SONIC – MEIJER SUBDIVISION LOT #4

Commercial Development

Hendricks County, Plainfield, Indiana

NORTHPOINTE ENGINEERING & SURVEYING, Inc.

WBE/DBE Certified

May 2, 2019

Table of Contents

Sonic

Section		Page Number
1 -	Professional Certification	3
2 -	Drainage Summary	4
3 -	Location Map	5
4 -	Site Runoff Coefficient Calculation	6
5 -	Storm Sewer Calculations	8
6 -	Meijer Drainage Report	16

Professional Certification

Sonic

The following report and accompanying computations have been developed by me or under my direct supervision.

Venus Thorne
Professional Engineer
Registration Number: 11200278

NORTHPOINTE ENGINEERING & SURVEYING, Inc.
WBE/DBE Certified

Drainage Summary

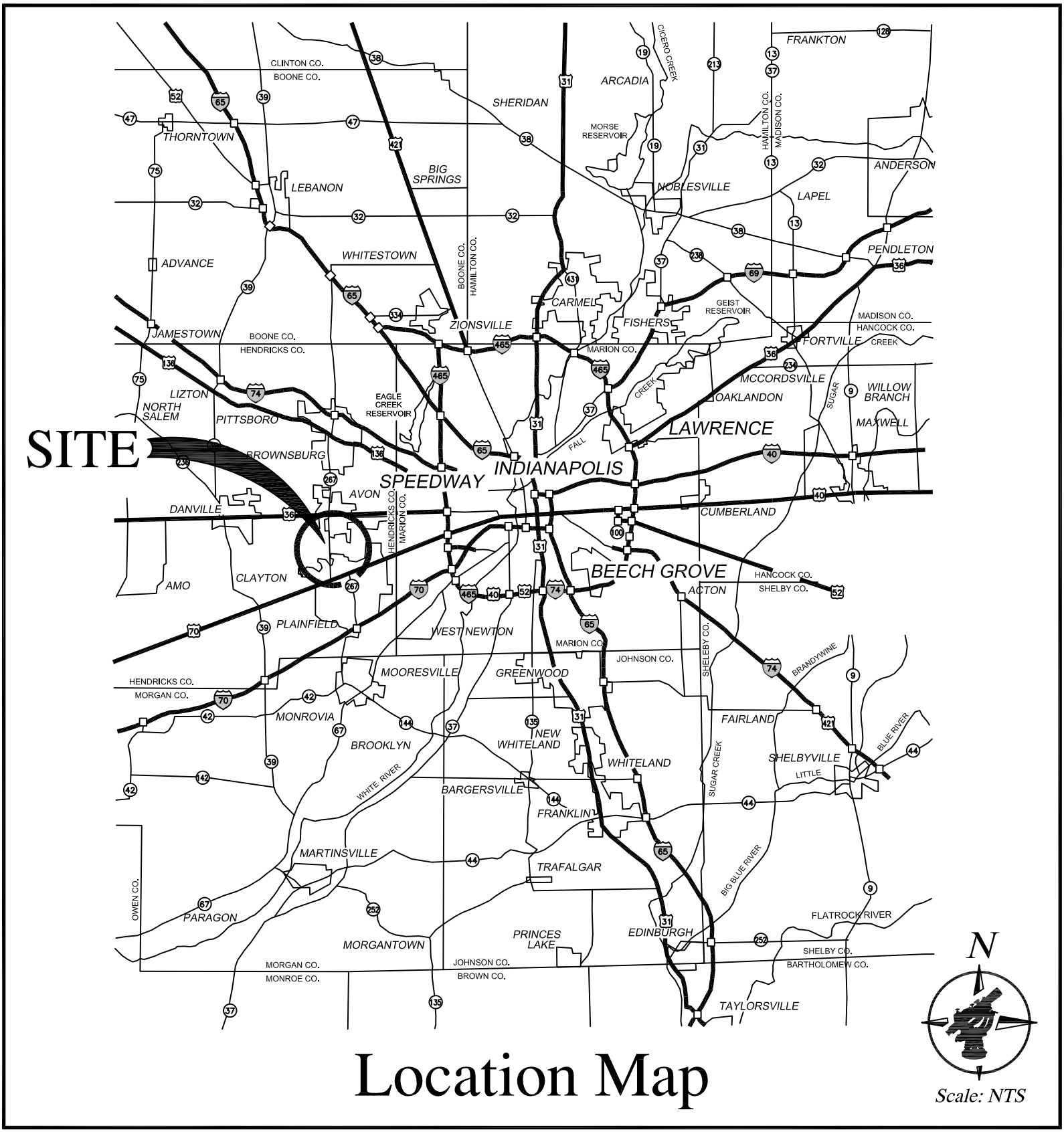
Sonic

Sonic is a proposed commercial development located on Outlot B of the Meijer development at 400 Dan Jones Road in Plainfield. The project site for the proposed fast food restaurant consists of 1.70 acres.

Site History / Existing Site Conditions:
The existing site is grass covered. The site is one of the outlots of the Meijer Development designed in 2013. The drainage report for the Meijer development is included within this report. The site lies with the contributing area to Detention Basin 2 of the developed site. The storm sewer system and detention were designed to handle runoff from the development of this site. In addition, water quality was provided for this development via an Aqua-Swirl water quality structure. The storm, detention and water quality were designed assuming a runoff coefficient of 0.80.0

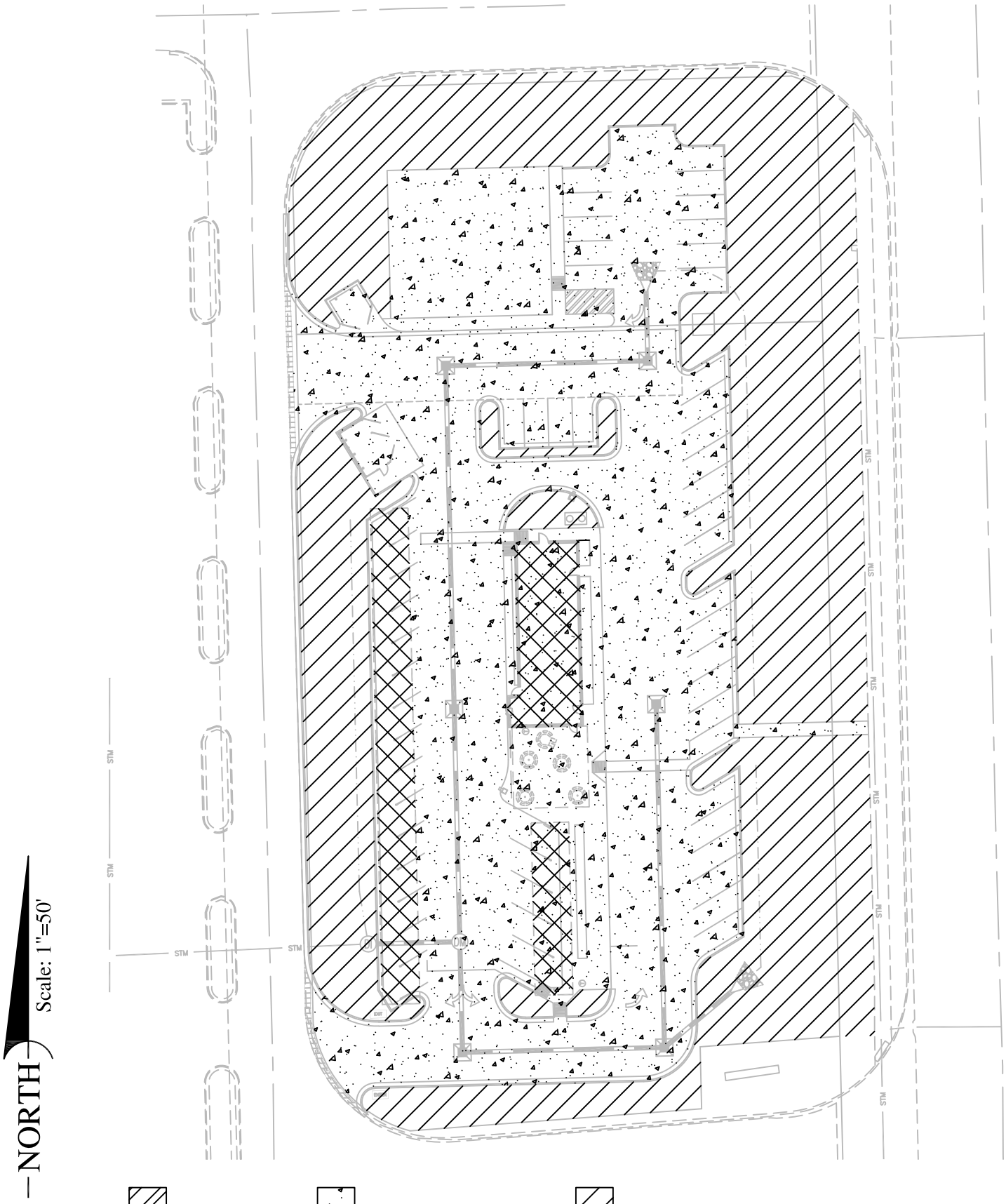
Proposed Site Conditions:
The runoff for the proposed site is being routed through the proposed storm and will tie into the existing 18" storm stub pipe located on the northwest corner of the site. This storm sewer was designed to handle the runoff from the development and outlets into the existing detention pond. The developed site will have a runoff coefficient of 0.58. This is below the designed runoff coefficient of .80. The proposed site map and runoff coefficient calculation is enclosed.

Storm Sewers:
The proposed runoff for the storm sewers were calculated using the rational method and the 10-year storm event per the Town of Plainfield Standards and Specifications. Flow rates in the storm sewers were calculated using the Manning Formula.



