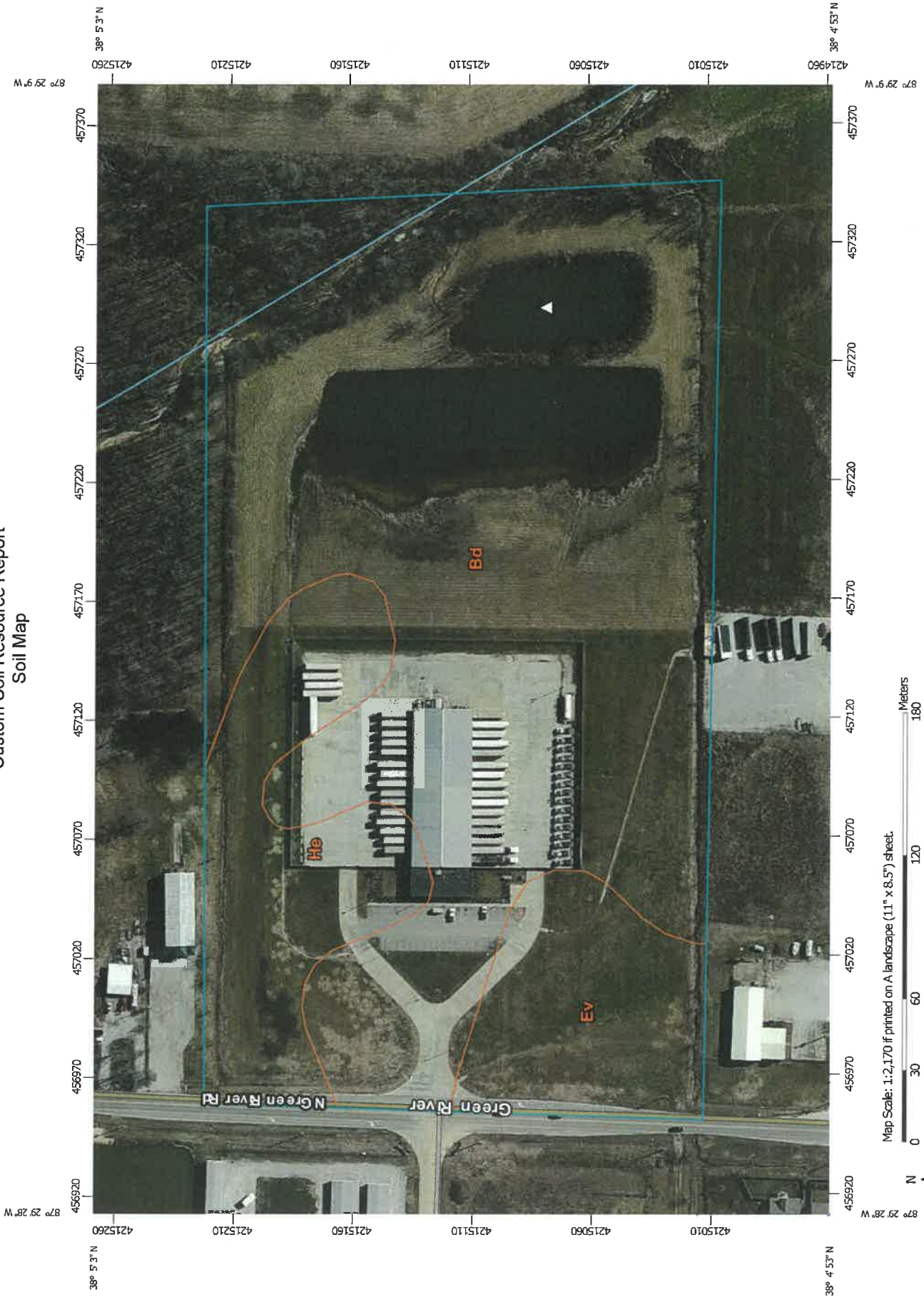
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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.








































Custom Soil Resource Report Soil Map



Map Scale: 1:2,170 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soils	 Stony Spot
 Soil Map Unit Polygons	 Very Stony Spot
 Soil Map Unit Lines	 Wet Spot
 Soil Map Unit Points	 Other
 Special Point Features	 Special Line Features
 Blowout	 Streams and Canals
 Borrow Pit	 Rails
 Clay Spot	 Interstate Highways
 Closed Depression	 US Routes
 Gravel Pit	 Major Roads
 Gravelly Spot	 Local Roads
 Landfill	 Background
 Lava Flow	 Aerial Photography
 Marsh or swamp	
 Mine or Quarry	
 Miscellaneous Water	
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
 Slide or Slip	
 Sodic Spot	

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Vanderburgh County, Indiana
 Survey Area Data: Version 15, Sep 11, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Vanderburgh County, Indiana (IN163)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Bd	Birds silt loam	15.2	74.5%
Ev	Evansville silt loam	2.1	10.4%
He	Henshaw silt loam	3.1	15.0%
Totals for Area of Interest		20.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

Custom Soil Resource Report

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Vanderburgh County, Indiana

Bd—Birds silt loam

Map Unit Setting

National map unit symbol: 5gbh

Elevation: 340 to 700 feet

Mean annual precipitation: 40 to 46 inches

Mean annual air temperature: 52 to 57 degrees F

Frost-free period: 170 to 210 days

Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Birds and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Birds

Setting

Landform: Backswamps on flood plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Interfluve

Down-slope shape: Concave

Across-slope shape: Linear

Parent material: Silty alluvium

Typical profile

Ap - 0 to 12 inches: silt loam

Bg - 12 to 52 inches: silt loam

Cg - 52 to 80 inches: stratified silt loam to loam

Properties and qualities

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Poorly drained

Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Available water storage in profile: Very high (about 13.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: B/D

Other vegetative classification: Trees/Timber (Woody Vegetation)

Custom Soil Resource Report

Ev—Evansville silt loam

Map Unit Setting

National map unit symbol: 5gbl
Elevation: 360 to 600 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Evansville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Evansville

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 9 inches: silt loam
Bg - 9 to 40 inches: silty clay loam
Cg - 40 to 66 inches: stratified silt loam to silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 20 percent
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Other vegetative classification: Trees/Timber (Woody Vegetation)

He—Henshaw silt loam

Map Unit Setting

National map unit symbol: 5gbp
Elevation: 340 to 700 feet
Mean annual precipitation: 40 to 46 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 170 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Henshaw and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Henshaw

Setting

Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy lacustrine deposits

Typical profile

Ap - 0 to 7 inches: silt loam
Bt1 - 7 to 28 inches: silty clay loam
Bt2 - 28 to 43 inches: silty clay loam
C - 43 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
***Hydrologic Soil Group:* C/D**
Other vegetative classification: Trees/Timber (Woody Vegetation)

Custom Soil Resource Report

Minor Components

Evansville

Percent of map unit: 3 percent

Landform: Depressions

Other vegetative classification: Trees/Timber (Woody Vegetation)

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