Stormwater Quality Plan

City of Marshfield, Wisconsin

MSA Project No. R00584064

June, 2014

Prepared by:

MSA Professional Services, Inc.
2901 International Lane, Suite 300
Madison, WI 53704

"Your Trusted Partner"

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 2

3.0 WATER QUALITY MODELING 2

3.1 RAINFALL DATA 3

3.2 WINSLAMM POLLUTANT LOADING FILES 3

3.3 MODEL PARAMETER FILES 3

3.4WATERSHEDS, LAND USES, SOURCE AREAS, AND SOIL TYPES. 4

3.5WATER QUALITY MANAGEMENT PRACTICES 10

4.0 APPLICATION OF REGULATORY CONDITIONS TO WINSLAMM INPUT DATA 22

4.1EVELOPED URBAN AREA MODELING GUIDANCE 23

5.0 FINDINGS 25

5.1 MODEL RESULTS AND DISCUSSION 25

5.2 STREET SWEEPING EFFICIENCY 28

5.3 VEGETATED SWALE TREATMENT EFFICIENCY 28

5.4 CATCH BASIN TREATMENT EFFICIENCY 29

5.5 STRUCTURAL BMP PERFORMANCE 31

6.0 RECOMMENDATIONS 34

©June 2014 MSA Professional Services, Inc.

LIST OF TABLES

TABLE 1 1
TABLE 2 5
TABLE 3 7
TABLE 4 8
TABLE 5 9
TABLE 6 10
TABLE 7 13
TABLE 8 24
TABLE 9 25
TABLE 10 25
TABLE 11A 26
TABLE 11B 26
TABLE 11C 27
TABLE 12 28
TABLE 13 28
TABLE 14 30
TABLE 15A 32
TABLE 15B 33
TABLE 15C 33
TABLE 16 35
TABLE 17 36

LIST OF APPENDICES

APPENDIX A – Maps
APPENDIX B – Street Sweeping and Catch Basin Cleaning Data
APPENDIX C – Swale Density Data
APPENDIX D – Swale Infiltration Rate Assessment
APPENDIX E – Catch Basin Density Data
APPENDIX F – Catch Basin Starting Sediment Depth Analysis
APPENDIX G – Outfall BMP Geometric Data
APPENDIX H – WDNR Model Guidance for Compliance with NR151/NR216
APPENDIX I – Concept Plans for Future BMPs
APPENDIX J – Concept Plan Preliminary Cost Estimates
APPENDIX K – Summary Output Tables

©June 2014 MSA Professional Services, Inc.

1.0 EXECUTIVE SUMMARY

This report documents the findings of a study conducted for purposes of determining the City of Marshfield's compliance with Total Suspended Solids reductions in accordance with NR216.07(6)(b) and NR151.13. The standards outlined within these two chapters require that regulated communities, including the City of Marshfield, achieve 20% and 40% reductions in total suspended solids in runoff that enters waters of the state according to a certain schedule. For the City of Marshfield, the compliance date for achieving a 20% reduction was 2008. 2011 Wisconsin Act 32 amended the language of applicable state statutes prohibiting establishing a date by which a community must achieve compliance with the 40% reduction standard.

The findings of this study are taken from a detailed WinSLAMM Version 10.0.3 water quality model of the City. The model was used to evaluate TSS (and Total Phosphorus) reduction provided by the City's extensive network of roadside swales, catch-basin-inlets to the storm sewer system, and 83 existing 'end-of-pipe' structural stormwater management facilities within the City's stormwater management system. The model was also used to evaluate the City's current street sweeping program.

The modeling completed as part of this project was conducted on a watershed specific basis. There are three major watershed boundaries which divide the City of Marshfield; they are the Upper Yellow River, the Little Eau Pleine River, and Mill Creek. The results from each model describing the 'regulated TSS load' were taken from each model and summed across the entire study area to produce the data presented in Table 1.

TABLE 1
City of Marshfield Current Total Suspended Solids Reduction Performance

Combined Study Area	Area	Total Load		TSS Removed by Existing BMPs	
	acres	tons/yr.	lbs./ac/yr.	tons/yr.	%
Total All Watersheds	**8,804.9**	996.6	226.4	322.0	32.3%
City Limits	**8,568.7**	986.5	230.3	319.4	32.4%
NR151 Regulated Area	**7,012.6**	950.3	271.0	308.0	32.4%

With its current management practices, the City of Marshfield achieves 32.4% TSS reduction within the NR151-regulated areas of the City. This exceeds the current requirements of NR151.

It is anticipated that the approval of the Wisconsin River Total Maximum Daily Load (TMDL) study currently being developed by the WDNR will result in required pollutant load reductions specific to each major watershed in the City. These requirements may exceed current standards of NR151. In anticipation of potential additional requirements, this report also evaluated the effectiveness of 13 new

© June 2014 MSA Professional Services, Inc.

water quality BMPs and modifications to 8 existing BMPs at removing additional TSS. Cumulatively, these BMPs could achieve an estimated TSS reduction of 99 tons/year (TSS Load within City limits).

2.0 INTRODUCTION

The City of Marshfield is required to obtain a Wisconsin Pollution Discharge Elimination System (WPDES) Phase II permit to discharge stormwater runoff from the City's Municipal Separate Storm Sewer System (MS4) and comply with the standards specified in Wisconsin rules NR151 and NR216. NR216.07(6)(b) and NR151.13(2)(b) collectively require regulated municipalities to achieve 20% and 40% reductions in total suspended solids in runoff that enters waters of the state according to a certain schedule. For the City of Marshfield, the compliance date for achieving a 20% reduction was 2008. 2011 Wisconsin Act 32 amended the language of applicable state statutes prohibiting establishing a date by which a community must achieve compliance with the 40% reduction standard. This report documents the findings of a modeling study conducted for purposes of determining the City of Marshfield's compliance with TSS reductions standards.

3.0 WATER QUALITY MODELING

The findings of this study are taken from a detailed WinSLAMM Version 10.0.3 model of the City's stormwater management system. WinSLAMM is a Wisconsin Department of Natural Resources (WDNR) approved model recommended for use in determining TSS removal rates from stormwater management practices for assessment of compliance with WPDES requirements (see notation NR216.07(6)(b) – "The department believes that computer modeling is the most efficient and cost effective method for calculating pollutant loads. Pollutant loading models such as [Win]SLAMM, P8 or equivalent methodology may be used to evaluate the efficiency of the design in reducing total suspended solids.") 'WinSLAMM' abbreviates "Source Loading and Management Model [for Windows]."

SLAMM was originally developed to better understand the relationships between sources of urban runoff pollutants and runoff quality. It has been continually expanded since the late 1970s and has been revised to include a wide variety of source area (runoff and pollutant generators) and outfall control practices (runoff and pollutant management practices). SLAMM is based on actual field observations and has minimal reliance on theoretical processes.

Input data required by WinSLAMM for each model application includes a number of data files that describe local meteorological and hydrological conditions and pollutant loading characteristics. These files are prescribed for use in the WinSLAMM model by the USGS Wisconsin Water Science Center and include parameter files for rainfall, pollutant distribution, runoff coefficients, particulate solids concentrations, and pollutant delivery data.

© June 2014 MSA Professional Services, Inc.

3.1 RAINFALL DATA

The USGS has evaluated rainfall data collected across the state of Wisconsin for many years and has identified annual rainfall records for five locations in the state that are felt to be representative of typical rainfall precipitation conditions. For Marshfield, the closest rainfall record recommended for use in water quality modeling is the Green Bay five year rainfall record starting in 1968 (a five-year model run is specified by WDNR for evaluations which include street sweeping). Modeling protocols established by WDNR require elimination of the winter season (where precipitation principally falls as snow or ice) from the model simulation as WinSLAMM cannot accommodate snowfall and runoff from snowmelt events. The range of winter dates applicable to the Green Bay rainfall data run from November 25 to March 29. Thus, any single-year simulation runs from March 30 to November 24.

3.2 WinSLAMM POLLUTANT LOADING FILES

Pollutant loading files required by the WinSLAMM model include a *Pollutant Probability Distribution File, Runoff Coefficient File, Particulate Solids Concentration File, Particulate Residue Reduction File, and a Street Delivery Parameter File.*

The *Pollutant Probability Distribution File* describes the pollutant loading from different source areas (land use types). This data is based upon actual pollutant loading collected from the study area or region.

The *Runoff Coefficient File* describes parameters specific to different source areas (land use types) that determine the runoff volumes resulting from rainfall events of different depth.

The *Particulate Solids Concentration File* contains parameters allowing the WinSLAMM model to determine the weight of particulate solids loadings resulting from runoff events of different volumes. The particulate solids concentration file includes data measured by the USGS from source areas including residential, commercial, and industrial rooftops; residential lawns; residential driveways; residential, commercial and industrial streets; commercial and industrial parking lots; freeways; and undeveloped areas.

The *Particulate Residue Reduction File* describes the fraction of total particulates that remains within the drainage system after rainfall events and so do not reach the system outfall.

The *Street Delivery Parameter File* contains data describing the fraction of total particulates that do not reach the outfall during a rain event, for different rain depths and street textures.

3.3 MODEL PARAMETER FILES

The following model parameter files were entered into the WinSLAMM model(s) for evaluation of the City of Marshfield's stormwater management system.

© June 2014 MSA Professional Services, Inc.

Rainfall Files -	***WisReg – Green Bay Five Year Rainfall.ran***
Pollutant Probability Distribution File -	***WI_GEO01.ppdx***
Runoff Coefficient File -	***v10 WI_SL06 Dec06.rsv***
Particulate Solids Concentration File -	***WI_avg01.pscx***
Street Delivery File:	
Residential/Other -	***WI_Res and Other Urban Dec06.std***
Institutional/Commercial/Industrial -	***WI_Com Inst Indust Dec06.std***
Freeway -	***Freeway Dec06.std***

3.4 WATERSHEDS, LAND USES, SOURCE AREAS, AND SOIL TYPES.

Watersheds are the sources of runoff and pollutants simulated by the program. WinSLAMM Version 10 is capable of modeling complex systems of interconnected *watersheds* each of which can contain up to six discrete *land uses*; residential, institutional, commercial, industrial, freeway, and other urban areas. Each land use contains specific runoff and pollutant *source areas* including roofs, paved parking/storage areas, unpaved parking/storage areas, playground, driveways, sidewalks/walks, street areas, landscaped areas (small and large), undeveloped areas, isolated/water body area, other pervious areas and impervious areas (directly connected and indirectly connected). Each source area is further categorized by *soil texture*, including sand, silt, and clay soil types.

3.4.1 Determination of Watershed Boundaries

For this study, watershed areas draining to existing or proposed water quality management practices were delineated using the GIS program ArcMap 10. Delineation of watersheds was completed using two-foot contour interval topographic maps overlaid with storm sewer and surface drainage system maps provided by the City of Marshfield.

The water quality modeling study area includes the entire city limits and those areas outside the city limits that drain via sheet flow or constructed draining infrastructure to an existing or proposed structural water quality management practice within the City. Map-1, 'Study Area Limits' and Map-7 'Existing and Proposed Structural BMPs' identify the limits of the study area and the subwatersheds within the study limits. These maps can be found in Appendix A.

3.4.2 Development of WinSLAMM Land Use Data

The City provided MSA with a GIS Land Use data layer file describing land use within the City. Each parcel within the City was assigned a unique land use. Not all these land uses are supported by WinSLAMM and so MSA performed some minor reclassification to fit the definitions which are allowed by WinSLAMM. Table 2, on the following page, documents this reclassification.

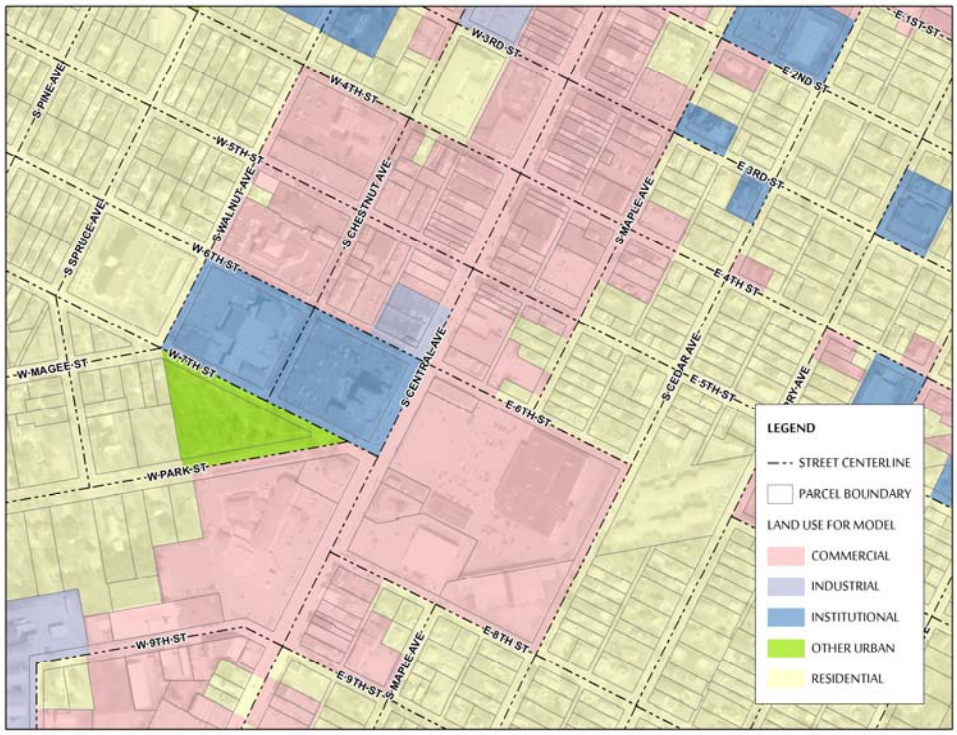
For street right-of-way (ROW) areas, MSA created a generalized 'ROW' polygon

(covering all regions not classified within the original land use dataset – i.e. areas not defined as parcels). This new polygon was then divided along the street centerlines with the resulting pieces assigned land use according to the classification of the adjacent parcel. Figure 1, below, provides an example of how this was accomplished:

Table 2
Correlation of City GIS Land Use to WinSLAMM Land Use

City GIS Land Use Classification	WinSLAMM Land Use Classification
Agricultural	Other Urban
Commercial	Commercial
Industrial	Industrial
Institutional	Institutional
Open Space	Other Urban
Recreational	Other Urban
Residential	Residential
Water	Special
Wooded	Other Urban

Figure 1
Illustration of how Land Use Classifications were assigned to ROW areas.



Areas that were not covered by the dataset provided by the City were added manually, using a combination of Wood County parcel data and visual interpretation of aerial photographs.

Map-2 in the Appendix A identifies WinSLAMM land uses within the study area.

3.4.3 Development of WinSLAMM Source Area Data

The City provided MSA with planimetric data in GIS format covering the entire study area (data provided extends beyond the City limits). The data was composed of some 'line' work and some 'polygon' work which needed to be compressed into a single polygon dataset so that the areas of each individual source area could be determined. Significant amounts of the planimetrics data overlapped, therefore the data was 'cleaned' by assigning a single WinSLAMM Source Area to these regions. Typically 'impervious' overruled 'pervious' source areas to be conservative within the model.

Table 3, on the following page, indicates how the input data was classified within the model:

Map-3 identifies WinSLAMM source areas within the study area.

In addition to requiring the size and type and size of source area data, it was necessary to describe the level of 'connectedness' that each source had had to the stormwater drainage system. This data was not available from the City and would have required a substantial effort beyond the scope of this project to develop. Fortunately, the WinSLAMM model comes with several built in 'Standard Land Use' files which describe the distribution of typical source areas – and their individual connectedness – within various land use types. MSA extracted and summarized data describing the connectedness of impervious areas for individual source areas from these standard land use files and applied them to the source area data developed using the City's planimetric data. Table 4, on page 8, documents the connectedness applied to impervious areas occurring within each land use applied in the Marshfield WinSLAMM models.

© June 2014 MSA Professional Services, Inc.

Table 3
Correlation of City GIS Planimetric Data to WinSLAMM Source Area Data

Surface Type	Pavement Type	Structure Type	WinSLAMM Source Area	Original Data Source
Alley	Paved	Non-Structure	Paved Street Area	Planimetrics
Alley	Unpaved	Non-Structure	UnPaved Street Area	Planimetrics
Athletic Court	Paved	Non-Structure	Playground	Planimetrics
Athletic Field	Paved	Non-Structure	Small Landscaped Area	Planimetrics
Athletic Track	Paved	Non-Structure	Playground	Planimetrics
Bike Path	Paved	Non-Structure	Sidewalks/Walks	Planimetrics
Bike Path	Unpaved	Non-Structure	Sidewalks/Walks	Planimetrics
Bridge Deck	Paved	Non-Structure	Paved Street Area	Planimetrics
Courtyard	Paved	Non-Structure	Sidewalks/Walks	Planimetrics
Deck	Unknown	Non-Structure	Sidewalks/Walks	Planimetrics
Driveway	Paved	Non-Structure	Driveways	Planimetrics
Driveway	Unpaved	Non-Structure	Driveways	Planimetrics
Footbridge	Paved	Non-Structure	Sidewalks/Walks	Planimetrics
Median	Unpaved	Non-Structure	Small Landscaped Area	Planimetrics
Median	Paved	Non-Structure	Paved Street Area	Planimetrics
Park	Unpaved	Non-Structure	Large Landscaped Area	Planimetrics
Parking	Paved	Non-Structure	Paved Parking/Storage	Planimetrics
Parking	Unpaved	Non-Structure	Unpaved Parking/Storage	Planimetrics
Patio	Unknown	Non-Structure	Sidewalks/Walks	Planimetrics
Paved Area	Paved	Non-Structure	Paved Parking/Storage	Planimetrics
Ponded Water	Unpaved	Non-Structure	Isolated/Water Body Area	Planimetrics
Road	Paved	Non-Structure	Paved Street Area	Planimetrics
Road	Bridge	Non-Structure	Paved Street Area	Planimetrics
Road	Unpaved	Non-Structure	UnPaved Street Area	Planimetrics
Runway	Paved	Non-Structure	Other Impervious (Airport)	Planimetrics
Shoulder	Paved	Non-Structure	Paved Street Area	Planimetrics
Shoulder	Unpaved	Non-Structure	UnPaved Street Area	Planimetrics
Sidewalk	Paved	Non-Structure	Sidewalks/Walks	Planimetrics
Storage Area	Unknown	Non-Structure	Unpaved Parking/Storage	Planimetrics
Structure	Paved	Building	Roofs	Planimetrics
Structure	Paved	Foundation	Roofs	Planimetrics
Structure	Paved	Overhead Structure	Roofs	Planimetrics
Structure	Paved	Silo	Roofs	Planimetrics
Structure	Paved	Tank	Roofs	Planimetrics
Structure	Paved	Propane Tank	Roofs	Planimetrics
Structure	Unpaved	Ruin	Sidewalks/Walks	Planimetrics
			Undeveloped Area	Land Use
			Undeveloped Area	Land Use
			Large Landscaped Area	Remaining Area

© June 2014 MSA Professional Services, Inc.

Table 4
Connectivity of Impervious Source Area

WinSLAMM Land Use Classification	**Commercial**		**Industrial**		**Institutional**		**Residential**		**Other Urban**	
Original WinSLAMM Standard Land Use[1]	**Strip Commercial**		**Light Industrial**		**Institutional**		**MDR No Alleys**		**MDR No Alleys[2]**	
Source Area	**Directly Connected Impervious Area**	**Unconnected Impervious Area**	**Directly Connected Impervious Area**	**Unconnected Impervious Area**	**Directly Connected Impervious Area**	**Unconnected Impervious Area**	**Directly Connected Impervious Area**	**Unconnected Impervious Area**	**Directly Connected Impervious Area**	**Unconnected Impervious Area**
Roofs[3]	100.0%	0.0%	91.0%	9.0%	96.0%	4.0%	30.0%	70.0%	30.0%	70.0%
Paved/Unpaved Parking/Storage	96.7%	3.3%	83.4%	16.6%	90.5%	9.5%	100.0%	0.0%	100.0%	0.0%
Driveways	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	73.7%	26.3%	73.7%	26.3%
Sidewalks/Walks	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	50.0%	50.0%	50.0%	50.0%
Paved/Unpaved Street Area	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%
Other Impervious (Airport)[4]	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
Playground[4]	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
Landscaped Area[4]	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
Isolated/Water Body Area[4]	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
Undeveloped Area[4]	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%

1. WinSLAMM Standard Land Use File used as template for impervious area connectivity

2. MDR-No Alleys used to determine connectivity of land uses not fitting into other categories. Reports from WDNR (validated in this study) indicate that MDR-No Alleys is typical of most urban areas.

3. All residential roofs assumed to be pitched. All non-residential roofs assumed to be flat

4. Any impervious area found within *playgrounds, landscaped area, water body, or undeveloped* land uses assumed to be unconnected.

3.4.4 Development of WinSLAMM Soil Texture Data

WinSLAMM requires that the soil underlying all source areas be classified by texture as *sand, silt, or clay*. The WinSLAMM 'Frequently Asked Questions (FAQ)' document on the WinSLAMM web site (http://winslamm.com/faq.html) states that soil textures are to be assigned according to the hydrologic soil group (HSG) assigned each soil type by to the USDA county soil atlas; 'When we set up the soil classifications clayey, silty and sandy, we assumed that they would correspond to the SCS classification A, B, C, and D soils, with: A – Sandy, B – Silty, C and D - Clayey.'

Table 5, below, identifies the soil types within the project study area identified in the Wood and Marathon County Soil Atlases and identifies the soil texture class assigned to each soil for entry into WinSLAMM according to the relationship described above. Soils with a dual classification such as B/D indicate the HSG of the soil in a drained and undrained condition, respectively. With one exception described below, soils were assumed to be drained as this is a common condition in urban areas.

Table 5
Study Area Soil Textures

Soil Map Unit	Soil Name	Hydrologic Soil Group (HSG)	WinSLAMM Soil Texture
Ab	Alluvial land, wet	B/D	Silt
EaB	Eaupleine silt loam, 2 to 6 percent slopes	B	Silt
FgB	Fenwood-Rozellville silt loams, 2 to 6 percent slopes	B	Silt
Fh	Fordum silt loam, 0 to 1 percent slopes	D	Clay
LoB	Loyal silt loam, 1 to 6 percent slopes	C	Clay
LoC	Loyal silt loam, 6 to 12 percent slopes	C	Clay
Ma	Mann silt loam	B/D	Silt
Mc	Markey mucky peat	A/D	Silt[1]
Mf	Marshfield silt loam	B/D	Silt
MfA	Marshfield silt loam, 0 to 3 percent slopes	B/D	Silt
SaB	Santiago silt loam, 2 to 6 percent slopes	B	Silt
SaC	Santiago silt loam, 6 to 12 percent slopes	B	Silt
UoB	Udorthents, loamy, gently sloping	B	Silt
W	Water		Silt/Clay[2]
WeA	Withee silt loam, 0 to 2 percent slopes	C	Clay
WeB	Withee silt loam, 2 to 6 percent slopes	C	Clay
WtA	Withee silt loam, 0 to 3 percent slopes	C	Clay

1. Markey mucky peat, which occupies 0.6 acres within the study area was reclassified as silt texture for simplicity of modeling.
2. Water areas were manually reclassified according to the HSG of neighboring soils.

There were two exceptions to the approach described above for the application of soil textures to the study area:

- Soils identified in the county soil atlases as 'water' do not have an assigned HSG. These areas were manually reclassified to the match the HSG and soil texture of adjacent soil types
- One very small area (0.6 acres) of HSG A/D soils was reclassified as silt soil. This was done for purposes of simplicity of data entry.

Approximately 91.0% of the project study area has clay texture soils; while the remaining 9% has silt texture soils. Map-4 identifies WinSLAMM soil textures within the study area.

3.5 WATER QUALITY MANAGEMENT PRACTICES

WinSLAMM allows for assignation of water quality management practices for individual *source areas* within a land use type, within the *drainage system* serving the watershed, or at the '*outfall*' (point of discharge of the watershed). The City of Marshfield contains a great number of water quality management practices, all of which have been included in this model to the maximum extent practicable. Each practice was input into the model according to the structure identified in Table 6, below:

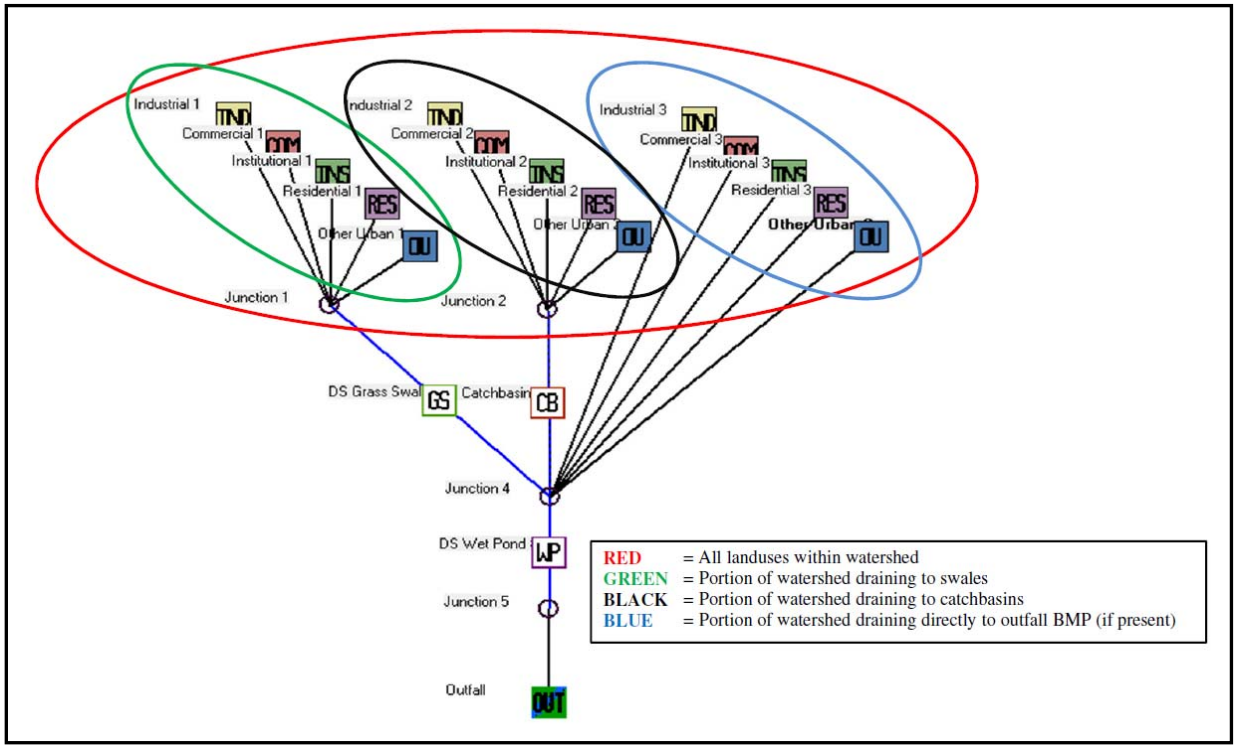
Table 6
Application of BMPs within WinSLAMM Model network

Practice	Level of Application within WinSLAMM
Street Sweeping	Source Area (Street)
Catch Basins	Drainage System
Vegetated Swales	Drainage System
Detention Ponds (Wet/Dry)	Outfall
Biofilters	Outfall
Hydrodynamic Device (Stormceptor)	Outfall

The structure of any WinSLAMM model follows a cascading pattern; starting first with land uses which contain source areas; these are then connected to drainage system elements; and finally, outfall system elements. Figure 2, below, presents a typical example of how any individual subwatershed in the City of Marshfield WinSLAMM model might be expected to be constructed. The model nodes which are circled represent nodes describing drainage areas for various land uses and source areas. Each possible land use is included multiple times in the model network to reflect the portion of each watershed which drains to a system of catchbasins or swales or which drains to neither type of system (and direct to an outfall device). Collectively all three drainage network types are collected in a single junction and routed to the pond or other outfall device which receives runoff and pollutant loads from the entire subwatershed. Note; not all land uses, drainage system BMPs, or outfall BMPs are

found in every subwatershed.

Figure 2
Example WinSLAMM model Network Subwatershed Level



3.5.1 Application of Street Sweeping in WinSLAMM

Street sweeping is a management practice applied at the *street source area* level within the WinSLAMM model and was the only management practice evaluated in this manner.

WinSLAMM is capable of modeling both mechanical and vacuum-assisted street sweeping. Sweeping intervals may be altered and sweeping may be evaluated with and without parking restrictions. Parking restrictions assume that cars are not allowed to park on streets on days when sweeping is to occur.

Street sweeping data was provided by the City of Marshfield Engineering Department (see Appendix B). The City uses a regenerative 'vacuum-assisted' street sweeper. The City indicates that the following streets are swept weekly:

- Streets Swept Weekly
  - Roddis Avenue and Central Avenue from 29th Street to McMillan
  - Veterans Parkway from 8th Street to Oak Street
  - Downtown streets and alleys bounded by 7th Street and Blodgett Street (Chestnut and Maple inclusive)

- All other streets with curb and gutter are swept biweekly.

All streets served by swales, cemetery roadways, and roadways within the fairgrounds are swept twice per year. Some downtown parking lots are reported to be swept also. However as WinSLAMM evaluates street sweeping according to 'curb-length' of street swept, it is unable to accommodate sweeping of any of these areas.

MSA used the street centerline GIS dataset, along with the PASER table to locate the specific roads that were swept weekly. Alleys were also added to this dataset. The remaining streets that indicated the presence of a 'curb' within the PASER data were assumed to be swept bi-weekly. Map – 5 indicates the location and frequency of street sweeping applied to the WinSLAMM model.

Earlier discussion described how source areas within the City were determined using GIS data. This exercise resulted in a GIS dataset which provided the areas of each discrete. source area. As mentioned previously, WinSLAMM evaluates street sweeping according to the 'curb-length' of street swept. For street with curb on both sides, the 'curb-length' is twice the street length. The City of Marshfield provided road centerline data in GIS format which indicates the road surface width for most segment. Within the study area, the dataset contains 821,430 ft. of road; however, only 728,871 ft. (89% of the total) had an associated 'surface width' attribute. Since this didn't describe the entire City it was necessary to extrapolate data to describe segments with no reported width.

The WinSLAMM land use dataset described earlier was used to assign a land use to roads that intersected each land use type. A weighted average (by length) of surface width was determined for each land use, excluding any road segments that did not have a 'surface width' attribute. Roads that intersected multiple land use types were used within all of the appropriate land use averages. It was noted that a large number of residential streets intersected commercial areas, without actually paralleling commercial parcels. Therefore, any roads that did not significantly parallel commercial land were removed from the estimated surface width for the commercial average.

Table 7, below, documents the Marshfield specific street surface width according to the five land use classification used within the WinSLAMM model. Also presented in the table are the street widths within published 'standard land uses' supplied with the WinSLAMM model.

Table 7
Street Width Data

WinSLAMM Standard Land Use Data				Marshfield GIS Data
General Land Use Classification	**Specific Land Use**	**Average Street Width (ft.)**	**Average Street Width (ft.)**	**Average Street Width (ft.)**
Residential	High Rise	29.8	28.8	30.5
	High Density with Alleys	26.9		
	High Density without Alleys	30.6		
	Mobil Homes	111.4		
	Duplex	31.4		
	Medium Density without Alleys	30.9		
	Medium Density with Alleys	26.2		
	Multifamily	30.8		
	Low Density	25.5		
	Suburban	27.4		
Commercial	Office Park	52.3	53.8	40.5
	Strip	42.4		
	Downtown	59.8		
	Shopping Center	60.6		
Institutional	Miscellaneous	34.6	34.8	34.0
	Schools	35.7		
	Hospital	34.1		
Industrial	Light	35.3	35.6	37.4
	Medium	35.9		
Other Urban Area	Parks	26.9	28.8	31.9
	Cemetery	32.1		
	Open	27.6		

When data was entered into the WinSLAMM model, curb length was automatically determined by the model as the value resulting from total area divided by width times two.

A final parameter which must be described prior to simulating a street sweeping program is the parking density. The City reports that streets are swept at night; and that overnight on-street parking is allowed, but is not very common. As such, a 'light' parking density classification was assigned to all streets in the City. WinSLAMM assumes that light parking density exhibits, 'significant spacing between parked cars such that street

cleaners can easily get to the curb, between cars, for significant sections of the street.

All paved streets were entered as having an intermediate texture. Unpaved streets were entered as having a rough texture. Built-in default parameters for 'street dirt accumulation' were selected for all street types.

3.5.2 Application of Vegetated Swales in WinSLAMM

WinSLAMM requires several input parameters in order to evaluate the effectiveness of vegetated swales at reducing pollutants in stormwater runoff. These parameters include; drainage area, swale density (expresses as length of swale per acre), average swale geometry (bottom width, side-slope, longitudinal slope), vegetation height, flow retardance factor, and infiltration rate.

3.5.2.1 Determining Swale Drainage Area and Density

The principal input parameters of drainage area and swale densities were determined using GIS. The GIS dataset provided by the City included a file indicating the location of drain-tiles in the City; many of which were associated with roadside swales. However, the majority of roadside swales do not have tile underdrains so this data set was not sufficient on its own to identify all locations in the City where swales are present. It was determined from discussions with the City that swales are located along all streets that are not curbed. MSA created a preliminary map displaying assumed swale locations based on street centerline data set which has an attribute that indicates the presence of curb or lack thereof.

Swale Density. To determine swale density it was first necessary to determine the lengths of swales in the City; and subsequently within each subwatershed. To generate linework describing the location and extent of swales in the City, MSA used a combination of the street centerline dataset and the drain tile dataset:

- Non-curbed street centerlines (incorporating edits from the City) were buffered by ½ ROW minus 10 ft. (ROW determined from centerline PASER data). This buffer width was selected to place the edge of the buffer within the approximate location of the bottom of any roadside swale. Streets where ROW width data was unknown were generally assumed to have a 60 foot ROW. Some road segments were assumed to have a larger ROW based an aerial imagery and those with illogical ROW were adjusted also based on aerials. The resulting 'buffer' polygon dataset was converted to linework. This linework was the 'first cut' at a roadside swale alignment map.