Location Map

Proposed Site



Roof - 0.12 Ac Pavement - 0.93 Ac Lawn - 0.75 Ac

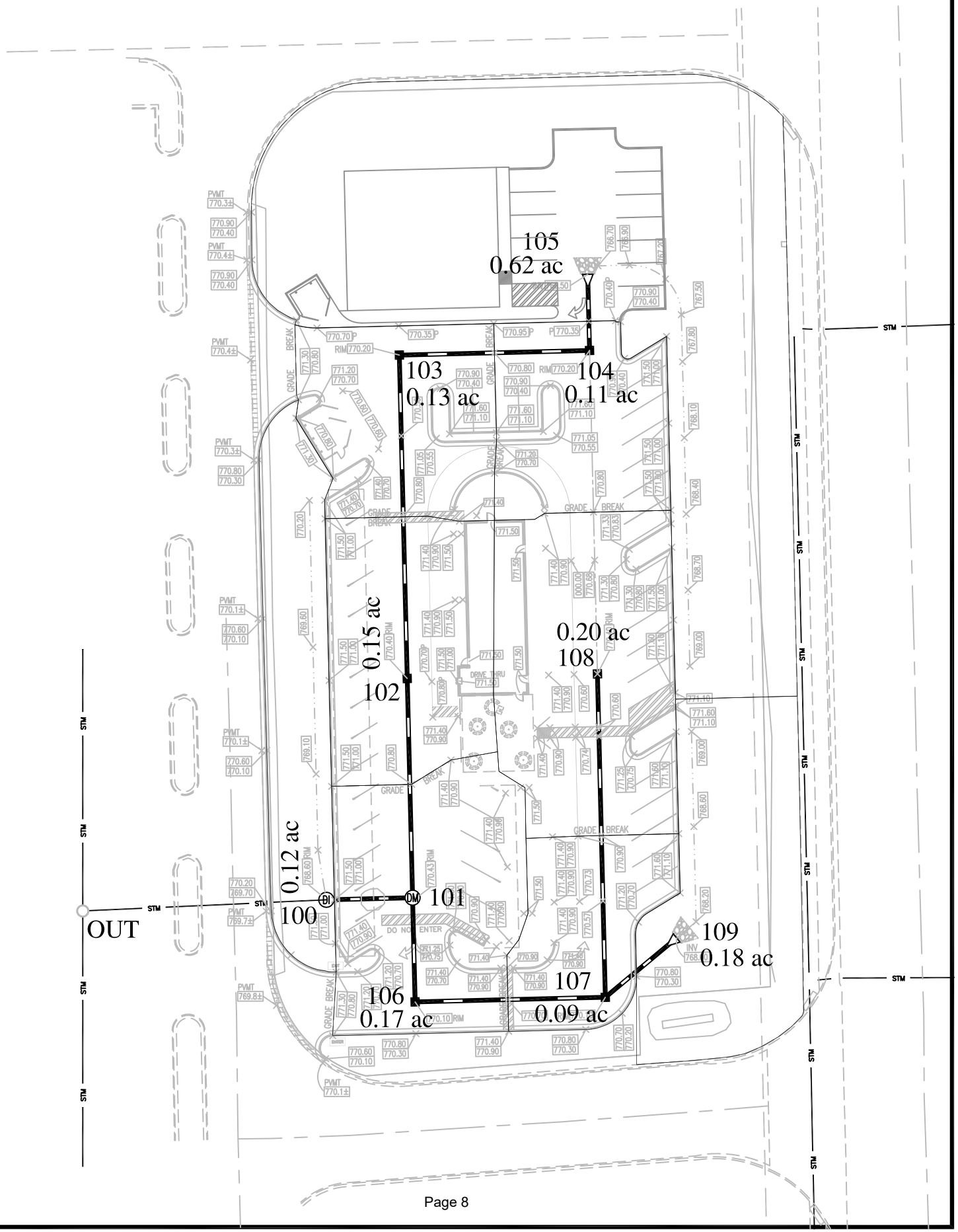
Basin ID: Sonic Out Lot

Composite Runoff Coefficient

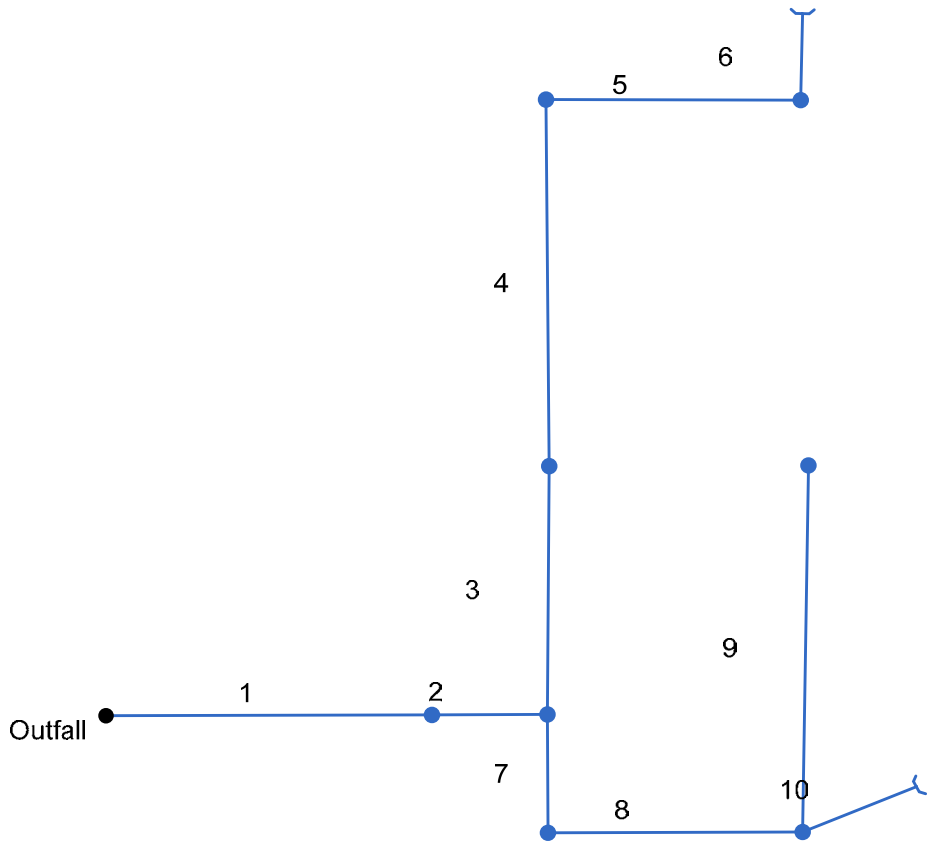
Description	Coeff.	Area (ac)	Product
Watertight Roof Surfaces	0.90	0.12	0.108
Pavement (concrete, asphalt)	0.85	0.93	0.7905
Gravel	0.85		0
Bare Earth	0.55		0
Steep grass	0.60		0
Turf Meadows	0.25		0
Forested Areas	0.20		0
Cultivated Fields	0.30		0
Cultivated Fields	0.40		0
Pasture	0.35		0
Woodlands	0.30		0
Lawns	0.20	0.75	0.15
Impervious Soils (Heavy)	0.55		0
Impervious Soils (with turf)	0.45		0
Slightly Pervious Soils	0.25		0
Slightly Pervious Soils (with turf)	0.25		0
Moderately Pervious Soil	0.15		0
Moderately Pervious Soil (with turf)	0.10		0
Business, Commercial & Industrial	0.85		0
Apartments & Townhouses	0.70		0
Schools & Churches	0.55		0
Single Family Lots < 10,000 sf	0.45		0
< 12,000 sf	0.45		0
< 17,000 sf	0.40		0
< 1/2 Acre	0.35		0
Park, Cemetery or Unimproved Area	0.30		0
Total =		1.8	1.0485

Composite C	**0.58**

Proposed Storm Basins



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 2019.05.01 Storm.stm	Number of lines: 10	Date: 5/2/2019

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	New	Grate	770.70	Cir	4.00	4.00	18	Cir	763.40	18	Cir	763.40
2	101	Manhole	770.43	Cir	4.00	4.00	18	Cir	763.62	15 12	Cir Cir	763.87 764.12
3	102	DropGrate	770.40	Cir	4.00	4.00	15	Cir	764.43	15	Cir	764.43
4	103	DropGrate	770.20	Cir	4.00	4.00	15	Cir	765.11	12	Cir	765.36
5	104	DropGrate	770.20	Cir	4.00	4.00	12	Cir	766.18	12	Cir	766.18
6	105	OpenHeadwall	0.00	n/a	n/a	n/a	12	Cir	766.50			
7	106	DropGrate	770.10	Cir	4.00	4.00	12	Cir	764.64	12	Cir	764.64
8	107	DropGrate	770.10	Cir	4.00	4.00	12	Cir	765.73	12 12	Cir Cir	765.73 767.00
9	108	DropGrate	770.40	Cir	4.00	4.00	12	Cir	767.00			
10	109	OpenHeadwall	0.00	n/a	n/a	n/a	12	Cir	768.20			

Project File: 2019.05.01 Storm.stm | Number of Structures: 10 | Run Date: 5/2/2019

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX-100	7.05	18	Cir	96.000	762.97	763.40	0.448	764.06	764.65	0.16	764.80	End	Grate
2	100-101	6.90	18	Cir	34.000	763.40	763.62	0.647	764.80	764.90	0.29	765.19	1	Manhole
3	101-102	3.88	15	Cir	86.000	763.87	764.43	0.651	765.19	765.45	0.10	765.55	2	DropGrate
4	102-103	2.94	15	Cir	127.000	764.43	765.11	0.535	765.55	765.84	0.36	766.20	3	DropGrate
5	103-104	2.17	12	Cir	75.000	765.36	766.18	1.093	766.20	766.81	n/a	766.81 j	4	DropGrate
6	104-105	1.52	12	Cir	30.000	766.18	766.50	1.067	766.81	767.02	n/a	767.02 j	5	OpenHeadwall
7	101-106	3.02	12	Cir	41.000	764.12	764.64	1.268	765.19	765.39	n/a	765.92 j	2	DropGrate
8	106-107	1.95	12	Cir	75.000	764.64	765.73	1.453	765.92	766.32	n/a	766.32 j	7	DropGrate
9	107-108	1.19	12	Cir	127.000	765.73	767.00	1.000	766.32	767.46	n/a	767.46 j	8	DropGrate
10	107-109	0.23	12	Cir	37.000	767.00	768.20	3.243	767.13	768.40	0.07	768.40	8	OpenHeadwall

Project File: 2019.05.01 Storm.stm | Number of lines: 10 | Run Date: 5/2/2019

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

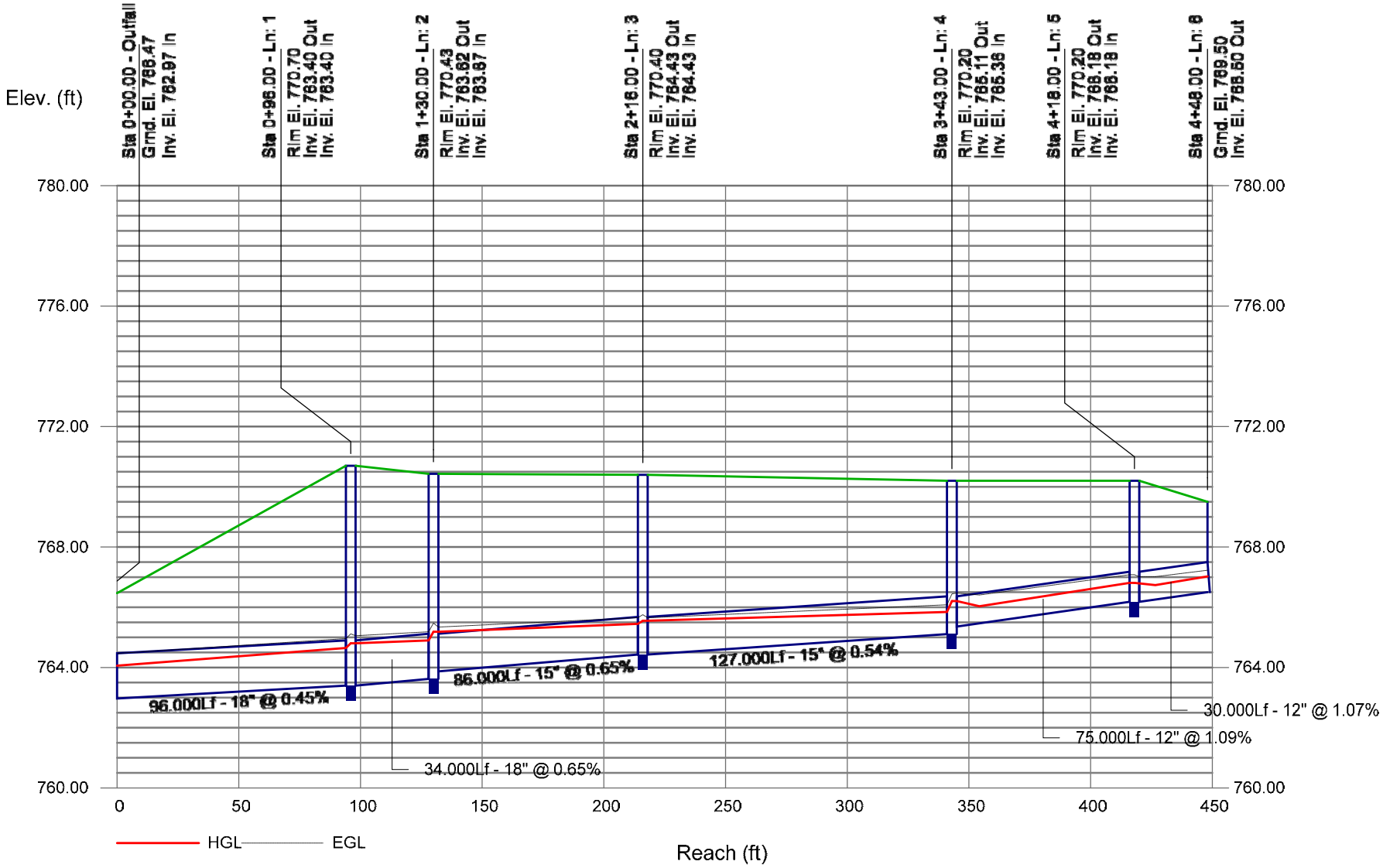
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	96.000	0.12	1.77	0.20	0.02	1.02	7.0	10.0	5.5	7.05	7.03	4.81	18	0.45	762.97	763.40	764.06	764.65	0.00	770.70	EX-100
2	1	34.000	0.00	1.65	0.00	0.00	0.99	0.0	9.8	5.5	6.90	8.45	4.16	18	0.65	763.40	763.62	764.80	764.90	770.70	770.43	100-101
3	2	86.000	0.15	1.01	0.90	0.14	0.56	5.0	6.6	6.4	3.88	5.21	3.39	15	0.65	763.87	764.43	765.19	765.45	770.43	770.40	101-102
4	3	127.000	0.13	0.86	0.85	0.11	0.42	5.0	5.7	6.7	2.94	4.73	3.24	15	0.54	764.43	765.11	765.55	765.84	770.40	770.20	102-103
5	4	75.000	0.11	0.73	0.85	0.09	0.31	5.0	5.3	6.9	2.17	3.72	3.62	12	1.09	765.36	766.18	766.20	766.81	770.20	770.20	103-104
6	5	30.000	0.62	0.62	0.35	0.22	0.22	5.0	5.0	7.0	1.52	3.68	3.29	12	1.07	766.18	766.50	766.81	767.02	770.20	0.00	104-105
7	2	41.000	0.17	0.64	0.90	0.15	0.44	5.0	9.6	5.6	3.02	4.01	4.32	12	1.27	764.12	764.64	765.19	765.39	770.43	770.10	101-106
8	7	75.000	0.09	0.47	0.85	0.08	0.28	5.0	9.1	5.7	1.95	4.29	3.24	12	1.45	764.64	765.73	765.92	766.32	770.10	770.10	106-107
9	8	127.000	0.20	0.20	0.85	0.17	0.17	5.0	5.0	7.0	1.19	3.56	2.91	12	1.00	765.73	767.00	766.32	767.46	770.10	770.40	107-108
10	8	37.000	0.18	0.18	0.20	0.04	0.04	7.0	7.0	6.3	0.23	6.41	2.96	12	3.24	767.00	768.20	767.13	768.40	770.10	0.00	107-109

Project File: 2019.05.01 Storm.stm | Number of lines: 10 | Run Date: 5/2/2019

NOTES:Intensity = 57.92 / (Inlet time + 9.10) ^ 0.80; Return period =Yrs. 10 ; Total flows limited to inlet captured flows ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: 2019.05.01 Storm.stm



Storm Sewer Profile

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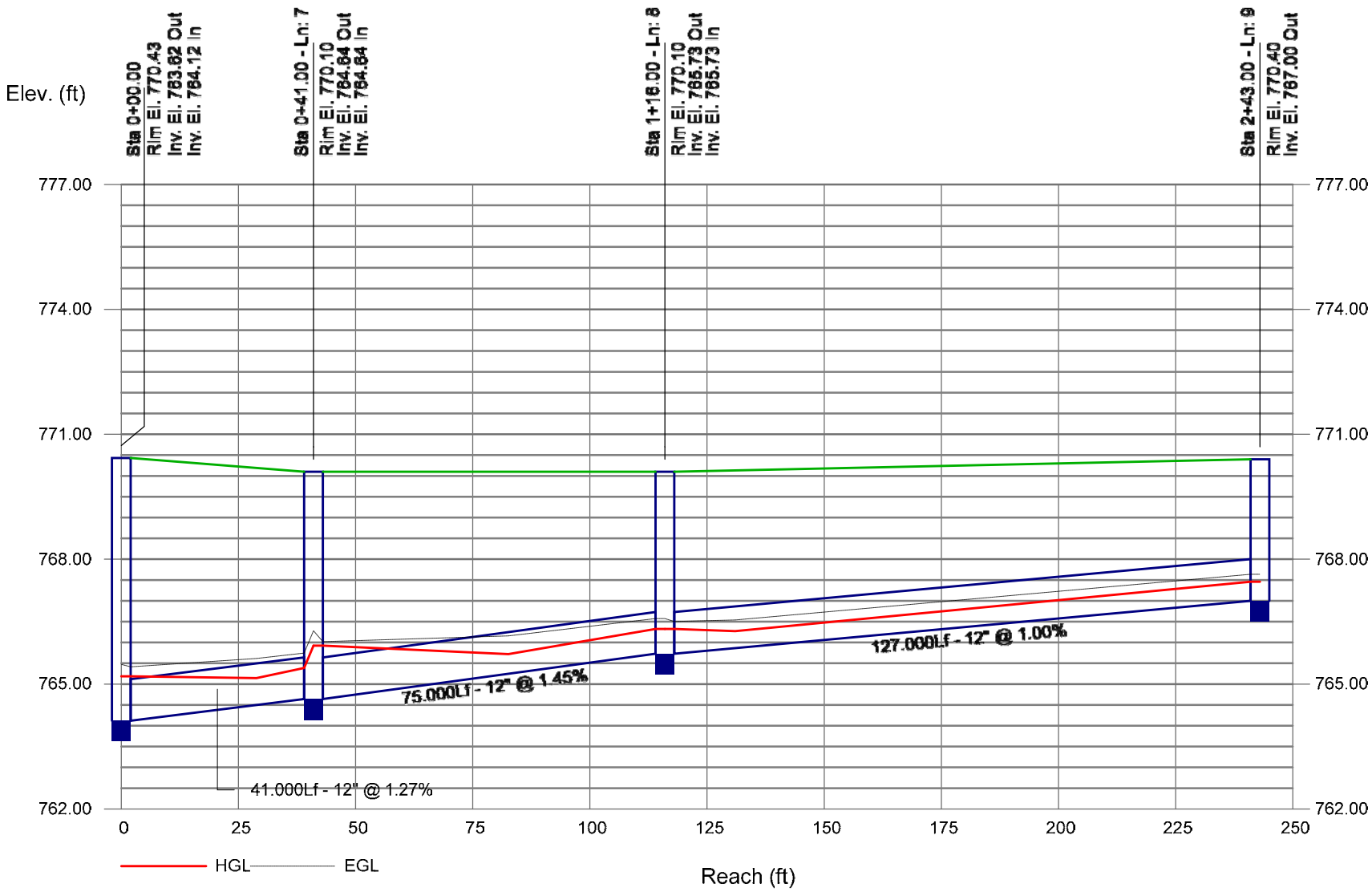