- The 'first-cut' roadside swale alignment map was first refined by eliminating areas of conflict between drain systems serving curbed streets. This was accomplished by creating another buffer around curbed streets. In this case curbed-street centerlines were buffered by the pavement width (obtained from the PASER dataset) plus 20 feet. Any of the generated 'swale' linework was erased where it intersected this 'curbed-street buffer'.
- A second revision to the preliminary roadside swale linework was completed by removing the '1/2 circle' end to the buffer which occurred at the end of dead-end streets.
- The third revision involved incorporation of the City's original drain-tile linework. Since the 'drain-tile' dataset provided by the City was assumed to be more accurate than the swale data generated in the above process, any area where the roadside-swale linework was overlaid by the drain-tile linework was replaced with drain-tile linework.
- Finally, as above, any 'drain-tile in ditch' linework that fell within the 'curbed-street' buffer' was removed from the final swale dataset.

This map was provided to the City and comments received were incorporated into a final GIS layer depicting the location of swales in the City.

Drainage Areas Tributary to Swales. Once the extent and alignment of roadside swales was defined it was necessary to determine subwatershed areas draining to swales. Because of the interconnected nature of the storm sewer and roadside swale systems, and the complicating factor that some portions of any subwatershed may be drained by swales or by storm sewers with catch basin inlets or by neither, completing this exercise manually would have required effort beyond the scope of this study. Instead, drainage areas tributary to roadside swales (and catch basins) were determined on a parcel-by-parcel basis using automated GIS tools.

- The first step in the process was to identify parcels which were obviously not served by either catchbasins or swales. A visual observation of the City showed that it appeared that most undeveloped parcels (agricultural, wooded, recreational, open space) were not served by swales. It was therefore assumed that these 'other urban' land uses were not served by either roadside swales or catchbasins.

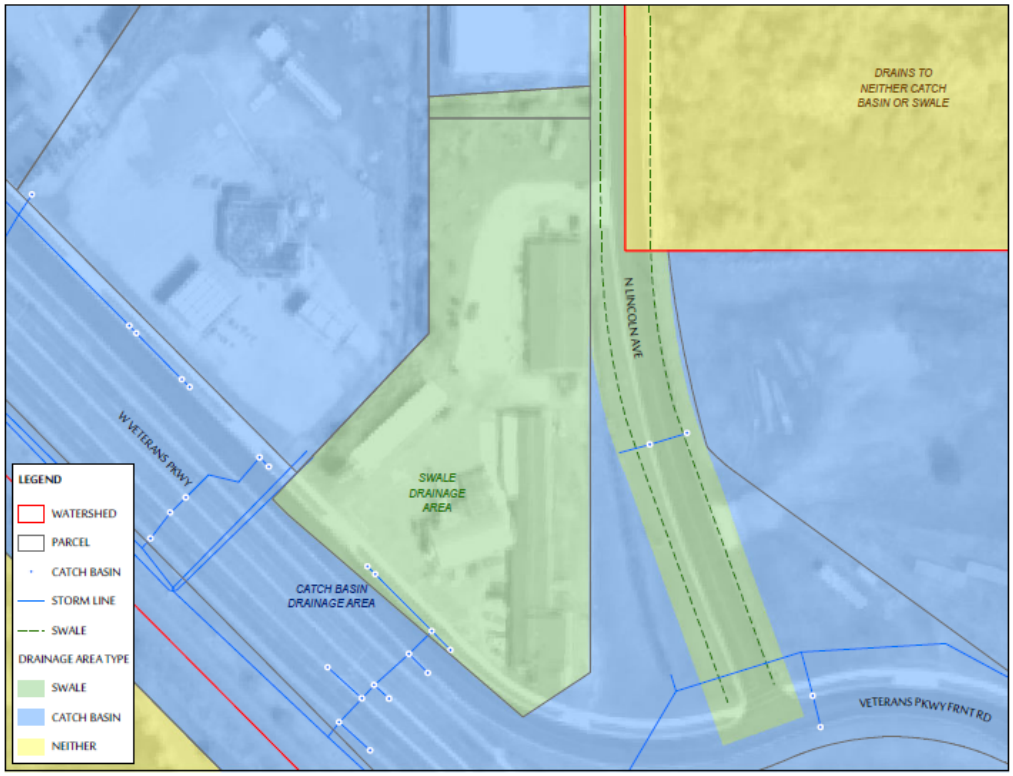
- GIS processing was completed to determine the centroid of each parcel not classified as 'other urban' land use. The drainage classification of

each parcel was classified according to whether the centroid of the parcel was closer to a roadside swale line or a storm sewer line.

- On occasion, because of the specific layout of parcel centroid and swale and storm sewer alignments there were isolated cases where a single parcel, or small group of parcels classified as either 'drained by swale' or 'drained by catchbasins' were surrounded by parcels of opposite classification. In these cases it was assumed that swale drainage trumped catch basin drainage.

Because this process was completed on a parcel-by-parcel method, when watershed boundaries were applied to determine the actual area tributary to each type of drainage system there were occasionally small portions of parcels served by either swales or catch basins that appeared within watershed that contained no swales or catchbasins. In these cases, during model data entry, these portions of each watershed were manually added to the portions of the watershed draining directly to the watershed outfall. Figure 3, below, demonstrates such an instance.

Figure 3
Image of 'Parcels Served by Swales' overlapping into watershed with no swales



Map-6 identifies the location of vegetated swales and areas served by swales within the study area. Appendix C summarizes swale densities applied to each subwatershed in the study area.

The resulting exercise identifies 2,650 acres of the City are served by approximately 118 miles of vegetated swales with an average swale density of 235 feet per acre. These swales serve 29 of the 92 watersheds evaluated in this study (although 2 watersheds contain negligible swale-drained areas), with swale densities ranging from 13 feet per acre to 2,600 feet per acre (ignoring the two previously described outlier watersheds).

3.5.2.2 Determining Swale Geometry Data and Other Model Inputs

In June 2013, MSA conducted field inspections of several swales throughout the City of Marshfield. These inspections also included testing for infiltration rates using a double ring infiltrometer.

Typical Swale Geometry. MSA's observation of swale cross-sections revealed a typical bottom with of zero feet ('V-bottom') and a swale side-slope of approximately 4h:1v. This typical geometry was confirmed in discussion with City staff. Figure 4 presents a photograph of a typical roadside swale.

Figure 4
An example of a Typical Grassed Swale
(South Tamarack Avenue)

Swale

Longitudinal Slopes. A value describing the average slope of swales was determined for each watershed. The swale GIS linework described above was 'clipped' at subwatershed boundaries and each swale segment was assigned an average slope based on a digital elevation model (DEM) which was derived from the 2-foot contour maps provided by the City. The average swale slope by subwatershed was then determined by taking a weighted average by length of all the swale segments within each individual watershed.

Typical Grass Height and Swale Retardance Factor. The typical grass height was assigned to be 4-inches from visual observation. In January 2011, WDNR held a 'Consultant Round Table' where WDNR technical staff and the developers of the WinSLAMM model indicated that it was most appropriate to assign a retardance factor of 'D' to swales in residential lands. This value has been applied throughout the City.

Swale Dynamic Infiltration Rates. As mentioned previously, a series of infiltration tests were conducted on a set of swale within the City of Marshfield in June of 2013. The results of these tests are summarized in Appendix D of this report. A 'dynamic infiltration' rate of 0.2 inches/hour was assigned to all swale areas. The dynamic infiltration rate is equal to 50% of the measured static minimum value of 0.4 inch/hour observed for all swale sites tested. There is no notable correlation in observed minimum infiltration rates between swales with and without tile underdrains. As such underdrain conditions were ignored in this evaluation.

3.5.3 Application of Catch Basins in WinSLAMM

WinSLAMM requires several input parameters necessary to evaluate the effectiveness of catch basins at capturing pollutants carried by stormwater runoff. These parameters include; drainage area, catch basin density (expressed as the number of catch basins per acre), average catch basin geometry (cross-sectional area and depth) outlet pipe characteristics (diameter, slope, and roughness), accumulated sediment depth at the start of the simulation and leakage rate through the bottom of the sump.

3.5.3.1 Determining Areas Served by Catch Basins and Catch Basin Density

Catch Basin Drainage Area. The portion of any subwatershed served by catch basins was determined according to the steps itemized in Section 2.5.2.1 of this report.

Catch Basin Density. The location and characteristics of storm sewer structures with sumps were identified in the City's GIS database. Only inlets with sumps were included in the modeling since, per WinSLAMM model documentation, '*The model assumes that catchbasins with sumps are located at inlets or with*

minimal flow-through capability. Sumps that are constructed in series would have increasingly larger flow rates in each device, which is not what the program would be modeling.'

- Beginning with the 'StormInlet' GIS data late, MSA selected elements classified with a subtype of 'Catch Basin'.
- Because an overwhelming majority of catch basins had 18-inch sump depths within the GIS database, catch basins with "null" values for depth were assigned a sump depth of 18-inches.
- Catch basins were eliminated from the total if they met either of the following criteria:
    - Elements with values for depth of 12-inches or less were omitted as WinSLAMM requires that sumps have a more than 12-inches depth.
    - Elements with depth values greater than 12 feet were omitted.

The number of catch basins within the portion of any subwatershed served by catchbasins was determined by overlaying the subwatershed boundary on the 'parcels-served-by-catchbasins' layers in GIS. The number of catch basins spatial located within the union of these two boundaries was assigned to each subwatershed; and specifically to that portion of each subwatershed which is drained by a storm sewer system containing catch basins.

The resulting exercise identifies 3,374 acres of the City are served by 3,362 catch basins with an average catch basin density of almost exactly 1.0 catch basin per acre. Appendix E summarizes catch basin densities applied to each subwatershed in the study area.

3.5.3.2 Determining Catch Basin Geometry Data

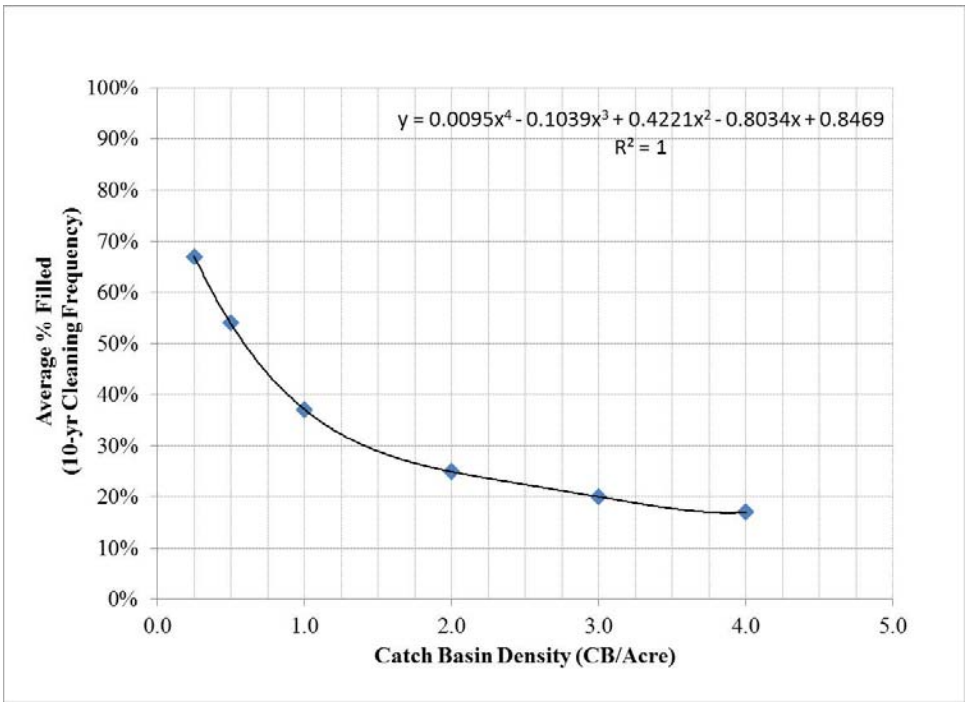
Catch Basin Sump Depth. The vast majority of catch basins remaining in the system after being screened per the previous section had depth values of 18-inches. For purposes of simplifying the model development process all catch basins (including those with 'null' values) were assumed to have an 18-inch sump depth.

Depth of Sediment in Sump At Beginning of Study. The depth of sediment in any catch basins sump is a function of the rate of accumulation of sediment within the sump and the frequency of cleaning of the sump. The City indicated that in 2012, 344 catch basins were cleaned; this is approximately 10% of all catch basins in the City and equates to roughly a 10-yr cleaning period.

The WinSLAMM model does not easily accommodate a rotating catch basin cleaning cycle; furthermore, data was not available indicating the precise rotation the City follows when cleaning catch basins, so it was impossible to determine the order by which specific catch basins were cleaned (and it is unlikely that the cleaning order accommodates watershed boundaries). Additionally, as WDNR requires that WinSLAMM models used for evaluation of street sweeping programs be solved using a 5-yr rainfall record it does not allow simulation of a long enough period such that the entire system of catch basins will be taken through a complete cleaning cycle.

Since all catch basins are not cleaned at once, each catch basin in the City's system will have different amounts of accumulated sediment at any one time. As there is no cost-effective way to estimate the accumulation of sediment within any individual catch basin, or even subwatershed-groupings of catch basins it was necessary to estimate an average depth of sediment within all catch basins at the beginning of the simulation. Figure 6 below describes a relationship used to estimate average catch basin sediment depth as a function of catch basin density. Appendix F provides information describing how this relationship was developed.

Figure 6
Depth of Sediment in Sumps at Beginning of Study



Note, in the above figure, the 'Average % Filled' is the percentage of available sediment storage which is filled. For catch basins with a sump depth of 18-

inches, the available storage depth is only 6-inches as the upper 12-inches of storage is assumed by WinSLAMM to be susceptible to scour and resuspension of accumulated sediment.

Catch Basin Outlet Pipe Configuration. All outlet pipes were all assigned model default parameters; 12-inches diameter, reinforced concrete pipe construction (n=0.013), and to have a slope of 2%.

Catch Basin Sump Surface Area. Catch basin inlets were assumed to have a uniform cross-sectional dimension of 2-feet by 3-feet (6 square feet) to match typical storm sewer inlet box dimensions. The sump area of each catch basin was assumed to have the same dimensions.

Catch Basin Depth from Sump Bottom to Street Level. All catch basins were assumed to have a depth of 5 feet from the bottom of the invert of the sump to the street surface (this matched closely to the majority of inlets with reported 18-inch sump depths).

Catch Basin Sump Leakage Rate. It was assumed that there was no loss of water through the catch basin bottom (leakage rate of zero inches/hour).

Map-6 identifies the location of catch basins and areas served by catch basins within the study area.

The resulting exercise identifies 3,374 acres of the City are served by 3,362 catch basins with an average catch basin density of almost exactly 1.0 catch basin per acre. Catchbasins are found in 40 of the 92 watersheds evaluated in this study (although 3 watersheds have a density of less than 0.25 catchbasins per acre and 2 other watersheds are so small as to have unrealistically high catch basin densities). Catch basins densities range from 0.3 catch basins per acre to 4.6 catch basins per acre (ignoring the five previously described outlier watersheds).

3.5.4 Application of Detention Ponds and other 'Outfall Devices' in WinSLAMM

There are 82 known existing structural stormwater quality management devices within the City of Marshfield's storm water management system (exclusive of swales and catchbasins) which were modeled using WinSLAMM. The City's engineering department provided construction plans for approximately 50% of these devices documenting necessary geometric data such as storage volume and outlet device configuration. Those BMPs where plan information was not available were visually inspected and necessary geometry data was estimated. The location of each BMP was identified in GIS and the drainage area, land use, and source areas tributary to each device were developed per steps described previously.

Appendix G presents the geometric data of all 83 existing structural stormwater

management practices. Note that the information in Appendix F is presented using the computer model HydroCAD 10.00, this was done for two reasons; the first is simply due to the fact that HydroCAD provides a very nice template for recording stormwater pond geometric data; the second is that on occasion, pond outlet structures are too complex to be accommodated by WinSLAMM, in these cases a numeric outlet rating curve (table of depth vs. storage volume vs. discharge rate) was developed using HydroCAD and directly entered into WinSLAMM.

Thirteen potential alternative structural BMPs were evaluated using WinSLAMM. Locations for these BMPs were selected according to recommendations made in previous studies and through interviews with City staff. Alternative BMPs were assumed to be wet detention ponds with permanent pool depths of five feet and live storage depths ranging from three to four feet (optimizing the live storage depth was not a critical component of this exercise). The surface area of the normal pool for each pond was estimated according to space available at the site determined using aerial photographs and a desire to achieve optimal TSS reduction. The outlet from each proposed pond was assumed to be a standard riser pipe with an orifice control at the normal water level and a crest set to allow overflows for large events while maximizing TSS reduction.

A great many of the existing BMPs are either dry ponds, or are wet ponds with less than three feet permanent pool depth. Internal routines within the WinSLAMM model force TSS reduction estimates to zero for dry detention ponds. TSS reduction estimates for wet ponds with less than three feet permanent pool depth are prorated downward in a linear fashion; a pond with a three-foot permanent pool is allowed the full modeled TSS reduction efficiency, a pond with a 1.5-foot permanent pool depth is assigned 50% of the modeled TSS reduction efficiency. Many of the existing dry ponds serve large drainage areas and if converted to wet detention ponds could achieve significant additional TSS reductions. As part of this study eight existing dry detention ponds were further evaluated to estimate their potential TSS reduction. These ponds were not modeled, but were evaluated according to their TSS-reduction potential as described in WDNR Conservation Practice Standard 1001.

Map-7 identifies the location of existing and proposed structural BMPs within the study area.

4.0 APPLICATION OF REGULATORY CONDITIONS TO WINSLAMM INPUT DATA

Three scenarios were evaluated using the WinSLAMM model. Scenario 1 consisted of an evaluation of the actual existing land use and stormwater management system within the City and all areas outside the City flowing overland, or via constructed infrastructure into the City. Scenario 2 is an evaluation of the generation and capture of pollutants within just the City limits. Scenario 2 is identical to Scenario 1 except that ‘other devices’ in WinSLAMM are used to suppress any TSS (or pollutant) loads generated outside the City limits. Scenario 3 is an evaluation of the City’s compliance with the regulatory requirements of NR151 and NR216. The WDNR has published detailed modeling guidance for

evaluation of the level of compliance with NR151 and NR216 which are discussed in Section 4.1.

It is anticipated that the approval of the Wisconsin River Total Maximum Daily Load (TMDL) study currently being developed by the WDNR will result in pollutant load reductions specific to each major watershed in the City. For this reason, each model scenario described above was developed using individual models for each major watershed in the City; the Upper Yellow River Watershed, the Little Eau Pleine Watershed, and the Mill Creek Watershed.

4.1 Developed Urban Area Modeling Guidance

The WDNR has developed very specific guidance regarding the application of water quality models for the assessment of compliance with the TSS reductions required by NR151 and NR216. This guidance was last revised in a document dated November 24, 2010 from Russ Rasmussen, Director of the Bureau of Watershed Management, titled, "Developed Urban Areas and the 20% and 40% TSS Reductions." This memorandum is included in its entirety in Appendix H and documents several key issues regarding the determination of regulated *Land Uses* within the corporate limits of a regulated municipality. Several key statements from the guidance memo are reproduced below:

"The total suspended solids control requirements of s. NR 151.13(2)(b)1.b. and 2., Wis. Adm. Code, may be achieved on an individual municipal basis. Control does not have to apply uniformly across the municipality."

"Areas Required to be Included in the Calculations
A municipality must include the following areas when calculating compliance with the developed urban area standard (s. NR 151.13, Wis. Adm. Code):

1. *Any developed area that was not subject to the post-construction performance standards of s. NR151.12 or 151.24, Wis. Adm. Code, that went into effect October 1, 2004 and that drains to the MS4 owned or operated by the municipality.*
2. *…*
3. *Any undeveloped (in-fill) areas under 5 acres. These areas must be modeled as fully developed, with a land use similar to the properties around them.*
4. *…*
5. *…*
6. *…*
7. *…"*

The language under item #1 above refers to the need to include all land areas NOT regulated by the standards of NR151.12 or NR151.24 developed prior to October 1, 2004. While it is not specifically stated here, subsequent information made available by the WDNR has clarified this statement to also mean that all development which has occurred on or after October 1, 2004, and was regulated by NR151.12 or NR151.24 must NOT be included in the calculations.

"Areas Prohibited from Inclusion in the Calculations
Areas and loadings that shall not be included:

1. *Lands zoned for agricultural use and operating as such.*
2. *Pollutant loadings from an upstream MS4*
3. *Undeveloped land parcels over 5 acres within the municipality. These areas will be subject to s. NR 151.12 or 151.24, Wis. Adm. Code, when developed"*
4. *Any internally drained area with natural infiltration.*
5. *Any active or inactive mining site.*
6. *Areas subject to the new development performance standards of NR151.12.*

Item #2 above refers to pollutant loadings, and not runoff. It is necessary to account for stormwater runoff from areas outside a regulated municipality that flow into the municipality so that the effect of the hydraulic loading from these areas that passes into a management practice (detention pond, etc.) is properly accounted for (i.e. effects on pollutant removal efficiency). Similarly, runoff, but not pollutants, from areas within the regulated municipality that are prohibited from inclusion in the calculations must be accounted for.

"Optional Areas to Include in the Calculations
Areas a municipality may, but is not required to, include in the developed urban area load calculation:

1. *Property that drains to waters of the state without passing through the permittee's MS4.*
2. *Any area that discharges to an adjacent municipality's MS4 without passing through the jurisdictional municipality's MS4.*
3. *Industrial facilities subject to a permit under subch. II of ch. NR 216, Wis. Adm. Code."*

For purposes of complying with the November 24, 2010 memorandum documenting model prohibitions model source areas were further altered to accommodate the various 'excluded/prohibited' areas described above. The WDNR provided a list of all construction activities (through summer 2013) that the WDNR had permitted under NR151.12 and NR151.24. Those parcels, or portions of parcels, covered by permits were coded within the model land use map as 'excluded' areas and are shown on Map – 8. Table 8, below, provides a comparison of the total area evaluated in Scenario 3 vs. that of Scenarios 1 and 2.

Table 8
Summary of Scenarios Evaluated with WinSLAMM

Scenario	Model Name	Total Area Modeled	Description
1	Total Watershed	8,805 acres	All lands within watershed boundaries analyzed[1]
2	City Limits	8,569 acres	Only lands within City limits analyzed[2]
3	NR216 Regulated Area	7,013 acres	Only lands allowed by WDNR guidance analyzed[3]

1. *The 'Total Watershed' area is further broken down into the watershed areas draining to the Upper Yellow River, the Little Eau Pleine River, and Mill Creek.*
2. *TSS Loads from areas outside City reduced to zero. Hydraulic loads from outside City included.*
3. *'Developed Urban Areas and the 20% and 40% TSS Reductions, November 24, 2010.'*

5.0 FINDINGS

5.1 MODEL RESULTS AND DISCUSSION

Tables 9 and 10 below summarize results of the WinSLAMM modeling across the entire study area and demonstrates the significance of applying the various exemptions and exclusions documented in the WDNR modeling guidance memorandum.

TABLE 9
City of Marshfield
Baseline Annual Total Suspended Solids and Total Phosphorus Loads

Scenario	Description	Area (acre)	Annual TSS Load (tons/year)	Annual TP Load (lbs/year)
1	Study Area	8804.9	996.6	N/A
2	City Limits	8568.7	986.5	5,818
3	NR151 Regulated Areas	7012.6	950.3	N/A

Tables 10a, 10b, and 10c on the following page documents the estimated performance of the City's stormwater management system at removing TSS from the three major watersheds in the City.

TABLE 10
City of Marshfield
Annual Total Suspended Solids and Total Phosphorus Reductions

Scenario	Description	TSS Reduction		TP Reduction	
		tons/yr.	%	tons/yr	%
1	Study Area	322.0	32.3	N/A	N/A
2	City Limits	319.4	32.4	1,854	31.9
3	NR151 Regulated Areas	308.0	32.4	N/A	N/A

Table 11a

Mill Creek Existing TSS Reduction Levels

Mill Creek	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices	
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%	tons/yr	%
Total Watershed	**4,136.6**	418.0	202.1	33.2	7.9%	23.5	5.6%	74.7	17.9%		45.3	10.8%	176.7	42.3%
City Limits	**4,034.9**	416.8	206.6	33.2	8.0%	23.5	5.6%	74.7	17.9%	36	44.6	10.7%	175.9	42.2%
NR151 Regulated Area	**3,377.2**	390.1	231.0	33.2	8.5%	22.1	5.7%	71.7	18.4%		40.0	10.2%	167.1	42.8%

1. Two sets of four existing biofilters modeled as single BMPs (actual model BMP count = 28)

Table 11b

Upper Yellow River Existing TSS Reduction Levels

Upper Yellow River	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices	
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs[1]	tons/yr	%	tons/yr	%
Total Watershed	**2,078.2**	148.7	143.1	6.8	4.6%	8.6	5.8%	30.7	20.7%		6.8	4.6%	52.9	35.6%
City Limits	**1,982.9**	144.3	145.6	6.8	4.7%	8.6	6.0%	30.7	21.3%	13	5.7	4.0%	51.9	35.9%
NR151 Regulated Area	**1,645.0**	136.1	165.5	6.8	5.0%	8.5	6.2%	29.6	21.7%		5.7	4.2%	50.6	37.2%

1. Three existing biofilters modeled as one BMP (actual model BMP count = 11)

Table 11c

Little Eau Pleine River Existing TSS Reduction Levels

Little Eau Pleine	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices	
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs[1]	tons/yr	%	tons/yr	%
Total Watershed	**2,590.1**	429.8	331.9	17.7	4.1%	19.1	4.4%	35.3	8.2%	34	20.3	4.7%	92.4	21.5%
City Limits	**2,550.8**	425.5	333.6	17.7	4.2%	19.1	4.5%	35.3	8.3%		19.5	4.6%	91.6	21.5%
NR151 Regulated Area	**1,990.4**	424.1	426.1	17.7	4.2%	18.8	4.4%	34.3	8.1%		19.5	4.6%	90.4	21.3%

1. *Four existing drp ponds modeled as one BMP; two existing biofilters modeled as one BMP; two existing wet ponds modeled as one BMP; one biofilter and dry pond modeled as one BMP; two dry ponds modeled as one BMP; and three wet ponds modeled as one BMP (actual model BMP count = 25)*

5.2 STREET SWEEPING EFFICIENCY

TSS reductions achieved by street sweeping capture 57.7 tons of TSS per year, or 5.8% of the annual load within City limits (scenario 2). While these numbers may appear small, this is because the portion of the City's load which is reachable by street sweeping operations is comparatively small. When looking at the actual performance at removing sediment from just street 'source areas' the true efficiency of street sweeping is revealed.

Table 12
Street Sweeping Efficiencies

Frequency	**TSS Reduction**	
	Min	Max
Weekly Street Sweeping	35.0%	37.8%
Bi-Weekly Street Sweeping	25.8%	27.0%

The results in Table 12 reflect City of Marshfield conditions of use of a vacuum-assisted sweeping, light parking density, and no parking controls. A sensitivity analysis of sediment reductions shows that increasing from bi-weekly to weekly sweeping frequency increases TSS reduction by approximately 10%. However, this translates into an increase of only 4.3% of the citywide load; increasing frequency from weekly to twice-per-week, further increases TSS reduction efficiency by approximately 8%, which is 4.1% of the City's regulated load.

Increases in sweeping efficiency do not appear to significantly reduce the effectiveness of catchbasin TSS reduction. However, increasing the frequency of street sweeping within subwatersheds containing outfall BMPs (which are not dry ponds) produces negligible additional reduction in Citywide TSS loads.

5.3 VEGETATED SWALE TREATMENT EFFICIENCY

Vegetated swales capture 140.7 tons of TSS per year, or 14.3% of the annual load within City limits (scenario 2). Table 13 presents the minimum and maximum efficiencies of swale systems evaluated on a subwatershed basis.

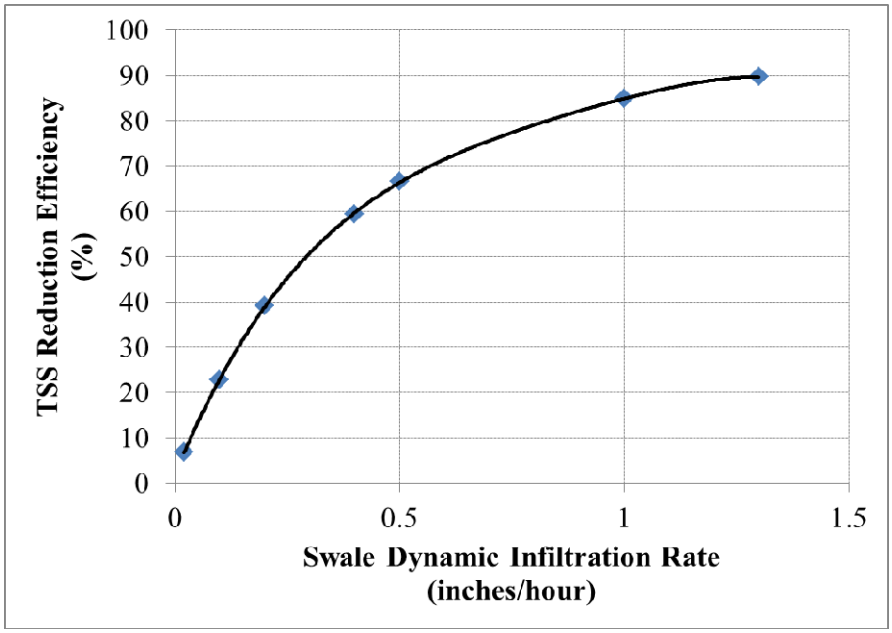
Table 13
Grassed Swale TSS Reduction Efficiency

TSS Reduction	
Min	Max
1.8%	62.8%

© June 2014 MSA Professional Services, Inc.

The performance of vegetated swales is principally dependent on dynamic infiltration rate. Other factors such as swale density, geometry, and longitudinal slope; and to a degree vegetation height and retardance, play a role in TSS reduction rates, but in the context of a mature existing system evaluation, these variables are largely fixed by the geography of the study area. With regards to infiltration rates, however, dynamic infiltration rates for the sample of swales measured during this study ranged from 0.2 inches/hour to 1.3 inches per hour (50% of observed static rate). For sake of staying conservative with this evaluation a uniform infiltration rate of 0.2 inches/hour was assigned to all swales in the City. Figure 7 below, documents the sensitivity of swale performance to TSS reduction rates and demonstrates how conservative this approach may be.

Figure 7
Grassed Swale TSS Reduction Efficiencies
as a Function of Dynamic Infiltration Rate
(Swale geometric parameters set to citywide averages)



5.4 CATCH BASIN TREATMENT EFFICIENCY

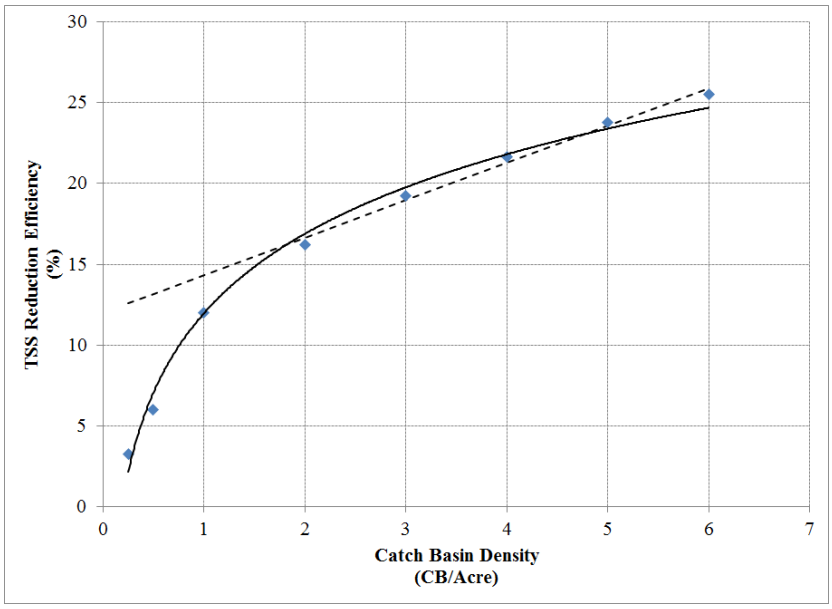
Catch basins capture 51.2 tons of TSS per year, or 5.2% of the annual load within City limits (scenario 2). Table 14 presents the minimum and maximum efficiencies of catch basins systems evaluated on a subwatershed basis.

Table 14
Catch Basins TSS Reduction Efficiency

TSS Reduction	
Min	Max
3.8%	75.8%

Catch basin TSS reduction performance is closely linked to catch basins density. A comparison of catch basin density to TSS reduction efficiency is present in Figure 8 below (five-year evaluation). The relationship between TSS reduction performance and catch basin density is almost linearly at catch basin densities above approximately 1 catch basin per acre (although at densities approaching 10 catch basins per acre the efficiency drops significantly below this linear projection). One reason that efficiencies drop at catch basin densities below 1 catch basin per acre is due to catch basins becoming full. For the City of Marshfield it was noted that at catch basins below 0.5 catch basins per acre that catch basins became full during the simulation period and average efficiencies dropped (note; WinSLAMM evaluates catch basins using an on-off algorithm; catch basins perform normally until sediment accumulates to within one foot of the outlet pipe elevation at which point they are 'turned off' and sediment reduction efficiency is set to zero).

Figure 8
Catch Basin TSS Reduction Efficiencies as a Function of Density



5.5 STRUCTURAL BMP PERFORMANCE

Existing Structural BMPs (wet ponds, biofilters, infiltration basins) capture 69.8 tons of TSS per year, or 7.1% of the annual load within City limits (scenario 2). Table 15a, 15b, and 15c document the performance of individual BMPs through the City.

© June 2014 MSA Professional Services, Inc.