Storm Sewer Profile

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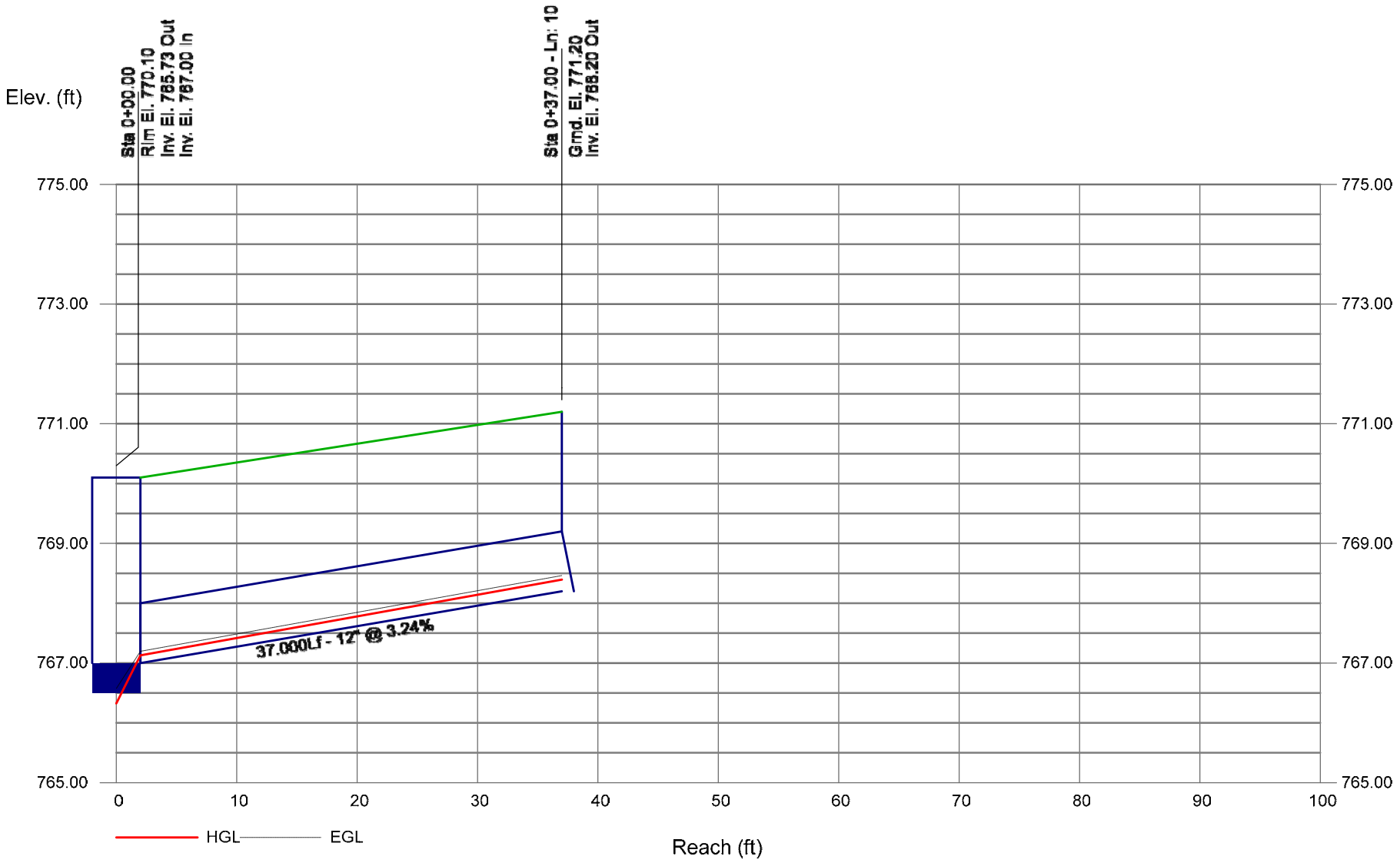


STORM WATER MANAGEMENT PLAN

Meijer PBB
Plainfield, Indiana

May 24, 2007
Revised: May 3, 2013

Table of Contents

Description	Page #
Storm Water Management Summary	1-3
Detention Basin & Outlet Design	4-15
BMP Sizing	16-18
Aqua-Swirl Maintenance Manual	19-22
Ditch Outlet Feasibility	23
Drainage from Adjacent Duke Property	24
Inlet Grate Capacity	25
Storm Sewer Calculations (11” x 17”)	26
Existing Drainage Plan, D1 (11” x 17”)	27
Proposed Drainage Plan, D2 (11” x 17”)	28
FEMA – Flood Insurance Rate Map (11”x17”)	29
Web Soil Survey – Area of Interest – Hendricks County, IN (11”x17”)	30

Storm Water Management Summary

Design Standards

The attached materials listed above constitute the storm water management design submittal for the referenced project. The design follows the HERPICC Storm Water Drainage Manual requirements for storm sewer and detention basin design, as well as the applicable requirements from the Town of Plainfield, Indiana drainage ordinances.

Existing Drainage Overview

The majority of the site currently drains into an existing storm sewer system along Dan Jones Road. In addition, a small portion of the north side of the site runs overland into an existing drainage ditch running along the north edge of the site and draining under Dan Jones Road to the east.

Proposed Drainage Overview

The majority of the storm water from the proposed Meijer development will be collected and conveyed to one of two detention basins. Detention Basin 1 is located at the west edge of the development, behind the Meijer store. Detention Basin 2 is located on the south side of the site, just west of the proposed gas station. Detention Basin 3 is located on the West side of the U.S. 40 driveway and detains road runoff. Detention Basin 4 will be constructed on Agree Outlot 1 along with the Meijer site development for use with future outlot development. Outlot C will have a future detention basin; this basin will be constructed with the Outlot C development and will discharge to the existing drainage ditch.

The soils on the site are mostly clay, removing the possibility of onsite stormwater discharge via infiltration. The proposed storm water outlet will discharge from the south detention basin into the storm sewer running down Dan Jones Road at MH #18.

Storm Sewer Design

The storm water collection and conveyance system was designed using the rational method with a 10-year design storm intensity. The storm sewer calculation sheets are attached for review. The proposed storm sewer system is designed with sufficient capacity and depth to convey future phases of the development, with the exception of Outlot C. A drainage plan showing catchment areas and developed rational coefficients for each storm sewer inlet structure is attached. All of the future outlots are assumed to have a developed rational coefficient of 0.80.

The storm sewer that runs between the Detention Basin 1 and the Detention basin 2 is designed to convey the 100-year emergency overflow from the Basin 1 into Basin 2.

Detention Basins Design

The detention basin design for each of the five basins is described below, and summarized in Table 1.

Basins 1 & 2

The overall area contributing to Detention Basins 1 and 2 are 5.25 acres and 23.56 acres, respectively. Existing peak discharge rates of 2.22 cfs and 9.03 cfs, respectively, were determined from the Town of Plainfield requirements shown in Ordinance No. 17-97, Drainage Ordinance.

The required 100-year storage volumes for Detention Basins 1 & 2 are determined to be 1.04 acre-feet and 5.02 acre-feet. The volumes provided are 1.54 acre-feet and 5.23 acre-feet

respectively. Overall post-development rational coefficients of 0.82 and 0.81 were used for the detention basins.

The design discharge rate from Detention Basin 2 is controlled by two 10" pipes that will restrict the flow to 10.61 cfs, which is less than the maximum permissible flow of 11.25 cfs (2.22cfs + 9.03 cfs).

Basin 3
The required 100-year storage volume for Detention Basin 3 is determined to be 0.08 acre-feet, and the volume provided is 0.13 acre-feet. The discharge rate from Basin 3 is controlled with a 2.5" orifice that restricts the release rate to 0.21 cfs, which is less than the maximum permissible flow of 0.26 cfs.

Basin 4
The required 100-year storage volumes for Detention Basin 4 is determined to be 0.46 acre-feet The volume provided is 0.76 acre-feet. The discharge rate from Basin 4 is controlled by a 6" stub from Catch Basin #40-1, which restricts the release rate to 1.42 cfs, which is less than the maximum permissible flow of 1.91 cfs.

Detention Basin	**Contributing Area (Acres)**	**Volume Required (ac-ft)**	**Volume Provided (ac-ft)**	**Allowable Release (cfs)**	**Actual Release (cfs)**
Basin 1	5.25	1.04	1.54	2.22	1.96
Basin 2	23.56	5.02	5.23	11.25	10.61
Basin 3	0.53	0.08	0.13	0.26	0.21
Basin 4	3.69	0.46	0.76	1.91	1.42

Table 1: Detention Basin Summary

Water Quality Design
Water quality treatment structures are provided at all three inlets to Detention Basin 2. These structures are sized to treat 1" of rainfall per the requirements from Chapter 9 of the Hendricks County Stormwater Technical Standards Manual. The basin inlet from the Gas Station / Convenience Store is proposed to be an off-line Aqua-Filter. The two basin inlets from the Main Store parking lot are Aqua-Swirls, and are flow through structures. Refer to the calculations for additional sizing information.

Water quality BMPs are not provided for Detention Basin 4. As it is unknown what Outlot 1 will be ultimately developed as, the Water Quality BMP should be constructed concurrent with future Outlot 1 development.

Stormwater Outlet
The stormwater outlet options are examined to determine their relative feasibility. There are two potential locations for a drainage outlet from the site:

1. The existing ditch adjacent to the north property line, with an invert elevation of approximately 765.93.
2. The Dan Jones Road 30" storm sewer located at southeast side of site, with an invert elevation of 759.82.

The existing ditch conveys stormwater runoff from north of the ditch, but it does not convey runoff from the Meijer site. The majority of the Meijer site currently drains via sheet flow from northwest to southeast and outlets into the Dan Jones Road storm sewer system. The low elevation on the existing site is approximately 763 feet.

The proposed minimum catch basin rim elevation is 764.50. The bottom elevation of the proposed Basin 2 is 761.50. If the existing ditch is used for the stormwater outlet, then the site would need to be raised approximately 7 feet to accomplish positive drainage to the ditch (see calculation on sheet 10). This fill depth of 7 feet equates to approximately 250,000 to 300,000 cubic yards of fill material. Due to the excessive quantity of haul on material required, the existing north ditch is not a prudent or feasible alternative for a positive drainage outlet.

The Dan Jones Road storm sewer system currently collects and conveys the undeveloped runoff from the Meijer site. The total undeveloped runoff rate currently draining to the Dan Jones Road storm sewer is 11.95 cfs during a 10-year design storm, from the 33.42 acres to be detained. The post-developed runoff rate from a 100-year storm is restricted to 11.91 cfs with a 15” pipe per the Town of Plainfield Drainage Ordinance. Therefore, connecting the detention basin outlet to the existing Dan Jones Road 30” storm sewer will not result in an increase in stormwater discharge rates to the public storm sewer system from the proposed Meijer site.

An emergency overflow is provided, and will only be used when the 100-year storm is exceeded within the two detention basins. The emergency overflow path is through a 4’ diameter overflow structure and a 30” storm sewer pipe. The proposed 30” storm sewer pipe discharges to the existing 30” storm sewer in Dan Jones Road at manhole 18. The required 100-year overflow rate is 55.77 cfs. The 30” storm sewer has a capacity of 46.98 cfs under pressure flow, with the headwater set at the south detention basin top of berm elevation. The proposed 30” overflow pipe will connect downstream to the existing 30” storm sewer in Dan Jones Road. For emergency flows exceeding 46.98 cfs, a secondary overflow will be initiated. The secondary spillway will flow over the Convenience Store's west access drive and into the 24" storm sewer.

The design storm for Detention Basin 2 is a 100-year storm frequency, 3-hour duration, with a 1.42 in/hr intensity. The time of concentration for stormwater to reach the basin after the end of the 3-hour storm is 52 minutes. Assuming that this design storm begins with 0.21 acre-feet already stored in the detention basins, it would take 3 hours and 52 minutes until the emergency overflow begins to discharge into the Dan Jones Road storm sewer system. The time of concentration for the Dan Jones storm sewer is approximately 24 minutes from the high point in Dan Jones Road to manhole #18. Therefore, the Dan Jones storm sewer will convey all right-of-way runoff within 24 minutes of the conclusion of the 3-hour duration storm; the Meijer overflow will then discharge to manhole #18 approximately 28 minutes later.

Project:	Meijer 256
	Plainfield, Indiana
	Hendrick County
Subject:	Stormwater Detention Basin Sizing
Date:	June 26, 2008
Modified	May 3, 2013

Detention Basin 1
Behind Meijer Store

Determination of Required Detention Basin Storage - Basin 1 based on 100-Year Storm Event

Design Information:

Basin 1 Drainage Area Information:

Watershed Area	5.25	Acres
Meijer Site Pervious Area =	0.65	Acre
Detention Basin Area=	0.69	Acre
Impervious Area=	3.91	Acre
Assumed Outlot "C" Factor =	0.80	
Pervious "C" Factor =	0.25	
Impervious "C" Factor =	0.90	
Weighted "C" Factor for Basin 1 Drainage Area =	0.82	
Time of Concentration (undeveloped watershed) (t_C)	30.43	minutes
Rainfall Intensity (i_U)	2.82	in/hr
Undeveloped Runoff Coefficient (C_U)	0.15	
Undeveloped Runoff Rate ($O = C_U*i_U*A_U$)	2.22	cfs
Actual Release Rate	1.96	cfs
*Developed Runoff Coefficient (C_D)	0.82	

(A) Storm Duration (Hours)		(B) Intensity For 100-year Storm* (in/hr)	(C) Inflow Rate (cfs)	(D) Release Rate (cfs)	(E) Stored Rate (cfs)	(F) Reservoir Size (Acre-Feet)
0.08	5	9.12	39.21	1.96	37.24	0.26
0.17	10	7.78	33.47	1.96	31.50	0.44
0.33	20	5.99	25.74	1.96	23.78	0.66
0.50	30	4.84	20.81	1.96	18.84	0.79
0.67	40	4.05	17.40	1.96	15.43	0.86
0.83	50	3.47	14.91	1.96	12.94	0.90
1.00	60	3.03	13.01	1.96	11.05	0.92
1.50	90	2.24	9.63	1.96	7.66	0.96
2.00	120	1.87	8.05	1.96	6.09	1.02
3.00	180	1.42	6.12	1.96	4.15	1.04
4.00	240	1.15	4.96	1.96	3.00	1.00
5.00	300	0.97	4.19	1.96	2.23	0.93
6.00	360	0.85	3.64	1.96	1.67	0.84
7.00	420	0.75	3.22	1.96	1.26	0.73
8.00	480	0.67	2.89	1.96	0.93	0.62
9.00	540	0.61	2.63	1.96	0.67	0.50
10.00	600	0.56	2.41	1.96	0.45	0.37

Required Storage =	1.04	acre-feet	
=	45,238	Cubic Feet	
=	**1675**	**Cubic Yards**	
Storage Provided: **Elev. 766.00 to 770.00** =	1.54	acre-feet	
	66,975	Cubic Feet	
=	2481	Cubic Yards	
Total Storage Provided =	**2481**	**Cubic Yards**	66975

Detention Basin 1

Undeveloped Runoff

Determine Undeveloped Time of Concentration

Kerby's Equation (HERPICC Drainage Manual, Chapter 3-8)

Overland flow L	500	ft	
Overland Slope	0.008	ft/ft	
Rougness Coeff, N	0.4		
T =	30.43	min	Table 3.2.4

Determine Undeveloped 10-Year Intensity

Chen's Method (HERPICC Drainage Manual, Chapter 2-23)

1	p 1hr 10yr	1.98	inches	Figures 2.2.4 - 2.2.6
	p 24hr 10yr	4.25	inches	
	p 1hr- 100yr	2.75	inches	
2	p 1_10/p 24_10 =	0.47		
	X = p 1_100/p 1_10 =	1.39		
3	a 1	26.0		Figure 2.2.3
	d'	9.0		
	n'	0.79		
4	Tr, recurrence interval	10	yr	
	i 1_10 = p 1_10/1 hr =	1.98	in/hr	
5	a' = a 1*i 1 10 log(10^(2-x)*Tr^(x-1)) =			
	a' (10 year) =	51.48		
6	i 10 Tc =	2.82	in/hr	

Determine Undeveloped 10-Year Runoff Rate

C_undeveoped	0.15	
Q=CiA =	2.22	cfs

Determine Basin 1 Volume Provided

Detention Volume Calculation

Elevation	Area (sft)	Incremen t Volume (cft)	Total Volume (cft)	Total Volume (cyd)	Total Volume (ac-ft)	
766	760					
767	7884	4322	4322	160	0.10	
768	16302	12093	16415	608	0.38	
769	26424	21363	37778	1399	0.87	
770	31970	29197	66975	2481	1.54	
771	35496	33733	100708	3730	2.31	
Interpolate Value						
769.30	28088	8177	**45955**	**1702**	**1.05**	Required
770.00	31970	0	**66975**	**2481**	**1.54**	Provided

Volume Required = 1675 cyd
Volume Provided = 2481 cyd

Project:	MJR 256	**By:**	jpm / dww
Subject:	Basin 1 Outlet Design	**Checked:**	
Date:	June 26, 2008		
Date:	May 3, 2013		

Orifice Calculation: Control MH 122

100-Year High Water Elevation =	769.30	ft
Spillway Overflow Elev. =	770.00	ft
Contributing Area =	5.25	acre
Allowable Release Rate (Ex 10-Yr) =	**2.22**	**cfs**
Orifice Invert =	765.75	ft
Orifice Diameter =	6	in

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal orifice flow rate (cfs)
a = flow area of orifice (sft)
H = design hydraulic head to centroid of orifice (ft)

a =	0.20	sft
H =	4.00	ft
Qp=	**1.96**	**cfs**

Emergency Outlet Calculation - West Basin:

Required 100-yr Overflow Rate:

Tc =	30.43	min	
I =	2.82	in/hr	(See Basin 1 Design)
C =	0.82		
A =	5.25	acre	
Req'd Q =	**12.14**	**cfs**	

Pressure Flow Through Pipe:

Spillway Overflow Elev. =	770.00	ft
Outlet Pipe Invert (Downstream IE of 18" @ CB 119) =	762.35	ft
Pipe Length (L) =	535	ft
Pipe Diameter =	18	in

Pressure Flow: Qp = 8a[H/(Kt + fL/D)]^0.5

Qp = principal spillway flow rate (cfs)
a = flow area of pipe (sft)
H = design hydraulic head to centroid of pipe (ft)
Kt = combined entrance and exit losses (= 1.0-1.8)
f = friction factor (~ 190n^2 / D^0.33)
L = length of pipe (ft)
D = Pipe Diameter (ft)
n = Mannings roughness coefficient

D =	1.5	ft
f =	0.03	
a =	1.77	sft
H =	6.90	ft
n =	0.013	
Kt =	1.80	
Qp=	**28.37**	**cfs**

Pressure Flow Into Outlet Structure:

Pressure Flow Through Structure Rim:

Spillway Overflow Elev. =	770.00	ft
Top of Berm =	771.00	ft
Rim Diameter =	24	in

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal structure flow rate (cfs)
a = flow area of rim(sft)
H = design hydraulic head (ft)

a =	3.14	sft
H =	1.00	ft
Qp=	15.71	cfs

Flow Through Low Flow Discharge Pipe:

Q = 1.96 cfs

Total Flow through Outlet Structure: **Q = 17.67 cfs**

Project: Meijer 256
Plainfield, Indiana
Hendrick County
Subject: Stormwater Detention Basin Sizing
Date: June 26, 2008
Modified: May 3, 2013

Detention Basin 2

Determination of Required Detention Basin Storage - Basin 2 based on 100-Year Storm Event

Design Information:

Basin 2 Drainage Area Information:

Watershed Area	23.56	Acres
Outlot Area Draining to South Basin (Outlots 2, A, B)=	5.61	Acre
Meijer Site Pervious Area =	2.41	Acre
Detention Basin Area=	1.87	Acre
Impervious Area=	13.68	Acre
Assumed Outlot "C" Factor =	0.80	
Pervious "C" Factor =	0.25	
Impervious "C" Factor =	0.90	
Weighted "C" Factor for Basin 2 Drainage Area =	0.81	
Time of Concentration (undeveloped watershed) (t_C)	52.44	minutes
Rainfall Intensity (i_U)	2.39	in/hr
Undeveloped Runoff Coefficient (C_U)	0.15	
Undeveloped Runoff Rate ($O = C_U{*}i_U{*}A_U$)	9.03	cfs
*Developed Runoff Coefficient (C_D)	0.81	

(A) Storm Duration (Hours)		(B) Intensity For 100-year Storm* (in/hr)	(C1) Inflow Rate from West Basin (cfs)	(C2) Inflow Rate (cfs)	(D) Release Rate (cfs)	(E) Stored Rate (cfs)	(F) Reservoir Size (Acre-Feet)
0.08	5	9.12	1.96	174.01	9.03	166.95	1.16
0.17	10	7.78	1.96	148.53	9.03	141.46	1.96
0.33	20	5.99	1.96	114.24	9.03	107.17	2.98
0.50	30	4.84	1.96	92.34	9.03	85.27	3.55
0.67	40	4.05	1.96	77.20	9.03	70.14	3.90
0.83	50	3.47	1.96	66.15	9.03	59.09	4.10
1.00	60	3.03	1.96	57.75	9.03	50.68	4.22
1.50	90	2.24	1.96	42.72	9.03	35.66	4.46
2.00	120	1.87	1.96	35.74	9.03	28.68	4.78
3.00	180	1.42	1.96	27.15	9.03	20.08	5.02
4.00	240	1.15	1.96	22.03	9.03	14.96	4.99
5.00	300	0.97	1.96	18.60	9.03	11.54	4.81
6.00	360	0.85	1.96	16.15	9.03	9.08	4.54
7.00	420	0.75	1.96	14.29	9.03	7.23	4.22
8.00	480	0.67	1.96	12.84	9.03	5.78	3.85
9.00	540	0.61	1.96	11.67	9.03	4.61	3.45
10.00	600	0.56	1.96	10.71	9.03	3.64	3.04

Required Storage =	5.02	acre-feet
=	218,724	Cubic Feet
=	**8101**	**Cubic Yards**
Storage Provided: **Elev. 761.00 to 764.50** =	5.23	acre-feet
	227,695	Cubic Feet
=	8433	Cubic Yards
Total Storage Provided =	**8433**	**Cubic Yards**

Detention Basin 2

Undeveloped Runoff

Determine Undeveloped Time of Concentration

Kerby's Equation (HERPICC Drainage Manual, Chapter 3-8)

Overland flow L	500	ft	
Overland Slope	0.0040	ft/ft	
Rougness Coeff, N	0.4		
T =	35.77	min	Table 3.2.4
Channelized flow L	1200	ft	
Overland Slope	0.0058	ft/ft	
Average Velocity	1.2	ft/s	Table 3.4.5
T =	16.67	min	
Total Tc =	52.44	min	

Determine Undeveloped 10-Year Intensity

Chen's Method (HERPICC Drainage Manual, Chapter 2-23)

1	p 1hr 10yr	1.98	inches	Figures 2.2.4 - 2.2.6
	p 24hr 10yr	4.25	inches	
	p 1hr- 100yr	2.75	inches	
2	p 1_10/p 24_10 =	0.47		
	X = p 1_100/p 1_10 =	1.39		
3	a 1	26.0		Figure 2.2.3
	d'	9.0		
	n'	0.79		
4	Tr, recurrence interval	10	yr	
	i 1_10 = p 1_10/1 hr =	1.98	in/hr	
5	a' = a 1*i 1 10 log(10^(2-x)*Tr^(x-1)) =			
	a' (10 year) =	51.48		
6	i 10 Tc =	2.55	in/hr	

Determine Undeveloped 10-Year Runoff Rate

C_undeveoped	0.15	
Q=CiA =	9.03	cfs

Determine Basin 2 Volume Provided

Detention Volume Calculation

Elevation	Area (sft)	Increment Volume (cft)	Total Volume (cft)	Total Volume (cyd)	Total Volume (ac-ft)	
761	26291					
762	65410	45851	45851	1698	1.05	
763	69541	67476	113326	4197	2.60	
764	79038	74290	187616	6949	4.31	
765	83520	81279	268895	9959	6.17	
Interpolate Value						
764.40	80831	31974	**219589**	**8133**	**5.04**	Required
764.50	81279	40079	**227695**	**8433**	**5.23**	Provided

Volume Required =	**8101 cyd**	5.02 ac-ft
Volume Provided =	**8433 cyd**	5.23 ac-ft
	Overdetain:	4%

Project:	MJR 256	**By:**	jpm / dww
Project #:	4481001		
Subject:	Basin 2 Outlet Design	**Checked:**	
Date:	June 26, 2008		
Modified:	May 3, 2013		

Orifice Calculation: Control MH 100

100-Year High Water Elevation =	764.40	ft
Spillway Overflow Elev. =	764.50	ft
Contributing Area (From Basins 1 & 2) =	28.81	acre
Allowable Release Rate (From Basins 1 & 2) =	**11.25**	**cfs**
Orifice Invert =	760.30	ft
Orifice Diameter =	10	in
Number of Orifices =	2	

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal orifice flow rate (cfs)
a = flow area of orifice (sft)
H = design hydraulic head to centroid of orifice (ft)

a =	0.55	sft
H =	3.78	ft
Qp=	**5.30**	**cfs**

Total Orifice Flow =	**10.61**	**cfs**

Emergency Outlet Calculation - Basin 2:

Required 100-yr Overflow Rate:

Tc =	52.44	min	
I =	2.39	in/hr	(See Detention Basin 1 Design)
C =	0.81		
A (from basins 1 & 2) =	28.81	acre	
Req'd Q =	**55.77**	**cfs**	

Pressure Flow Through Pipe:

Top of Detention Berm. =	766.00	ft
Outlet Pipe Invert =	759.82	ft
Pipe Length (L) =	247	ft
Pipe Diameter =	30	in

Pressure Flow: Qp = 8a[H/(Kt + fL/D)]^0.5

Qp = principal spillway flow rate (cfs)
a = flow area of pipe (sft)
H = design hydraulic head to centroid of pipe (ft)
Kt = combined entrance and exit losses (= 1.0-1.8)
f = friction factor (~ 190n^2 / D^0.33)
L = length of pipe (ft)
D = Pipe Diameter (ft)
n = Mannings roughness coefficient

D =	2.5	ft
f =	0.024	
a =	4.91	sft
H =	4.93	ft
n =	0.013	
Kt =	1.10	
* **Qp=**	**46.98**	**cfs**

* For flows exceeding 46.98 cfs, the emergency overflow will flow over the Convenience Store's South access drive and into the 18" storm sew

Pressure Flow Through Outlet Structure Rim:

Spillway Overflow Elev. =	764.50	ft	
Top of Berm =	766.00	ft	
Rim Diameter =	60	in	(5' dia required to fit 30" outlet pipe)

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal structure flow rate (cfs)
a = flow area of rim(sft)
H = design hydraulic head (ft)

a =	19.63	sft
H =	1.50	ft
Qp=	**120.24**	**cfs**

Project: Meijer 256
Plainfield, Indiana
Hendrick County
Subject: Stormwater Detention Basin Sizing
Date: June 26, 2008
Modified: May 3, 2013

Basin 3

Determination of Required Detention Basin Storage - Basin 3 based on 100-Year Storm Event

Design Information:

Basin 3 Drainage Area Information:

Watershed Area	0.53	Acres
Pervious Area =	0.17	Acre
Detention Basin Area=	0.12	Acre
Impervious Area=	0.24	Acre
Pervious "C" Factor =	0.25	
Impervious "C" Factor =	0.90	
Weighted "C" Factor for South Basin Drainage Area =	0.69	
Time of Concentration (undeveloped watershed) (t_C)	24.45	minutes
Rainfall Intensity (i_U)	3.22	in/hr
Undeveloped Runoff Coefficient (C_U)	0.15	
Undeveloped Runoff Rate ($O = C_U*i_U*A_U$)	0.26	cfs
Actual Release Rate =	0.21	cfs
*Developed Runoff Coefficient (C_D)	0.69	