Table 15a

TSS Reductions Achieved by Existing Outfall Practices within Mill Creek Watershed

Watershed ID	Outfall BMP Name	BMP Type	Direct Drainage Area (ac)	Drains to	TSS Load (tons/yr)	TSS Load Released (tons/yr)	TSS Load Trapped (tons/yr)	TSS Reduction Efficiency
Outside City Limits	-	-	101.7	-				
100	-	-	2678.9	-				
102	Marshfield Utilities	Wet Pond	3.5	-	0.097	0.017	0.080	82.4%
104	Mallard Pond	Wet Pond	4.2	-	0.094	0.003	0.091	96.8%
106	29th Street	Wet Pond	31.9	-	1.575	0.018	1.556	98.9%
108	Custom Fab & Repair - East	Wet Pond	1.7	P10002	0.069	0.007	0.062	90.0%
110	Custom Fab & Repair - West	Wet Pond	1.6	P10002	0.283	0.134	0.149	52.6%
112	Norwood Industrial Park	Wet Pond	48.0	-	3.232	0.275	2.957	91.5%
114	Prevention Genetics	Biofilter (4)	3.2	116	0.105	0.021	0.084	80.0%
116	Mill Creek Business Park	Infiltration Basin	157.2	-	9.052	0.000	9.052	100.0%
120	Prevention Genetics	Wet Pond	1.6	-	0.054	0.003	0.051	93.9%
122	Hume Ave Clinic	Wet Pond	0.9	-	0.219	0.002	0.216	98.9%
124	Industrial Park Pond	Wet Pond	18.1	-	0.501	0.120	0.381	76.0%
126	Galvin Avenue	Wet Pond	4.1	-	0.342	0.066	0.276	80.7%
128	Carbo Ceramics-SE	Biofilter	4.8	-	1.010	0.242	0.768	76.0%
130	Carbo Ceramics-SW	Biofilter	11.7	-	1.833	0.678	1.155	63.0%
132	Wick Building Systems	Dry Pond	30.3	-	5.175	5.175	0.000	0.0%
134	Marshfield Door Systems	None	42.4	P10006	7.218	7.217	0.000	0.0%
136	Lincoln Elementary School	Biofilter	1.0	-	0.108	0.051	0.058	53.2%
138	DBA Well's Investments	Wet Pond	1.7	P10004	0.058	0.009	0.049	84.3%
140	Vine	Wet Pond	78.1	-	6.469	0.879	5.589	86.4%
142	Fairgrounds	Dry Pond	33.0	144	2.578	2.578	0.000	0.0%
144	Peach Ave	Wet Pond	13.1	-	3.754	0.879	2.876	76.6%
146	Marshfield Fire & Rescue Facility	Biofilter (4)	1.8	-	0.353	0.060	0.293	83.0%
148	Pick N Save	Dry Pond	1.1	-	0.176	0.176	0.000	0.1%
150	SJ Miller Dry Pond	Infiltration Basin	6.3	-	0.167	0.056	0.111	66.4%
152	Wildwood Park Pond	Wet Pond	286.4	-	17.667	4.434	13.233	74.9%
154	Wildwood Park Cooling Pond	Wet Pond	104.4	152	4.246	0.155	4.091	96.4%
156	House of the Dove	Wet Pond	4.4	152	0.865	0.168	0.697	80.6%
158	Washington Elementary	Wet Pond	13.6	152	0.865	0.168	0.697	80.6%
M118	Existing Pond Upgrade - Figi's	Wet Pond	114.3	-	4.285	0.432	3.852	89.9%
M10002	Proposed Pond M10002	Wet Pond	108.6	-	11.588	2.118	9.469	81.7%
M10004	Proposed Pond M10004	Wet Pond	50.0	-	2.971	0.578	2.393	80.6%
M10006	Proposed Pond M10006	Wet Pond	144.5	-	25.414	10.341	15.073	59.3%
M10008	Proposed Pond M10008	Wet Pond	28.3	-	1.904	0.388	1.516	79.6%

Total Drainage Area	4136.6	TSS Trapped by Existing BMPs	44.571
Drainage Area In City	4034.9	TSS Trapped by Proposed BMPs	32.304

© June 2014 MSA Professional Services, Inc.

Table 15b
TSS Reductions Achieved by Existing Outfall Practices within Upper Yellow River Watershed

Watershed ID	Outfall BMP Name	BMP Type	Direct Drainage Area (ac)	Drains to	TSS Load (tons/yr)	TSS Load Released (tons/yr)	TSS Load Trapped (tons/yr)	TSS Reduction Efficiency
Outside City Limits	-	-	95.3					
200	-	-	1455.3	-				
202	Midstate Technical College	Dry Pond	7.4		0.486	0.486	0.000	0.0%
204	Sycamore	Dry Pond	13.3	-	0.686	0.686	0.000	0.0%
206	First Presbyterian Church	Dry Pond	9.7	-	0.593	0.593	0.000	0.0%
208	Washington Elementary	Biofilter	1.0	-	0.106	0.014	0.092	87.0%
210-214	Stoney River Assisted Living-SW	Biofilter (3)	3.3	P20006	0.090	0.028	0.062	69.0%
216	Prairie-Lake	Wet Pond	38.8	218, P20006	3.529	0.000	3.529	100.0%
218	Prairie-Pond	Wet Pond	19.3	P20006	1.075	0.194	0.882	82.0%
220	Cornerstone Community Church	Wet Pond	3.0	P20006	0.286	0.071	0.215	75.1%
222	Guard St 2	Infiltration Basin	1.8	-	1.776	1.199	0.577	32.5%
224	Veterans Pkwy Estates	Wet Pond	13.1	P20006	0.568	0.183	0.385	67.8%
226	Guard St 1	Dry Pond	21.5	222, P20006	1.563	1.563	0.000	0.0%
Y228	Existing Pond Upgrade - Ration/Berg	Wet Pond	13.0	-	0.878	0.059	0.819	93.3%
Y20002	Proposed Pond Y20002	Wet Pond	82.4	-	3.991	1.524	2.467	61.8%
Y20004	Proposed Pond Y20004	Wet Pond	207.2	-	13.808	2.516	11.292	81.8%
Y20006	Proposed Pond Y20006	Wet Pond	92.8	-	13.502	3.702	9.799	72.6%

Total Drainage Area	2078.2	TSS Trapped by Existing BMPs	5.743
Drainage Area In City	1982.9	TSS Trapped by Proposed BMPs	24.377

Table 15c
TSS Reductions Achieved by Existing Outfall Practices within Little Eau Pleine River Watershed

Watershed ID	Outfall BMP Name	BMP Type	Direct Drainage Area (ac)	Drains to	TSS Load (tons/yr)	TSS Load Released (tons/yr)	TSS Load Trapped (tons/yr)	TSS Reduction Efficiency
Outside City Limits	-	-	39.3					
300	-	-	1696.9	-				
302	Beverly Health Care	Wet Pond	39.8	-	3.665	1.662	2.003	54.6%
304	V&H Properties	Dry Pond	6.4	-	0.934	0.934	0.000	0.0%
306	Goodwill	Dry Pond	16.6	-	2.108	2.108	0.000	0.0%
308	Aldi Food Store	Inf	7.6	-	0.726	0.000	0.726	100.0%
310	Walmart NW	Dry Pond	16.7	-	3.288	3.288	0.000	0.0%
312	Walmart	Dry Pond	8.4	-	0.760	0.759	0.001	0.1%
314	Faith Fellowship-East[1]	Dry Pond	4.3	-	0.140	0.140	0.000	0.0%
316	Faith Fellowship-West	Dry Pond	3.3	-	0.108	0.108	0.000	0.0%
318	Wyndham Senior Villas	Dry Pond (4)	5.9	-	0.532	0.532	0.000	0.0%
320	Shoppes at Wood Ridge	Stormcepter	12.9	-	2.510	1.330	1.180	47.0%
322	Grant St Apartments	Dry Pond	4.1	-	0.401	0.401	0.000	0.0%
324	South Side Grant Street	Dry Pond	1.3	-	0.044	0.044	0.000	0.0%
326	Tiny Tigers Daycare-West	2 Biofilters	0.9	-	0.098	0.081	0.017	17.0%
328	Marshfield Tennis NOW Court	Wet Pond (2)	2.7	-	0.153	0.009	0.144	94.0%
330	Marshfield High School	Dry Pond	10.1	-	1.210	1.210	0.000	0.0%
332	Madison Elementary	1 Biofilter, 1 Dry	10.1	-	0.689	0.081	0.608	88.2%
334	Walgreen's	Dry Pond	1.5	-	0.256	0.256	0.000	0.0%
336	Marshfield Clinic Parking	Dry Pond (2)	6.5	-	2.097	2.097	0.000	0.0%
338	Walnut Ave Pond	Dry Pond (3)	242.9	-	25.949	11.200	14.749	56.8%
340	Fig Ave Development	Dry Pond	4.8	-	0.451	0.451	0.000	0.0%
342	Grant Elementary	Dry Pond	2.5	-	0.178	0.178	0.000	0.0%
344	Grant Elementary NW	Dry Pond	3.1	346	0.234	0.234	0.000	0.0%
346	Fig-McMillan	Dry Pond	29.6		3.661	3.660	0.001	0.0%
348	Fig Ave NW	Dry Pond	29.3	346	1.895	1.894	0.001	0.0%
350	Marshfield Clinic	Biofilter	1.3	-	0.066	0.013	0.053	80.0%
S30002	Proposed Pond S30002	Wet Pond	20.7		2.876	0.557	2.319	80.6%
S30004	Proposed Pond S30004	Wet Pond	139.7		27.982	10.175	17.807	63.6%
S30006	Proposed Pond S30006	Wet Pond	72.6	S30004	6.933	1.330	5.603	80.8%
S30008	Proposed Pond S30008	Wet Pond	148.3		5.217	2.506	2.711	52.0%

Total Drainage Area	2590.1	TSS Trapped by Existing BMPs	19.481
Drainage Area In City	2550.8	TSS Trapped by Proposed BMPs	28.440

1. WinSLAMM model erroneously reports 57.1% TSS trapped. BMP is a dry pond, so TSS Capture should be zero. Result manually reduced to zero.

© June 2014 MSA Professional Services, Inc.

6.0 RECOMMENDATIONS

The findings of this study show that the City is achieving an average annual TSS reduction between 32.3% and 32.4% depending on the modeling scenario. These findings show that the City of Marshfield is in full compliance with the Total Suspended Solids reductions in accordance with NR216.07(6)(b) and NR151.13.

The WDNR is currently developing a Total Maximum Daily Load study for the Wisconsin River Watershed. A recent conversation with WDNR staff responsible for the TMDL development have indicated that baseline loads for regulated communities like Marshfield be calculated based on a 20% TSS reduction. These baseline loads will be assessed on a watershed-by-watershed basis. This study has found that the lowest annual TSS reduction performance for any single watershed in the City is 21.3% (Little Eau Pleine River); showing the City of Marshfield to be achieving the minimum level of compliance that will be expected by regulated municipalities within the TMDL planning area.

Note, however, that the TMDL may determine that TSS (and) TP reductions within the City of Marshfield may need to be higher than currently estimated. The following recommendations are presented to position the City to be in the best position to reach these higher standards if and when they are required.

1.) **Implement a program to require inspection and routine maintenance of privately owned stormwater management practices.** This study included an evaluation of BMPs on 46 privately owned properties (some properties with multiple BMPS) which collectively remove 16.0 tons of sediment annually, or 1.6% of the Citywide annual TSS load (scenario 2). A fundamental assumption of this study is that each management practice is operating as originally planned. It is an accepted fact that once management practices capture a certain critical volume of TSS, their ability to capture additional TSS is reduced, or is lost altogether. To ensure continued compliance with regulatory standards it will be necessary to demonstrate the authority to maintain these various management practices.

2.) **Implement an accelerated catch basin cleaning frequency for subwatersheds where the catch basin density is less than 0.5 catch basins per acre.** The findings of this study have shown that catch basins with a density of less than 0.5 catch basins per acre will become completely full prior to cleaning when cleaned on a ten year cycle. Once full, TSS capture is reduced to zero. The City could increase its TSS capture by a small but quantifiable amount by increasing the frequency of cleaning of catch basins with low density

3.) **Implement a systemic program for measuring infiltration rates within grassed swales throughout the City.** This study has shown the significant importance of the City's system of grassed swales at removing TSS from stormwater runoff. This study was completed using an average dynamic infiltration rate of 0.2 inches per hour; however, tests

conducted on swales within this City have shown dynamic infiltration rates as high as 1.3 inches per hour. If additional tests can justify higher infiltration rates for specific subwatersheds the additional TSS reduction quantified by this effort could be substantial.

4.) **Retrofit Existing Water Quality BMPs or Construct Additional Water Quality BMPs.** This report evaluated 13 alternative new 'outfall' water quality BMPs. The locations for each alternative BMP are located on Map 7 in Appendix A. Concept plan for each alternative BMP are located in Appendix I. Preliminary cost estimates for alternative new and retrofit BMPs are included in Appendix J. These BMP are listed in the table below according to their estimated cost-effectiveness (Cost per annual-ton-TSS removed; not including design or administrative costs, or land acquisition). If and when the time comes to increase TSS reduction achieved by the City's stormwater management system it is recommended that there BMPs be implemented in order of cost-effectiveness as required on a watershed-by-watershed basis.

Note, all the BMPs indicated in Tables 16, and 17, below assume that the BMPs will be constructed as wet detention ponds. Depending on their proximity to the Marshfield Airports, wet detention ponds may be prohibited due to their tendency to attract wildlife, specifically waterfowl, which can pose a hazard to air traffic.

Table 16
Alternative Existing BMPs to Modify for Improved TSS Capture

Existing BMP to Retrofit	**TSS Captured** (tons/year)	**Estimated Construction Cost**	**Cost Per Ton TSS Captured** ($/ton/year)
132 - Wick Building Systems	3.11	$ 25,600	$8,245
142 - Fairgrounds	1.55[1]	$ 18,000	$11,635
344/346/348 - Fig	4.63	$ 54,400	$11,745
202 - Midstate Technical College	0.39	$ 6,100	$15,690
204 - Sycamore	0.55	$ 10,300	$18,770
206 - First Presbyterian Church	0.47	$ 9,500	$20,025
310 - Walmart NW	2.63	$ 52,800	$20,075
312 - Walmart	0.61	$ 25,200	$41,445

1. *BMP 142 is upstream from BMP 144. Modification to BMP 142 may negatively affect TSS capture rates for BMP 144.*

Table 17
Alternative New Water Quality BMPs

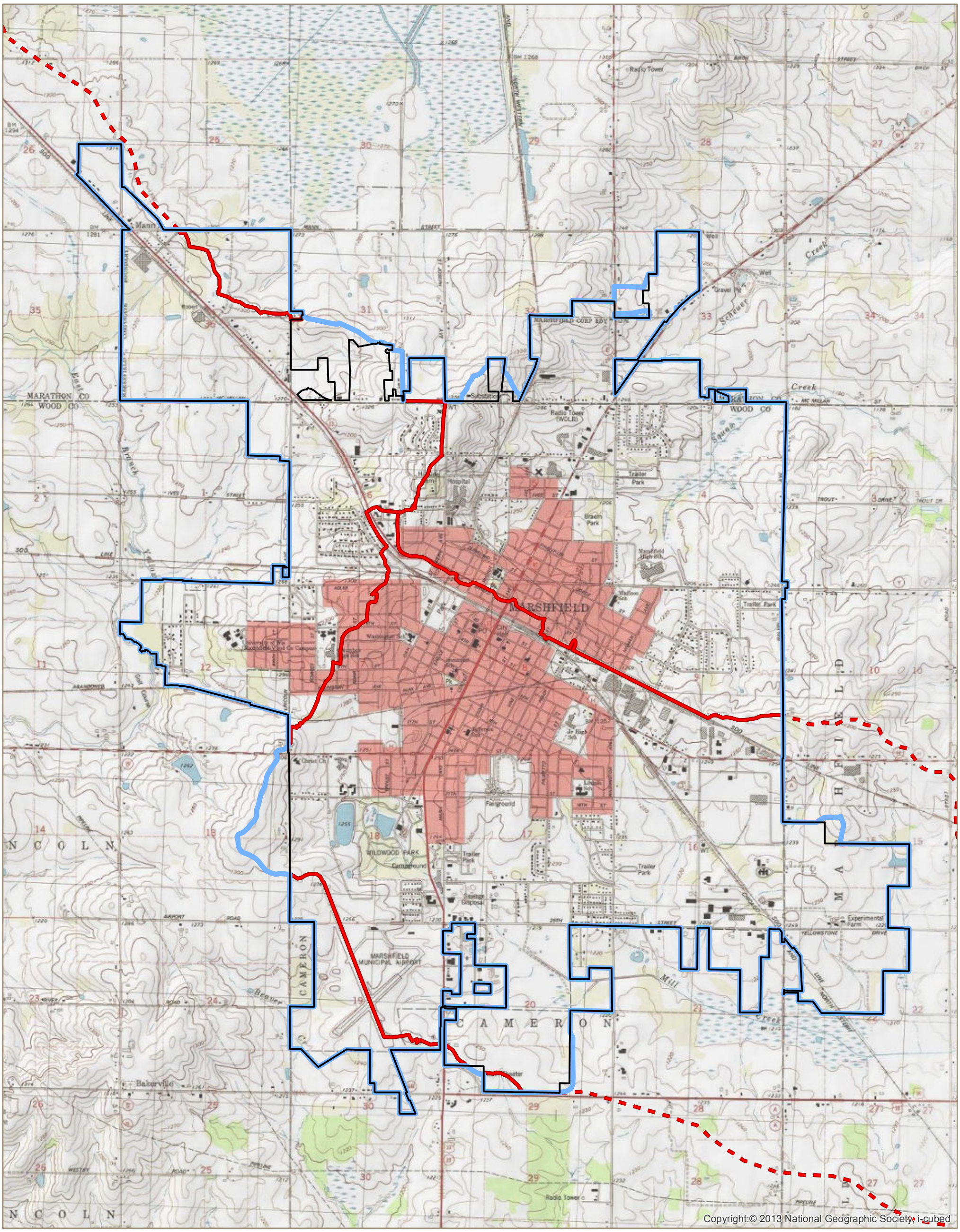
Proposed BMP	**TSS Captured** (tons/year)	**Estimated Construction Cost**	**Cost Per Ton TSS Captured** ($/ton/year)
S_30008	2.71	$89,830	$33,150
S_30004	17.81[1]	$716, 950	$40,255
S_30006	5.60[1]	$251,580	$44,925
S_30002	2.32	$129,155	$55,670
Y_20002	2.47	$74,880	$30,315
Y_20006	9.80	$333,580	$34,040
Y_20004	11.29	$441,220	$39,080
Y_228	0.82	$34,190	$41,695
M_10006	15.07	$220,825	$14,655
M_118	3.85	$78,000	$20,260
M_10002	9.47	$406,170	$42,890
M_10004	2.39	$205,725	$86,075
M_10008	1.52	$131,600	$86,580

BMP S_30006 is located upstream from BMP S_30004. The TSS reductions shown in this table reflect the conditions anticipated if both ponds are constructed. If only BMP S_30004 is constructed but BMP S_30006 is not, the TSS reduction of BMP S_30004 will be higher than presented in the table

APPENDIX A

MAPS

© June 2014 MSA Professional Services, Inc.



MAP 1: STUDY AREA LIMITS

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

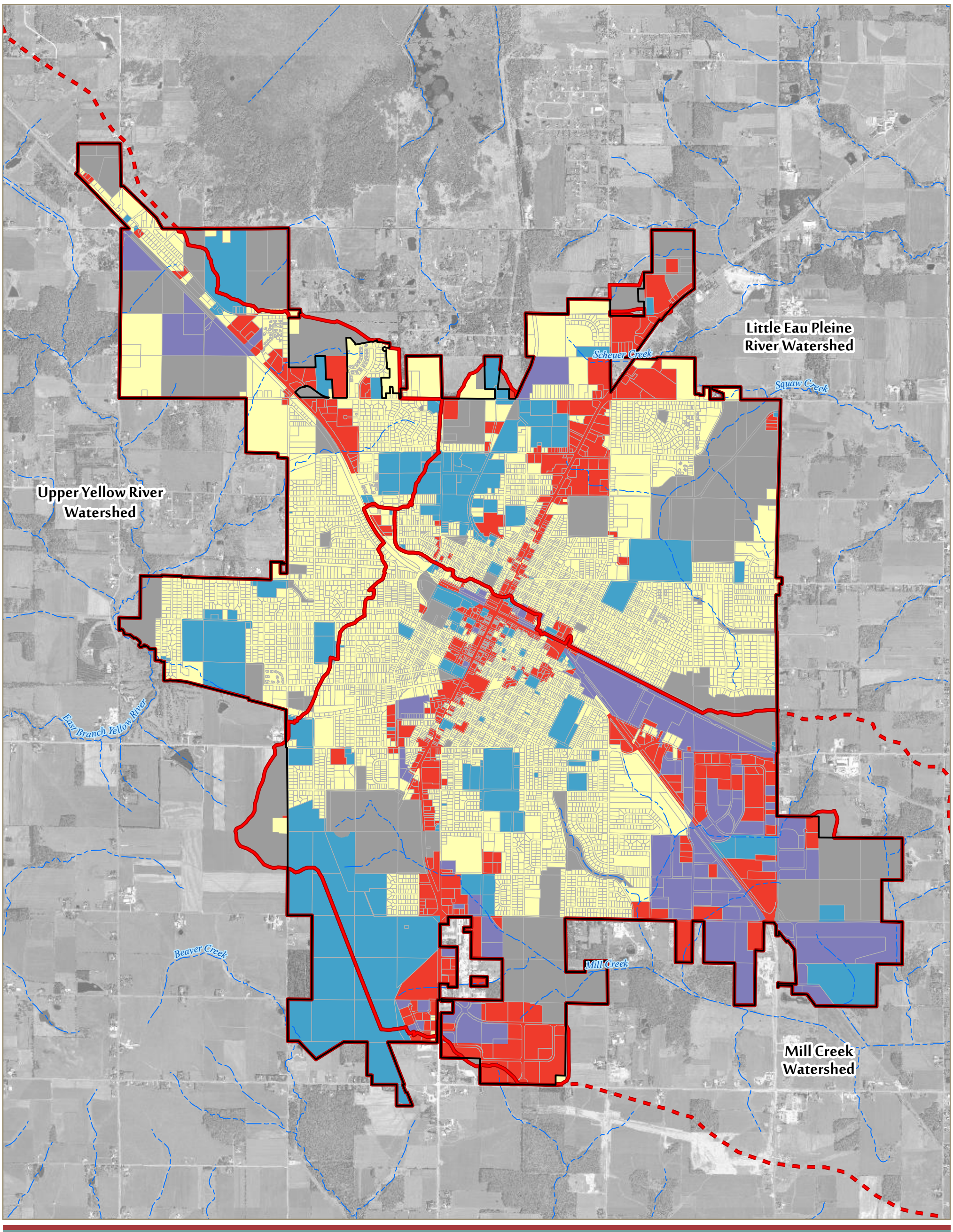
CITY LIMITS
RIVER/STREAM
STUDY AREA
STUDY AREA MAJOR WATERSHED
DNR WATERSHED

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD).
WATERSHEDS PROVIDED BY THE WDNR.
TOPO DERIVED FROM USGS QUADRANGLES AND PROVIDED BY ESRI.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 2: LAND USE

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED
PARCELS

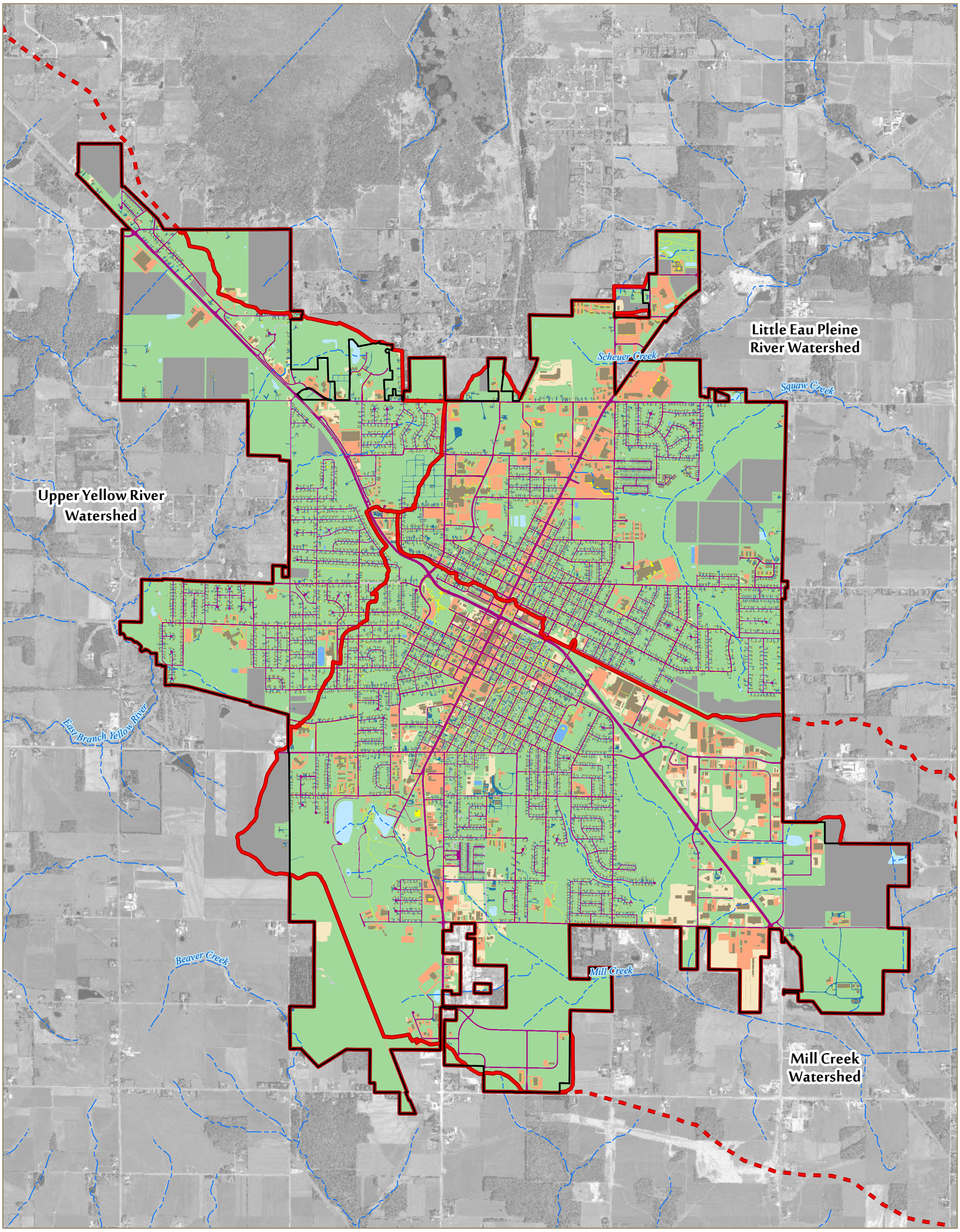
LANDUSE
COMMERCIAL
INDUSTRIAL
INSTITUTIONAL
RESIDENTIAL
OTHER URBAN

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD).
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 3: SOURCE AREA

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED

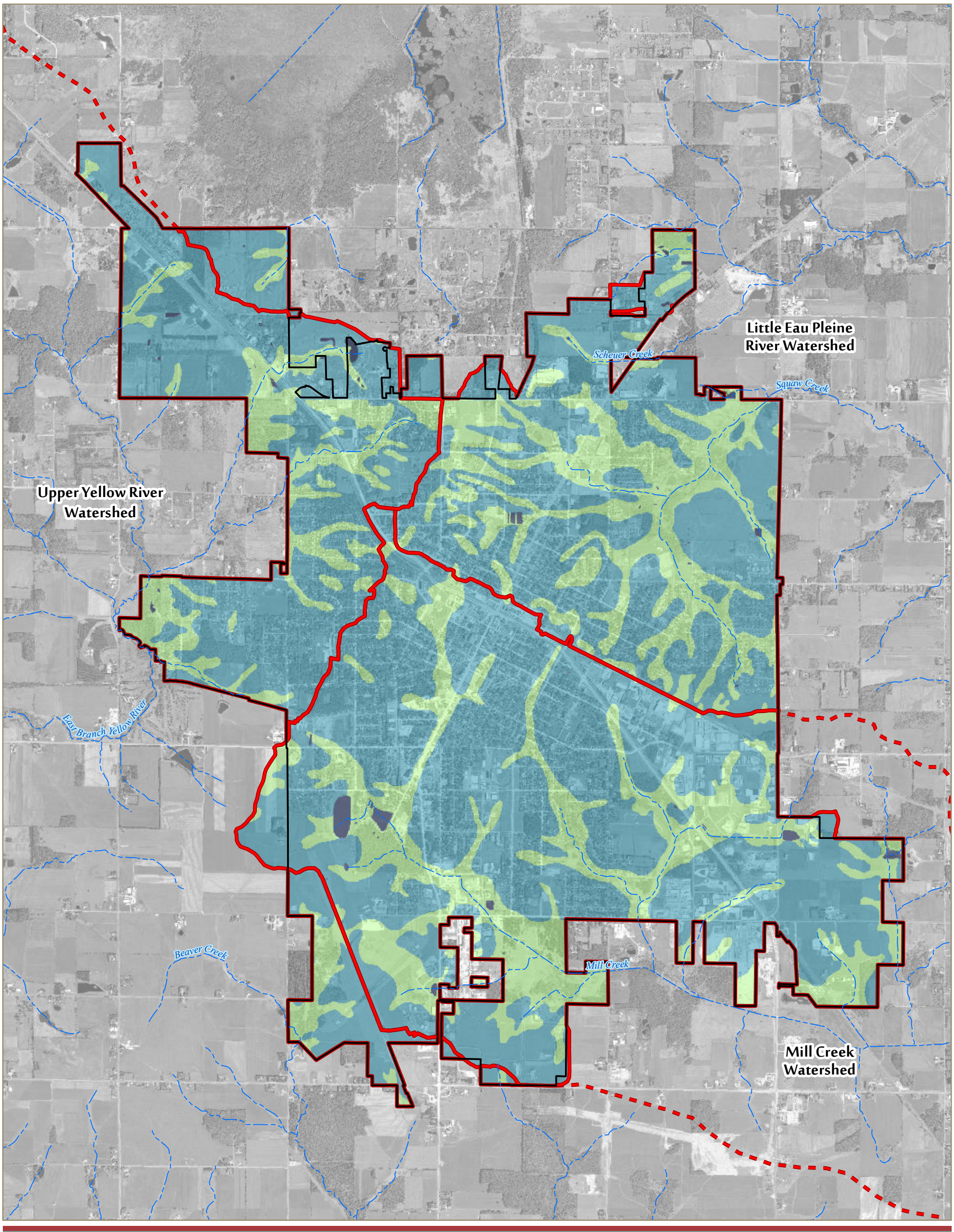
SOURCE AREA (WINSLAMM)
- PAVED STREET
- UNPAVED STREET
- DRIVEWAY
- SIDEWALK
- ROOF
- PAVED PARKING/STORAGE
- UNPAVED PARKING/STORAGE 1
- PLAYGROUND
- OPEN SPACE
- ISOLATED/WATER BODY AREA
- UNDEVELOPED AREA

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD).
WATERSHEDS FROM WDNR.
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 4: SOILS

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WISCONSIN

CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED

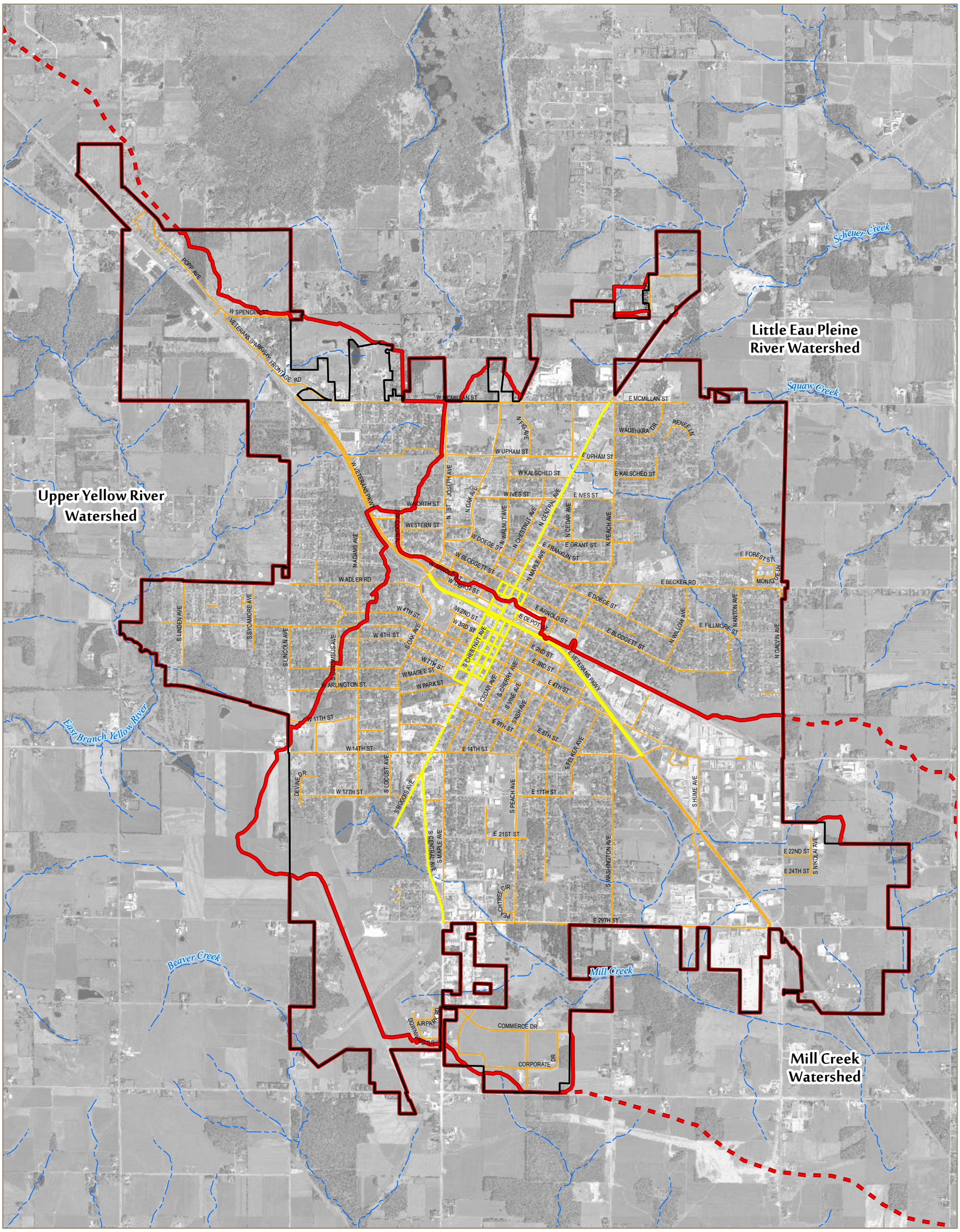
HYDROLOGIC SOIL GROUP
B
C
WATER

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
SOILS HYDROLOGIC SOIL GROUP PROVIDED BY USDA NRCS.
**SOIL GROUPS A AND D NOT SHOWN DUE TO SCALE (COMBINED AREA LESS THAN 1 ACRE).*
RIVER/STREAM FROM USGS (NHD).
WATERSHEDS FROM WDNR.
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 5: CURBED STREET SWEEPING