(A) Storm Duration (Hours)		(B) Intensity For 100-year Storm* (in/hr)	(C2) Inflow Rate (cfs)	(D) Actual Release Rate (cfs)	(E) Stored Rate (cfs)	(F) Reservoir Size (Acre-Feet)
0.08	5	9.12	3.35	0.21	3.14	0.02
0.17	10	7.78	2.86	0.21	2.65	0.04
0.33	20	5.99	2.20	0.21	1.99	0.06
0.50	30	4.84	1.78	0.21	1.57	0.07
0.67	40	4.05	1.49	0.21	1.28	0.07
0.83	50	3.47	1.27	0.21	1.06	0.07
1.00	60	3.03	1.11	0.21	0.90	0.08
1.50	90	2.24	0.82	0.21	0.61	0.08
2.00	120	1.87	0.69	0.21	0.48	0.08
3.00	180	1.42	0.52	0.21	0.31	0.08
4.00	240	1.15	0.42	0.21	0.22	0.07
5.00	300	0.97	0.36	0.21	0.15	0.06
6.00	360	0.85	0.31	0.21	0.10	0.05
7.00	420	0.75	0.28	0.21	0.07	0.04
8.00	480	0.67	0.25	0.21	0.04	0.03
9.00	540	0.61	0.22	0.21	0.02	0.01
10.00	600	0.56	0.21	0.21	0.00	0.00

Required Storage =	0.08	acre-feet
=	3,482	Cubic Feet
=	**129**	**Cubic Yards**
Storage Provided: **Elev. 759.42 to 761.00** =	0.13	acre-feet
	5,815	Cubic Feet
=	215	Cubic Yards
Total Storage Provided =	**215**	**Cubic Yards**

5815

Undeveloped Runoff

Determine Undeveloped Time of Concentration

Kerby's Equation (HERPICC Drainage Manual, Chapter 3-8)

Overland flow L	350	ft	
Overland Slope	0.01	ft/ft	
Rougness Coeff, N	0.4		
T =	24.45	min	Table 3.2.4

Determine Undeveloped 10-Year Intensity

Chen's Method (HERPICC Drainage Manual, Chapter 2-23)

1	p 1hr 10yr	1.98	inches	Figures 2.2.4 - 2.2.6
	p 24hr 10yr	4.25	inches	
	p 1hr- 100yr	2.75	inches	
2	p 1_10/p 24_10 =	0.47		
	X = p 1_100/p 1_10 =	1.39		
3	a 1	26.0		Figure 2.2.3
	d'	9.0		
	n'	0.79		
4	Tr, recurrence interval	10	yr	
	i 1_10 = p 1_10/1 hr =	1.98	in/hr	
5	a' = a 1*i 1 10 log(10^(2-x)*Tr^(x-1)) =			
	a' (10 year) =	51.48		
6	i 10 Tc =	3.22	in/hr	

Determine Undeveloped 10-Year Runoff Rate

C_undeveoped	0.15	
Q=CiA =	0.26	cfs

Determine Basin 3 Volume Provided

Detention Volume Calculation

Elevation	Area (sft)	Increment Volume (cft)	Total Volume (cft)	Total Volume (cyd)	Total Volume (ac-ft)	
760.4	0					
761	5202	1561	1561	58	0.04	
762	6458	5830	7391	274	0.17	
763	7733	7096	14486	537	0.33	
Interpolate Value						
761.35	5642	1898	**1898**	**70**	**0.04**	Required
761.75	6144	4255	**5815**	**215**	**0.13**	Provided

Volume Required =	**129 cyd**	0.08 ac-ft
Volume Provided =	**215 cyd**	0.13 ac-ft

Project:	MJR 256	**By:**	jpm / dww
Subject:	Basin 3 Outlet Design	**Checked:**	
Date:	August 10, 2007		
Modified:	May 3, 2013		

Orifice Calculation: CB 44-2

100-Year High Water Elevation =	761.35	ft
Spillway Overflow Elev. =	762.00	ft
Contributing Area =	0.53	acre
Allowable Release Rate =	**0.26**	**cfs**
Orifice Invert =	760.40	ft
Orifice Diameter =	2.5	in
Number of Orifices =	1	

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal orifice flow rate (cfs)
a = flow area of orifice (sft)
H = design hydraulic head to centroid of orifice (ft)

a =	0.03	sft
H =	1.50	ft
Qp=	**0.21**	**cfs**

Total Orifice Flow =	**0.21**	**cfs**

Emergency Outlet Calculation - South Basin:

Required 100-yr Overflow Rate:

Tc =	24.45	min
I =	3.22	in/hr
C =	0.69	
A =	0.53	acre
Req'd Q =	**1.18**	**cfs**

Pressure Flow Through Pipe:

Top of Detention Berm. =	763.00	ft
Outlet Pipe Invert =	759.40	ft
Pipe Length (L) =	58	ft
Pipe Diameter =	12	in

Pressure Flow: Qp = 8a[H/(Kt + fL/D)]^0.5

Qp = principal spillway flow rate (cfs)
a = flow area of pipe (sft)
H = design hydraulic head to centroid of pipe (ft)
Kt = combined entrance and exit losses (= 1.0-1.8)
f = friction factor (~ 190n^2 / D^0.33)
L = length of pipe (ft)
D = Pipe Diameter (ft)
n = Mannings roughness coefficient

D =	1	ft
f =	0.032	
a =	0.79	sft
H =	3.10	ft
n =	0.013	
Kt =	1.10	
* **Qp=**	**6.43**	**cfs**

Overland Grassed Spillway

Overflow Elev. =	762.00	ft
Top of Detention Berm =	762.50	ft

CALCULATE WEIR FLOW FOR
A TRAPEZOIDAL WEIR DESIGN
Q=C((a+b)/2-0.2H)H^1.5
C=3.O FOR A BROAD CRESTED BERM

C	H (feet)	a (top width) (feet)	b (bot width) (feet)	S (Side Slope)	Q (cfs)	
3	0.5	10	4	6	7.32	
3	0.5	**12**	**6**	**6**	**9.44**	Use this geometry.
3	0.5	14	8	6	11.56	

Project: Meijer PBB
Plainfield, Indiana
Hendrick County
Subject: Stormwater Detention Basin Sizing
Date: June 26, 2008
Modified: May 3, 2013

Basin 4

Determination of Required Detention Basin Storage - Basin 4 based on 100-Year Storm Event

Design Information:

Basin 4 Drainage Area Information:

Watershed Area	3.69	Acres
Pervious Area =	1.31	Acre
Detention Basin Area=	0.42	Acre
Impervious Area=	1.96	Acre
Pervious "C" Factor =	0.25	
Impervious "C" Factor =	0.90	
Weighted "C" Factor for South Basin Drainage Area =	0.67	
Time of Concentration (undeveloped watershed) (t_C)	21.55	minutes
Rainfall Intensity (i_U)	3.46	in/hr
Undeveloped Runoff Coefficient (C_U)	0.15	
Undeveloped Runoff Rate ($O = C_U*i_U*A_U$)	1.91	cfs
Actual Release Rate =	1.91	cfs
*Developed Runoff Coefficient (C_D)	0.67	

(A) Storm Duration (Hours)		(B) Intensity For 100-year Storm* (in/hr)	(C2) Inflow Rate (cfs)	(D) Actual Release Rate (cfs)	(E) Stored Rate (cfs)	(F) Reservoir Size (Acre-Feet)
0.08	5	9.12	22.50	1.91	20.58	0.14
0.17	10	7.78	19.20	1.91	17.29	0.24
0.33	20	5.99	14.77	1.91	12.86	0.36
0.50	30	4.84	11.94	1.91	10.03	0.42
0.67	40	4.05	9.98	1.91	8.07	0.45
0.83	50	3.47	8.55	1.91	6.64	0.46
1.00	60	3.03	7.47	1.91	5.55	0.46
1.50	90	2.24	5.52	1.91	3.61	0.45
2.00	120	1.87	4.62	1.91	2.71	0.45
3.00	180	1.42	3.51	1.91	1.60	0.40
4.00	240	1.15	2.85	1.91	0.93	0.31
5.00	300	0.97	2.41	1.91	0.49	0.21
6.00	360	0.85	2.09	1.91	0.17	0.09
7.00	420	0.75	1.85	1.91	-0.07	-0.04
8.00	480	0.67	1.66	1.91	-0.25	-0.17
9.00	540	0.61	1.51	1.91	-0.40	-0.30
10.00	600	0.56	1.38	1.91	-0.53	-0.44

Required Storage =	0.46	acre-feet	
=	20,159	Cubic Feet	
=	**747**	**Cubic Yards**	
Storage Provided: **Elev. 760.00 to 762.50** =	0.76	acre-feet	
	33,275	Cubic Feet	
=	1232	Cubic Yards	
Total Storage Provided =	**1232**	**Cubic Yards**	33275

Undeveloped Runoff

Determine Undeveloped Time of Concentration

Kerby's Equation (HERPICC Drainage Manual, Chapter 3-8)

Overland flow L	280	ft	
Overland Slope	0.011	ft/ft	
Rougness Coeff, N	0.4		
T =	21.55	min	Table 3.2.4

Determine Undeveloped 10-Year Intensity

Chen's Method (HERPICC Drainage Manual, Chapter 2-23)

1	p 1hr 10yr	1.98	inches	Figures 2.2.4 - 2.2.6
	p 24hr 10yr	4.25	inches	
	p 1hr- 100yr	2.75	inches	
2	p 1_10/p 24_10 =	0.47		
	X = p 1_100/p 1_10 =	1.39		
3	a 1	26.0		Figure 2.2.3
	d'	9.0		
	n'	0.79		
4	Tr, recurrence interval	10	yr	
	i 1_10 = p 1_10/1 hr =	1.98	in/hr	
5	a' = a 1*i 1 10 log(10^(2-x)*Tr^(x-1)) =			
	a' (10 year) =	51.48		
6	i 10 Tc =	3.46	in/hr	

Determine Undeveloped 10-Year Runoff Rate

C_undeveoped	0.15	
Q=CiA =	1.91	cfs

Determine Basin 4 Volume Provided

Detention Volume Calculation

Elevation	Area (sft)	Increment Volume (cft)	Total Volume (cft)	Total Volume (cyd)	Total Volume (ac-ft)	
760.25	12000					
761	13680	9630	9630	357	0.22	
762	16405	15043	24673	914	0.57	
763	19606	18006	42678	1581	0.98	
Interpolate Value						
762.30	17222	20087	**20087**	**744**	**0.46**	Required
762.50	18006	8603	**33275**	**1232**	**0.76**	Provided

Volume Required = **747 cyd** 0.46 ac-ft

Volume Provided = **1232 cyd** 0.76 ac-ft

Project:	MJR PBB	**By:**	jpm / dww
Subject:	Basin 4 Outlet Design	**Checked:**	
Date:	August 10, 2007		
Modified:	May 3, 2013		

Orifice Calculation: CB 40-1

100-Year High Water Elevation =	762.30	ft
Spillway Overflow Elev. =	762.50	ft
Contributing Area (From Basins 4 & 5) =	3.69	acre
Allowable Release Rate (From Basins 4 & 5) =	**1.91**	**cfs**
Orifice Invert =	760.17	ft
Orifice Diameter =	6	in
Number of Orifices =	1	

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal orifice flow rate (cfs)
a = flow area of orifice (sft)
H = design hydraulic head to centroid of orifice (ft)

a =	0.20	sft
H =	2.08	ft
Qp=	**1.42**	**cfs**

Total Orifice Flow =	**1.42**	**cfs**

Emergency Outlet Calculation - Basin 4

Required 100-yr Overflow Rate:

Tc =	21.55	min
I =	3.46	in/hr
C =	0.67	
A =	3.69	acre
Req'd Q =	**8.53**	**cfs**

Pressure Flow Through Pipe:

Top of Detention Berm. =	763.00	ft
Outlet Pipe Invert =	759.50	ft
Pipe Length (L) =	60	ft
Pipe Diameter =	15	in

Pressure Flow: Qp = 8a[H/(Kt + fL/D)]^0.5

Qp = principal spillway flow rate (cfs)
a = flow area of pipe (sft)
H = design hydraulic head to centroid of pipe (ft)
Kt = combined entrance and exit losses (= 1.0-1.8)
f = friction factor (~ 190n^2 / D^0.33)
L = length of pipe (ft)
D = Pipe Diameter (ft)
n = Mannings roughness coefficient

D =	1.25	ft
f =	0.030	
a =	1.23	sft
H =	2.88	ft
n =	0.013	
Kt =	1.10	
* **Qp=**	**10.46**	**cfs**

Pressure Flow Through Outlet Structure Rim:

Spillway Overflow Elev. =	762.50	ft
Top of Berm =	763.00	ft
Rim Diameter =	24	in

Orifice Flow: Qp = 5a(H)^0.5

Qp = principal structure flow rate (cfs)
a = flow area of rim(sft)
H = design hydraulic head (ft)

a =	3.14	sft
H =	0.50	ft
Qp=	**11.11**	**cfs**

Project: Meijer PBB
Project # 4481001
Subject: BMP Design
Date: June 26, 2008
Revised: December 21, 2012

Flow Through BMP Sizing

Basin 2, BMP located upstream of Outlet 104 :

1	Percent Impervious per storm sewer design (I) =	91%	
2	Curve number for water quality storm event per Figure 9-1 (CNwq) =	99.0	
3	Volumetric Runoff Coefficient (Rv)		
	Rv = .05 + .009 (I) =	0.87	
4	Rainfall Depth for water quality storm event (P)	1.00	in
5	Cumulative 24-hour Runoff Depth, (Qa) =	0.87	in
6	Time of Concentration per storm sewer design =	18.65	min
	Tc =	0.31	hr
7	Drainage Area (per storm sewer design)	12.56	ac
	Drainage Area (Am) =	0.020	sq-mi
8	Unit Peak Discharge (qu) for SCS type II rainfall distribution (See Page __ for qu discharge graph.)		
	a) Determine Ia/P		
	Initial Abstraction (TR55, Table 4-1)	0.041	
	Ia/P =	0.041	
	Unit Peak Discharge, qu =	680	*csm/in
9	Peak Discharge, qp = qu x Am x Q		
	1" storm, 24-hours		
	Area =	0.02	sq-mi
	Unit Peak Discharge, qu =	680	*csm/in
	Runoff Depth, Q =	0.87	in
	Water Quality Discharge Rate, qp =	**11.60**	**cfs**

Basin 2, BMP located upstream of Outlet 112 :

1	Percent Impervious per storm sewer design (I) =	84%	
2	Curve number for water quality storm event per Figure 9-1 (CNwq) =	98.2	
3	Volumetric Runoff Coefficient (Rv)		
	Rv = .05 + .009 (I) =	0.81	
4	Rainfall Depth for water quality storm event (P)	1.00	in
5	Cumulative 24-hour Runoff Depth, (Qa) =	0.81	in
6	Time of Concentration per storm sewer design =	20.59	min
	Tc =	0.34	hr
7	Drainage Area (per storm sewer design)	6.52	ac
	Drainage Area (Am) =	0.010	sq-mi
8	Unit Peak Discharge (qu) for SCS type II rainfall distribution (See Page __ for qu discharge graph.)		
	a) Determine Ia/P		
	Initial Abstraction (TR55, Table 4-1)	0.041	
	Ia/P =	0.041	
	Unit Peak Discharge, qu =	650	*csm/in
9	Peak Discharge, qp = qu x Am x Q		
	1" storm, 24-hours		
	Area =	0.01	sq-mi
	Unit Peak Discharge, qu =	650	*csm/in
	Runoff Depth, Q =	0.81	in
	Water Quality Discharge Rate, qp =	**5.34**	**cfs**

* CSM = cubic feet per square mile

Basin 2, BMP located upstream of Outlet 101 :

1	Percent Impervious per storm sewer design (I) =	77%	
2	Curve number for water quality storm event per Figure 9-1 (CNwq) =	97.5	
3	Volumetric Runoff Coefficient (Rv)		
	Rv = .05 + .009 (I) =	0.74	
4	Rainfall Depth for water quality storm event (P)	1.00	in
5	Cumulative 24-hour Runoff Depth, (Qa) =	0.74	in
6	Time of Concentration per storm sewer design =	15.15	min
	Tc =	0.25	hr
7	Drainage Area (per storm sewer design)	1.12	ac
	Drainage Area (Am) =	0.002	sq-mi
8	Unit Peak Discharge (qu) for SCS type II rainfall distribution (See Page __ for qu discharge graph.)		
	a) Determine Ia/P		
	Initial Abstraction (TR55, Table 4-1)	0.052	
	Ia/P =	0.052	
	Unit Peak Discharge, qu =	740	*csm/in
9	Peak Discharge, qp = qu x Am x Q		
	1" storm, 24-hours		
	Area =	0.00	sq-mi
	Unit Peak Discharge, qu =	740	*csm/in
	Runoff Depth, Q =	0.74	in
	Water Quality Discharge Rate, qp =	**0.96**	**cfs**

Notes:
* CSM = cubic feet per square mile
** If Ia/P is outside range in qu discharge graph, then nearest Ia/P value.

Figure 9-1
Curve Number Calculation for Water Quality Storm Event

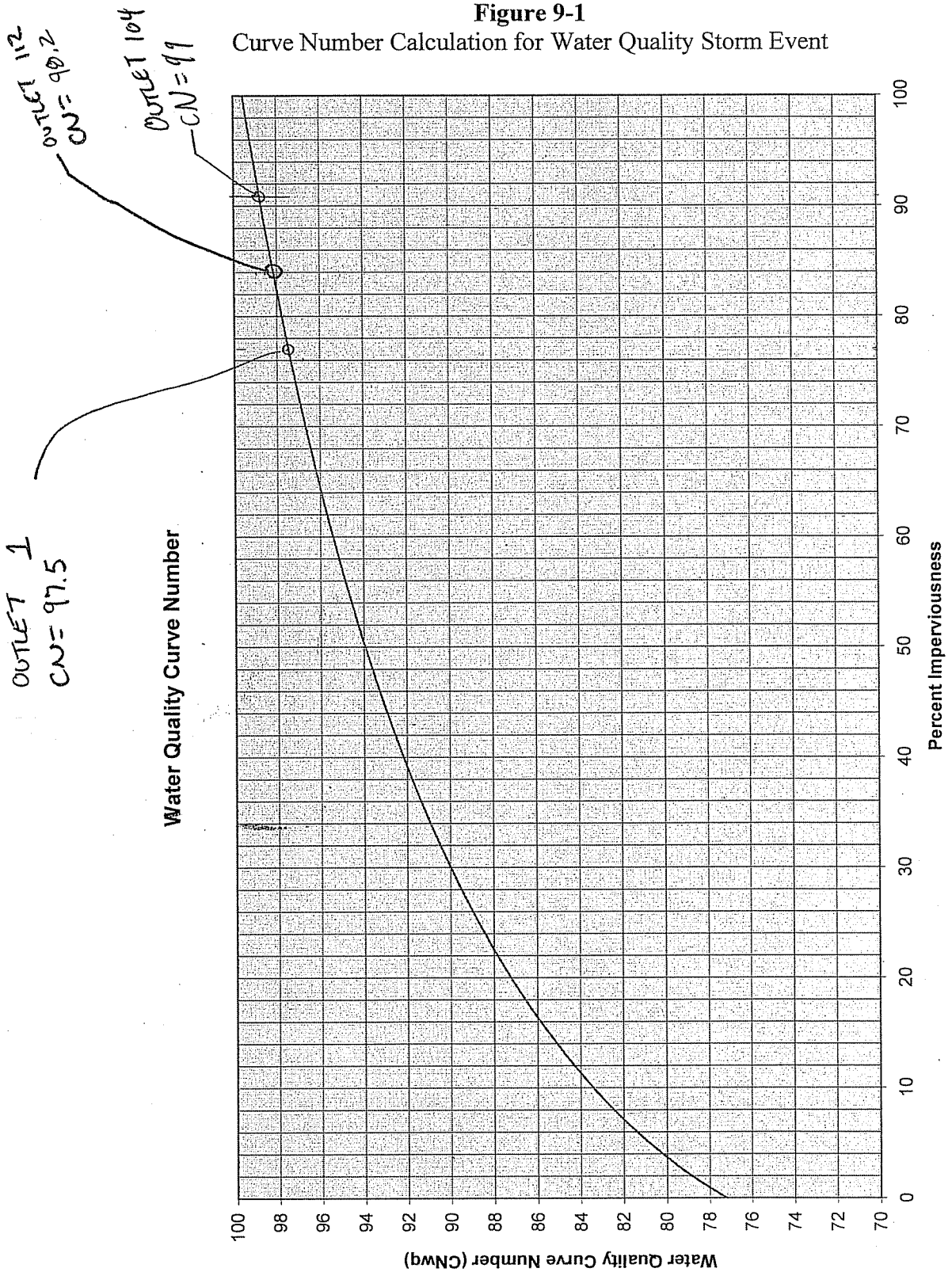
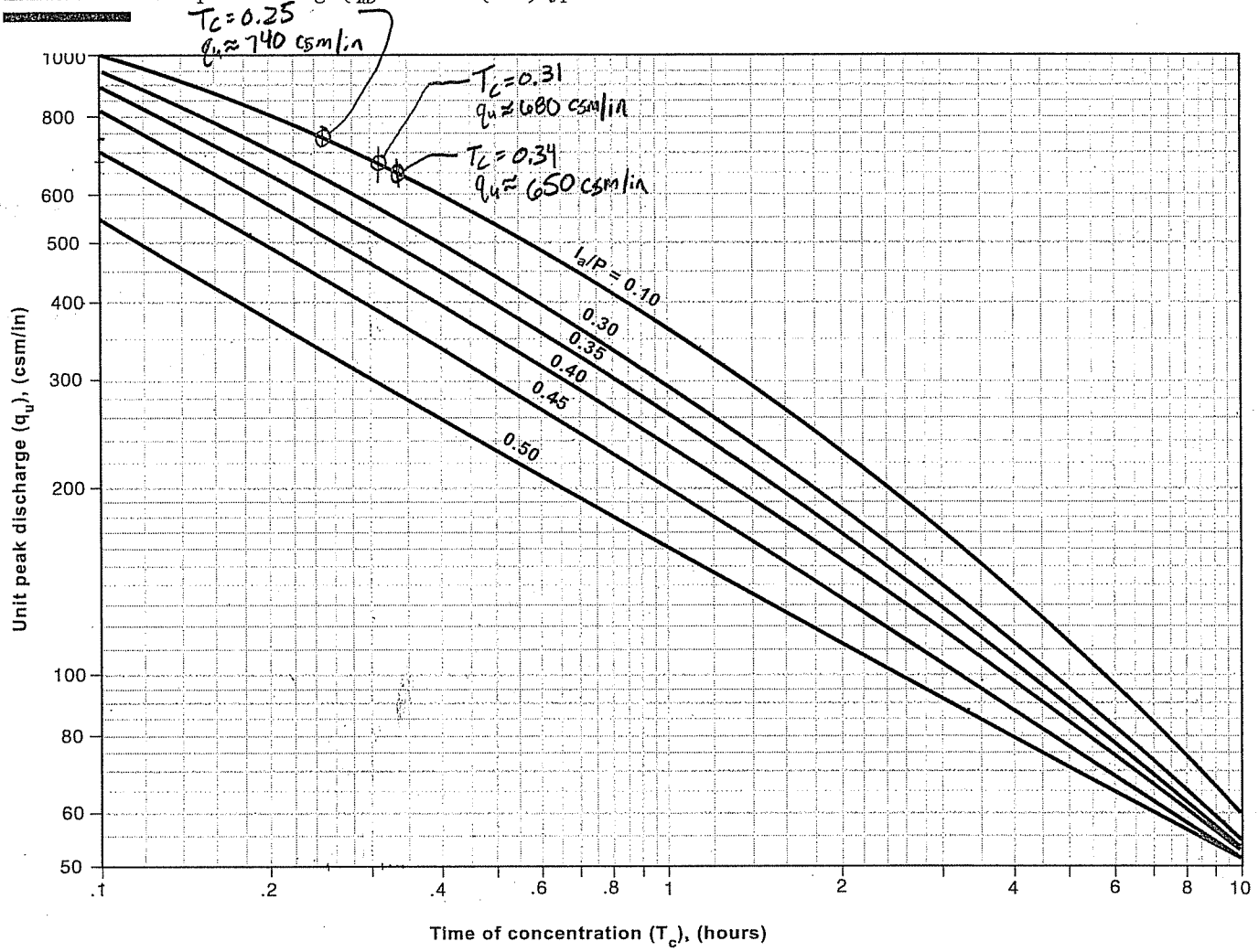


Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



Inspection

All AquaShield™ products can be inspected from the surface, eliminating the need to enter the systems to determine when cleanout should be performed.

In most cases, AquaShield™ recommends a quarterly inspection of the Stormwater Treatment Systems for the first year of operation to develop an appropriate schedule of maintenance.

Based on experience of the system's first year in operation, we recommend that the inspection schedule be revised to reflect the site-specific conditions encountered. Typically, the inspection schedule for subsequent years is reduced to semi-annual inspection.

Aqua-Swirl™ Maintenance

The Aqua-Swirl™ has been designed to minimize and simplify the inspection and maintenance process. The system can be inspected and maintained completely from the surface, thereby eliminating the need for confined space entry.

Furthermore, the entire structure (specifically, the floor) is accessible for visual inspection from the surface. There are no areas of the structure that are blocked from visual inspection or periodic cleaning.

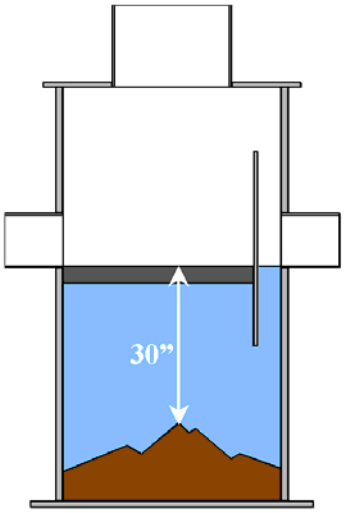
Inspection of any free-floating oil and floatable debris can be directly observed and maintained through the manhole access provided directly over the swirl chamber.

Aqua-Swirl™ Inspection Procedure

To inspect the Aqua-Swirl™, a hook is needed to remove the manhole cover. AquaShield™ provides a customized manhole cover with our logo to make it easy for maintenance crews to locate the system in the field. We also provide a permanent metal information plate attached inside the access riser, which provides our contact information, the Aqua-Swirl™ model size, and serial number.

Sediment inspection using a stadia rod

The only tools needed to inspect the Aqua-Swirl™ system are a flashlight and a measuring device such as a stadia rod or pole. Given the tremendous accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device to the top of the sediment pile and to the surface of the water. When the sediment pile is within 30 to 36 inches of the water surface, the system should be maintained.



It should be noted that in order to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the *top* of the sediment pile. The finer sediment at the top of the pile, typically offers less resistance to the measuring device than the larger particles.

Aqua-Swirl™ Cleanout Procedure

Clean out of the Aqua-Swirl™ is simple. Free-floating oil and floatable debris can be observed and removed directly through the 30-inch service access provided.

A vacuum truck can be used to remove the accumulated sediment and debris. It is important to note that the entire sediment storage area can be reached with a vacuum hose from the surface (reaching all the sides).

Vacuum truck cleans the Aqua-Swirl™

Disposal of the material is typically treated in the same fashion as catch basin cleanouts. AquaShield™ recommends that all materials removed be handled and disposed of in accordance with local and state requirements.

An “Inspection and Maintenance Manual” is provided with each Aqua-Swirl™ system for more detailed maintenance procedures. On the following page, you will find sample Inspection Data Sheets.

Aqua-Swirl™ Inspection Data Sheet

Location: _____

Date	Inspector Name	Distance to Sediment (in.)	Distance to Water (in.)	Floatable Layer Thickness (describe)	Maintenance Required? (yes/no)

Aqua-Swirl™ Maintenance Data Sheet

Inspector: _____ Date: _____
Location: _____ Time: _____

INSPECTION

General Site Condition

Visible Evidence of Spills/ Releases (oils, grease, fuels, paints, chemicals):

_____

Visible Evidence of Heavy Sediment Deposition:

_____

Swirl

Condition of Swirl: _____

_____

Condition of Baffle: _____

_____

Distance to Sediment: _____
Distance to Water: _____

**Note: If sediment is less than 30 to 36 inches below water surface, sediment should be removed.

CONTAMINATION REMOVAL DATA

Floating Oil and Debris

Approx. Volume: _____
Description: _____
Elapsed Removal Time: _____

Sediment

Approx. Volume: _____
Description: _____
Elapsed Removal Time: _____

Other Comments

_____

_____

Project:	MJR PBB	**By:**	JPM
Project #:	4481001		7/23/2007
Subject:	Positive Outlet Feasibility - Existing Ditch	**Checked:**	
Date:	July 23, 2007		

Positive Outlet Feasibility: Calculation For Using Existing Ditch

Ditch Invert Elevation =	765.93	ft
Pipe Length to Detention Basin =	1330	ft
Pipe Slope =	0.20%	
Drop in Pipe Slope =	2.66	ft
Detention Basin Invert Elevation =	761.5	ft
Required height to raise site if discharging to ditch =	**7.09**	**ft**

The Proposed site is graded to balance earthwork volumes.
Raising the site by 7' would result in approximatley 250,000-300,000 cubic yards of fill. This is not feasible.