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

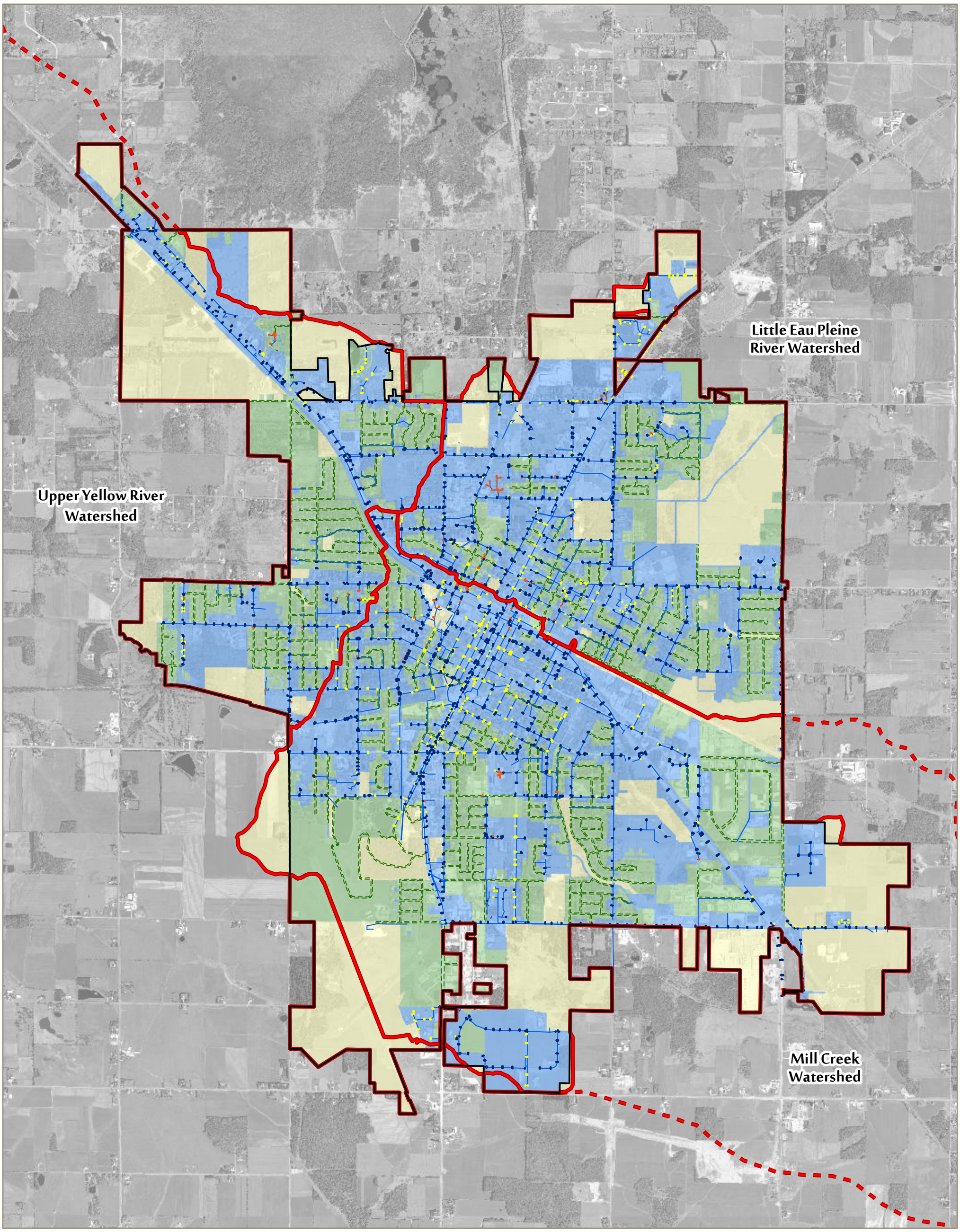
CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED
CURBED STREETS SWEPT WEEKLY
CURBED STREETS SWEPT BI-WEEKLY

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD).
WATERSHEDS FROM WDNR.
CURBED STREET SWEEPING ROUTINE PROVIDED BY THE CITY.
UNCURBED STREETS THAT ARE SWEPT ARE NOT INCLUDED WITH THE WINSLAMM MODEL.
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 6: DRAINAGE SYSTEM

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

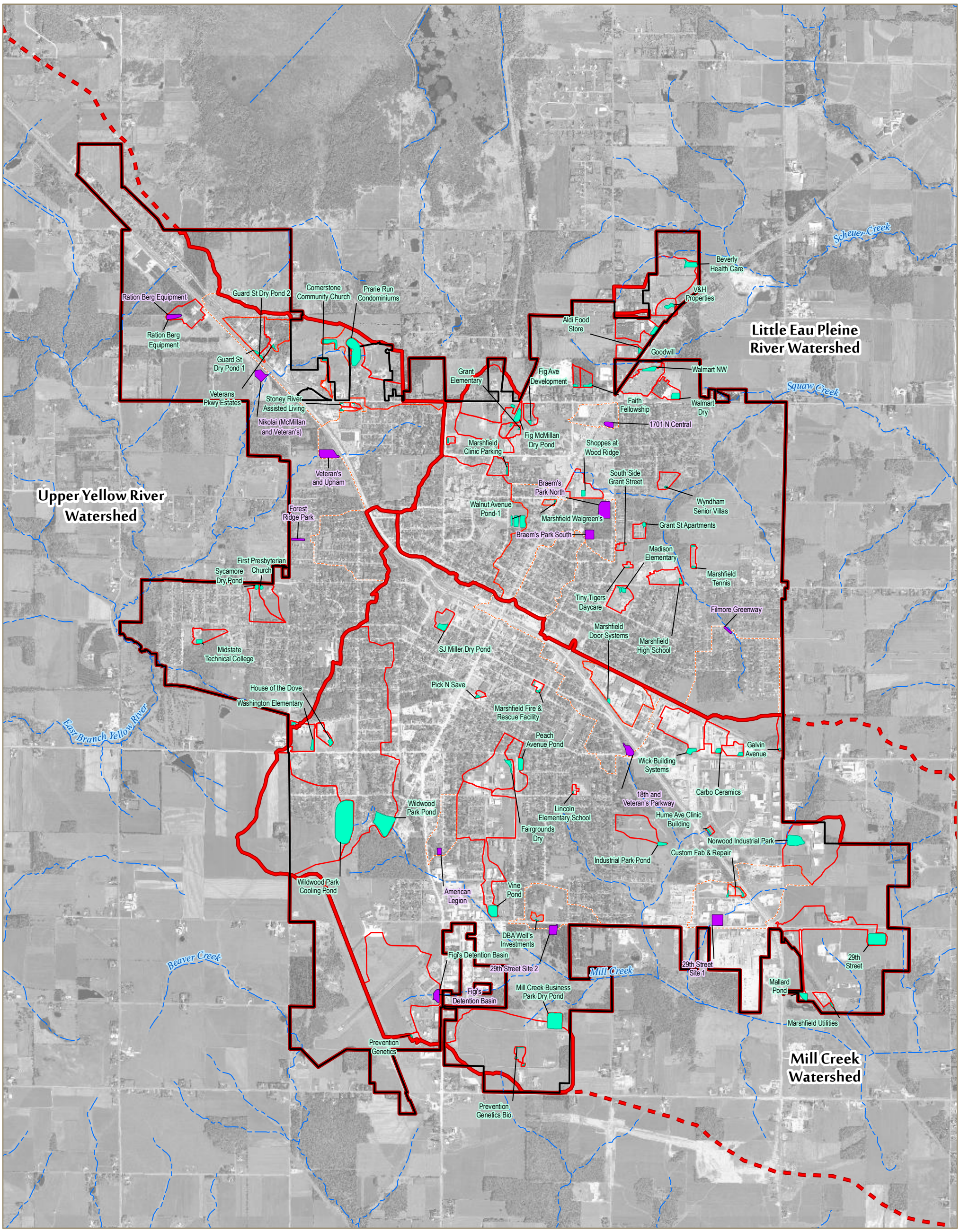
CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED
SWALE
STORM LINE
SUMP DEPTH > 12 INCHES
SUMP DEPTH <= 12 INCHES
NO SUMP DEPTH PROVIDED

DRAINAGE TYPE
SWALE
CATCH BASIN
NEITHER

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
ONLY CATCH BASINS WITH A SUMP DEPTH GREATER THAN 12" WERE USED IN WIN SLAMM MODELING. THOSE WITHOUT A PROVIDED SUMP DEPTH WERE ASSUMED TO BE 18".
RIVER/STREAM FROM USGS (NHD).
WATERSHEDS FROM WDNR.
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N
0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES



MAP 7: EXISTING AND PROPOSED STRUCTURAL BMPS

CITY OF MARSHFIELD
WOOD/MARATHON CO., WI

CITY LIMITS
RIVER/STREAM
EXISTING POND
PROPOSED POND
STUDY AREA MAJOR WATERSHED
DNR WATERSHED
EXISTING POND WATERSHED
PROPOSED POND WATERSHED

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD).
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

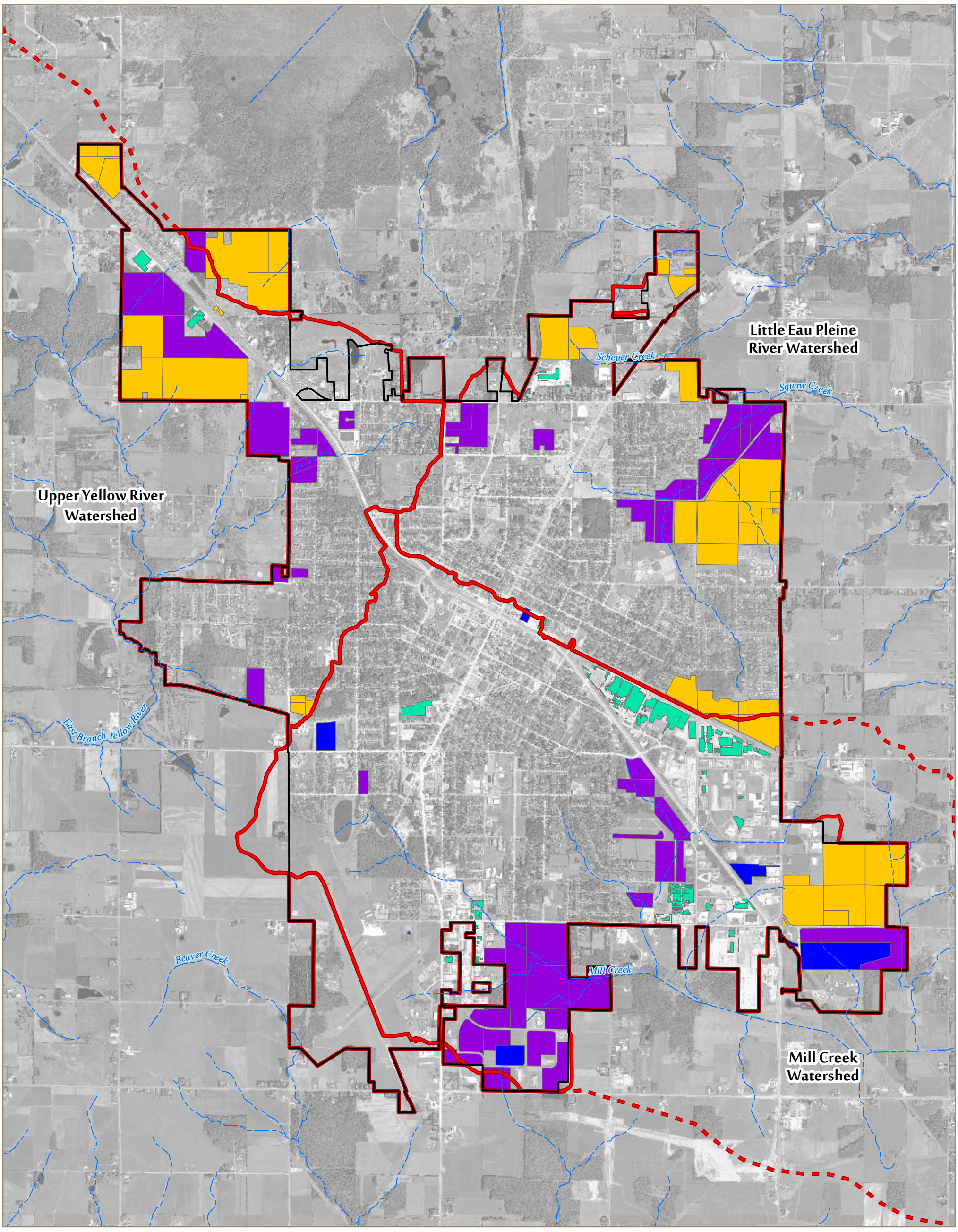
N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES

Printed by: aconverse, File: P:\580s\584\00584064\GIS\WinSLAMMData_Map7_Ponds.mxd

Print Date: 4:01:35 PM 2/14/2014



MAP 8: EXCLUDED AREAS

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WISCONSIN

CITY LIMITS
RIVER/STREAM
STUDY AREA MAJOR WATERSHED
DNR WATERSHED

EXEMPT AREA
AGRICULTURAL LAND
UNDEVELOPED PARCEL (>5 AC)

PERMITTED FACILITIES, INDUSTRIAL
PERMITTED FACILITIES, STORMWATER NOI

DATA SOURCES:
BASE DATA PROVIDED BY CITY.
RIVER/STREAM FROM USGS (NHD). WATERSHEDS FROM WDNR.
PERMITTED FACILITIES WITH THE "OTHER" CLASSIFICATION INCLUDE NONMETALLIC MINING OPERATIONS, STORMWATER SCRAP RECYCLING AND THOSE THAT FALL UNDER THE NEW DEVELOPMENT PERFORMANCE STANDARDS.
AERIAL IMAGERY COMBINED NAIP AND WROC 2010.

N

0 700 1,400 2,800 Feet

MSA PROFESSIONAL SERVICES

APPENDIX B

STREET SWEEPING AND CATCH BASIN CLEANING DATA

© June 2014 MSA Professional Services, Inc.

Eric Thompson

From: Turchi, Tom <Tom.Turchi@ci.marshfield.wi.us>
Sent: Friday, December 06, 2013 2:04 PM
To: Eric Thompson
Cc: Erik Sorensen; Amber Converse; Kevin Orner
Subject: RE: Message from "RNP002673234AEF"
Attachments: MS4 Annual Report Form 3400-195 4 1 13.pdf

Eric,
The responses to your questions are noted below to the best of my knowledge.

Thomas Turchi
Thomas R. Turchi, P.E.
City Engineer
City of Marshfield
630 South Central Avenue
P.O. Box 727
Marshfield, WI 54449-0727
Phone: 715.486.2034
Fax: 715.384.7631
Email: Tom.Turchi@ci.marshfield.wi.us
Web page: www.ci.marshfield.wi.us

Please consider our environment before printing this e-mail.
Producing 1 ton of paper consumes 3 tons of wood and 19,075 gallons of water and emits 5,690 lbs CO2 equiv. and generates 2,278 lbs of solid waste.

Information contained in this e-mail message is confidential information intended only for the personal use of the individual or entity named above. This email may also be attorney-client communication which is privileged and confidential. If the reader of this message is not the intended recipient, you are hereby notified that any distribution or copying of this e-mail is strictly prohibited. If you received the e-mail in error, please inform us promptly by reply e-mail, then delete the e-mail and destroy any printed copy. Thank You.

From: Eric Thompson [mailto:Ethompson@msa-ps.com]
Sent: Friday, December 06, 2013 11:20 AM
To: Turchi, Tom
Cc: Erik Sorensen; Amber Converse; Kevin Orner
Subject: RE: Message from "RNP002673234AEF"

Tom,

Thanks for getting this back to us.

On a related note; can you comment on the following:

Sumps
There is a 2007 email in the 2008 SW report by Earthtech estimating that there are 3,060 catchbasins citywide which are cleaned approximately once every 3 years. However, the GIS database indicates that there are 2975 storm inlets with sumps (out of 3909) and 312 storm manholes with sumps (out of 2299) for a total of 3287. 3752 Catch basins total 2288 MHs total 2012.

1.) *Can you Please confirm:*

a. *the number of sumps, and 2893 Catch Basins with sumps – 315 MH's with sumps (3208) (2012).*
b. *The frequency of sump cleaning*. Last year 344 were cleaned or replaced

Street Sweeping

From a 2006 memo included in the 2008 SW report the following schedule for sweeping is provided: All current sweeping practices are still being done as stated from the 2006 memo.

a.) Weekly:

Roddis and Central from 29th to McMillan
Veterans Parkway from 8th to Oak
Downtown streets and alleys bounded by 7th, Blodgett (Chestnut and Maple inclusive)
There is an indication of some parking lots that are swept, but the model is unable to accommodate this - and so we won't be able to account for this.

b.) Biweekly

All other Streets with curb and gutter

c.) The memo also indicates that all ditched streets, cemetery roadways and the fairgrounds are swept twice per year (it actually says biannual, but I assume this means twice/year) but crediting TSS reduction from sweeping of non-curbed streets is not allowed by WDNR, so we won't be accounting for this.

The 2006 report indicates that the City uses a 2003 Elgin Crosswind Series J regenerative air street cleaner. BTW, this should be classified in WinSLAMM as a 'vacuum' sweeper – I've asked for clarification by WDNR. We have a brand new regenerative "vacuum" sweeper as the 2003 sweeper was totaled last year. The operator left the box up when driving under a bridge.

2.) Please also confirm the following:

a.) The frequencies of sweeping are still valid, in 2012 we swept 2,802 lane miles
b.) The City still uses the regenerative air sweeper, Yes
c.) Whether the City has any parking bans on any streets, and One side overnight parking Apr to Nov on all ditched streets. Curb and gutter allows overnight parking April to Nov.
d.) Whether any sweeping is done at night (in areas where this is advantageous due to a lower density of parked cars). Yes we do sweep at night. Overnight parking is still not very common in the city. Has only been allowed by ordinance since July of 2012.

Thanks,

EJT

-----Original Message-----
From: Turchi, Tom [mailto:Tom.Turchi@ci.marshfield.wi.us]
Sent: Thursday, December 05, 2013 3:57 PM
To: Eric Thompson
Subject: FW: Message from "RNP002673234AEF"

Eric,
Staff & I have gone through the pdf you submitted showing ditched streets and ditched streets with underdrain.
We have highlighted several changes. From this map we have discovered that our street division had not been submitting changes to our GIS coordinator. Please review the changes and contact me if you have any questions.
Thank you very much for running the example with our ditched streets. I find it extremely informative and can't wait to see the revised results of our new model.
I am assuming from the previous email that you believe that the TP reductions from the swales with underdrain may be minimal as the underdrain water is reintroduced into the surface water.

I have a few files that I will be getting to Todd tomorrow morning.
Thank you again for your efforts
Tom

Thomas Turchi
Thomas R. Turchi, P.E.
City Engineer
City of Marshfield
630 South Central Avenue
P.O. Box 727
Marshfield, WI 54449-0727
Phone: 715.486.2034
Fax: 715.384.7631
Email: Tom.Turchi@ci.marshfield.wi.us
Web page: www.ci.marshfield.wi.us

Please consider our environment before printing this e-mail.
Producing 1 ton of paper consumes 3 tons of wood and 19,075 gallons of water and emits 5,690 lbs CO2 equiv. and generates 2,278 lbs of solid waste.

Information contained in this e-mail message is confidential information intended only for the personal use of the individual or entity named above. This email may also be attorney-client communication which is privileged and confidential. If the reader of this message is not the intended recipient, you are hereby notified that any distribution or copying of this e-mail is strictly prohibited. If you received the e-mail in error, please inform us promptly by reply e-mail, then delete the e-mail and destroy any printed copy. Thank You.

-----Original Message-----
From: N7 Printer Admin [mailto:n7@ci.marshfield.wi.us]
Sent: Thursday, December 05, 2013 2:41 PM
To: Turchi, Tom
Subject: Message from "RNP002673234AEF"

This E-mail was sent from "RNP002673234AEF" (Aficio MP C4501).

Scan Date: 12.05.2013 15:41:10 (-0500)
Queries to: n7@ci.marshfield.wi.us

City of Marshfield

APPENDIX C

SWALE DENSITY DATA

© June 2014 MSA Professional Services, Inc.

Vegetated Swale Data						
Watershed ID	**GIS-Determined Area of Subwatershed Served by Swales**	**Area of Subwatershed Served by Swales Applied to Model**	**Total Length of Swales**	**Swale Density**	**Weighted Average Swale Slope**	**Note**
	(acres)	(acres)	(ft)	(ft/Acre)	(%)	
100	902.83	902.83	210196	232.82	1.38	
102		0.00				
104		0.00				
106		0.00				
108	1.44	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
110	1.65	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
112	0.53	0.53	492	922.71	1.85	
114		0.00				
116	15.81	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
118	42.71	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
120		0.00				
122	0.90	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
124		0.00				
126		0.00				
128	4.79	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
130	10.89	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
132	16.36	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
134		0.00				
136	0.97	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
138	1.74	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
140	51.15	51.15	13673	267.29	1.32	
142	12.62	12.62	1740	137.95	1.20	
144	3.15	3.15	745	236.88	2.23	
146		0.00				
148		0.00				
150		0.00				
152	116.51	116.51	24243	208.09	1.59	
154	90.25	90.25	11636	128.93	1.38	
156		0.00				
158		0.00				
200	477.03	477.03	109096	228.70	1.70	
202		0.00				
204	0.62	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
206	6.63	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
208		0.00				
210	0.19	0.19	8	42.15	0.76	
212		0.00				
214	0.52	0.52	40	76.59	0.89	
216	11.48	11.48	147	12.76	0.74	
218	4.05	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
220		0.00				
222	0.37	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
224	11.21	11.21	1350	120.37	1.55	
226	2.95	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
228		0.00				
300	513.48	513.48	130550	254.25	1.66	
302	2.00	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
304	0.64	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
306		0.00				
308		0.00				
310		0.00				
312		0.00				
314	0.04	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
316	0.03	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
318	4.87	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
320		0.00				
322	4.06	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
324	0.00	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
326	0.04	0.04	83	2268.67	1.87	
328	0.04	0.04	116	2605.47	1.79	
330		0.00				
332		0.00				
334		0.00				
336		0.00				
338	61.80	61.80	15354	248.46	2.34	
340		0.00				
342		0.00				
344		0.00				
346		0.00				
348	8.07	8.07	590	73.06	3.92	
350		0.00				
1012		0.00				
1016		0.00				
1052		0.00				
1054			3702		1.15	No Area, Swale Length Ignored
2016		0.00	516		1.11	No Area, Swale Length Ignored
2018		0.00	92		2.28	No Area, Swale Length Ignored
2020		0.00				
3002		0.00				
3006			645		3.44	No Area, Swale Length Ignored
3048	0.00	0.00				No Swales in Watershed, Area Served moved to 'Neither' Classification
P10002	41.36	41.36	5291	127.91	0.68	
P10004	24.84	24.84	5592	225.14	1.48	
P10006	15.79	15.79	3070	194.45	1.67	
P10008	9.33	9.33	2864	307.05	2.08	
P200006			1542		1.82	No Area, Swale Length Ignored
P20002	67.66	67.66	20244	299.21	2.41	
P20004	97.52	97.52	25278	259.22	2.24	
P20006	11.76	11.76	2890	245.78	1.80	
P30002		0.00				
P30004	23.24	23.24	7704	331.47	2.11	
P30006	33.96	33.96	12806	377.12	1.90	
P30008	63.58	63.58	11702	184.06	1.66	
		Total	**Total**	**Average**		
		2650	**623999**	**235**		

APPENDIX D

SWALE INFILTRATION RATE ASSESSMENT

© June 2014 MSA Professional Services, Inc.

MEMO

To: City of Marshfield

From: Eric Thompson, P.E., CFM, Greg Skemp, CST

Subject: Infiltration Test Results

Date: June 19, 2013

Infiltration tests were completed by MSA Professional Services on June 10th and 11th, 2013. There was no rain on either day of testing. However, significant rainfall was observed on the two days prior to inspections: 0.43" on June 8 and 0.29" on June 9.

Infiltration testing was completed by Greg Skemp, CST. An abbreviated two-hour double-ring infiltrometer test was completed for each site as allowed by WDNR.

Prior to testing the City identified multiple areas within the City where drainage is conveyed via open channel systems, or greenways. These locations are identified on the attached map and fall into one of three categories; roadside swales with underdrains, roadside swales without underdrains and large natural greenways. Each of these sites was inspected prior to conducting infiltration testing. During the inspections each of the natural greenways was observed to include a flowing watercourse and so was determined to not have a substantial infiltrative capacity. As such testing was only conducted for a sample set of roadside swales.

The observed infiltration rate for each site is noted in the table below.

Site	Location	Condition	Infiltration Rate (in/hr)
1	90' North of Blodgett In West Ditch of Marathon St	No Under Drain	0.4
2	West Ditch on N. Wood Ave. 10' South 1400/1406 Lot line	No Under Drain	1.1
3	West Ditch on S State Ave	No Under Drain	0.4
4	N End Drake Ct Cul-de-sac @ 300 HSE	Under Drain	0.8
5	East Ditch on Cedar St 30' South of 15th St @ HSE #1601	Under Drain	1.1
6	East Ditch on Weber Ave	Under Drain	2.6
7	West Ditch on Palmetto Ave	Under Drain	0.4

The infiltration rates for sites 2, 3, 5, and 6 were determined by fitting a curve through the data points and determining the value expected to occur at 24 hours (the asymptote that would result from a full-duration infiltration test). The infiltration rates for sites 1, 4, and 7 were determined by numerically averaging the last few data points since a curve-fit resulted in unrealistically low or negative infiltration rates.

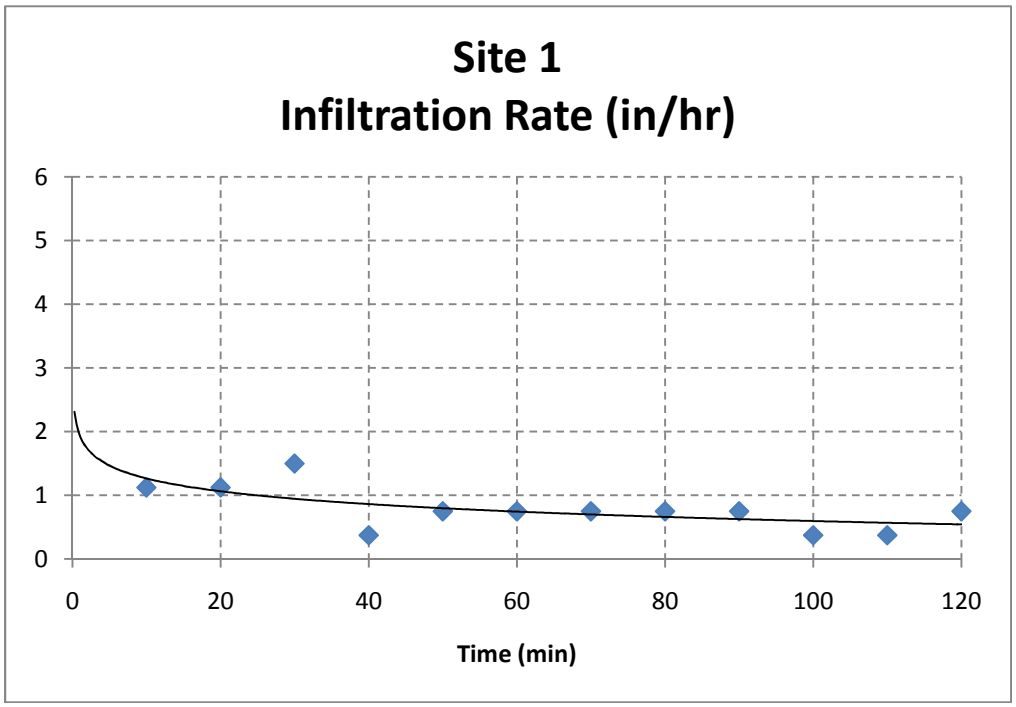
Infiltration test data

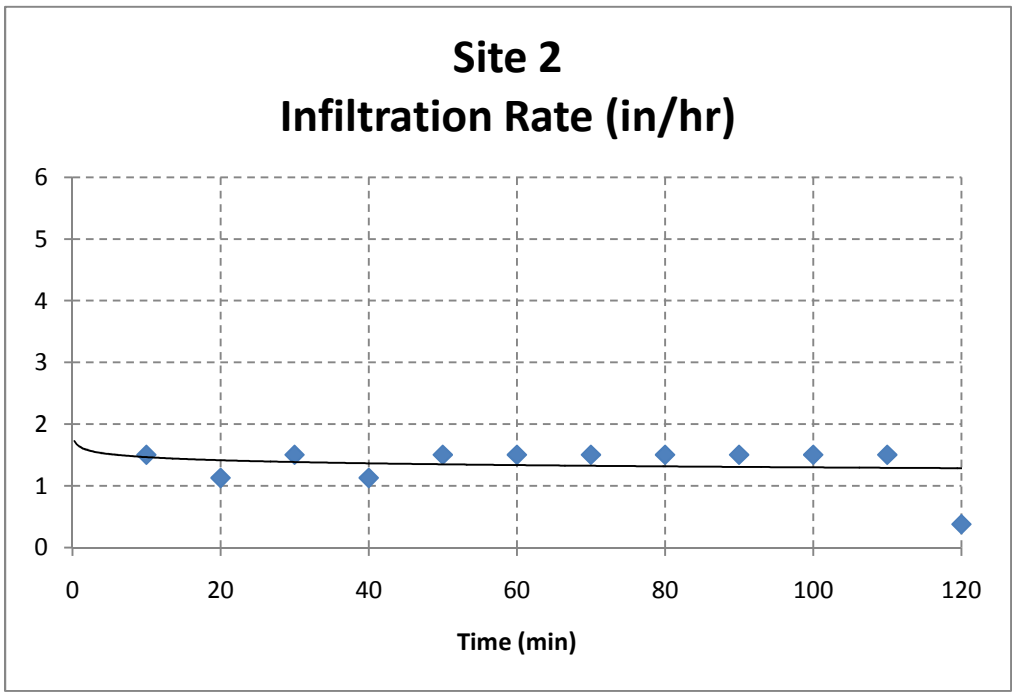
	1: Blodgett		2: Wood		3: State		4: Drake	
Time	Water Level Change	Infiltration Rate	Water Level Change	Infiltration Rate	Water Level Change	Infiltration Rate	Water Level Change	Infiltration Rate
(min)	(in)	(in/hr)	(in)	(in/hr)	(in)	(in/hr)	(in)	(in/hr)
10	0.19	1.1	0.25	1.5	0.13	0.8	1.00	6.0
20	0.19	1.1	0.19	1.1	0.06	0.4	0.38	2.3
30	0.25	1.5	0.25	1.5	0.13	0.8	0.19	1.1
40	0.06	0.4	0.19	1.1	0.13	0.8	0.25	1.5
50	0.13	0.8	0.25	1.5	0.13	0.8	0.19	1.1
60	0.13	0.8	0.25	1.5	0.13	0.8	0.19	1.1
70	0.13	0.8	0.25	1.5	0.13	0.8	0.19	1.1
80	0.13	0.8	0.25	1.5	0.06	0.4	0.13	0.8
90	0.13	0.8	0.25	1.5	0.13	0.8	0.13	0.8
100	0.06	0.4	0.25	1.5	0.13	0.8	0.13	0.8
110	0.06	0.4	0.25	1.5	0.06	0.4	0.13	0.8
120	0.13	0.8	0.06	0.4	0.06	0.4	0.13	0.8
Asy	0.4		1.1		0.4		0.8	

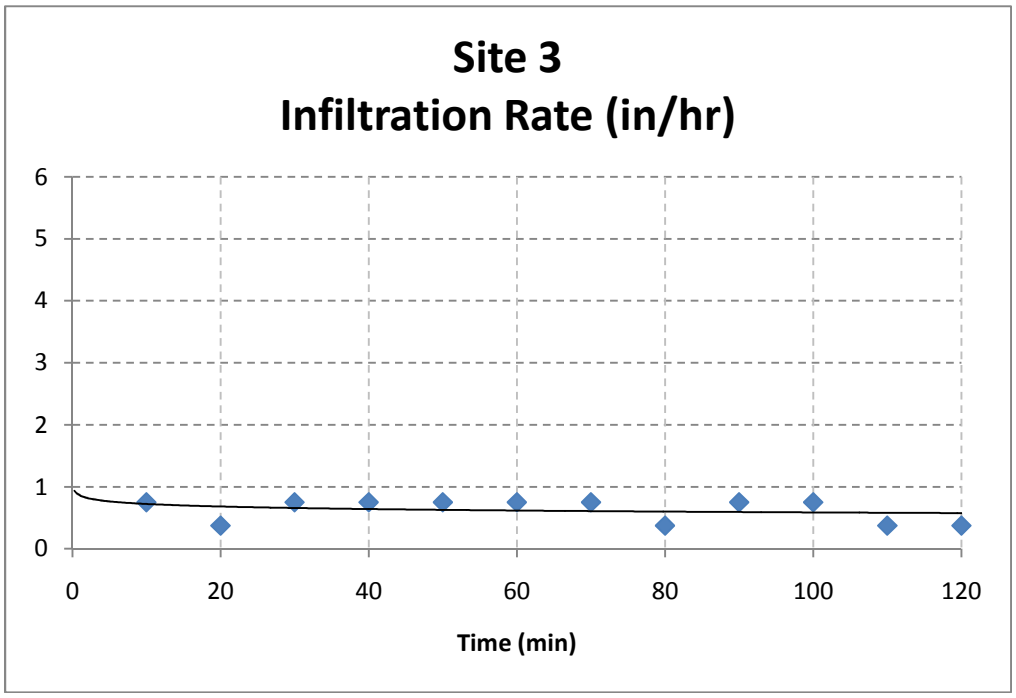
	5: Cedar		6: Weber		7: Palmetto	
Time	Water Level Change	Infiltration Rate	Water Level Change	Infiltration Rate	Water Level Change	Infiltration Rate
(min)	(in)	(in/hr)	(in)	(in/hr)	(in)	(in/hr)
10	0.25	1.5	0.50	3.0	0.19	1.1
20	0.13	0.8	0.44	2.6	0.19	1.1
30	0.19	1.1	0.56	3.4	0.25	1.5
40	0.25	1.5	0.56	3.4	0.06	0.4
50	0.25	1.5	0.56	3.4	0.13	0.8
60	0.25	1.5	0.44	2.6	0.13	0.8
70	0.25	1.5	0.56	3.4	0.13	0.8
80	0.25	1.5	0.44	2.6	0.13	0.8
90	0.19	1.1	0.44	2.6	0.13	0.8
100	0.19	1.1	0.50	3.0	0.06	0.4
110	0.13	0.8	0.44	2.6	0.06	0.4
120	0.19	1.1	0.44	2.6	0.13	0.8
Asy	1.1		2.6		0.4	

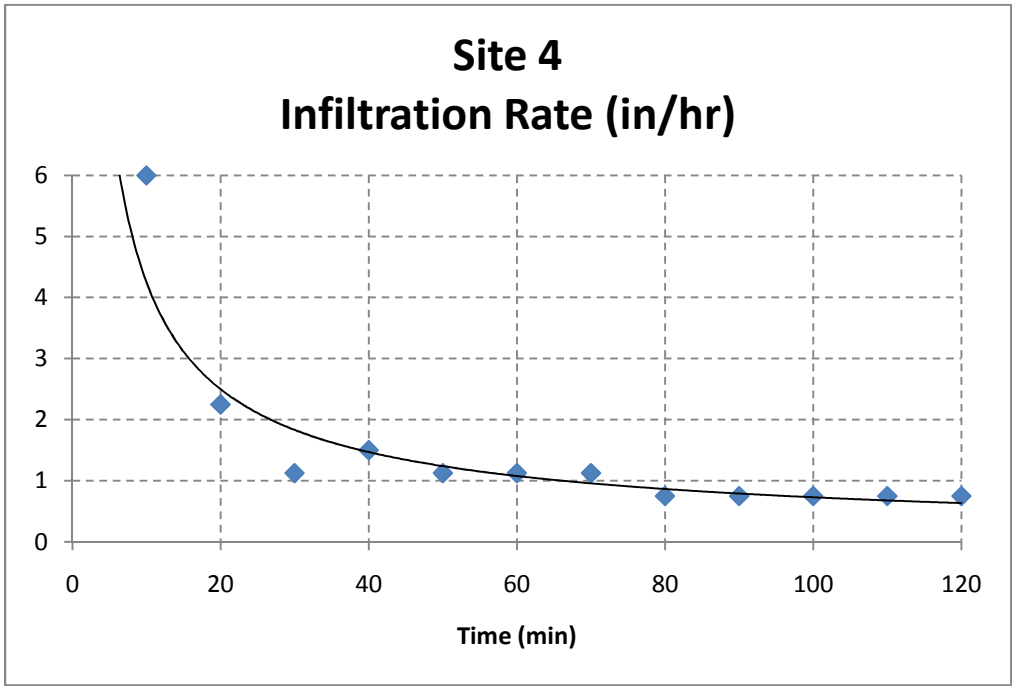
Offices in Illinois, Iowa, Minnesota, and Wisconsin

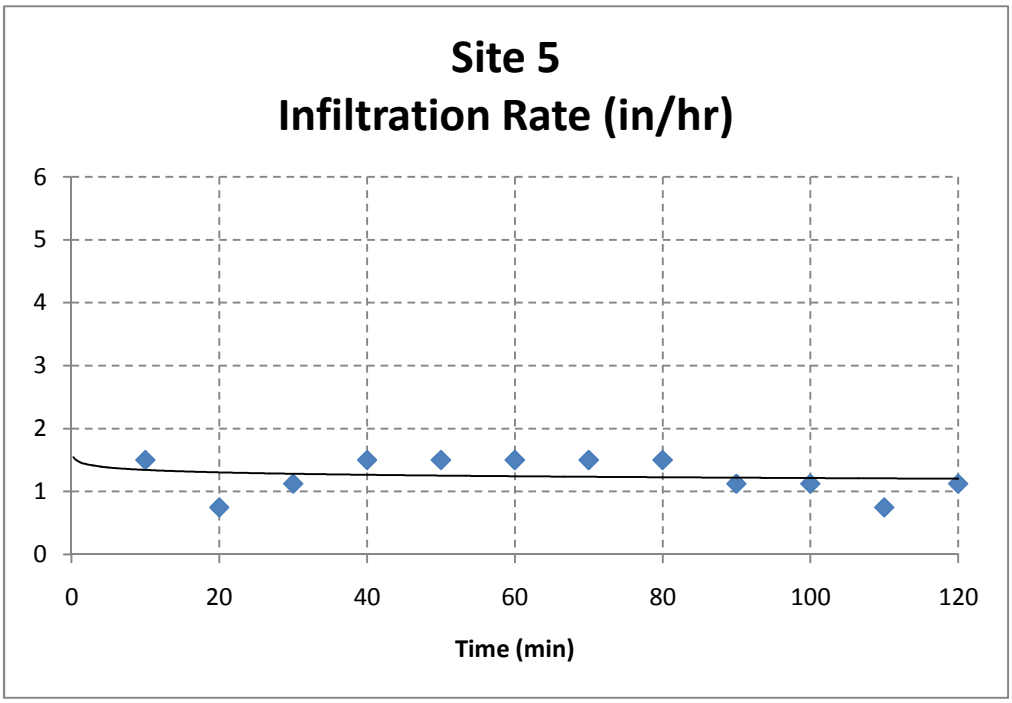
2901 International Lane, Suite 300, Madison, WI 53704-3133
(608) 242-7779 (800) 446-0679
FAX: (608) 242-5664 WEB ADDRESS: www.msa-ps.com

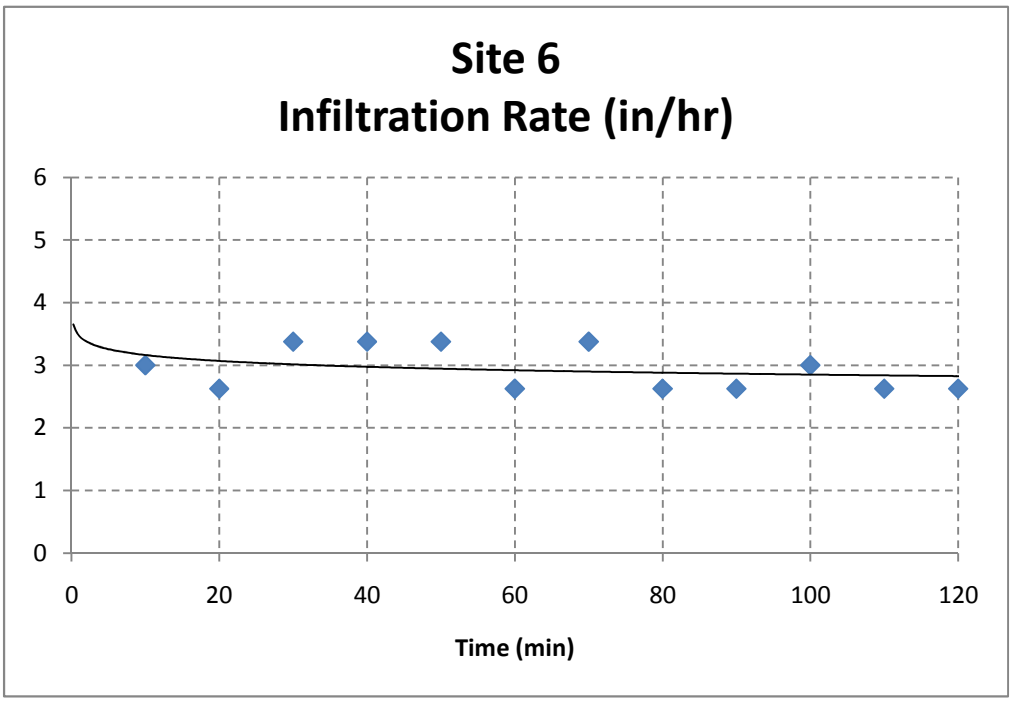

Site 1
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)


Site 2
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)


Site 3
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)


Site 4
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)


Site 5
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)


Site 6
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)

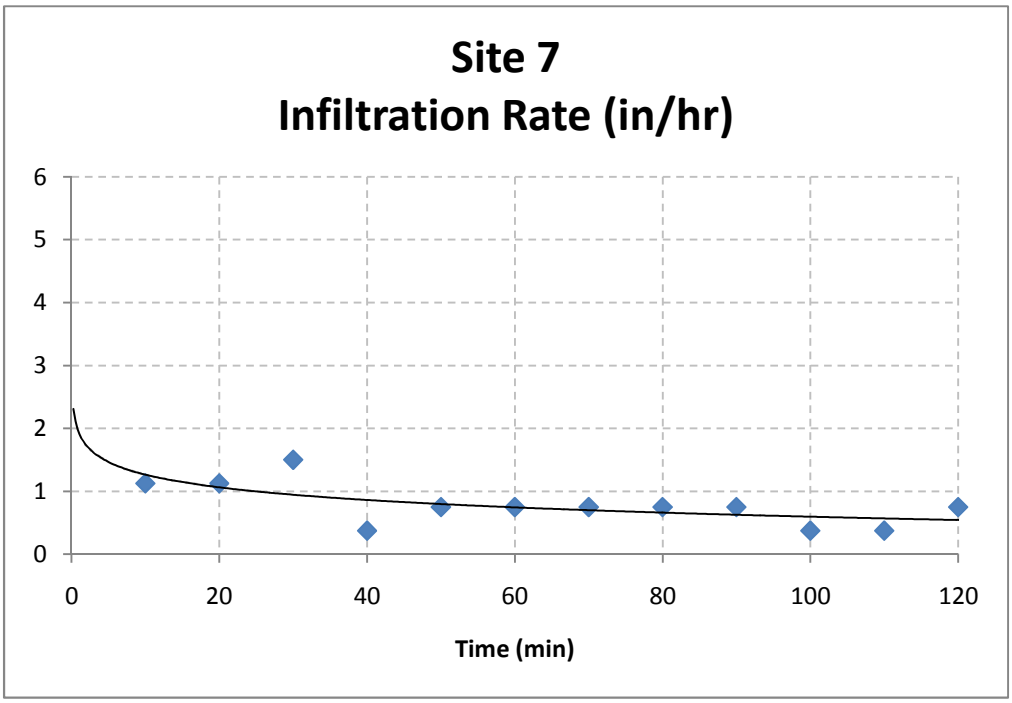

Site 7
Infiltration Rate (in/hr)
6
5
4
3
2
1
0
0
20
40
60
80
100
120
Time (min)

Figure 1: Greenway East of S. Washington Ave. & Green Acres Dr.

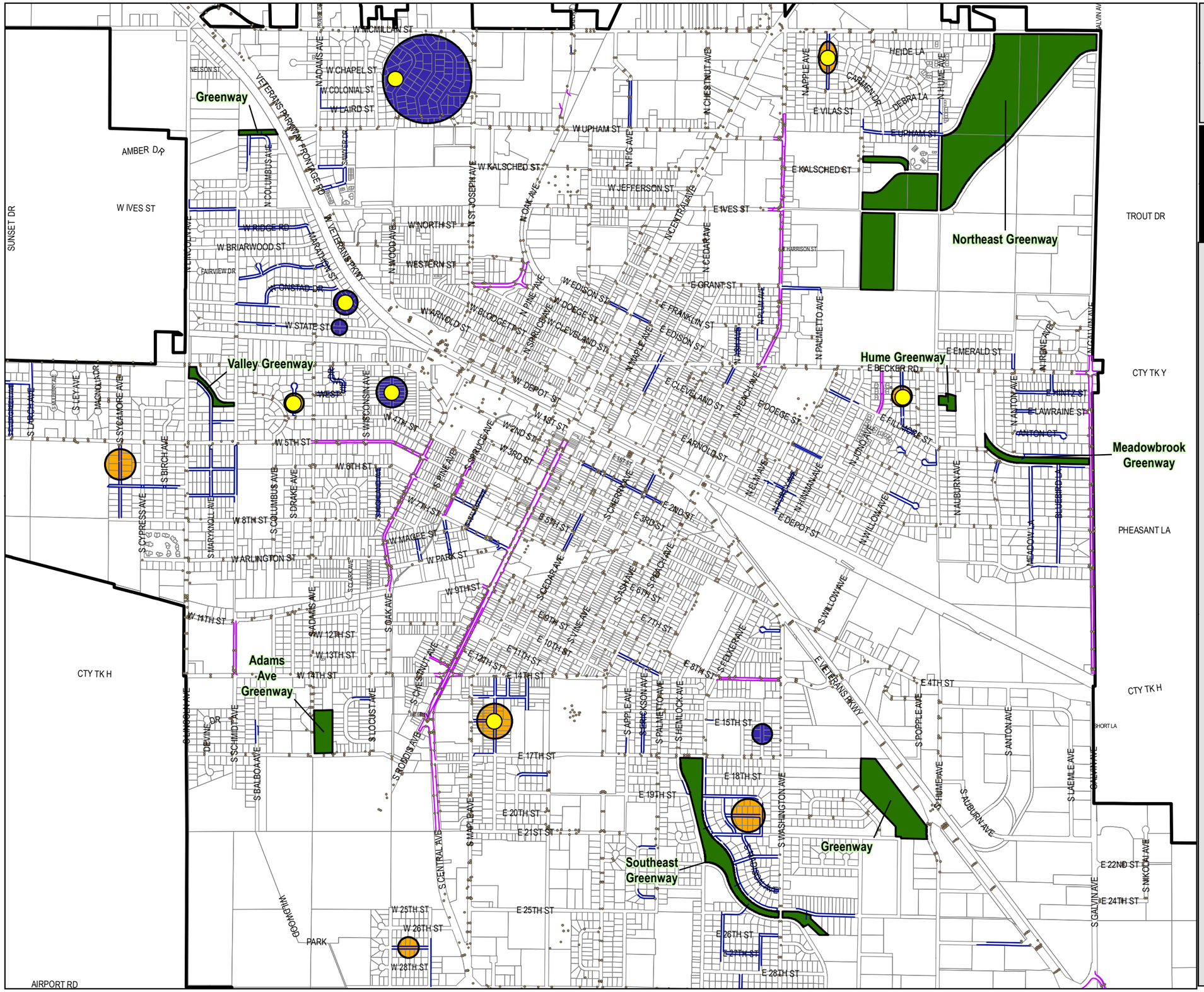
Figure 2: Meadowbrook Greenway

Figure 3: Northeast Greenway

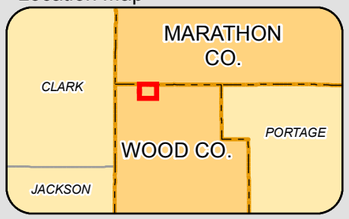
Figure 4: Adams Avenue Greenway

Possible Infiltration Testing Locations

City of Marshfield
Wood and Marathon Counties, Wisconsin



Location Map



- Infiltration Testing Site
- City Limits
- Parcel
- Storm Inlet

Possible Infiltration Testing Locations

- No Drain Tile, Residential
- Drain Tile, Residential
- Greenway

Drain Tile: Type

- Ditch
- Roadway

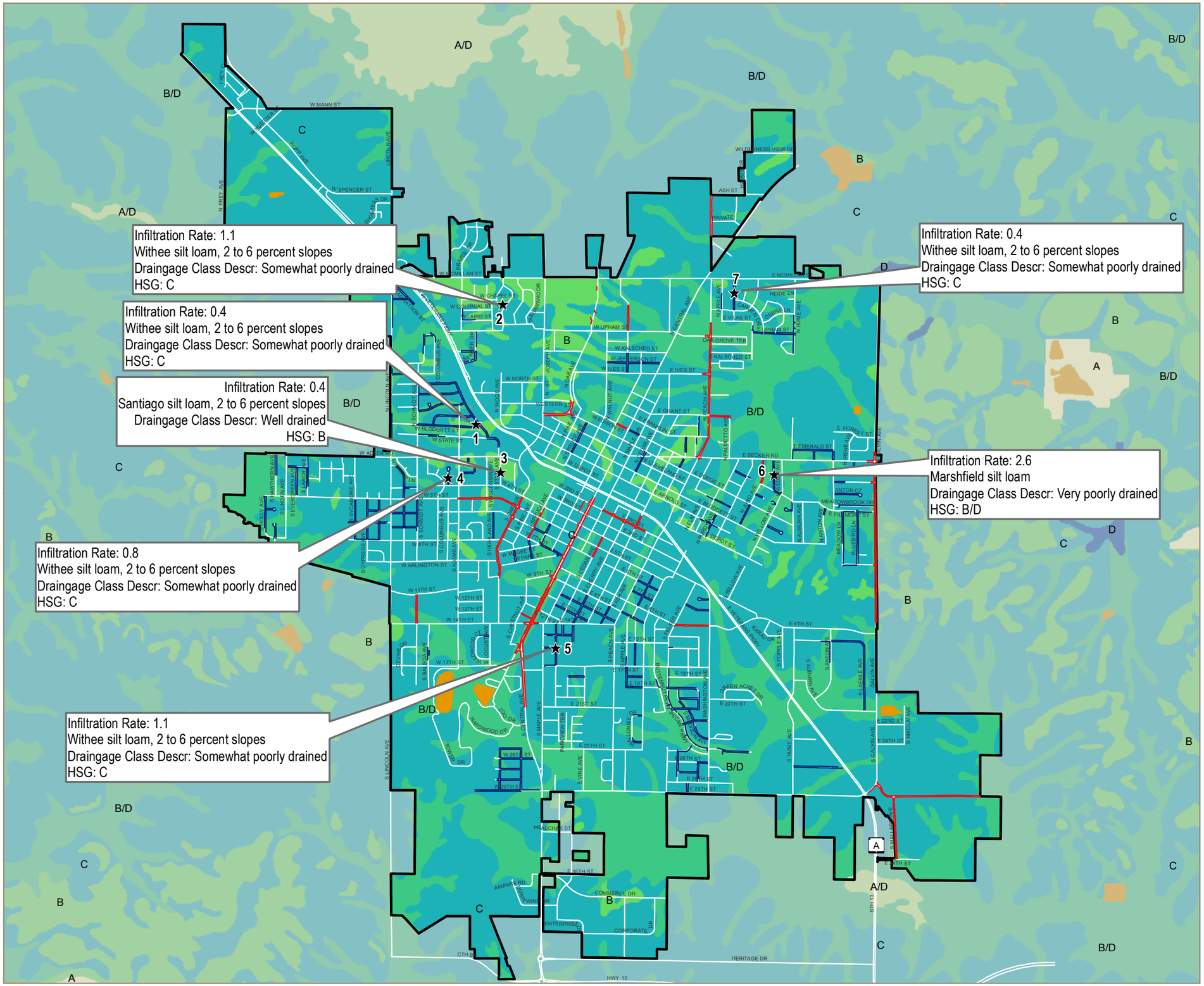
0 800 1,600 3,200 Feet

Sources:
- City and County Base Data
- Aerial Imagery from USDA (2010 NAIP)

MSA PROFESSIONAL SERVICES

Printed: ethompson, 3:26:57 PM 6/20/2013 File: C:\Users\ethompson\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\TRMWXZJN\00584064_InfiltrationTesting.mxd

INFILTRATION TESTING SITES



CITY LIMITS

DRAIN TILE: DITCH

DRAIN TILE: ROADWAY

★ INFILTRATION TESTING SITE

HYDROLOGIC SOIL GROUP

- A
- A/D
- B
- B/D
- C
- D
- NO-VALUE

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 750 1,500 3,000 Feet

APPENDIX E

CATCH BASIN DENSITY DATA

© June 2014 MSA Professional Services, Inc.

Catch Basin Data					
Watershed ID	**GIS-Determined Area of Subwatershed Served by Catch Basins**	**Area of Subwatershed Served by CBs Applied to Model**	**Number of CBs**	**Catch Basin Density**	**Note**
	(acres)	(acres)		(#/Acre)	
100	1005.08	1005.08	1208	1.20	
102	0.20				No CBs in Watershed, Area Served moved to 'Neither' Classification
104	4.20	4.20	15	3.57	
106	10.00	10.00	31	3.10	
108	0.29	0.29	1	3.41	
110					
112	41.59	41.59	14	0.34	
114	3.16				No CBs in Watershed, Area Served moved to 'Neither' Classification
116	135.61	135.61	67	0.49	
118	3.84				No CBs in Watershed, Area Served moved to 'Neither' Classification
120					
122					
124	18.10	18.10	7	0.39	
126	1.75	1.75	8	4.57	
128					
130					
132	12.37				No CBs in Watershed, Area Served moved to 'Neither' Classification
134	38.89	38.89	1	0.03	
136	0.00				No CBs in Watershed, Area Served moved to 'Neither' Classification
138					
140	26.98	26.98	21	0.78	
142	20.38	20.38	7	0.34	
144	9.96	9.96	15	1.51	
146	1.84	1.84	1	0.54	
148	1.13				No CBs in Watershed, Area Served moved to 'Neither' Classification
150	0.71				No CBs in Watershed, Area Served moved to 'Neither' Classification
152	164.21	164.21	153	0.93	
154	10.42	10.42	11	1.06	
156	4.43				No CBs in Watershed, Area Served moved to 'Neither' Classification
158	13.58				No CBs in Watershed, Area Served moved to 'Neither' Classification
200	322.14	322.14	263	0.82	
202	7.39				No CBs in Watershed, Area Served moved to 'Neither' Classification
204	12.71	12.71	9	0.71	
206	3.04	3.04	1	0.33	
208	1.03				No CBs in Watershed, Area Served moved to 'Neither' Classification
210	1.21				No CBs in Watershed, Area Served moved to 'Neither' Classification
212	0.88				No CBs in Watershed, Area Served moved to 'Neither' Classification
214	0.54				No CBs in Watershed, Area Served moved to 'Neither' Classification
216	27.29	27.29	16	0.59	
218	15.21				No CBs in Watershed, Area Served moved to 'Neither' Classification
220	2.96				No CBs in Watershed, Area Served moved to 'Neither' Classification
222	1.48	1.48	4	2.70	
224	1.88				No CBs in Watershed, Area Served moved to 'Neither' Classification
226	18.53	18.53	13	0.70	
228	0.39				No CBs in Watershed, Area Served moved to 'Neither' Classification
300	677.07	677.07	552	0.82	
302	22.43	22.43	20	0.89	
304	5.74				No CBs in Watershed, Area Served moved to 'Neither' Classification
306	16.60				No CBs in Watershed, Area Served moved to 'Neither' Classification
308	7.55				No CBs in Watershed, Area Served moved to 'Neither' Classification
310	16.71				No CBs in Watershed, Area Served moved to 'Neither' Classification
312	8.36				No CBs in Watershed, Area Served moved to 'Neither' Classification
314	4.28				No CBs in Watershed, Area Served moved to 'Neither' Classification
316	3.23				No CBs in Watershed, Area Served moved to 'Neither' Classification
318	0.98				No CBs in Watershed, Area Served moved to 'Neither' Classification
320	12.91				No CBs in Watershed, Area Served moved to 'Neither' Classification
322					
324	1.28				No CBs in Watershed, Area Served moved to 'Neither' Classification
326	0.85				No CBs in Watershed, Area Served moved to 'Neither' Classification
328	2.67				No CBs in Watershed, Area Served moved to 'Neither' Classification
330	10.14				No CBs in Watershed, Area Served moved to 'Neither' Classification
332	10.14	10.14	2	0.20	
334	1.53				No CBs in Watershed, Area Served moved to 'Neither' Classification
336	6.53				No CBs in Watershed, Area Served moved to 'Neither' Classification
338	177.86	177.86	205	1.15	
340	4.83				No CBs in Watershed, Area Served moved to 'Neither' Classification
342	2.46				No CBs in Watershed, Area Served moved to 'Neither' Classification
344	3.15				No CBs in Watershed, Area Served moved to 'Neither' Classification
346	13.16	13.16	2	0.15	
348	13.04	13.04	14	1.07	
350	0.00	0.00	1	699.21	
1012					
1016	0.00				No CBs in Watershed, Area Served moved to 'Neither' Classification
1052					
1054	0.00				No CBs in Watershed, Area Served moved to 'Neither' Classification
2016					
2018					
2020					
3002					
3006					
3048					
P10002	67.16	67.16	37	0.55	
P10004	6.15	6.15	17	2.77	
P10006	123.34	123.34	189	1.53	
P10008	13.00	13.00	22	1.69	
P200006	0.00	0.00	7	13814.72	
P20002	11.61	11.61	16	1.38	
P20004	102.95	102.95	97	0.94	
P20006	79.26	79.26	88	1.11	
P30002	20.73	20.73	10	0.48	
P30004	84.45	84.45	136	1.61	
P30006	36.83	36.83	57	1.55	
P30008	40.13	40.13	24	0.60	
		Total	**Total**	**Average**	
		3374	**3362**	**1.00**	

APPENDIX F

CATCH BASIN STARTING SEDIMENT DEPTH ANALYSIS

© June 2014 MSA Professional Services, Inc.

MEMO

To: City of Marshfield

From: Eric Thompson, P.E., CFM

Subject: Determination of Catch Basin Sediment Starting Depths

Date: January 30, 2014

Introduction

This memorandum document the development of the formula used to estimate the average sediment depth within catch basins in the City of Marshfield.

Background

The City of Marshfield cleans approximately 10% of its catch basins annually. Data is not currently available indicating the rotation the City follows when cleaning catch basins, regardless, WinSLAMM does not easily accommodate a rotating catch basin cleaning cycle during a model simulation. Furthermore, WDNR requires that WinSLAMM models used for evaluation of street sweeping programs be solved using a 5-yr rainfall record. This does not allow simulation of a long enough period such that the City's entire system of catch basins would be taken through a complete cleaning cycle.

Since all catch basins are not cleaned at once, each catch basin in the City's system will have different amounts of accumulated sediment at any one time. As there is no cost-effective way to estimate the accumulation of sediment within any individual catch basin, or even subwatershed-groupings of catch basins it was necessary to estimate an average depth of sediment within all catch basins at the beginning of the simulation.

Method

This evaluation was completed through a number of steps. The first step involved solving a WinSLAMM model to estimate the rate at which catch basins fill with sediment. These simulations were completed using a simple model with a single 100-acre watershed using the built in WinSLAMM standard land use describing 'Medium Density Residential Land Use – No Alleys'. This land use has been suggested to be typical of Wisconsin MS4 communities like Marshfield. In fact, this land use (clayey soils) produces an annual TSS load of 261 pounds per acre per year which compares well to the 271 pounds per acre per year for NR151 regulated parts of the City of Marshfield.

Offices in Illinois, Iowa, Minnesota, and Wisconsin
2901 International Lane, Suite 300, Madison, WI 53704-3133
(608) 242-7779 (800) 446-0679
FAX: (608) 242-5664 WEB ADDRESS: www.msa-ps.com

This model was solved and various densities of catch basins were assigned to the drainage system. The following geometric data were assigned to the catch basin systems:

Catch Basin Sump Depth. All catch basins were assumed to have an 18-inch sump depth.

Catch Basin Outlet Pipe Configuration. All outlet pipes were all assigned model default parameters; 12-inches diameter, reinforced concrete pipe construction (n=0.013), and to have a slope of 2%.

Catch Basin Sump Surface Area. Catch basin inlets were assumed to have a uniform cross-sectional dimension of 2-feet by 3-feet (6 square feet) to match typical storm sewer inlet box dimensions. The sump area of each catch basin was assumed to have the same dimensions.

Catch Basin Depth from Sump Bottom to Street Level. All catch basins were assumed to have a depth of 5 feet from the bottom of the invert of the sump to the street surface.

Catch Basin Sump Leakage Rate. It was assumed that there was no loss of water through the catch basin bottom (leakage rate of zero inches/hour).

Each simulation was started with no sediment in the catch basin sumps. The model was solved for catch basin densities ranging from 0.25 catch basins per acre to 4.0 catch basins per acre. The simulations were run for five years using model parameter files appropriate for the City of Marshfield. Table 1, below documents the total sediment accumulation within sumps at the end of each model year.

Table 1
Estimated Average Sediment Accumulation for Various Catch Basin Densities

CB Density		0.25		0.50		1.00		2.00		3.00		4.00	
Season End	Year	% Full	Change	% Full	Change	% Full	Change	% Full	Change	% Full	Change	% Full	Change
	0	0.00		0.00		0.00		0.00		0.00		0.00	
12/3/1968	1	20.08	20.08	13.57	13.57	9.05	9.05	6.08	6.08	4.59	4.59	3.87	3.87
12/3/1969	2	38.03	17.96	25.69	12.12	17.17	8.12	11.52	5.45	9.23	4.64	7.80	3.93
12/3/1970	3	56.79	18.76	38.40	12.70	25.76	8.59	17.27	5.75	13.46	4.23	11.37	3.57
12/4/1971	4	70.44	13.65	47.60	9.21	31.96	6.19	21.41	4.14	17.82	4.36	15.06	3.69
12/5/1972	5	89.56	19.12	60.47	12.87	40.62	8.66	27.21	5.80	21.99	4.17	18.58	3.52
		Ave	17.91	Ave	12.09	Ave	8.12	Ave	5.44	Ave	4.40	Ave	3.72

Sediment accumulation rates for each of the simulated catch basin densities were applied over a ten-year cycle with a rotating cleaning cycle. If a catch basin filled up, no additional sediment was allowed to accumulate.

0.25 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.18	0.36	0.54	0.72	0.91	1.00	1.00	1.00	1.00
2	1.00	0.00	0.18	0.36	0.54	0.72	0.91	1.00	1.00	1.00
3	1.00	1.00	0.00	0.18	0.36	0.54	0.72	0.91	1.00	1.00
4	1.00	1.00	1.00	0.00	0.18	0.36	0.54	0.72	0.91	1.00
5	1.00	1.00	1.00	1.00	0.00	0.18	0.36	0.54	0.72	0.91
6	0.91	1.00	1.00	1.00	1.00	0.00	0.18	0.36	0.54	0.72
7	0.72	0.91	1.00	1.00	1.00	1.00	0.00	0.18	0.36	0.54
8	0.54	0.72	0.91	1.00	1.00	1.00	1.00	0.00	0.18	0.36
9	0.36	0.54	0.72	0.91	1.00	1.00	1.00	1.00	0.00	0.18
10	0.18	0.36	0.54	0.72	0.91	1.00	1.00	1.00	1.00	0.00

0.50 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98	1.00
2	1.00	0.00	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98
3	0.98	1.00	0.00	0.12	0.24	0.37	0.49	0.61	0.73	0.86
4	0.86	0.98	1.00	0.00	0.12	0.24	0.37	0.49	0.61	0.73
5	0.73	0.86	0.98	1.00	0.00	0.12	0.24	0.37	0.49	0.61
6	0.61	0.73	0.86	0.98	1.00	0.00	0.12	0.24	0.37	0.49
7	0.49	0.61	0.73	0.86	0.98	1.00	0.00	0.12	0.24	0.37
8	0.37	0.49	0.61	0.73	0.86	0.98	1.00	0.00	0.12	0.24
9	0.24	0.37	0.49	0.61	0.73	0.86	0.98	1.00	0.00	0.12
10	0.12	0.24	0.37	0.49	0.61	0.73	0.86	0.98	1.00	0.00

1.0 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66	0.74
2	0.74	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66
3	0.66	0.74	0.00	0.08	0.16	0.25	0.33	0.41	0.49	0.57
4	0.57	0.66	0.74	0.00	0.08	0.16	0.25	0.33	0.41	0.49
5	0.49	0.57	0.66	0.74	0.00	0.08	0.16	0.25	0.33	0.41
6	0.41	0.49	0.57	0.66	0.74	0.00	0.08	0.16	0.25	0.33
7	0.33	0.41	0.49	0.57	0.66	0.74	0.00	0.08	0.16	0.25
8	0.25	0.33	0.41	0.49	0.57	0.66	0.74	0.00	0.08	0.16
9	0.16	0.25	0.33	0.41	0.49	0.57	0.66	0.74	0.00	0.08
10	0.08	0.16	0.25	0.33	0.41	0.49	0.57	0.66	0.74	0.00

2.0 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50
2	0.50	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44
3	0.44	0.50	0.00	0.06	0.11	0.17	0.22	0.28	0.33	0.39
4	0.39	0.44	0.50	0.00	0.06	0.11	0.17	0.22	0.28	0.33
5	0.33	0.39	0.44	0.50	0.00	0.06	0.11	0.17	0.22	0.28
6	0.28	0.33	0.39	0.44	0.50	0.00	0.06	0.11	0.17	0.22
7	0.22	0.28	0.33	0.39	0.44	0.50	0.00	0.06	0.11	0.17
8	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.00	0.06	0.11
9	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.00	0.06
10	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.00

3.0 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36	0.40
2	0.40	0.00	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36
3	0.36	0.40	0.00	0.04	0.09	0.13	0.18	0.22	0.27	0.31
4	0.31	0.36	0.40	0.00	0.04	0.09	0.13	0.18	0.22	0.27
5	0.27	0.31	0.36	0.40	0.00	0.04	0.09	0.13	0.18	0.22
6	0.22	0.27	0.31	0.36	0.40	0.00	0.04	0.09	0.13	0.18
7	0.18	0.22	0.27	0.31	0.36	0.40	0.00	0.04	0.09	0.13
8	0.13	0.18	0.22	0.27	0.31	0.36	0.40	0.00	0.04	0.09
9	0.09	0.13	0.18	0.22	0.27	0.31	0.36	0.40	0.00	0.04
10	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36	0.40	0.00

4.0 CB/Acre	Percent Full									
Year	1	2	3	4	5	6	7	8	9	10
1	0.00	0.04	0.08	0.11	0.15	0.19	0.23	0.26	0.30	0.34
2	0.34	0.00	0.04	0.08	0.11	0.15	0.19	0.23	0.26	0.30
3	0.30	0.34	0.00	0.04	0.08	0.11	0.15	0.19	0.23	0.26
4	0.26	0.30	0.34	0.00	0.04	0.08	0.11	0.15	0.19	0.23
5	0.23	0.26	0.30	0.34	0.00	0.04	0.08	0.11	0.15	0.19
6	0.19	0.23	0.26	0.30	0.34	0.00	0.04	0.08	0.11	0.15
7	0.15	0.19	0.23	0.26	0.30	0.34	0.00	0.04	0.08	0.11
8	0.11	0.15	0.19	0.23	0.26	0.30	0.34	0.00	0.04	0.08
9	0.08	0.11	0.15	0.19	0.23	0.26	0.30	0.34	0.00	0.04
10	0.04	0.08	0.11	0.15	0.19	0.23	0.26	0.30	0.34	0.00

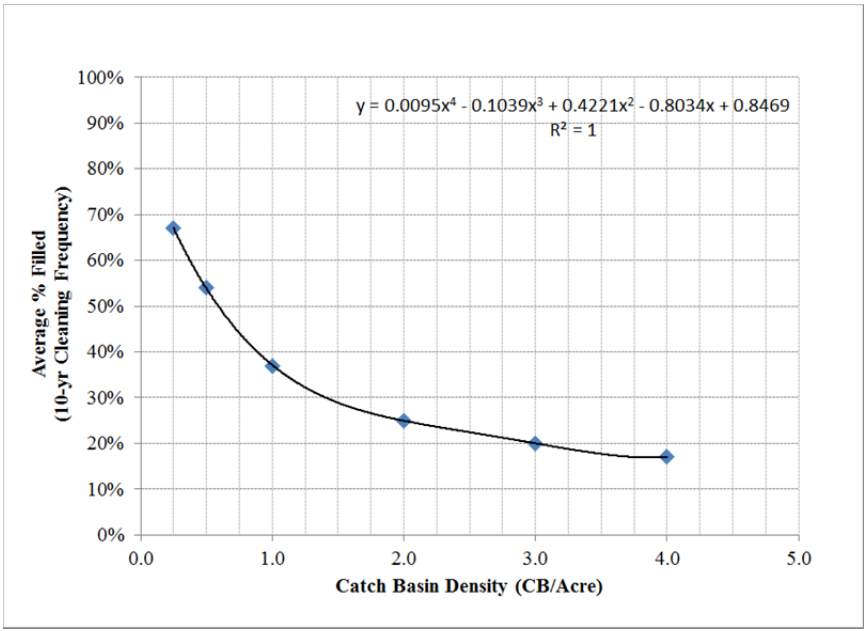
The average sediment depth within all catch basins for the duration of each 10-yr tabulation simulation was determined, tabulated and plotted to determine a curve fit for the data.