Project:	MJR PBB
Subject:	Offsite Flow - Culvert Design
Date:	August 10, 2007
Modified:	June 26, 2008

Meijer PBB - Plainfield, Indiana
Offsite flow on Duke property that is tributary to the existing system draining between outlots A and 1

Watershed Area =	7.06225895	acres
Overland flow path = 1,200 feet		
Overland Slope = 0.58%		
Kerby's Equation t=	49.3693391	minutes

p 1 10	1.98	inches
p 24 10	4.25	inches
p 1 100	2.75	inches

p 1 10/p 24 10 =	0.46588235
X = p 1 100/p 1 10 =	1.38888889
a 1	31.6
d'	9.9
n'	0.79

i 1 10 = p 1 10/1 hr =	1.98	inches/hr
a' = a 1*i 1 10 log(10^(2-x)*Tr^(x-1)) =	62.568	log(4.084*Tr^.388889)

a' (10 year) =	62.566

i 10 49.37 =	2.48772645	in/hr

C value = 0.37

Q=CiA =	.37*2.488*7.06 =	6.5005183	cfs

See storm sewer design for culvert size.

progressive ae

Project: Meijer PBB
Date: May 3, 2012
Revised:

Flow Capacity of Inlet Grates

Design Notes & Assumptions:

The orifice method is valid for flow depths of 4" or greater.
A weir calculation should be used for flow depths less than 4"

Design Input:

Orifice Coefficient [C] =	0.67	
Gravity (g) =	32.2	ft/sec^2
Storm Intensity (10-Year, 15 Min Concentration Time) =	3.80	in/hr
Developed Rational Coefficient =	1.00	

Design Calculations:

Orifice Equation: Q = C*a*(2*g*H)^0.5

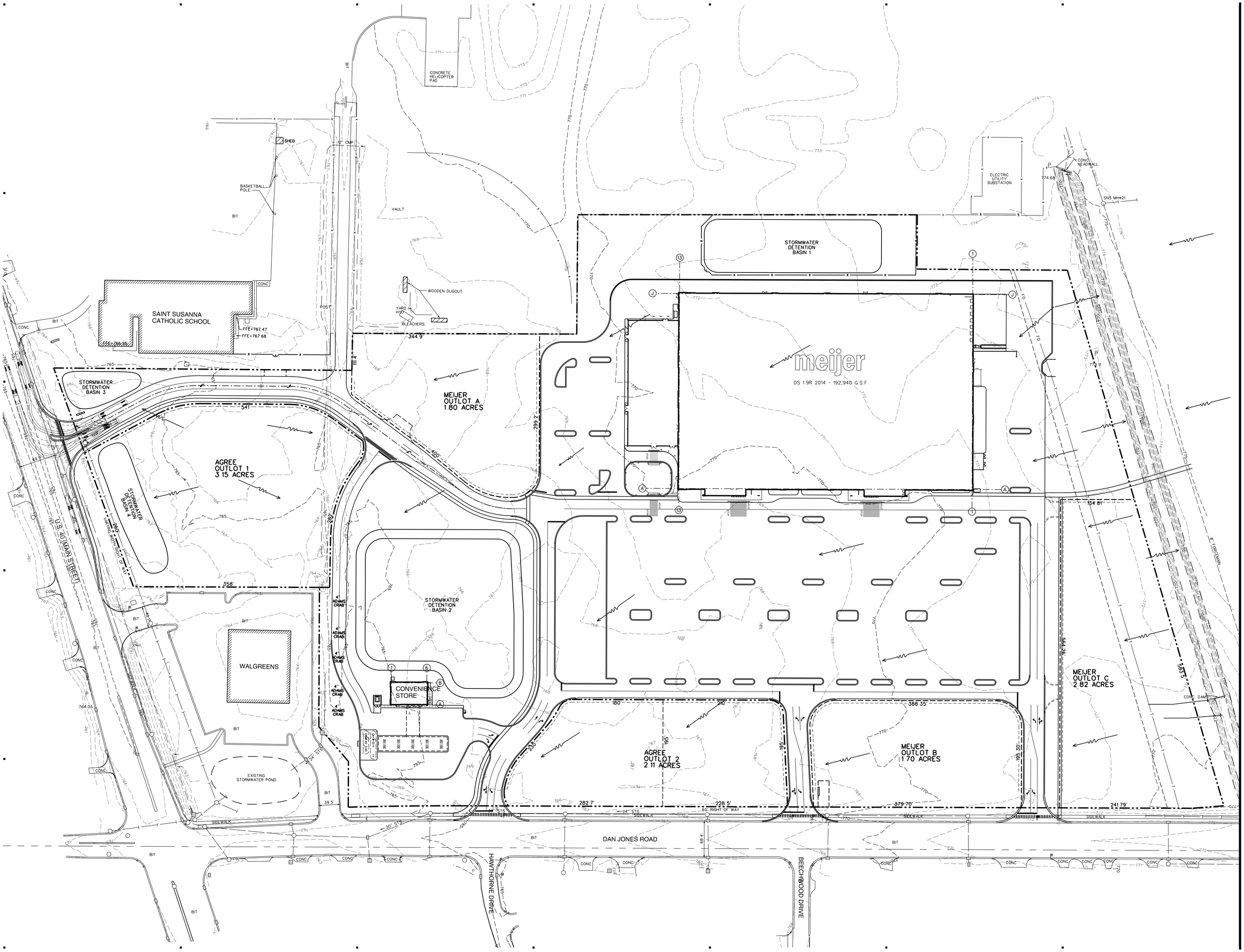
Description	Casting Type	Open Area	Open Area	Depth of Flow	Flow Capacity	Max Dev. Area
		sq-ft	(sq-in)	(in)	(cfs)	(acre)
Ditch Grate	NEENAH R-4342	2.0	288	4	6.21	1.63
Rolled Curb	NEENAH R-3501-T	1.4	201.6	4	4.35	1.14
Straight Curb single	NEENAH R-3287-10V	2.1	302.4	4	6.52	1.72
Straight Curb double	NEENAH R-3287-15V	3.2	460.8	4	9.93	2.61
Square Flat Grate	NEENAH R-3405	1.5	216	4	4.66	1.23
Round Flat Grate	NEENAH R-2501	1.1	158.4	4	3.41	0.90
MJR Double Square Grate	EJIW 5236	3.1	440	4	9.49	2.50

Storm-Drainage Design Summary - Rational Method

Project Name: MEIJER 256 **Preparer:** JPM / DWW **Checked By:**
Project ID: 4256001 **Date:** 5/23/2007 **Date:**
Project Locatio TOWN OF PLAINFIELD, HENDRICKS COUNTY, IN **Last Revised:** 5/2/2013

Design Assumptions:
Manning's Equation where n = 0.013 Concrete Pipe

1	2	12	13	14	15	16	17	18		19	11A	20	21	22	23	24	25	26	33	34	35	36	41	42	43	44
					Proposed Conditions														Hydraulic Grade Line Elevation		Full Flow Conditions			Cover Over Pipe Crown (ft)		
Notes	Upper Structure ID	Lower Structure ID	Pipe Diameter	Pipe Length	Pipe Slope	Upper Invert Elevation	Lower Invert Elevation	Upper Rim Elevation	Lower Rim Elevation	Catchment Drainage Area (sft)	Catchment Drainage Area (acres)	Impervious Area (acres)	Weighted Runoff Coefficient "C"	Time of Concentration (min)	C x A	Sum of C x A	Rainfall Intensity (in/hr)	Design Flow (cfs)	Flowing Full (cfs)	Upper	Lower	Velocity (ft/s)	Time of Flow (min)	Ground to Pipe Invert (ft)	Upper	Lower	* Depth of Hydraulic Grade Line below Rim Elevation
Meijer Outlot B	CB 109-1	CB 109	18	115	0.50%	763.50	762.92	769.00	768.20	76342	1.75	1.49	0.80	15.00	1.40	1.40	4.55	6.37	7.43	766.33	765.91	4.20	0.46	5.50	4.00	3.78	2.67
Agree Outlot 2	CB 106-1	CB 106	24	120	0.25%	761.65	761.35	765.20	767.25	94685	2.17	1.85	0.80	15.00	1.74	1.74	4.55	7.90	11.31	764.46	764.31	3.60	0.56	3.55	1.55	3.90	0.74
	CB 110-2	CB 110-1	12	132	0.65%	764.60	763.74	768.40	768.40	34705	0.80	0.72	0.83	15.00	0.66	0.66	4.55	3.01	2.87	767.82	766.88	3.66	0.60	3.80	2.80	3.66	0.58
	CB 110-1	CB 110	18	126	0.40%	763.74	763.24	768.40	768.30	49652	1.14	1.10	0.88	15.60	1.00	1.67	4.47	7.45	6.64	766.88	766.24	3.76	0.56	4.66	3.16	3.56	1.52
	CB 110	CB 109	24	126	0.25%	763.24	762.92	768.30	768.20	48460	1.11	1.07	0.87	16.16	0.97	2.64	4.41	11.64	11.31	766.24	765.91	3.60	0.58	5.06	3.06	3.28	2.06
	CB 109	CB 108	30	190	0.30%	762.92	762.35	768.20	768.00	63008	1.45	1.40	0.88	16.74	1.27	5.31	4.35	23.09	22.47	765.91	765.31	4.58	0.69	5.28	2.78	3.15	2.29
	CB 108	CB 107	30	126	0.35%	762.35	761.91	768.00	768.00	57926	1.33	1.28	0.88	17.44	1.17	6.48	4.27	27.69	24.27	765.31	764.73	4.94	0.42	5.65	3.15	3.59	2.69
	CB 107	CB 106	36	188	0.30%	761.91	761.35	768.00	767.25	48016	1.10	1.06	0.87	17.86	0.96	7.44	4.23	31.47	36.53	764.73	764.31	5.17	0.61	6.09	3.09	2.90	3.27
	CB 106	CB 105	36	60	0.33%	761.35	761.15	767.25	766.75	45631	1.05	0.92	0.82	18.47	0.86	10.04	4.17	41.84	38.32	764.31	764.08	5.42	0.18	5.90	2.90	2.60	2.94
Aquaswirl btwn	CB 105	Outlet 104	36	53	0.28%	761.15	761.00	766.75	764.00	28901	0.66	0.55	0.79	18.65	0.52	10.57	4.15	43.83	35.29	764.08	763.85	4.99	0.18	5.60	2.60	0.00	2.67
										Area Subtotal =	12.56	11.44															
										Impervious	91%																
Meijer Outlot A	CB 119-1	CB 119	18	47	0.45%	762.55	762.34	766.00	770.00	83705	1.92	1.63	0.80	15.00	1.54	1.54	4.55	6.99	7.05	764.92	764.71	3.99	0.20	3.45	1.95	6.16	1.08
	MH 122	CB 121	18	174	0.45%	764.75	763.97	770.00	771.40	0	0.00	-	0.90	15.00	0.56	0.56	4.55	2.56	7.05	765.62	765.52	3.99	0.73	5.25	3.75	5.93	4.38
	CB 121	CB 120	18	240	0.45%	763.97	762.89	771.40	770.00	7862	0.18	0.18	0.90	15.73	0.16	0.73	4.46	3.24	7.05	765.52	765.29	3.99	1.00	7.43	5.93	5.61	5.88
	CB 120	CB 119	18	121	0.45%	762.89	762.34	770.00	770.00	46653	1.07	1.05	0.89	16.73	0.95	1.67	4.35	7.28	7.05	765.29	764.71	3.99	0.51	7.11	5.61	6.16	4.71
	CB 119	MH 113	24	77	0.64%	762.34	761.85	770.00	770.34	28127	0.65	0.61	0.87	17.24	0.56	3.77	4.29	16.20	18.10	764.71	764.32	5.76	0.22	7.66	5.66	6.49	5.29
																	* Storm sewer from MH 113 to MH 122 is low flow and overflow route from Detention Basin 1. Storm sewer will be under pressure flow during overflow scenario.										
																	* Design Flow from MH 122 to CB 121 is allowable low flow release rate from West Basin (existing 10-year = 2.56 cfs)										
																	* See pressure flow calculations for Detention Basin 1 overflow capacity from MH 122 to MH 113										
	rdl	CB 118	6	27	4.30%	766.50	765.34	774.00	769.13	34454	0.79	0.67	0.90	15.00	0.71	0.71	4.55	3.24	1.16	775.44	766.46	5.93	0.08	7.50	7.00	3.29	-1.44
	CB 118	CB 117	12	124	1.00%	765.34	764.10	769.13	768.00	3811	0.09	0.05	0.60	15.00	0.05	0.76	4.55	3.47	3.56	769.03	767.86	4.54	0.46	3.79	2.79	2.90	0.10
	CB 117	CB 116	18	233	0.26%	764.10	763.49	768.00	772.00	65242	1.50	1.03	0.70	15.46	1.05	1.81	4.49	8.13	5.36	767.86	766.46	3.03	1.28	3.90	2.40	7.01	0.14
	CB 116	MH 115	18	126	0.26%	763.49	763.17	772.00	773.47	14320	0.33	0.27	0.78	16.74	0.26	2.07	4.35	8.98	5.36	766.46	765.54	3.03	0.69	8.51	7.01	8.80	5.54
	MH 115	MH 114-1	24	272	0.16%	763.17	762.73	773.47	773.57	0	0.00	-	0.78	17.43	0.00	2.07	4.27	8.83	9.05	765.54	765.12	2.88	1.57	10.30	8.30	8.84	7.93
	MH 114-1	MH 114	24	275	0.16%	762.73	762.29	773.71	773.57	0	0.00	-	0.78	17.43	0.00	2.07	4.27	8.83	9.05	765.12	764.71	2.88	1.59	10.98	8.98	9.28	8.59
	MH 114	MH 113	24	275	0.16%	762.29	761.85	773.57	770.34	0	0.00	-	0.78	19.00	0.00	2.07	4.11	8.50	9.05	764.71	764.32	2.88	1.59	11.28	9.28	6.49	8.86
Aquaswirl btwn	MH 113	Outlet 112	30	100	0.35%	761.85	761.50	770.34	764.00	0	0.00	-	0.78	20.59	0.00	5.84	3.96	23.13	24.27	764.32	764.00	4.94	0.34	8.49	5.99	0.00	6.02
										Area Subtotal =	6.52	5.49															
										Impervious	84%																
	rdl	CB 128	6	27	10.00%	771.50	768.80	774.00	773.15	38732	0.89	0.76	0.90	15.00	0.80	0.80	4.55	3.64	1.77	780.70	769.35	9.04	0.05	2.50	2.00	3.85	-6.70
	rdl	CB 127	6	27	10.00%	771.50	768.80	774.00	773.15	33296	0.76	0.65	0.90	15.00	0.69	0.69	4.55	3.13	1.77	777.03	768.65	9.04	0.05	2.50	2.00	3.85	-3.03
	rdl	CB 127-1	6	27	9.85%	771.50	768.84	774.00	773.15	28230	0.65	0.55	0.90	15.00	0.58	0.58	4.55	2.65	1.76	775.33	769.30	8.97	0.05	2.50	2.00	3.81	-1.33
	CB 127-1	CB 127	12	102	2.00%	768.84	766.80	773.15	773.15	2164	0.05	0.05	0.90	15.00	0.04	0.63	4.55	2.85	5.04	769.30	768.65	6.42	0.26	4.31	3.31	5.35	3.85
	rdl	CB 129	6	27	8.80%	771.50	769.13	774.00	773.15	58018	1.33	1.13	0.90	15.00	1.20	1.20	4.55	5.45	1.66	795.22	769.77	8.48	0.05	2.50	2.00	3.52	-21.22
	CB 129	CB 128	18	133	1.00%	769.13	767.80	773.15	773.15	4497	0.10	0.10	0.90	15.00	0.09	1.29	4.55	5.87	10.51	769.77	769.35	5.94	0.37	4.02	2.52	3.85	3.38
	CB 128	CB 127	18	83	1.20%	767.80	766.80	773.15	773.15	2968	0.07	0.07	0.90	15.37	0.06	2.15	4.50	9.69	11.51	769.35	768.65	6.51	0.21	5.35	3.85	4.85	3.80
	CB 127	FES 126	24	30	1.00%	766.80	766.50	773.15	768.50	2543	0.06	0.06	0.90	15.59	0.05	3.52	4.48	15.77	22.62	768.65	768.50	7.20	0.07	6.35	4.35	0.00	4.50
Gas Station	CB 103-2	MH 103	12	20	0.20%	762.46	762.42	766.10	766.45	16401	0.38	0.32	0.81	15.00	0.31	0.31	4.55	1.39	1.59	762.71	762.68	2.03	0.16	3.64	2.64	3.03	3.39
	CB 103-1	MH 103	12	18	0.40%	762.49	762.42	766.10	766.45	32524	0.75	0.54	0.72	15.00	0.54	0.54	4.55	2.45	2.25	762.76	762.68	2.87	0.10	3.61	2.61	3.03	3.34
Aqua-Filter	MH 103	MH 102	18	39	3.35%	762.42	761.11	766.45	766.45	0	0.00	-	0.72	15.10	0.00	0.84	4.53	3.83	19.23	762.68	762.62	10.88	0.06	4.03	2.53	3.84	3.77
	MH 102	Outlet 101	18	94	0.12%	761.11	761.00	766.45	762.50	0	0.00	-	0.72	15.16	0.00	0.84	4.53	3.82	3.64	762.62	762.50	2.06	0.76	5.34	3.84	0.00	3.83
										Area Subtotal =	1.12	0.87															
										Impervious	77%																
	Duke Culvert	Duke Culvert	18	95	3.16%	765.00	762.00	N/A	N/A	307632	7.06	0.94	0.37	49.36	2.59	2.59	2.35	6.08	18.67	763.82	763.50	10.56	0.15	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	CB 125-1	CB 125	24	315	0.30%	760.25	759.30	764.50	763.80	104158	2.39	1.38	0.63	49.54	1.50	4.09	2.34	9.57	12.44	761.42	760.86	3.96	1.33	4.25	2.25	2.50	3.08
	CB 125	CB 124	24	82	0.30%	759.30	759.05	763.80	763.37	19030	0.44	0.11	0.42	50.86	0.18	4.27	2.30	9.82	12.39	760.86	760.70	3.94	0.35	4.50	2.50	2.32	2.94
	CB 124	Ex CB 53	24	266	0.32%	759.05	758.20	763.37	761.81	4800	0.11	-	0.25	51.21	0.03	4.30	2.29	9.83	12.80	760.70	760.20	4.07	1.09	4.32	2.32	1.61	2.67
																	* 6" roof drain leads will not carry entire 10-year flow. For flows exceeding 6" capacity, water will overflow through roof scuppers, then drain to catch basins.										