Table 2
Average Sediment Amount within Catch Basins
as a function of Catch Basin Density
(10-yr cleaning cycle)

Catch Basin Density	Average Percent Full
CB/Acre	(%)
0.25	67%
0.5	54%
1	37%
2	25%
3	20%
4	17%

When plotted, this resulted in the chart below. The curve-fit through the data was used to assign starting depths within catch basins according to the City's GIS data.

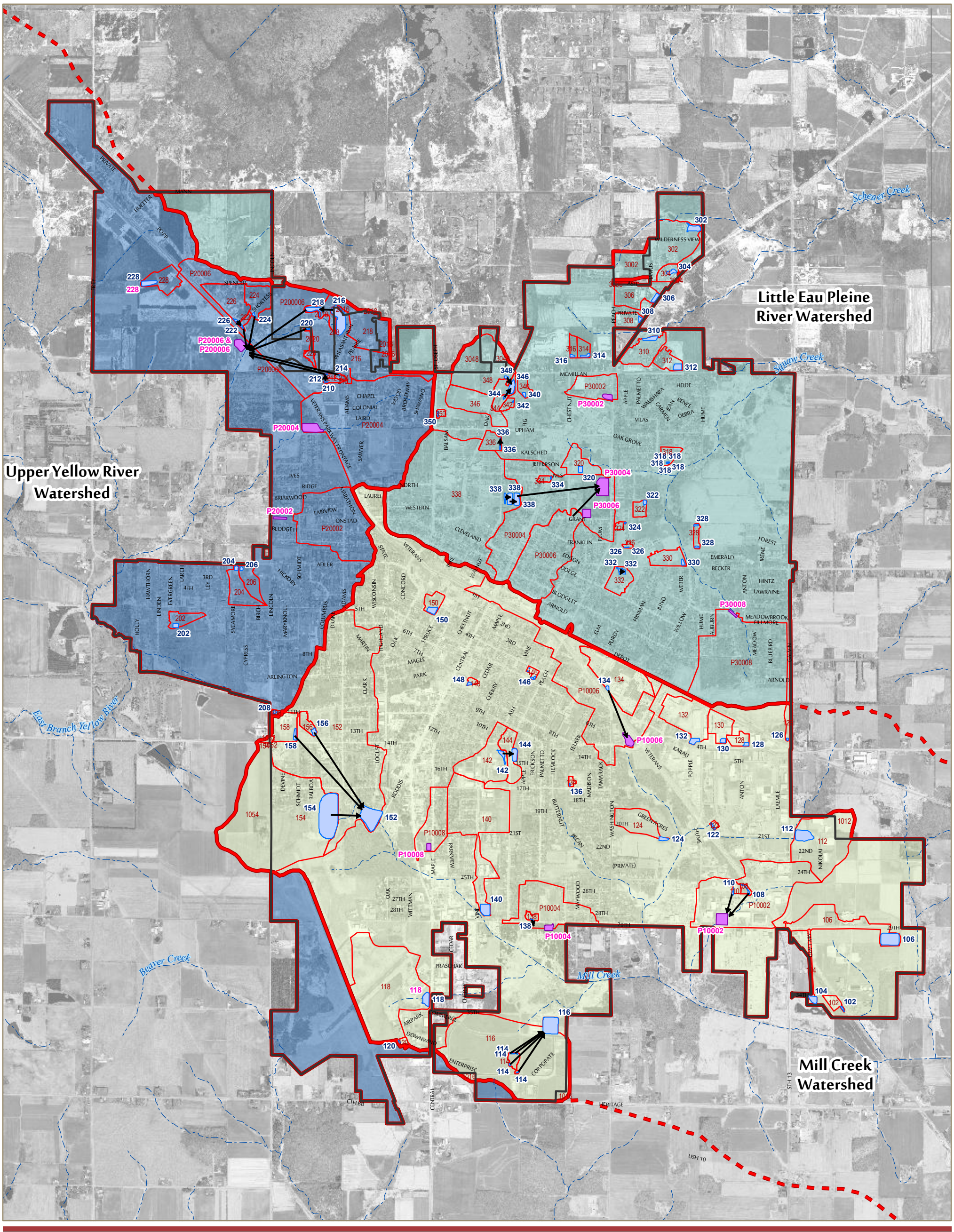
Figure 1
Average Sediment Amount within Catch Basins
as a function of Catch Basin Density
(10-yr cleaning cycle)



APPENDIX G

OUTFALL BMP GEOMETRIC DATA

© June 2014 MSA Professional Services, Inc.



EXISTING PONDS AND POND CONNECTIONS

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WISCONSIN

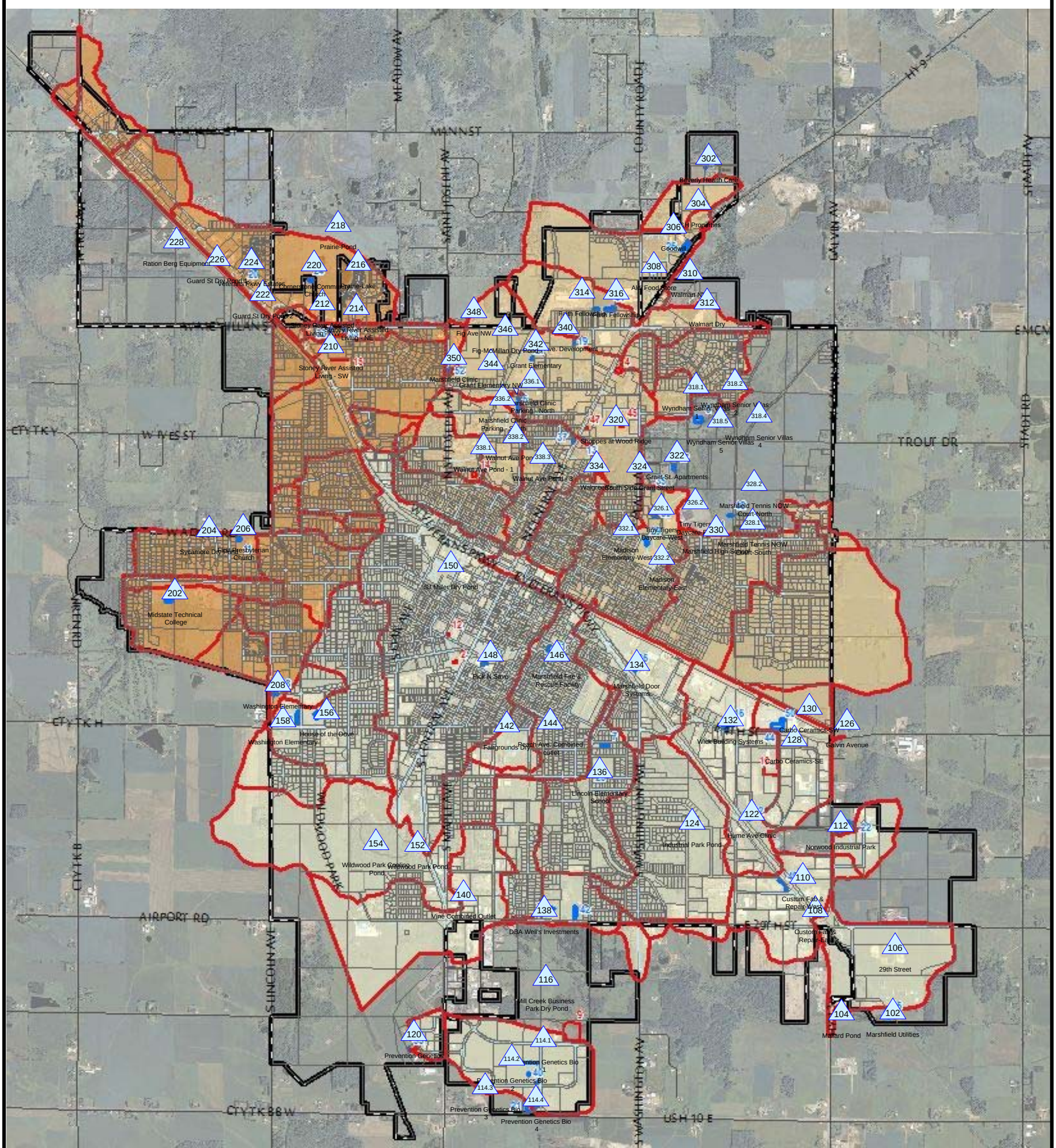
CITY LIMITS
STUDY AREA MAJOR WATERSHED
POND CONNECTIONS
MILL CREEK WATERSHED
PROPOSED PONDS
WATERSHED
RIVER/STREAM (NHD)
LITTLE EAU PLEINE WATERSHED
EXISTING PONDS
YELLOW RIVER WATERSHED

DATA SOURCES:
BASE DATA AND AERIAL (WROC 2010) PROVIDED BY CITY OF MARSHFIELD.
ADDITIONAL AERIAL OUTSIDE OF THE CITY LIMITS FROM USDA (NAIP 2010).
STREAMS FORM NATIONAL HYDROLOGY DATASET.

N

0 0.125 0.25 0.5 Miles

MSA PROFESSIONAL SERVICES



Subcat Reach Pond Link

Routing Diagram for Marshfield HydroCAD

Prepared by MSA Professional Services, Printed 6/16/2014

HydroCAD® 10.00 s/n 01114 © 2013 HydroCAD Software Solutions LLC

Summary for Pond 102: Marshfield Utilities

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,204.00'	0.358 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,204.00	0.002	0.000	0.000
1,206.00	0.011	0.013	0.013
1,207.00	0.017	0.014	0.027
1,208.00	0.026	0.021	0.048
1,209.00	0.036	0.031	0.079
1,210.00	0.057	0.046	0.126
1,211.00	0.068	0.062	0.188
1,212.00	0.083	0.075	0.264
1,213.00	0.104	0.093	0.358

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,210.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	1,212.75'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 4	1,212.75'	**24.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	1,210.00'	**18.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 1,210.00' / 1,209.80' S= 0.0020 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#5	Device 4	1,211.00'	**0.8' long x 1.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.59 2.63 2.63 2.65 2.71 2.80 2.86 3.00 2.99 2.96 3.20 3.27 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Culvert** (Controls 0.00 cfs)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 104: Mallard Pond

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	4.356 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,205.00	0.116	0.000	0.000
1,206.00	0.160	0.138	0.138
1,208.00	0.263	0.423	0.561
1,210.00	0.532	0.795	1.356
1,212.00	0.776	1.308	2.664
1,214.00	0.916	1.692	4.356

Device	Routing	Invert	Outlet Devices
#1	Primary	1,210.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	1,213.25'	**20.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	1,211.50'	**4.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#4	Primary	1,210.25'	**12.0" Round Culvert** L= 15.0' Ke= 0.500 Inlet / Outlet Invert= 1,210.25' / 1,210.25' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **4=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 106: 29th Street

Wet

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.004 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.004 af
Secondary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,216.00' Surf.Area= 3.521 ac Storage= 15.377 af
Peak Elev= 1,216.00' @ 5.00 hrs Surf.Area= 3.521 ac Storage= 15.377 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,211.00'	39.128 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,211.00	2.801	0.000	0.000
1,215.00	3.206	12.014	12.014
1,216.00	3.521	3.363	15.377
1,220.00	4.102	15.246	30.623
1,222.00	4.403	8.505	39.128

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,218.39'	**10.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Secondary	1,220.00'	**20.0' long x 26.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Device 4	1,215.97'	**8.5" Vert. Orifice/Grate** C= 0.600
#4	Primary	1,215.92'	**36.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,215.92' / 1,215.92' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,216.00' (Free Discharge)
└─**4=Culvert** (Passes 0.00 cfs of 0.01 cfs potential flow)
  ├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.59 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,216.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 108: Custom Fab & Repair-East

Wet

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,232.00' Surf.Area= 0.083 ac Storage= 0.173 af
Peak Elev= 1,232.00' @ 5.00 hrs Surf.Area= 0.083 ac Storage= 0.173 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,229.00'	0.388 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,229.00	0.046	0.000	0.000
1,230.00	0.046	0.046	0.046
1,231.00	0.063	0.054	0.100
1,232.00	0.083	0.073	0.173
1,233.00	0.105	0.094	0.267
1,234.00	0.137	0.121	0.388

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,232.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Device 4	1,233.50'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 4	1,233.99'	**24.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	1,231.50'	**15.0" Round Culvert** L= 65.0' Ke= 0.500 Inlet / Outlet Invert= 1,231.50' / 1,230.85' S= 0.0100 '/' Cc= 0.900 n= 0.010, Flow Area= 1.23 sf
#5	Secondary	1,234.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,232.00' (Free Discharge)
└─**4=Culvert** (Passes 0.00 cfs of 1.10 cfs potential flow)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,232.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 110: Custom Fab & Repair-West

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,230.00'	0.343 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,230.00	0.046	0.000	0.000
1,231.00	0.063	0.054	0.054
1,232.00	0.083	0.073	0.127
1,233.00	0.105	0.094	0.222
1,234.00	0.137	0.121	0.343

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,232.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Device 4	1,233.50'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 4	1,233.99'	**24.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	1,231.50'	**15.0" Round Culvert** L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,231.50' / 1,230.85' S= 0.0108 '/' Cc= 0.900 n= 0.010, Flow Area= 1.23 sf
#5	Secondary	1,234.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Culvert** (Controls 0.00 cfs)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 112: Norwood Industrial Park

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,236.00' Surf.Area= 3.003 ac Storage= 9.735 af
Peak Elev= 1,236.00' @ 5.00 hrs Surf.Area= 3.003 ac Storage= 9.735 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,232.50'	24.338 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,232.50	2.560	0.000	0.000
1,236.00	3.003	9.735	9.735
1,238.00	3.383	6.386	16.121
1,240.00	4.834	8.217	24.338

Device	Routing	Invert	Outlet Devices
#1	Primary	1,239.00'	**300.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	1,236.00'	**12.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 1,236.00' / 1,236.00' S= 0.0000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,236.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 114.1: Prevention Genetics Bio 1

The site has four biofilters, which were found to achieve 80.1% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 80.1%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,240.75'	0.342 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,240.75	0.051	0.000	0.000
1,241.75	0.051	0.051	0.051
1,245.00	0.051	0.166	0.217
1,246.00	0.076	0.063	0.280
1,246.50	0.171	0.062	0.342

Device	Routing	Invert	Outlet Devices
#1	Primary	1,241.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	1,240.75'	**3.600 in/hr Exfiltration over Surface area**
#3	Primary	1,246.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
├─**1=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 114.2: Prevention Genetics Bio 2

The site has four biofilters, which were found to achieve 80.1% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 80.1%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,234.25'	0.727 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,234.25	0.112	0.000	0.000
1,235.25	0.112	0.112	0.112
1,238.50	0.112	0.364	0.476
1,239.00	0.135	0.062	0.538
1,240.00	0.244	0.189	0.727

Device	Routing	Invert	Outlet Devices
#1	Primary	1,234.92'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Device 1	1,234.25'	**3.600 in/hr Exfiltration over Surface area**
#3	Primary	1,239.00'	**24.0" Vert. Orifice/Grate** C= 0.600
#4	Secondary	1,239.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
  - **2=Exfiltration** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 114.3: Prevention Genetics Bio 3

The site has four biofilters, which were found to achieve 80.1% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 80.1%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,236.05'	0.460 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,236.05	0.063	0.000	0.000
1,237.05	0.063	0.063	0.063
1,240.30	0.063	0.205	0.268
1,241.00	0.090	0.054	0.321
1,242.00	0.188	0.139	0.460

Device	Routing	Invert	Outlet Devices
#1	Primary	1,234.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Device 1	1,236.72'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	1,236.05'	**3.600 in/hr Exfiltration over Surface area**
#4	Primary	1,240.80'	**24.0" Vert. Orifice/Grate** C= 0.600
#5	Secondary	1,241.30'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
  - **2=Orifice/Grate** (Controls 0.00 cfs)
  - **3=Exfiltration** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 114.4: Prevention Genetics Bio 4

The site has four biofilters, which were found to achieve 80.1% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 80.1%.

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

Summary for Pond 116: Mill Creek Business Park Dry Pond

Inf

Volume	Invert	Avail.Storage	Storage Description
#1	1,216.00'	26.042 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,216.00	3.800	0.000	0.000
1,218.00	4.157	7.957	7.957
1,220.00	4.528	8.685	16.642
1,222.00	4.872	9.400	26.042

Device	Routing	Invert	Outlet Devices
#1	Primary	1,218.00'	**10.0' long x 50.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,220.00'	**6.0' long x 34.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	1,221.99'	**12.0' long x 14.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 120: Prevention Genetics

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,241.00'	1.122 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,241.00	0.009	0.000	0.000
1,242.00	0.021	0.015	0.015
1,243.00	0.032	0.027	0.042
1,244.00	0.049	0.040	0.082
1,245.00	0.101	0.075	0.157
1,246.00	0.123	0.112	0.269
1,248.00	0.188	0.311	0.580
1,250.00	0.354	0.542	1.122

Device	Routing	Invert	Outlet Devices
#1	Device 3	1,245.00'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#2	Device 3	1,246.05'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	1,245.00'	**10.0" Round Culvert** L= 232.0' Ke= 0.500 Inlet / Outlet Invert= 1,245.00' / 1,243.96' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf
#4	Device 3	1,250.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**3=Culvert** (Controls 0.00 cfs)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  ├─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 122: Hume Ave Clinic

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,224.00' Surf.Area= 0.061 ac Storage= 0.125 af
Peak Elev= 1,224.00' @ 5.00 hrs Surf.Area= 0.061 ac Storage= 0.125 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,221.00'	1.088 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,221.00	0.022	0.000	0.000
1,225.00	0.074	0.192	0.192
1,226.00	0.193	0.134	0.326
1,228.00	0.570	0.763	1.088

Device	Routing	Invert	Outlet Devices
#1	Primary	1,225.00'	**4.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,224.00'	**12.0" Round Culvert** L= 12.0' Ke= 0.500 Inlet / Outlet Invert= 1,224.00' / 1,223.75' S= 0.0208 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,224.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 124: Industrial Park Pond

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,222.00' Surf.Area= 0.243 ac Storage= 0.562 af
Peak Elev= 1,222.00' @ 5.00 hrs Surf.Area= 0.243 ac Storage= 0.562 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,217.00'	2.512 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,217.00	0.011	0.000	0.000
1,220.00	0.121	0.198	0.198
1,222.00	0.243	0.364	0.562
1,227.00	0.537	1.950	2.512

Device	Routing	Invert	Outlet Devices
#1	Primary	1,222.00'	**1.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Primary	1,225.50'	**11.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#3	Primary	1,226.00'	**13.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,222.00' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 126: Galvin Avenue

The site has one wet pond, which was found to achieve 79% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 79%.

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,257.10' Surf.Area= 0.058 ac Storage= 0.141 af
Peak Elev= 1,257.10' @ 5.00 hrs Surf.Area= 0.058 ac Storage= 0.141 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,253.00'	0.376 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,253.00	0.010	0.000	0.000
1,254.00	0.021	0.016	0.016
1,256.00	0.047	0.068	0.084
1,258.00	0.067	0.114	0.198
1,260.00	0.111	0.178	0.376

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,259.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,257.10'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,257.10' / 1,257.10' S= 0.0000 '/' Cc= 0.900 n= 0.024, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,257.10' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,257.10' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 128: Carbo Ceramics-SE

The site has one biofilter, which was found to achieve 76% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 76%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,246.00'	0.580 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,246.00	0.235	0.000	0.000
1,247.00	0.288	0.262	0.262
1,248.00	0.349	0.319	0.580

Device	Routing	Invert	Outlet Devices
#1	Primary	1,246.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	1,246.75'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	1,247.99'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 130: Carbo Ceramics-SW

The site has one biofilter, which was found to achieve 63% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 63%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,251.00'	1.426 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,251.00	0.273	0.000	0.000
1,252.00	0.311	0.292	0.292
1,253.00	0.347	0.329	0.621
1,254.00	0.399	0.373	0.994
1,255.00	0.466	0.432	1.426

Device	Routing	Invert	Outlet Devices
#1	Primary	1,251.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	1,253.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	1,254.99'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 132: Wick Building Systems

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,243.30'	3.440 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,243.30	0.211	0.000	0.000
1,246.00	0.388	0.809	0.809
1,248.00	0.683	1.071	1.880
1,250.00	0.877	1.560	3.440

Device	Routing	Invert	Outlet Devices
#1	Primary	1,243.40'	**22.4" Vert. Orifice/Grate** C= 0.600
#2	Secondary	1,248.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 134: Marshfield Door Systems

After reviewing the site stormwater report and discussing with City staff, no evidence exists that any BMPs were constructed. These conclusions were input into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

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

Summary for Pond 136: Lincoln Elementary School

Biofilter

Volume	Invert	Avail.Storage	Storage Description
#1	1,237.00'	0.172 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,237.00	0.039	0.000	0.000
1,238.00	0.052	0.045	0.045
1,239.00	0.066	0.059	0.105
1,240.00	0.069	0.068	0.172

Device	Routing	Invert	Outlet Devices
#1	Device 5	1,238.60'	**14.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Device 5	1,237.25'	**10.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	1,239.00'	**30.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#4	Discarded	1,237.00'	**0.050 in/hr Exfiltration over Surface area**
#5	Primary	1,235.50'	**12.0" Round Culvert** L= 77.0' Ke= 0.500 Inlet / Outlet Invert= 1,235.50' / 1,235.00' S= 0.0065 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**5=Culvert** (Controls 0.00 cfs)
  ├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 138: DBA Well's Investments

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,216.00'	0.262 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,216.00	0.002	0.000	0.000
1,217.00	0.004	0.003	0.003
1,218.00	0.007	0.006	0.008
1,219.00	0.010	0.008	0.017
1,220.00	0.014	0.012	0.029
1,221.00	0.043	0.028	0.057
1,222.00	0.059	0.051	0.109
1,223.00	0.076	0.068	0.176
1,224.00	0.096	0.086	0.262

Device	Routing	Invert	Outlet Devices
#1	Primary	1,221.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	1,222.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	1,223.00'	**12.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#4	Primary	1,221.00'	**12.0" Round Culvert** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 1,221.00' / 1,220.80' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **4=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 140: Vine Combined Outlet

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,215.00' Surf.Area= 1.369 ac Storage= 5.353 af
Peak Elev= 1,215.00' @ 5.00 hrs Surf.Area= 1.369 ac Storage= 5.353 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,210.00'	18.025 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,210.00	0.855	0.000	0.000
1,212.00	1.009	1.864	1.864
1,214.00	1.197	2.206	4.070
1,216.00	1.542	2.739	6.809
1,218.00	1.789	3.331	10.140
1,220.00	1.963	3.752	13.892
1,222.00	2.170	4.133	18.025

Device	Routing	Invert	Outlet Devices
#1	Primary	1,214.65'	**30.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 1,214.65' / 1,213.88' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf
#2	Device 1	1,214.65'	**control structure rating curve** Head (feet) 0.00 0.10 0.20 0.30 0.60 0.90 1.20 1.50 1.80 2.10 2.40 2.70 3.00 3.30 3.60 3.90 4.20 4.50 4.80 5.10 5.40 5.70 6.00 6.30 6.60 Disch. (cfs) 0.000 0.170 0.510 0.920 2.610 4.800 7.380 10.320 13.500 15.930 17.940 20.240 24.200 29.580 36.100 43.920 53.000 62.840 73.440 84.750 96.730 109.340 122.540 136.310 150.610
#3	Device 2	1,215.00'	**36.0" Round Culvert** L= 17.0' Ke= 0.500 Inlet / Outlet Invert= 1,215.00' / 1,214.65' S= 0.0206 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#4	Secondary	1,220.00'	**15.0' long x 60.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,215.00' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 0.84 cfs potential flow)
  └─**2=control structure rating curve** (Passes 0.00 cfs of 1.20 cfs potential flow)
    └─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,215.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 142: Fairgrounds Dry

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,253.49'	6.313 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,253.49	0.001	0.000	0.000
1,256.00	0.134	0.169	0.169
1,258.00	1.227	1.361	1.530
1,260.00	3.556	4.783	6.313

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,260.00'	**200.0' long x 25.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,253.49'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	1,253.49'	**24.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,253.49' / 1,253.49' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 144: Peach Ave. Combined outlet

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,247.18' Surf.Area= 0.735 ac Storage= 2.709 af
Peak Elev= 1,247.18' @ 5.00 hrs Surf.Area= 0.735 ac Storage= 2.709 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,242.00'	9.677 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,242.00	0.386	0.000	0.000
1,244.00	0.475	0.861	0.861
1,246.00	0.591	1.066	1.927
1,247.18	0.735	0.782	2.709
1,248.00	0.796	0.628	3.337
1,250.00	0.951	1.747	5.084
1,252.00	1.118	2.069	7.153
1,254.00	1.406	2.524	9.677

Device	Routing	Invert	Outlet Devices
#1	Primary	1,246.50'	**18.0" Round Culvert** L= 48.0' Ke= 0.500 Inlet / Outlet Invert= 1,246.50' / 1,245.71' S= 0.0165 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	1,246.50'	**Control structure rating curve** Head (feet) 0.00 0.10 0.20 0.30 0.60 0.90 1.20 1.50 1.80 2.10 2.40 2.70 3.00 3.30 3.60 3.70 3.80 3.90 4.20 4.50 4.80 5.10 5.40 5.70 6.00 6.30 6.60 6.90 Disch. (cfs) 0.000 0.020 0.070 0.120 0.210 0.260 0.310 0.350 0.390 0.420 0.460 0.490 0.510 0.540 0.560 0.950 1.750 2.700 6.580 11.600 17.520 22.070 25.610 28.670 31.420 33.930 36.270 38.450
#3	Device 2	1,247.18'	**18.0" Round Culvert** L= 21.9' Ke= 0.500 Inlet / Outlet Invert= 1,247.18' / 1,246.50' S= 0.0311 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#4	Secondary	1,252.75'	**30.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,247.18' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 2.19 cfs potential flow)
  └─**2=Control structure rating curve** (Passes 0.00 cfs of 0.22 cfs potential flow)
    └─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,247.18' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 146: Marshfield Fire & Rescue Facility

The site has four biofilters, which were found to achieve 83.3% TSS performance for the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 83.3%.

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

Summary for Pond 148: Pick N Save

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,259.20'	1.060 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,259.20	0.016	0.000	0.000
1,260.00	0.022	0.015	0.015
1,262.00	0.095	0.117	0.132
1,264.00	0.136	0.231	0.363
1,266.00	0.561	0.697	1.060

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,264.00'	**200.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,259.20'	**12.0" Round Culvert** L= 166.0' Ke= 0.500 Inlet / Outlet Invert= 1,259.20' / 1,258.62' S= 0.0035 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 150: SJ Miller Dry Pond

Inf

Volume	Invert	Avail.Storage	Storage Description
#1	1,266.50'	13.720 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,266.50	0.500	0.000	0.000
1,268.00	0.604	0.828	0.828
1,270.00	1.035	1.639	2.467
1,272.00	1.831	2.866	5.333
1,274.00	6.556	8.387	13.720

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,273.00'	**500.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	1,267.34'	**42.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,267.34' / 1,267.34' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 9.62 sf
#3	Primary	1,266.59'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,266.59' / 1,266.59' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
└─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 152: Wildwood Park Pond

Wet

Volume	Invert	Avail.Storage	Storage Description
#1	1,234.50'	35.197 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,234.50	5.583	0.000	0.000
1,238.00	6.604	21.327	21.327
1,240.00	7.266	13.870	35.197

Device	Routing	Invert	Outlet Devices
#1	Primary	1,238.00'	**28.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64
#2	Primary	1,239.00'	**300.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 154: Wildwood Park Cooling Pond

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,257.00' Surf.Area= 14.594 ac Storage= 63.985 af
Peak Elev= 1,257.00' @ 5.00 hrs Surf.Area= 14.594 ac Storage= 63.985 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,252.50'	109.489 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,252.50	14.000	0.000	0.000
1,256.00	14.306	49.535	49.535
1,258.00	14.882	29.188	78.724
1,260.00	15.883	30.765	109.489

Device	Routing	Invert	Outlet Devices
#1	Primary	1,257.00'	**12.0' long x 32.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,259.00'	**1,300.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,257.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 156: House of the Dove

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,258.00' Surf.Area= 0.409 ac Storage= 1.914 af
Peak Elev= 1,258.00' @ 5.00 hrs Surf.Area= 0.409 ac Storage= 1.914 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,248.00'	2.840 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,248.00	0.069	0.000	0.000
1,250.00	0.112	0.181	0.181
1,252.00	0.155	0.267	0.448
1,254.00	0.201	0.356	0.804
1,256.00	0.250	0.451	1.255
1,258.00	0.409	0.659	1.914
1,258.50	0.482	0.223	2.137
1,259.00	0.558	0.260	2.397
1,259.50	0.637	0.299	2.695
1,259.70	0.808	0.145	2.840

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,260.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Primary	1,258.33'	**18.0" Round Culvert** L= 42.0' Ke= 0.500 Inlet / Outlet Invert= 1,258.33' / 1,257.71' S= 0.0148 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#3	Primary	1,258.01'	**4.0" Round Culvert** L= 42.0' Ke= 0.500 Inlet / Outlet Invert= 1,258.01' / 1,257.79' S= 0.0052 '/' Cc= 0.900 n= 0.011, Flow Area= 0.09 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,258.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
└─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,258.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 158: Washington Elementary

Wet

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,272.00' Surf.Area= 0.499 ac Storage= 1.961 af
Peak Elev= 1,272.00' @ 5.00 hrs Surf.Area= 0.499 ac Storage= 1.961 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,266.50'	6.536 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,266.50	0.214	0.000	0.000
1,272.00	0.499	1.961	1.961
1,274.00	0.644	1.143	3.104
1,276.00	0.862	1.506	4.610
1,278.00	1.064	1.926	6.536

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,276.50'	**12.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,272.00'	**12.0" Round Culvert** L= 103.0' Ke= 0.500 Inlet / Outlet Invert= 1,272.00' / 1,267.98' S= 0.0390 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,272.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,272.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 202: Midstate Technical College

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,240.50'	0.256 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,240.50	0.000	0.000	0.000
1,241.00	0.012	0.003	0.003
1,242.00	0.087	0.049	0.052
1,243.00	0.321	0.204	0.256

Device	Routing	Invert	Outlet Devices
#1	Primary	1,242.50'	**20.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	1,240.50'	**12.0" Round Culvert** L= 50.0' Ke= 0.700 Inlet / Outlet Invert= 1,240.50' / 1,240.00' S= 0.0100 '/' Cc= 0.900 n= 0.010, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 204: Sycamore Dry Pond

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,260.00'	1.737 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,260.00	0.001	0.000	0.000
1,261.00	0.166	0.084	0.084
1,262.00	0.195	0.180	0.264
1,264.00	0.270	0.465	0.729
1,266.00	0.357	0.627	1.356
1,267.00	0.405	0.381	1.737

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,266.00'	**12.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,260.00'	**24.0" Round Culvert** L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,260.00' / 1,258.74' S= 0.0210 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 206: First Presbyterian Church

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,265.00'	1.144 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,265.00	0.055	0.000	0.000
1,266.00	0.077	0.066	0.066
1,268.00	0.132	0.209	0.275
1,270.00	0.198	0.330	0.605
1,272.00	0.341	0.539	1.144

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,270.00'	**15.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,265.00'	**15.0" Round Culvert** L= 50.0' Ke= 0.600 Inlet / Outlet Invert= 1,265.00' / 1,263.80' S= 0.0240 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 208: Washington Elementary

The site has one biofilter, which was found to achieve 87.15% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 87.15%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,280.00'	0.354 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,280.00	0.003	0.000	0.000
1,281.00	0.040	0.022	0.022
1,282.00	0.081	0.061	0.082
1,284.00	0.191	0.272	0.354

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,283.00'	**135.0' long x 35.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,280.00'	**6.0" Round Culvert** L= 21.5' Ke= 0.500 Inlet / Outlet Invert= 1,280.00' / 1,279.48' S= 0.0242 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 210: Stoney River Assisted Living - SW

The site has three biofilters, which were found to achieve 69% TSS performance for the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 69%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,316.00'	0.006 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,316.00	0.002	0.000	0.000
1,317.00	0.003	0.003	0.003
1,318.00	0.004	0.004	0.006

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,317.75'	**100.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	1,316.00'	**4.0" Round Culvert** L= 200.0' Ke= 0.500 Inlet / Outlet Invert= 1,316.00' / 1,315.25' S= 0.0037 '/' Cc= 0.900 n= 0.011, Flow Area= 0.09 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 212: Stoney River Assisted Living - NW

The site has three biofilters, which were found to achieve 69% TSS performance for the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 69%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,314.50'	0.144 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,314.50	0.062	0.000	0.000
1,315.00	0.092	0.038	0.038
1,316.00	0.118	0.105	0.144

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,315.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,315.50'	**30.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Device 4	1,314.50'	**3.600 in/hr Exfiltration over Surface area**
#4	Primary	1,310.92'	**8.0" Round Culvert** L= 200.0' Ke= 0.500 Inlet / Outlet Invert= 1,310.92' / 1,310.92' S= 0.0000 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Culvert** (Controls 0.00 cfs)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Exfiltration** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 214: Stoney River Assisted Living - NE

The site has three biofilters, which were found to achieve 69% TSS performance for the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 69%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,318.00'	0.137 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,318.00	0.046	0.000	0.000
1,319.00	0.069	0.057	0.057
1,320.00	0.091	0.080	0.137

Device	Routing	Invert	Outlet Devices
#1	Device 4	1,318.80'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,319.50'	**30.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Device 4	1,318.00'	**3.600 in/hr Exfiltration over Surface area**
#4	Primary	1,315.54'	**4.0" Round Culvert** L= 36.0' Ke= 0.500 Inlet / Outlet Invert= 1,315.54' / 1,315.54' S= 0.0000 '/' Cc= 0.900 n= 0.011, Flow Area= 0.09 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Culvert** (Controls 0.00 cfs)
  ├─**1=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Exfiltration** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 216: Prairie-Lake

The site has one wet pond, which was found to achieve 99.93% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 99.93%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,281.00'	12.011 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,281.00	0.761	0.000	0.000
1,282.00	0.823	0.792	0.792
1,283.00	0.886	0.855	1.647
1,284.00	0.950	0.918	2.565
1,285.00	1.166	1.058	3.622
1,286.00	1.419	1.293	4.915
1,287.00	1.578	1.498	6.413
1,288.00	1.758	1.668	8.081
1,289.00	1.960	1.859	9.941
1,290.00	2.181	2.071	12.011

Device	Routing	Invert	Outlet Devices
#1	Primary	1,282.05'	**36.0" Round Culvert** L= 47.0' Ke= 0.500 Inlet / Outlet Invert= 1,282.05' / 1,282.00' S= 0.0011 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Device 1	1,285.00'	**90.0 deg x 1.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir X 2.00** Cv= 2.50 (C= 3.13)
#3	Device 1	1,286.00'	**30.0" x 64.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,288.50'	**10.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 218: Prairie-Pond

The site has one wet pond, which was found to achieve 81.66% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 81.66%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,273.00'	65.120 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,273.00	1.190	0.000	0.000
1,292.00	4.110	50.350	50.350
1,293.00	5.000	4.555	54.905
1,294.00	5.110	5.055	59.960
1,295.00	5.210	5.160	65.120

Device	Routing	Invert	Outlet Devices
#1	Primary	1,293.00'	**12.0" Round Culvert** L= 25.0' Ke= 0.500 Inlet / Outlet Invert= 1,293.00' / 1,292.00' S= 0.0400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Secondary	1,294.00'	**25.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 220: Cornerstone Community Church

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,280.00' Surf.Area= 0.128 ac Storage= 0.318 af
Peak Elev= 1,280.00' @ 5.00 hrs Surf.Area= 0.128 ac Storage= 0.318 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,275.00'	2.036 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,275.00	0.016	0.000	0.000
1,277.50	0.055	0.089	0.089
1,280.00	0.128	0.229	0.318
1,282.00	0.240	0.368	0.685
1,284.00	0.338	0.578	1.263
1,286.00	0.435	0.773	2.036

Device	Routing	Invert	Outlet Devices
#1	Primary	1,285.00'	**85.0' long x 25.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,280.00'	**18.0" Round Culvert** L= 120.0' Ke= 0.500 Inlet / Outlet Invert= 1,280.00' / 1,279.75' S= 0.0021 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,280.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 222: Guard St Dry Pond 2

Inf

Volume	Invert	Avail.Storage	Storage Description
#1	1,268.00'	0.785 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,268.00	0.023	0.000	0.000
1,270.00	0.180	0.203	0.203
1,272.00	0.402	0.582	0.785

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,271.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	1,269.40'	**24.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,269.40' / 1,269.40' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 224: Veterans Pkwy Estates

Wet

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,274.00' Surf.Area= 0.176 ac Storage= 0.437 af
Peak Elev= 1,274.00' @ 5.00 hrs Surf.Area= 0.176 ac Storage= 0.437 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,269.00'	1.468 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,269.00	0.020	0.000	0.000
1,270.00	0.038	0.029	0.029
1,272.00	0.097	0.135	0.164
1,274.00	0.176	0.273	0.437
1,276.00	0.252	0.428	0.865
1,278.00	0.351	0.603	1.468

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,277.00'	**15.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,274.00'	**24.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 1,274.00' / 1,274.00' S= 0.0000 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,274.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,274.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 226: Guard St Dry Pond 1

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,266.90'	1.079 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,266.90	0.001	0.000	0.000
1,268.00	0.046	0.026	0.026
1,270.00	0.177	0.223	0.249
1,272.00	0.325	0.502	0.751
1,273.01	0.325	0.328	1.079

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,273.00'	**16.0' long x 40.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,266.90'	**30.0" W x 19.0" H, R=33.5" Elliptical RCP_Elliptical 30x19** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,266.90' / 1,266.90' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 3.28 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=RCP_Elliptical 30x19** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 228: Ration Berg Equipment

The site has one basin which is used for fire protection purposes, not for stormwater management. The basin was inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%. The pond can be improved and is analyzed as a potential future pond.

Volume	Invert	Avail.Storage	Storage Description
#1	1,283.00'	1.286 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,283.00	1.066	0.000	0.000
1,284.00	1.505	1.286	1.286

Device	Routing	Invert	Outlet Devices
#1	Primary	1,283.50'	**40.0' long x 40.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 302: Beverly Health Care

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	2.80 cfs @	5.00 hrs, Volume=	0.362 af,	Atten= 0%, Lag= 0.0 min
Primary	=	2.80 cfs @	5.00 hrs, Volume=	0.362 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,205.00' Surf.Area= 0.809 ac Storage= 1.573 af
Peak Elev= 1,205.00' @ 5.00 hrs Surf.Area= 0.809 ac Storage= 1.573 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,201.50'	11.787 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,201.50	0.039	0.000	0.000
1,204.50	0.750	1.184	1.184
1,205.00	0.809	0.390	1.573
1,206.00	1.059	0.934	2.507
1,208.00	1.345	2.404	4.911
1,210.00	1.626	2.971	7.882
1,212.00	2.279	3.905	11.787

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,208.00'	**20.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,204.50'	**36.0" Round Culvert X 2.00** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 1,204.50' / 1,204.25' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=2.80 cfs @ 5.00 hrs HW=1,205.00' (Free Discharge)
└**2=Culvert** (Barrel Controls 2.80 cfs @ 2.75 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,205.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 304: V&H Properties

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,232.50'	3.007 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,232.50	0.000	0.000	0.000
1,233.00	1.230	0.308	0.308
1,235.00	1.470	2.700	3.007

Device	Routing	Invert	Outlet Devices
#1	Primary	1,232.50'	**24.0" Round Culvert X 2.00** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 1,232.50' / 1,228.10' S= 0.0440 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Secondary	1,234.00'	**12.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 306: Goodwill

Dry

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	9.66 cfs @	5.00 hrs, Volume=	0.704 af,	Atten= 0%, Lag= 0.0 min
Primary	=	9.66 cfs @	5.00 hrs, Volume=	0.704 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,230.00' Surf.Area= 0.684 ac Storage= 0.684 af
Peak Elev= 1,230.00' @ 5.00 hrs Surf.Area= 0.684 ac Storage= 0.684 af

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	1,229.00'	4.028 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,229.00	0.684	0.000	0.000
1,230.00	0.684	0.684	0.684
1,232.00	0.827	1.511	2.195
1,234.00	1.006	1.833	4.028

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,233.50'	**380.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	1,227.75'	**18.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 1,227.75' / 1,227.50' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf

Primary OutFlow Max=9.66 cfs @ 5.00 hrs HW=1,230.00' (Free Discharge)
└**2=Culvert** (Barrel Controls 9.66 cfs @ 5.47 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,230.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 308: Aldi Food Store

Inf

Volume	Invert	Avail.Storage	Storage Description
#1	1,236.00'	1.828 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,236.00	0.241	0.000	0.000
1,238.00	0.449	0.690	0.690
1,240.00	0.689	1.138	1.828

Device	Routing	Invert	Outlet Devices
#1	Primary	1,238.00'	**230.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 310: Walmart NW

The site has one dry pond, which does not obtain credit for TSS removal. The zero TSS removal was then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,232.00'	7 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,232.00	0	0	0
1,234.00	1	1	1
1,236.00	1	2	3
1,238.00	3	4	7

Device	Routing	Invert	Outlet Devices
#1	Primary	1,237.00'	**70.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 312: Walmart Dry

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,218.00'	5.160 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,218.00	0.416	0.000	0.000
1,220.00	0.847	1.263	1.263
1,222.00	0.964	1.811	3.074
1,224.00	1.122	2.086	5.160

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,223.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,217.00'	**24.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,217.00' / 1,217.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 314: Faith Fellowship

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,247.00'	1.158 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,247.00	0.176	0.000	0.000
1,248.00	0.231	0.204	0.204
1,249.00	0.287	0.259	0.462
1,250.00	0.347	0.317	0.780
1,251.00	0.410	0.378	1.158

Device	Routing	Invert	Outlet Devices
#1	Primary	1,247.00'	**0.5' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#2	Primary	1,248.50'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height
#3	Primary	1,249.50'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,250.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#5	Primary	1,247.00'	**18.0" Round Culvert** L= 460.0' Ke= 0.900 Inlet / Outlet Invert= 1,247.00' / 1,242.10' S= 0.0107 '/' Cc= 0.900 n= 0.010, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **5=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 316: Faith Fellowship

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,253.00'	0.414 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,253.00	0.092	0.000	0.000
1,254.00	0.121	0.107	0.107
1,255.00	0.153	0.137	0.244
1,256.00	0.188	0.170	0.414

Device	Routing	Invert	Outlet Devices
#1	Primary	1,253.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	1,253.75'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	1,255.00'	**5.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Primary	1,253.00'	**12.0" Round Culvert** L= 100.0' Ke= 0.900 Inlet / Outlet Invert= 1,253.00' / 1,250.00' S= 0.0300 '/' Cc= 0.900 n= 0.010, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **4=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 318.1: Wyndham Senior Villas 1

The site has four dry ponds, which do not obtain credit for TSS removal. The zero TSS removal was then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,199.00'	0.187 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,199.00	0.056	0.000	0.000
1,200.00	0.091	0.073	0.073
1,201.00	0.137	0.114	0.187

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,200.50'	**6.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	1,199.00'	**8.0" Round Culvert** L= 20.0' Ke= 0.700 Inlet / Outlet Invert= 1,199.00' / 1,198.50' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 318.2: Wyndham Senior Villas 2

The site has four dry ponds, which do not obtain credit for TSS removal. The zero TSS removal was then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,199.50'	0.566 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,199.50	0.120	0.000	0.000
1,200.00	0.148	0.067	0.067
1,201.00	0.180	0.164	0.231
1,202.00	0.490	0.335	0.566

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,201.50'	**6.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	1,199.25'	**8.0" Round Culvert** L= 20.0' Ke= 0.700 Inlet / Outlet Invert= 1,199.25' / 1,198.75' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 318.4: Wyndham Senior Villas 4

The site has four dry ponds, which do not obtain credit for TSS removal. The zero TSS removal was then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,198.25'	0.132 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,198.25	0.032	0.000	0.000
1,199.00	0.060	0.034	0.034
1,200.00	0.136	0.098	0.132

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,199.50'	**6.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	1,198.25'	**8.0" Round Culvert** L= 20.0' Ke= 0.012 Inlet / Outlet Invert= 1,198.25' / 1,197.75' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 318.5: Wyndham Senior Villas 5

The site has four dry ponds, which do not obtain credit for TSS removal. The zero TSS removal was then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 0%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,197.00'	0.226 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,197.00	0.065	0.000	0.000
1,198.00	0.101	0.083	0.083
1,199.00	0.184	0.142	0.226

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,198.50'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	1,197.00'	**8.0" Round Culvert** L= 20.0' Ke= 0.012 Inlet / Outlet Invert= 1,197.00' / 1,196.50' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#3	Primary	1,197.00'	**8.0" Round Culvert** L= 20.0' Ke= 0.700 Inlet / Outlet Invert= 1,197.00' / 1,196.50' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **2=Culvert** (Controls 0.00 cfs)
- **3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 320: Shoppes at Wood Ridge

The site has stormcepters, which were found to achieve 46.8% TSS performance based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 46.8%.

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

Summary for Pond 322: Grant St. Apartments

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,202.00'	1.150 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,202.00	0.157	0.000	0.000
1,204.00	0.265	0.422	0.422
1,206.00	0.463	0.728	1.150

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,205.00'	**15.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,202.00'	**10.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 1,202.00' / 1,202.00' S= 0.0000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.55 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 324: South Side Grant Street

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,210.00'	0.110 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,210.00	0.024	0.000	0.000
1,211.00	0.039	0.031	0.031
1,212.00	0.057	0.048	0.079
1,212.50	0.067	0.031	0.110

Device	Routing	Invert	Outlet Devices
#1	Primary	1,210.00'	**3.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600
#2	Primary	1,211.00'	**36.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	1,211.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#4	Primary	1,210.00'	**8.0" Round Culvert** L= 20.0' Ke= 0.900 Inlet / Outlet Invert= 1,210.00' / 1,209.75' S= 0.0125 '/' Cc= 0.900 n= 0.010, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **1=Orifice/Grate** (Controls 0.00 cfs)
- **2=Orifice/Grate** (Controls 0.00 cfs)
- **4=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 326.1: Tiny Tigers Daycare-West

The site has two biofilters, which were found to achieve 17% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 17%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,209.00'	0.256 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,209.00	0.011	0.000	0.000
1,210.00	0.011	0.011	0.011
1,212.00	0.234	0.245	0.256

Device	Routing	Invert	Outlet Devices
#1	Primary	1,211.99'	**90.0' long x 90.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,209.00'	**1.630 in/hr Exfiltration over Surface area**
#3	Primary	1,209.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	1,211.50'	**24.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
├─**3=Orifice/Grate** (Controls 0.00 cfs)
└─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 326.2: Tiny Tigers Daycare-East

The site has two biofilters, which were found to achieve 17% TSS performance over the entire site based on the site stormwater report. The site stormwater report's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 17%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,208.00'	0.267 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,208.00	0.011	0.000	0.000
1,210.00	0.011	0.022	0.022
1,212.00	0.234	0.245	0.267

Device	Routing	Invert	Outlet Devices
#1	Primary	1,211.99'	**90.0' long x 90.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,208.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	1,210.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	1,208.00'	**1.630 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
├─**2=Orifice/Grate** (Controls 0.00 cfs)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 328.1: Marshfield Tennis NOW Court-South

The site has two wet ponds, which were modeled separately and found to achieve 94% TSS performance over the entire site. The separate model's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 94%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	0.897 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,200.00	0.043	0.000	0.000
1,202.00	0.069	0.112	0.112
1,204.00	0.102	0.171	0.283
1,206.00	0.170	0.272	0.555
1,208.01	0.170	0.342	0.897

Device	Routing	Invert	Outlet Devices
#1	Primary	1,207.00'	**14.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,205.50'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,205.50' / 1,205.50' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 328.2: Marshfield Tennis NOW Court-North

The site has two wet ponds, which were modeled separately and found to achieve 94% TSS performance over the entire site. The separate model's results were then inserted into the overall SLAMM model as an "other device" with pollutant removal set to 94%.

Volume	Invert	Avail.Storage	Storage Description
#1	1,199.50'	0.550 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,199.50	0.003	0.000	0.000
1,200.00	0.005	0.002	0.002
1,201.00	0.012	0.008	0.010
1,203.00	0.032	0.044	0.054
1,205.00	0.064	0.096	0.151
1,206.00	0.129	0.096	0.247
1,208.00	0.174	0.303	0.550

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,206.25'	**14.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,204.50'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,204.50' / 1,204.50' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 330: Marshfield High School

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,201.30'	1.724 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,201.30	0.325	0.000	0.000
1,204.00	0.332	0.887	0.887
1,206.00	0.505	0.837	1.724

Device	Routing	Invert	Outlet Devices
#1	Primary	1,201.30'	**12.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	1,204.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 332.1: Madison Elementary-West

Biofilter

Volume	Invert	Avail.Storage	Storage Description
#1	1,219.50'	0.319 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,219.50	0.108	0.000	0.000
1,220.00	0.209	0.079	0.079
1,221.00	0.271	0.240	0.319

Device	Routing	Invert	Outlet Devices
#1	Primary	1,220.25'	**4.0' long x 25.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,219.50'	**1.630 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 332.2: Madison Elementary-East

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,217.00'	3.117 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,217.00	0.115	0.000	0.000
1,218.00	0.387	0.251	0.251
1,220.00	0.568	0.955	1.206
1,222.00	1.343	1.911	3.117

Device	Routing	Invert	Outlet Devices
#1	Primary	1,220.00'	**390.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	1,217.00'	**24.0" Round Culvert** L= 85.0' Ke= 0.500 Inlet / Outlet Invert= 1,217.00' / 1,216.70' S= 0.0035 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 334: Walgreen's

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,225.50'	0.140 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,225.50	0.000	0.000	0.000
1,225.75	0.021	0.003	0.003
1,226.00	0.023	0.005	0.008
1,227.00	0.036	0.029	0.038
1,228.00	0.050	0.043	0.081
1,229.00	0.068	0.059	0.140

Device	Routing	Invert	Outlet Devices
#1	Primary	1,225.50'	**15.0" Round Culvert** L= 67.0' Ke= 0.500 Inlet / Outlet Invert= 1,225.50' / 1,223.50' S= 0.0299 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	1,225.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	1,228.00'	**31.5" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 336.1: Marshfield Clinic Parking - North

Dry

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,261.50' @ 5.00 hrs Surf.Area= 0.006 ac Storage= 0.000 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,261.50'	0.228 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,261.50	0.006	0.000	0.000
1,264.00	0.026	0.040	0.040
1,266.00	0.052	0.078	0.118
1,266.50	0.063	0.029	0.147
1,267.50	0.099	0.081	0.228

Device	Routing	Invert	Outlet Devices
#1	Device 3	1,265.50'	**2.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Secondary	1,267.00'	**80.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#3	Primary	1,261.00'	**15.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,261.00' / 1,259.11' S= 0.0630 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#4	Device 3	1,261.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Device 3	1,267.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,261.50' (Free Discharge)
└─**3=Culvert** (Passes 0.00 cfs of 1.10 cfs potential flow)
  ├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,261.50' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 336.2: Marshfield Clinic Parking - South

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,262.50'	0.531 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,262.50	0.013	0.000	0.000
1,264.00	0.046	0.044	0.044
1,266.00	0.204	0.250	0.294
1,267.00	0.269	0.236	0.531

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,265.50'	**10.0' long x 48.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,262.50'	**18.0" Round Culvert** L= 35.0' Ke= 0.500 Inlet / Outlet Invert= 1,262.50' / 1,262.00' S= 0.0143 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 338.1: Walnut Ave Pond - 1

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,237.00' Surf.Area= 0.375 ac Storage= 1.082 af
Peak Elev= 1,237.00' @ 5.00 hrs Surf.Area= 0.375 ac Storage= 1.082 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,232.00'	4.837 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,232.00	0.080	0.000	0.000
1,233.00	0.135	0.108	0.108
1,234.00	0.174	0.155	0.262
1,236.00	0.306	0.480	0.742
1,238.00	0.444	0.750	1.492
1,240.00	0.886	1.330	2.822
1,242.00	1.129	2.015	4.837

Device	Routing	Invert	Outlet Devices
#1	Primary	1,237.00'	**8.0' long x 25.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,237.50'	**72.0' long x 21.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	1,239.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,237.00' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 338.2: Walnut Ave Pond - 2

Wet

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,233.50' Surf.Area= 1.176 ac Storage= 4.419 af
Peak Elev= 1,233.50' @ 5.00 hrs Surf.Area= 1.176 ac Storage= 4.419 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,229.00'	21.446 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,229.00	0.781	0.000	0.000
1,230.00	0.901	0.841	0.841
1,232.00	1.026	1.927	2.768
1,234.00	1.226	2.252	5.020
1,236.00	1.613	2.839	7.859
1,238.00	2.262	3.875	11.734
1,240.00	2.444	4.706	16.440
1,242.00	2.562	5.006	21.446

Device	Routing	Invert	Outlet Devices
#1	Primary	1,233.50'	**8.0' long x 25.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,234.00'	**69.0' long x 21.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	1,235.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,233.50' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 338.3: Walnut Ave Pond - 3

Wet

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Secondary	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 1,231.00' Surf.Area= 1.418 ac Storage= 3.555 af
Peak Elev= 1,231.00' @ 5.00 hrs Surf.Area= 1.418 ac Storage= 3.555 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,228.00'	35.039 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,228.00	0.970	0.000	0.000
1,229.00	1.115	1.043	1.043
1,230.00	1.246	1.180	2.223
1,231.00	1.418	1.332	3.555
1,232.00	1.666	1.542	5.097
1,234.00	2.470	4.136	9.233
1,236.00	3.064	5.534	14.767
1,238.00	3.333	6.397	21.164
1,240.00	3.483	6.816	27.980
1,242.00	3.576	7.059	35.039

Device	Routing	Invert	Outlet Devices
#1	Device 2	1,231.35'	**13.7' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#2	Primary	1,230.35'	**24.0" Round Culvert** L= 128.0' Ke= 0.700 Inlet / Outlet Invert= 1,230.35' / 1,229.60' S= 0.0059 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	1,230.35'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 3	1,231.00'	**2.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#5	Secondary	1,240.00'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,231.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 2.02 cfs potential flow)
  ├─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Passes 0.00 cfs of 0.60 cfs potential flow)
    └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=1,231.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 340: Fig Ave. Development

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,252.50'	1.112 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,252.50	0.013	0.000	0.000
1,254.00	0.036	0.037	0.037
1,256.00	0.160	0.196	0.233
1,258.00	0.213	0.373	0.606
1,260.00	0.293	0.506	1.112

Device	Routing	Invert	Outlet Devices
#1	Device 3	1,252.50'	**10.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	1,258.00'	**40.0' long x 80.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	1,252.50'	**18.0" Round Culvert** L= 630.0' Ke= 0.700 Inlet / Outlet Invert= 1,252.50' / 1,250.60' S= 0.0030 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**3=Culvert** (Controls 0.00 cfs)
  └─**1=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 342: Grant Elementary

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,266.50'	0.497 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,266.50	0.007	0.000	0.000
1,268.00	0.033	0.030	0.030
1,270.00	0.099	0.132	0.162
1,272.00	0.236	0.335	0.497

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,270.00'	**250.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Device 4	1,269.25'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 4	1,266.50'	**6.0" Round Culvert** L= 75.0' Ke= 0.500 Inlet / Outlet Invert= 1,266.50' / 1,266.25' S= 0.0033 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf
#4	Primary	1,266.00'	**12.0" Round Culvert** L= 170.0' Ke= 0.500 Inlet / Outlet Invert= 1,266.00' / 1,263.03' S= 0.0175 '/' Cc= 0.900 n= 0.024, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**4=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 344: Grant Elementary NW

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,276.00'	0.761 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,276.00	0.002	0.000	0.000
1,278.00	0.110	0.112	0.112
1,280.00	0.539	0.649	0.761

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,279.00'	**35.0' long x 105.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,272.65'	**12.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,272.65' / 1,272.35' S= 0.0150 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 346: Fig-McMillan Dry Pond

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,268.00'	10.466 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,268.00	0.001	0.000	0.000
1,270.00	0.022	0.023	0.023
1,272.00	0.425	0.447	0.470
1,274.00	0.754	1.179	1.649
1,276.00	0.940	1.694	3.343
1,278.00	1.088	2.028	5.371
1,280.00	1.261	2.349	7.720
1,282.00	1.485	2.746	10.466

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,280.00'	**164.0' long x 36.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	1,268.00'	**30.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,268.00' / 1,268.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 348: Fig Ave NW

Dry

Volume	Invert	Avail.Storage	Storage Description
#1	1,280.00'	4.946 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,280.00	0.001	0.000	0.000
1,282.00	0.016	0.017	0.017
1,284.00	0.173	0.189	0.206
1,286.00	0.346	0.519	0.725
1,288.00	0.565	0.911	1.636
1,290.00	0.833	1.398	3.034
1,292.00	1.079	1.912	4.946

Device	Routing	Invert	Outlet Devices
#1	Primary	1,280.00'	**36.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 1,280.00' / 1,280.00' S= 0.0000 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf
#2	Primary	1,291.00'	**240.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 350: Marshfield Clinic

The site has one biofilter and was modeled as an "other device" with pollutant removal set to 80% to meet DNR requirements for new development circa 2010.

Volume	Invert	Avail.Storage	Storage Description
#1	1,367.60'	0.557 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,367.60	0.102	0.000	0.000
1,368.00	0.151	0.051	0.051
1,369.00	0.210	0.180	0.231
1,370.00	0.442	0.326	0.557

Device	Routing	Invert	Outlet Devices
#1	Primary	1,368.40'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
└─**1=Orifice/Grate** (Controls 0.00 cfs)

APPENDIX H

WDNR MODEL GUIDANCE FOR COMPLIANCE WITH NR151/NR216

© June 2014 MSA Professional Services, Inc.

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 24, 2010

TO: Regional Water Leaders, Basin Leader & Experts
Stormwater Permit Staff (via Email)

FROM: Russ Rasmussen, Director
Bureau of Watershed Management

SUBJECT: Developed Urban Areas and the 20% and 40% TSS Reductions
Sections NR 151.13(2) and NR 216.07(6), Wis. Adm. Code

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts. ***This document supersedes the guidance memo dated June 6, 2005, subsequent errata dated 8/15/05 and April, 2009 and the guidance memo dated May 14, 2010.***

Issue

Under s. NR 151.13 (2), Wis. Adm. Code, a municipality subject to the municipal stormwater permit requirements of subch. I of ch. NR 216, Wis. Adm. Code, must, to the maximum extent practicable, implement a 20% and a 40% reduction in total suspended solids in runoff that enters waters of the state as compared to no controls, by March 10, 2008 and March 10, 2013, respectively. Staff who work with affected municipalities need guidance on what areas under the municipalities' jurisdictions will be included in this requirement. They also need to know what is meant by "no controls" and "with controls", and what methods are acceptable for making these calculations.

Discussion

Chapter NR 216, Wis. Adm. Code, is the implementation code for the developed urban area performance standard. Applicability for permit coverage purposes is dictated by s. NR 216.02, Wis. Adm. Code. Under this provision, owners or operators of the following municipal separate storm sewer systems (MS4s) are required to obtain coverage under a WPDES municipal stormwater permit:

- MS4s serving populations of 100,000 or more.
- Previously notified owners or operators of municipal separate storm sewer systems.
- MS4s within urbanized areas as identified by EPA.
- MS4s serving populations over 10,000 unless exempted by DNR.

"MS4" is defined under s. NR 216.002 (17), Wis. Adm. Code, as a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all the following criteria:

- Owned or operated by a municipality.
- Designed or used for collecting or conveying stormwater.
- Not a combined sewer conveying both sanitary and stormwater.

Printed on Recycled Paper

- Not part of a publicly owned wastewater treatment works that provides secondary or more stringent treatment.

"Waters of the state" is defined under s. 283.01 (20), Stats., and it includes surface water, wetlands and groundwater. Waters of the state may overlap with the definition of MS4. For this purpose, if a waterway meets the definition of an MS4, it will be regulated as an MS4. The significant language in that definition is whether or not the municipality owns or operates the drainage way (i.e., maintains, has easement access for work, dredges, etc.). For example, when a "stream" is designed or used for collecting or conveying stormwater such as flowing through a municipally owned or operated culvert or bridge restriction, that "stream" is part of the MS4.

Under s. NR 216.07 (6)(a), Wis. Adm. Code, a municipality must develop a stormwater management program to achieve compliance with the developed urban area performance standard (s. NR 151.13 (2), Wis. Adm. Code). Developed areas are generally those that were not subject to the post-construction performance standards (s. NR 151.12 or NR 151.24, Wis. Adm. Code). The total suspended solids control requirements of s. NR 151.13 (2)(b)1.b. and 2., Wis. Adm. Code, may be achieved on an individual municipal basis. Control does not have to apply uniformly across the municipality. The control may also be applied on a watershed or regional basis by involving several municipalities. However, note that the Department is proposing to revise s. NR 151.12, Wis. Adm. Code, to limit the geographic extent of the watershed or regional area that municipalities may collectively meet the developed urban area standard.

A municipality is required under s. NR 216.07 (6)(b), Wis. Adm. Code, to provide an assessment of the actions taken to comply with the performance standards. This assessment may take the form of an annual progress report. The initial assessment must include a pollutant-loading analysis using a model such as SLAMM, P8 or equivalent methodology that is approved by the department. At a minimum, a pollutant-loading analysis must be conducted for total suspended solids and phosphorus. A model would not be run again after the initial assessment unless significant management changes occurred that should be accounted for, or the progress report indicates a re-run is necessary.

DNR Guidance

To comply with the code, the developed urban area must be modeled under a "no control" condition and a "with controls" condition. The 20% and 40% TSS reductions are assessed against the "no control" condition for the entire area served by the MS4 as defined below. They are not applied uniformly across the municipality, nor are they applied drainage area by drainage area within the municipal boundary. In most cases however, a calculation drainage basin by drainage basin will be used to determine the total loading and the achieved reductions.

Areas Required to be Included in the Calculations

A municipality must include the following areas when calculating compliance with the developed urban area standard (s. NR 151.13, Wis. Adm. Code):

1. Any developed area that was not subject to the post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, for new development only, that drains to the MS4 owned or operated by the municipality. The baseline developed urban area does not change due to future redevelopment of existing urban areas.
2. Any area covered by an NOI submitted prior to October 1, 2004 where development is still underway. The pollutant load shall be based on full build out. If it is known that the future development of some parcels may require compliance with s. NR 151.12 or NR 151.24, Wis. Adm. Code, then these areas may be excluded from the calculation.
3. Any undeveloped (in-fill) areas under 5 acres. These areas must be modeled as fully developed, with a land use similar to the properties around them.
4. For municipalities with large areas of agricultural lands separating areas of development, only the developed areas within the urbanized area as defined by the U.S. Census Bureau.

5. Non-manufacturing areas of industrial facilities such as customer or employee parking lots. (The manufacturing, outside storage and vehicle maintenance areas of these industrial facilities are covered under subch. II of ch. NR 216, Wis. Adm. Code, industrial permit.)
6. Any industry that has certified a condition of "no exposure" in accordance with s. NR 216.21(3), Wis. Adm. Code.
7. Any connecting highways as identified and listed in the Official Highway State Truck Highway System Maps at: http://www.dot.wisconsin.gov/localgov/highways/connecting.htm

Areas Prohibited from Inclusion in the Calculations

Areas and loadings that shall not be included:

1. Lands zoned for agricultural use and operating as such.
2. Pollutant loadings from an upstream MS4 (independent of whether it is regulated under a ch. NR 216, Wis. Adm. Code, permit) unless the municipality has an agreement to share the pollutant control credit with the upstream municipality.
3. Undeveloped land parcels over 5 acres within the municipality. These areas will be subject to the new development post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, when developed.
4. Any internally drained area with natural infiltration. (This does not include engineered or constructed infiltration areas.) However, a separate guidance memo dated April 6, 2009 (Subject: Developed Urban Areas and the 20% and 40% Reductions - Internally Drained Areas) provides conditions under which an internally drained area may be included in the calculation.
5. Any active or inactive mining site unless it has been reclaimed into another land use. The pollutant load associated with a mining site is not included in the calculation. However, runoff which drains into a mining site would be eligible for treatment credit in accordance with the April 6, 2009 guidance memo.
6. Areas subject to the new development performance standards of s. NR 151.12, Wis. Adm. Code.

Optional Areas to Include in the Calculations

Areas a municipality may, but is not required to, include in the developed urban area load calculation:

1. Property that drains to *waters of the state* without passing through the permittee's MS4.
2. Any area that discharges to an adjacent municipality's MS4 (Municipality B) without passing through the jurisdictional municipality's MS4 (Municipality A). Municipality B that receives the discharge into their MS4 may choose to be responsible for this area from Municipality A. If Municipality B has a stormwater treatment practice that serves a portion of A as well as a portion of B, then the practice must be modeled as receiving loads from both areas, independent of who carries the responsibility for the area. However, if runoff from an area within Municipality A's jurisdiction drains into Municipality B's MS4 but then drains back into Municipality A's MS4 farther downgradient, then Municipality B does not have the option of including the load from Municipality A in their analysis and the load from that area is Municipality A's responsibility.
3. Industrial facilities subject to a permit under subch. II of ch. NR 216, Wis. Adm. Code, except the pollutant load associated with an active or inactive mining site. This exclusion covers the facilities that are required to have permit coverage. Contact the regional stormwater specialist or central office to get a list of permitted facilities within a municipality.
   - The industrial NR 216 permit covers areas with industrial materials and activities, specifically areas with manufacturing, vehicle maintenance, storage of materials, etc.

A municipality may include any of the areas identified above in their developed urban area as part of their load calculation provided the areas are not prohibited from inclusion in the calculation. If they choose to include an area, it must be included in both the "no controls" and "with controls" condition. Inclusion of areas they choose to be responsible for will allow them to take credit for any of those areas that may have controls in place. For example, if an industrial park would have been excluded because all the industries in the industrial park have an NR 216 industrial permit, but the municipality chooses to keep this area in their "no controls" area, then any best management practices existing or built to serve the industrial park can be included in the "with controls" scenario.