paep
PAEP Architecture Engineering 1, Inc.
1811 4 Mile Rd N.E., Grand Rapids, MI 49525
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PROPOSED STORE
meijer STORE PBB
TOWN OF PLAINFIELD
HENDRICKS COUNTY, INDIANA

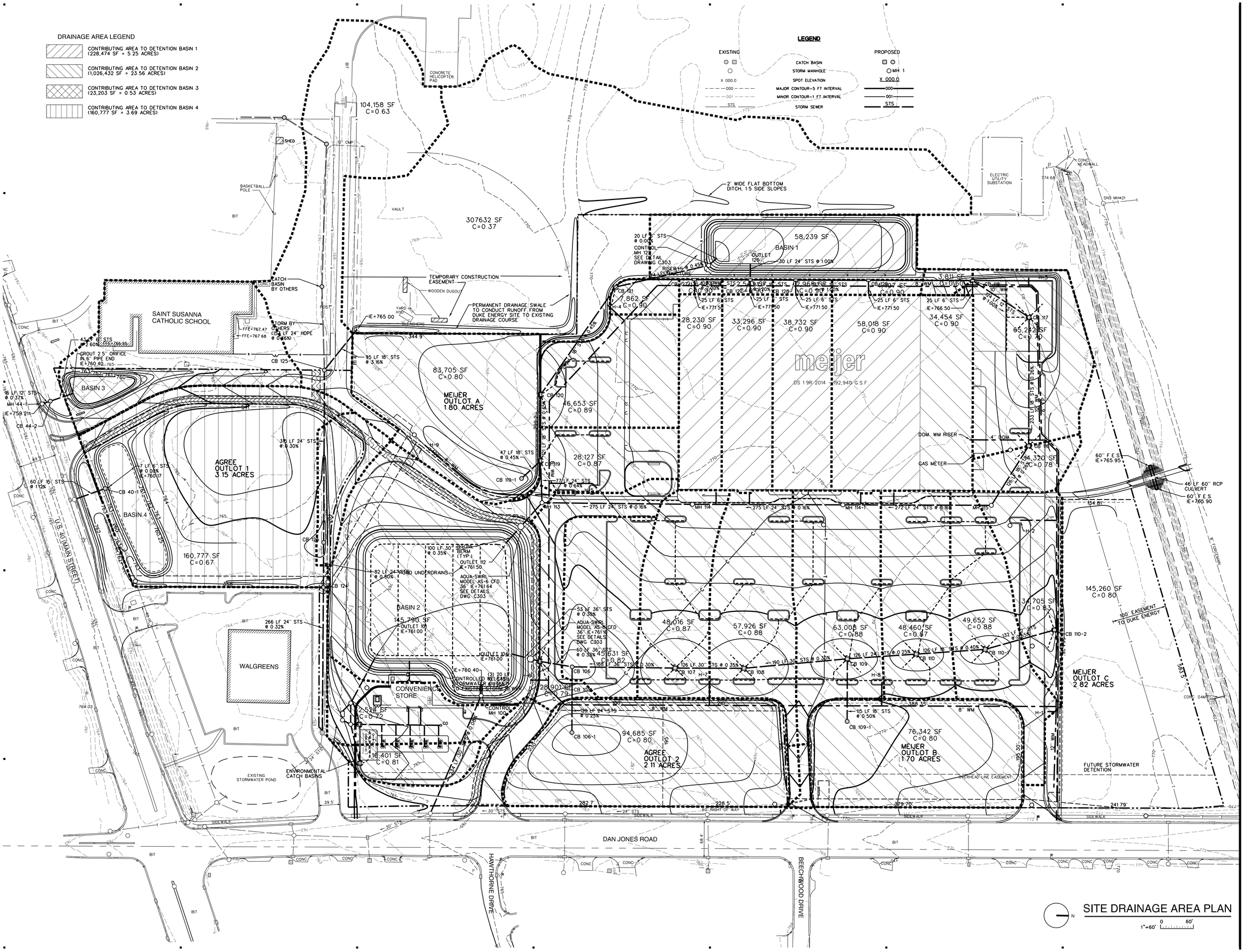
05/03/13	INFRASTRUCTURE PERMIT REVIEW	
12/21/12	REVIEW	
10/10/07	REVIEW	

EX SITE DRAINAGE PLAN
WITH PROPOSED LAYOUT

FILE NO 0425601
OWNER NO J0805442
STORE NO PBB

D1

5/2/2013 5:14:19 PM P:\0425601\PL1\D1.DGN DEFAULT



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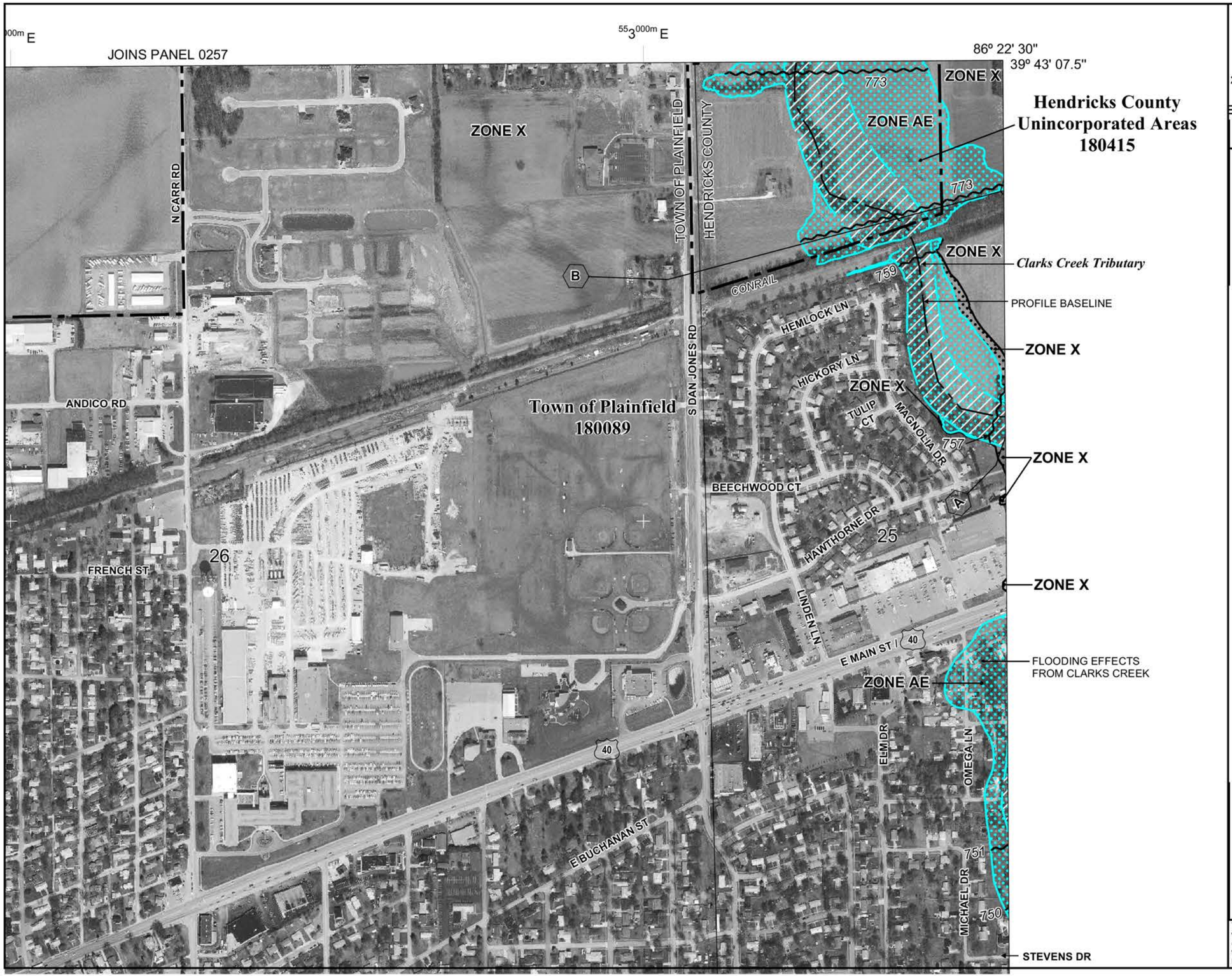
PROPOSED STORE
meijer STORE PBB
TOWN OF PLAINFIELD
HENDRICKS COUNTY, INDIANA

05/03/2013	INFRASTRUCTURE PERMIT
12/21/12	REVIEW
8/10/07	REVIEW
5/24/07	REVIEW

SITE DRAINAGE AREA PLAN

FILE NO 042560
OWNER NO J080S44256
STORE NO PBB

D2



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0259D

FIRM

FLOOD INSURANCE RATE MAP

HENDRICKS COUNTY, INDIANA
AND INCORPORATED AREAS

PANEL 259 OF 375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENDRICKS COUNTY	180415	0259	D
PLAINFIELD, TOWN OF	180089	0259	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
18063C0259D

EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Soil Map—Hendricks County, Indiana
(AGREE - MEIJER 256 DEVELOPMENT)

Map Scale: 1:2,120 if printed on B size (11" x 17") sheet.

N

Meters
0 10 20 40 60

Feet
0 50 100 200 300

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

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

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:2,120 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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 accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

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

Soil Survey Area: Hendricks County, Indiana
Survey Area Data: Version 16, Sep 25, 2012

Date(s) aerial images were photographed: 7/14/2003; 8/19/2003

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

Hendricks County, Indiana (IN063)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Bs	Brookston silty clay loam	16.8	34.3%
CrA	Crosby silt loam, 0 to 3 percent slopes	32.1	65.7%
Totals for Area of Interest		**48.9**	**100.0%**