Model Inputs

Model Version:
To model the TSS load in the area served by the MS4, the municipality must select a model such as SLAMM, P8 or an equivalent method deemed acceptable by the Department. For the analysis to show compliance with the 40% developed urban area performance standard, SLAMM version 9.2 or P8 version 3.4 or a subsequent version of these models may be used. As part of the reporting process, the municipality must identify which model version is being used. The analysis must use the same version for both the "no controls" scenario and the "with controls" scenario unless it is verified that the "no controls" pollutant discharge load does not change between the model versions. If there is a change in the no controls pollutant discharge load then the new pollutant discharge load corresponding with the version of the model selected for the analysis needs to be utilized. An entire city-wide municipal "no controls" scenario does not need to be remodeled, only those areas being updated with the new version of the model.

"No control"
In SLAMM, the "no controls" condition generally will be based on the standard land use files for different land uses. This assumes certain default parameter files, an assumed level of disconnection and an assumed distribution of road smoothness. The "no controls" condition for each land use is based on this assumed percent of disconnected imperviousness. All land uses as modeled must be equal to the connected imperviousness values in the standard land use files unless site specific data is available. However under the "with controls" condition, land use that has a greater level of disconnection than the values in the standard land use files may take credit for volume and pollutant reduction. In P8, the help menu provides standard land use values that can be used for the percent directly connected versus indirectly connected impervious surfaces.

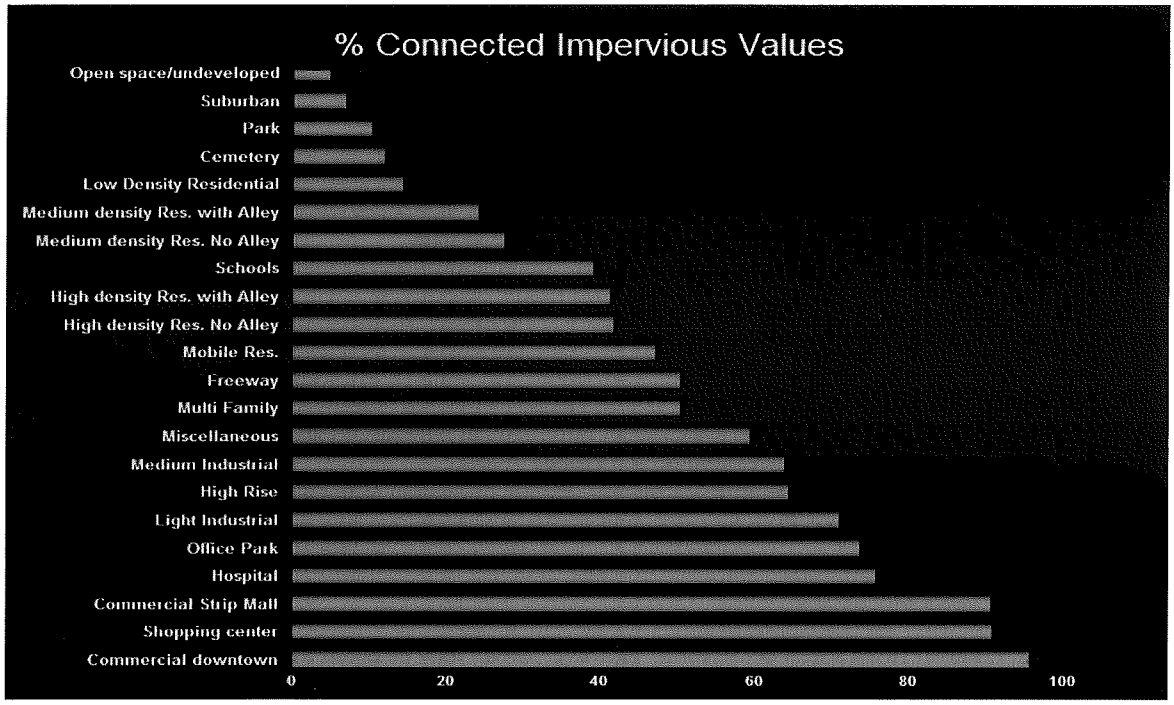
All roads within the urbanized area that are part of a county or town's MS4 are the responsibility of the county or town. To generate a load under "no controls", model the road based on the nearest urban land use, even if agricultural land use is on one or both sides of the road. Select the urban land use that will most likely typify the traffic that will be on that road (for example commercial or residential) and include that area in the corresponding standard land use file.

For the drainage system, the default will be curb and gutter (even if the drainage system is currently swale drainage), in fair condition. For "no controls" there will be no recognition of street sweeping, catch basin cleaning, swale drainage, or the existence of any engineered best management practices. These practices and facilities will be accounted for under the "with controls" condition.

A municipality is not required to use the standard land use files if it has surveyed the land uses in its developed urban area and has "real" source area data on which to base the input files. The percent connected imperviousness must be verified in the field. Disconnection may be assumed for residential rooftops where runoff has a flow path of 20 feet or greater over a pervious area in good condition. Disconnection for impervious surfaces other than residential rooftops may be assumed provided all of the following are met:

- The source area flow length does not exceed 75 feet,
- The pervious area is covered with a self-sustaining vegetation in "good" condition and at a slope not exceeding 8%,
- The pervious area flow length is at least as long as the contributing impervious area and there can be no additional runoff flowing into the pervious area other than that from the source area.
- The pervious area must receive runoff in a sheet flow manner across an impervious area with a pervious width at least as wide as the contributing impervious source area.

The table below shows the overall percent connected imperviousness that is associated with SLAMM standard land use files. The overall percent disconnection shown in this table is not input into SLAMM as the percent disconnection, rather the individual road, roof top, sidewalk, etc. areas have their own individual connectedness included in the standard land use files.



"With controls"

The "with controls" condition is applied to the developed urban area with the inclusion of the practices and facilities (existing and proposed). Modeling is a means to confirm a practice's efficiency for the conditions found in Wisconsin. If the model cannot predict efficiencies for certain practices that the municipality identifies as water quality practices, then a literature review must be conducted to estimate the reduction value. Proprietary stormwater practices that utilize settling as their means of solids reduction should be modeled in accordance with DNR Technical Standard 1006 (Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices).

When designing treatment practices, runoff draining to the practice from off-site must be taken into account in determining the treatment efficiency of the practice. Any impact on the efficiency must be compensated for by increasing the size of the practice accordingly.

Practices on private property that drain to an MS4 can be included in the "with controls" scenario for a municipality, provided the municipality enters into an agreement or equivalent enforceable mechanism with the stormwater treatment facility owner that will ensure the practice is properly maintained. An operation and maintenance plan, including a maintenance schedule, must be developed for the stormwater treatment facility in accordance with relevant DNR technical standards. The agreement or equivalent mechanism between the municipality and the private owner should include the following:

- A description of the stormwater treatment facility including dimensions and location.
- Identify the owner of the property on which the stormwater treatment facility is located.
- Identify who is responsible for implementing the operation and maintenance plan.
- Outline a means of terminating the agreement that includes notifying DNR.

The efficiency of the practice on private property must be modeled using the best information the municipality can obtain on the design of the practice. For example, permanent pool area is not sufficient information to know the pollutant reduction efficiency of a wet detention basin even if it matches the area requirements identified in Technical Standard 1001 Wet Detention Basin for an 80% reduction. Information on the depth of the wet pool and the outlet design are critical features that determine whether a detention pond is providing 80% TSS reduction.

Further clarifications

- If a portion of a municipality's MS4 drains to a stormwater treatment facility in an adjacent municipality, the municipality generating the load will not receive any treatment credit due to the downstream municipality's treatment facility unless there is an inter-municipal agreement where the downstream

municipality agrees to allow the upstream municipality to take credit for such treatment. DNR anticipates that such an agreement would have the upstream municipality assist with the construction and/or maintenance of the treatment facility. This contract must be in writing with signatures from both municipalities specifying how the treatment credit will be shared.

- The model results will be the basis for determining compliance with the permit for "no controls" and "with controls" TSS load.
- For reporting purposes, the pollutant load must be summarized as the cumulative total for the developed urban area served by the MS4. Additionally pollutant loads for grouped drainage areas as modeled shall also be reported. Drainage areas may be grouped at the discretion of the modeler for such reasons as to emphasize higher priority areas, balance model development with targeting or for cost-effectiveness.
- No credit should be taken for sweeping of non-curbed streets.
- The additional runoff volume from areas that are exempt or outside of the developed urban area to which the TSS standard applies needs to be accounted for when it drains into the treatment device. The pollutant load can be "turned off" but the runoff hydrology needs to be accounted for to properly calculate the treatment efficiency of the device.
- Due to concerns of sediment resuspension, basins with an outlet on the bottom are generally not eligible for pollutant removal based solely on settling. However, credit may be taken for treatment due to infiltration or filtration. Features to prevent scour should always be included for any practice where appropriate.
- When street cleaning is applied across a watershed with devices that serve only certain areas within the watershed, it is acceptable to first take credit for street cleaning across the entire watershed but then the treatment efficiency for devices must be reduced by the efficiency of the street cleaning to prevent double counting.
- To model a combination of mechanical broom and vacuum assisted street cleaning, it may require an analysis of several model runs depending on the timing of the mechanical and vacuum cleaning. If mechanical broom and vacuum cleaning occur at generally the same time (e.g. within two weeks of each other) then only the removal efficiency of the vacuum cleaning should be taken. If the municipality performs broom sweeping in the spring or fall and vacuum clean the remained of the year, calculate the combined cleaning efficiency using the following method:
  (A) Model the entire street cleaning program as if entire period is done by a mechanical broom cleaner.
  (B) Model just the period of time for vacuum cleaning (do not include the mechanical broom cleaning).
  (C) Model the same period as B) but with a mechanical broom.
  (D) The overall combined efficiency would be A + B – C.

WinSLAMM clarification:

- WinSLAMM 9.3.4 and earlier versions of WinSLAMM result in double counting of pollutant removal for most treatment practices modeled in series. WinSLAMM 9.2 and subsequent versions contain warnings to help alert modelers of this issue. The modeler will need to make adjustments to ensure that the results do not include double credit for removal of the same particle size. PV & Associates has created a document titled 'Modeling Practices in Series Using WinSLAMM' which helps to guide a user as to whether and or how certain practices can be modeled in series and this document is available at: http://winslamm.com/Select_documentation.html

P8 clarifications

- P8 does not account for scour and sediment resuspension. DNR requires that a wet basin with less than a 3-foot permanent pool have its treatment efficiency reduced. A basin with zero permanent pool depth should be considered to get zero credit for pollutant removal due to settling and a basin with 3 or more feet of permanent pool depth can be given the full pollutant removal efficiency credited by settling. The pollutant removal efficiency may be given straight-line depreciation such that a basin with a 1.5 foot-deep permanent pool would be eligible for 1/2 the pollutant removal efficiency that would be credited due to settling.
- A device that DNR gives no credit for pollutant removal may still be modeled if it is in series with other practices because of its benefit on runoff storage capacity that may enhance the treatment efficiency of downgradient treatment devices. To do so, turn the treatment efficiency off in P-8.

- P8 starts its model runs with no water in the basins. P8 should be started an extra year before the "keep dates", in order to allow the model to fill up ponds to the lowest outlet elevation.

Approved By:

Gordon Stevenson, Chief
Runoff Management Section

APPENDIX I

CONCEPT PLANS FOR FUTURE BMPS

© June 2014 MSA Professional Services, Inc.

M - 118: FIGI'S DETENTION BASIN

PROPOSED POND

EXISTING POND

PARCEL

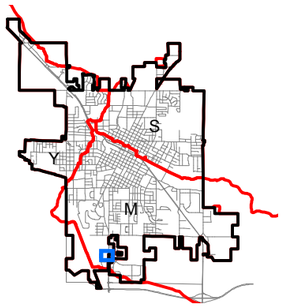
WETLAND INDICATOR SOILS

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

RIVER/STREAM

PAGE 13 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

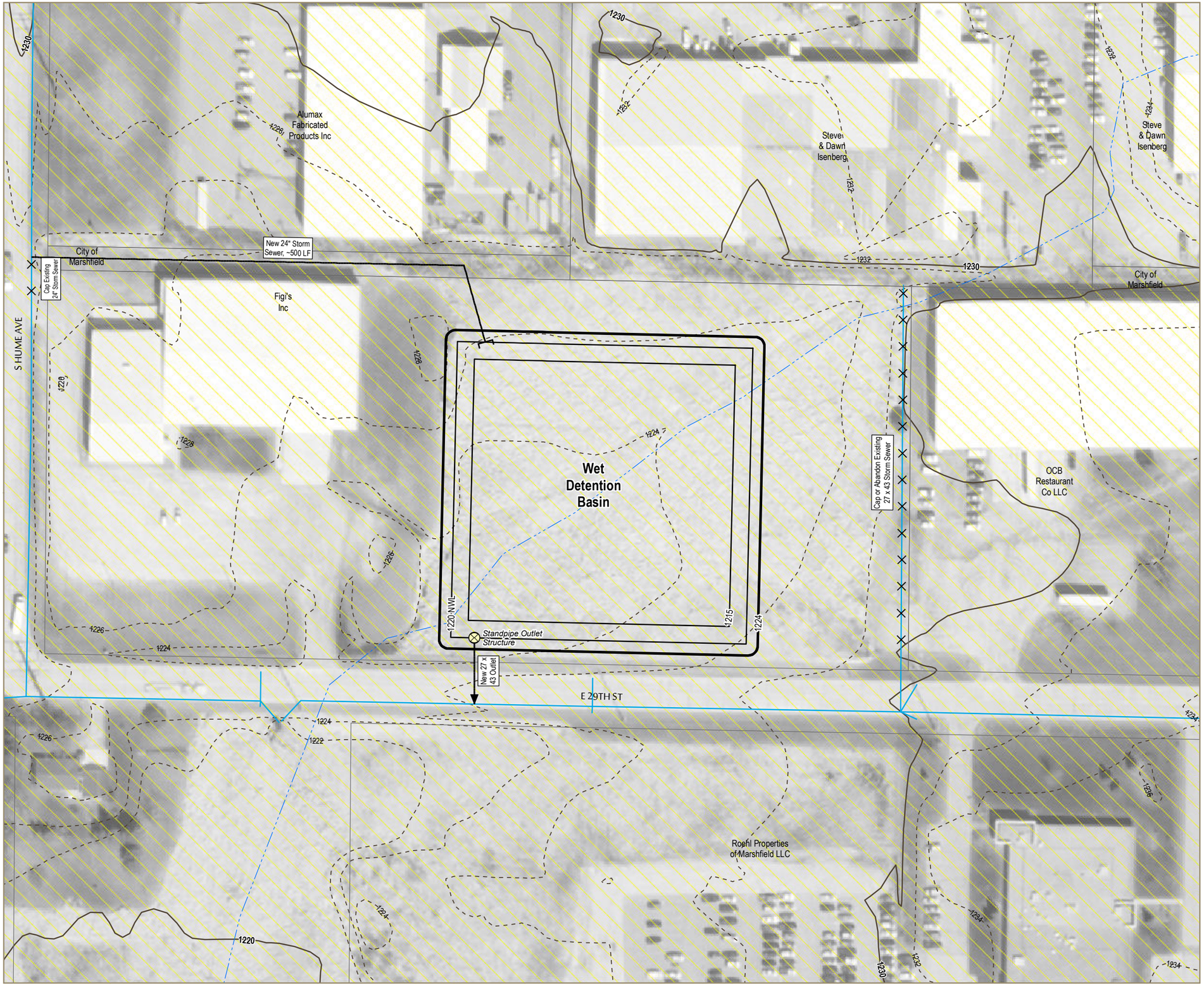
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

M - 10002: 29TH STREET SITE 1



PROPOSED POND

PARCEL

WETLAND INDICATOR SOILS

NEW STORM SEWER (INLET)

NEW STORM SEWER (OUTLET)

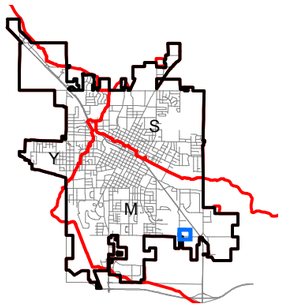
ABANDON/CAP STORM SEWER

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

RIVER/STREAM

PAGE 1 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

M - 10004:
29TH STREET SITE 2

PROPOSED POND

EXISTING POND

PARCEL

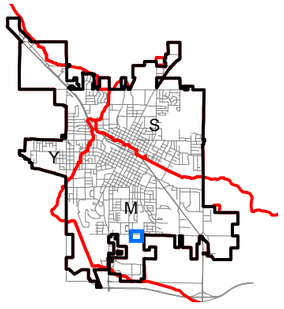
WETLAND

WETLAND INDICATOR SOILS

SWALE/STREAM DIVERSION

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

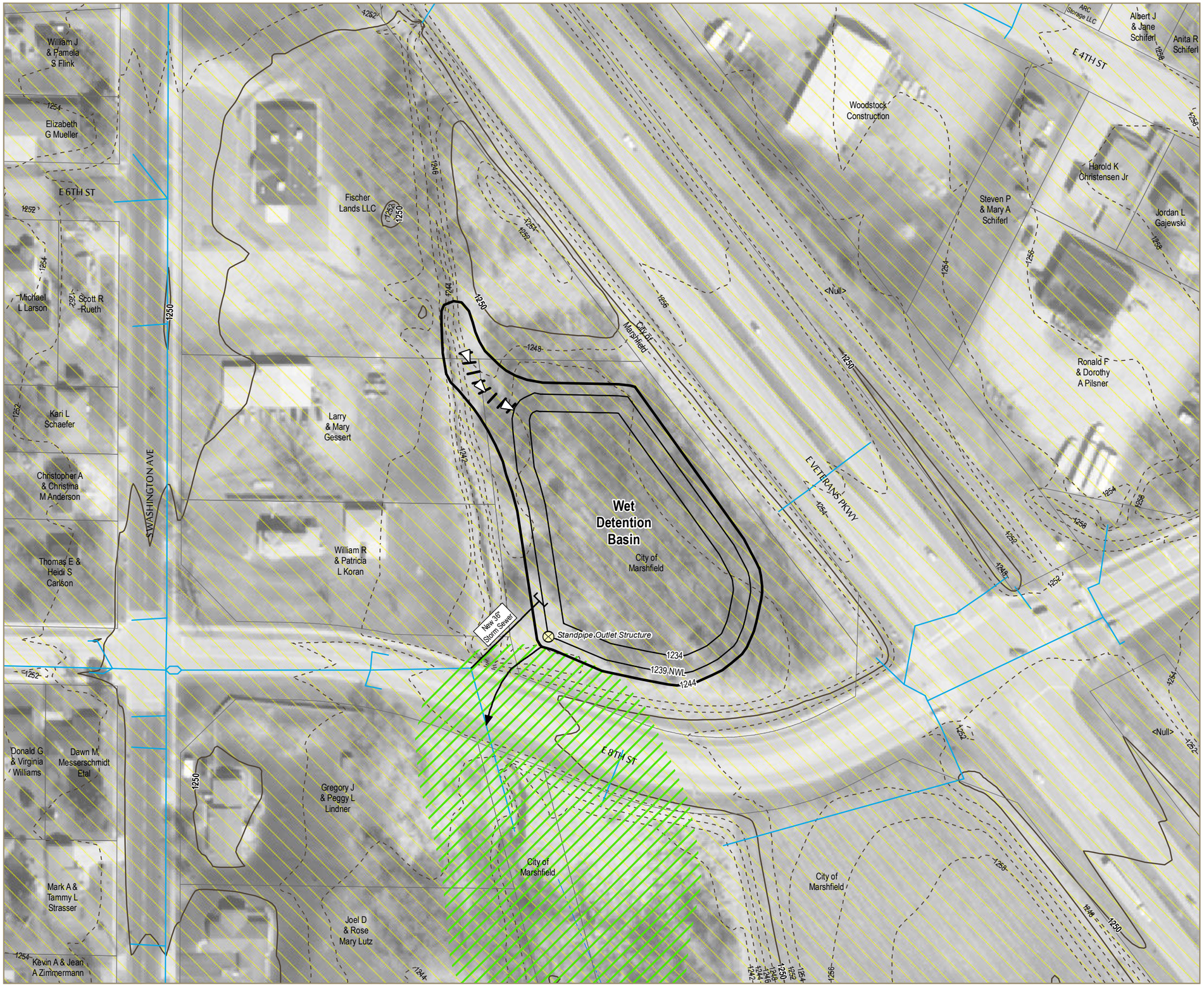
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

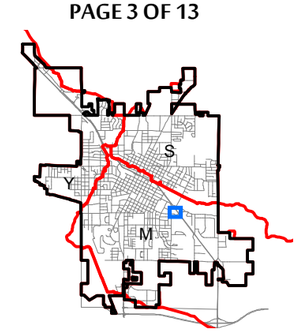
0 25 50 100 Feet

M - 10006: 18TH AND VETERAN'S PARKWAY



PROPOSED POND
PARCEL
WETLAND
WETLAND INDICATOR SOILS
NEW STORM SEWER (INLET)
NEW STORM SEWER (OUTLET)
SWALE/STREAM DIVERSION
PROPOSED OUTLET STRUCTURE
EXISTING STORM SEWER
RIVER/STREAM

PAGE 3 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

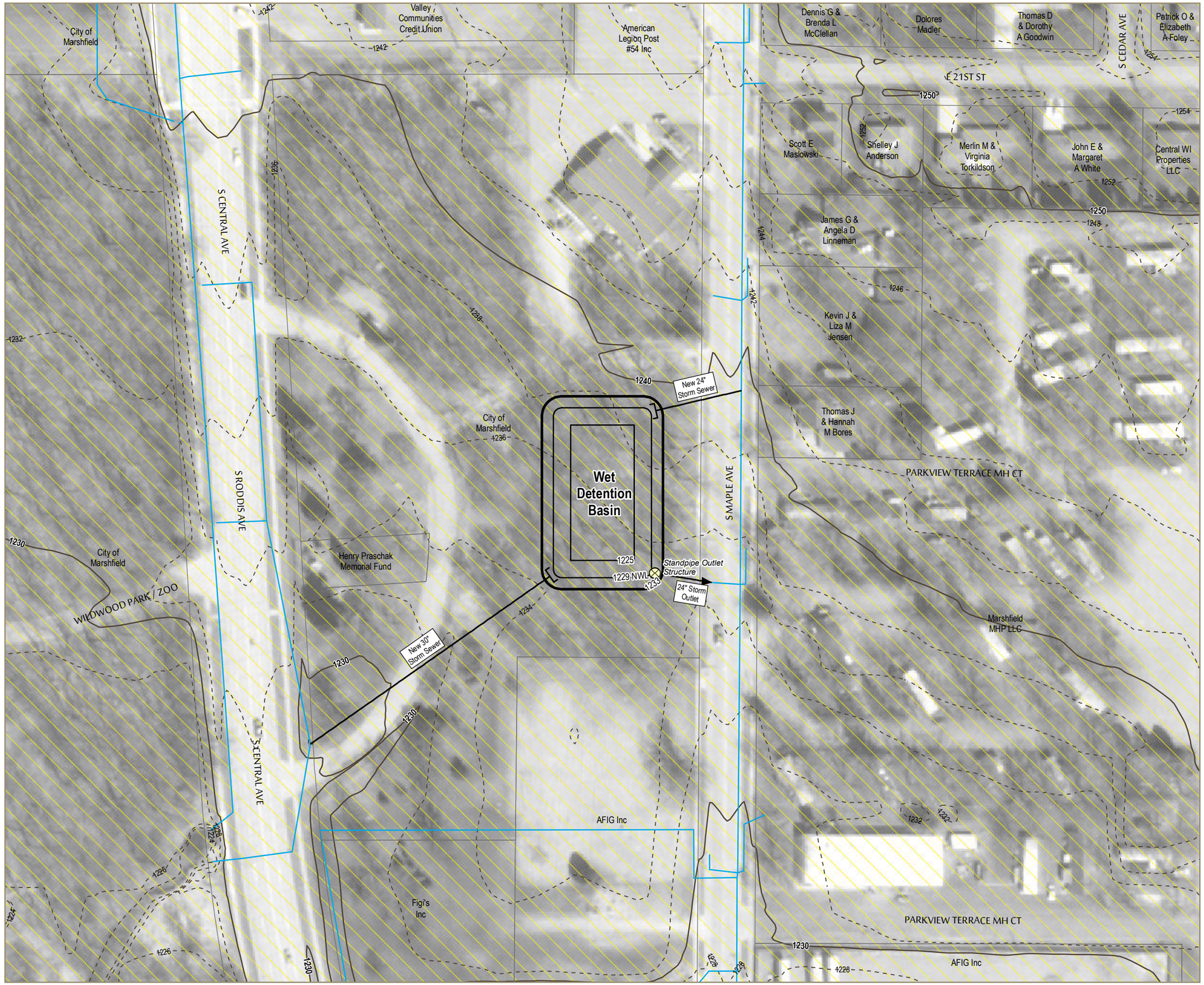
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

M - 10008: AMERICAN LEGION



PROPOSED POND

PARCEL

WETLAND INDICATOR SOILS

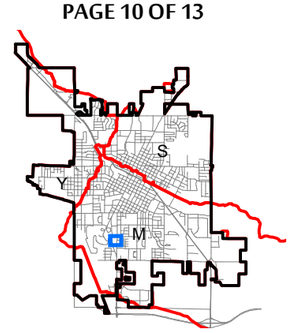
NEW STORM SEWER (INLET)

NEW STORM SEWER (OUTLET)

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

PAGE 10 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

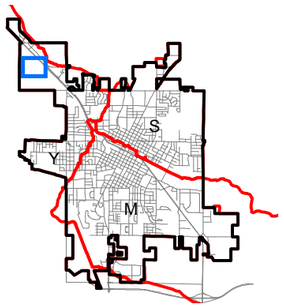
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

0 25 50 100 Feet

Y - 228: RATION BERG EQUIPMENT

PROPOSED POND
EXISTING POND
PARCEL
WETLAND
WETLAND INDICATOR SOILS
SWALE/STREAM DIVERSION
PROPOSED OUTLET STRUCTURE
EXISTING STORM SEWER
RIVER/STREAM



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

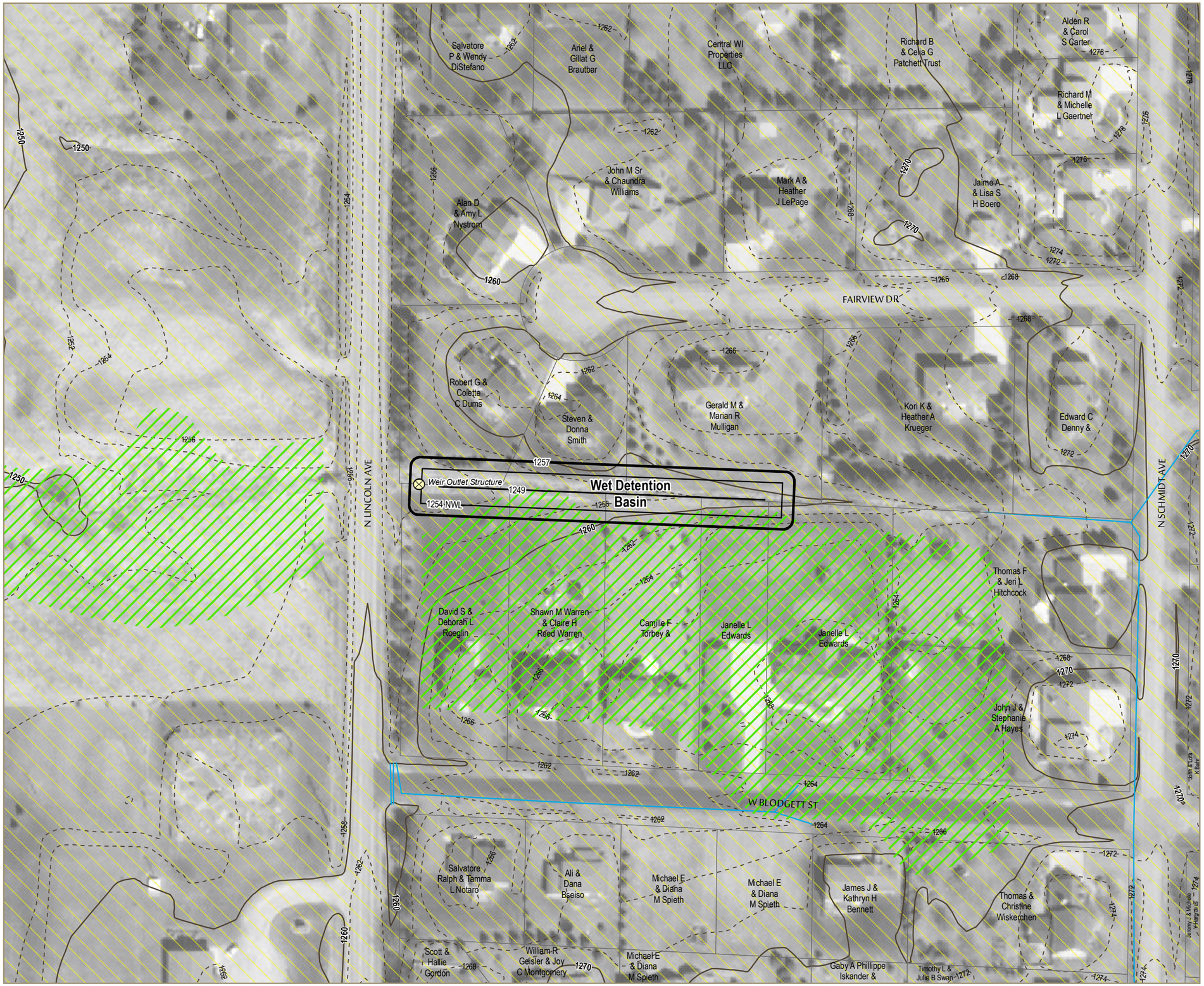
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

Feet
0 25 50 100

Y - 20002: FOREST RIDGE PARK



PROPOSED POND

PARCEL

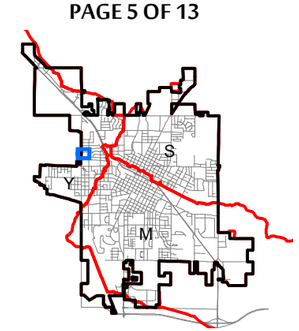
WETLAND

WETLAND INDICATOR SOILS

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

PAGE 5 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

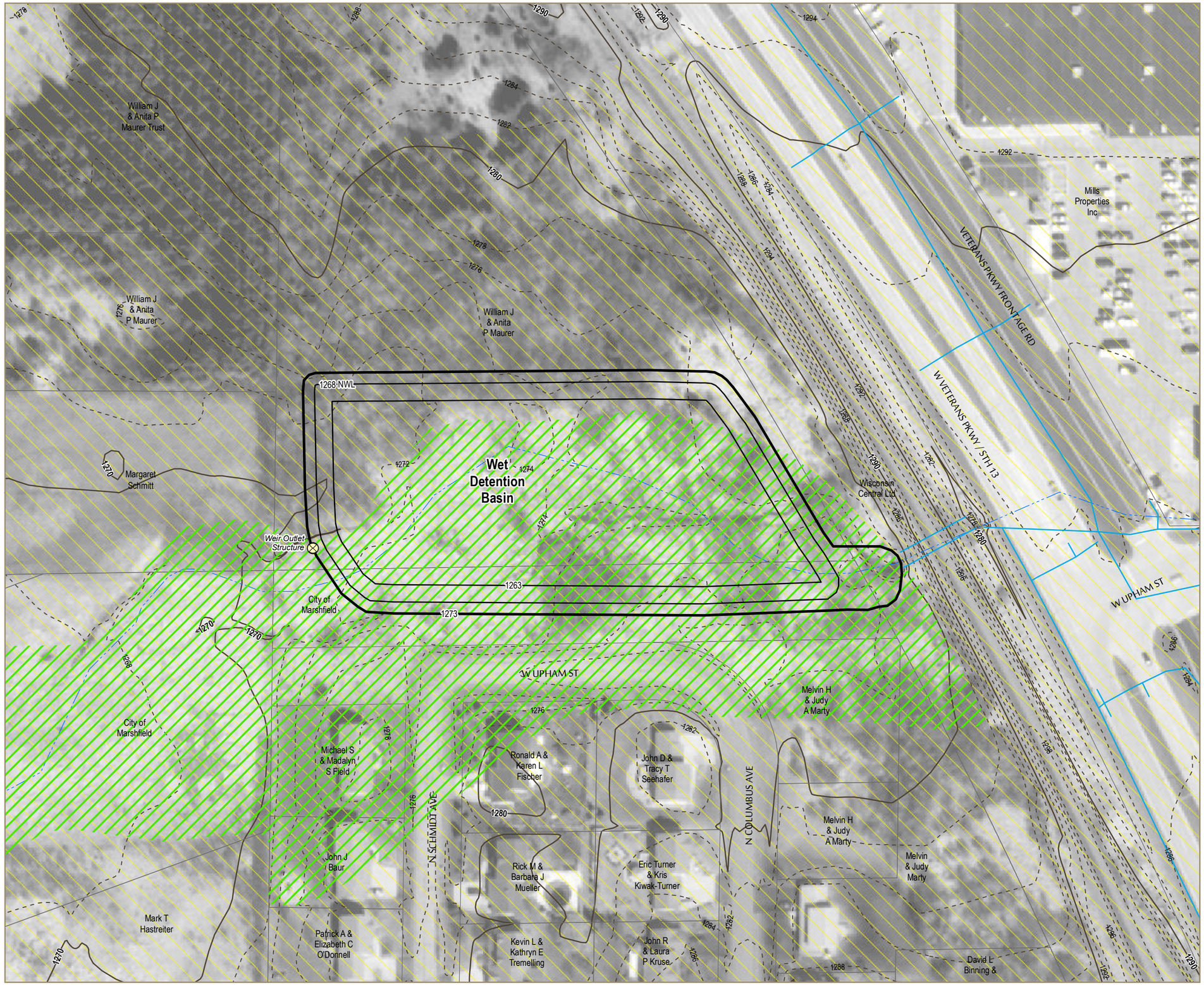
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

Y - 20004: VETERAN'S AND UPHAM



PROPOSED POND

PARCEL

WETLAND

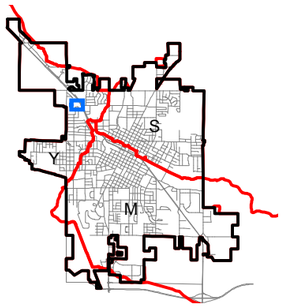
WETLAND INDICATOR SOILS

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

RIVER/STREAM

PAGE 6 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

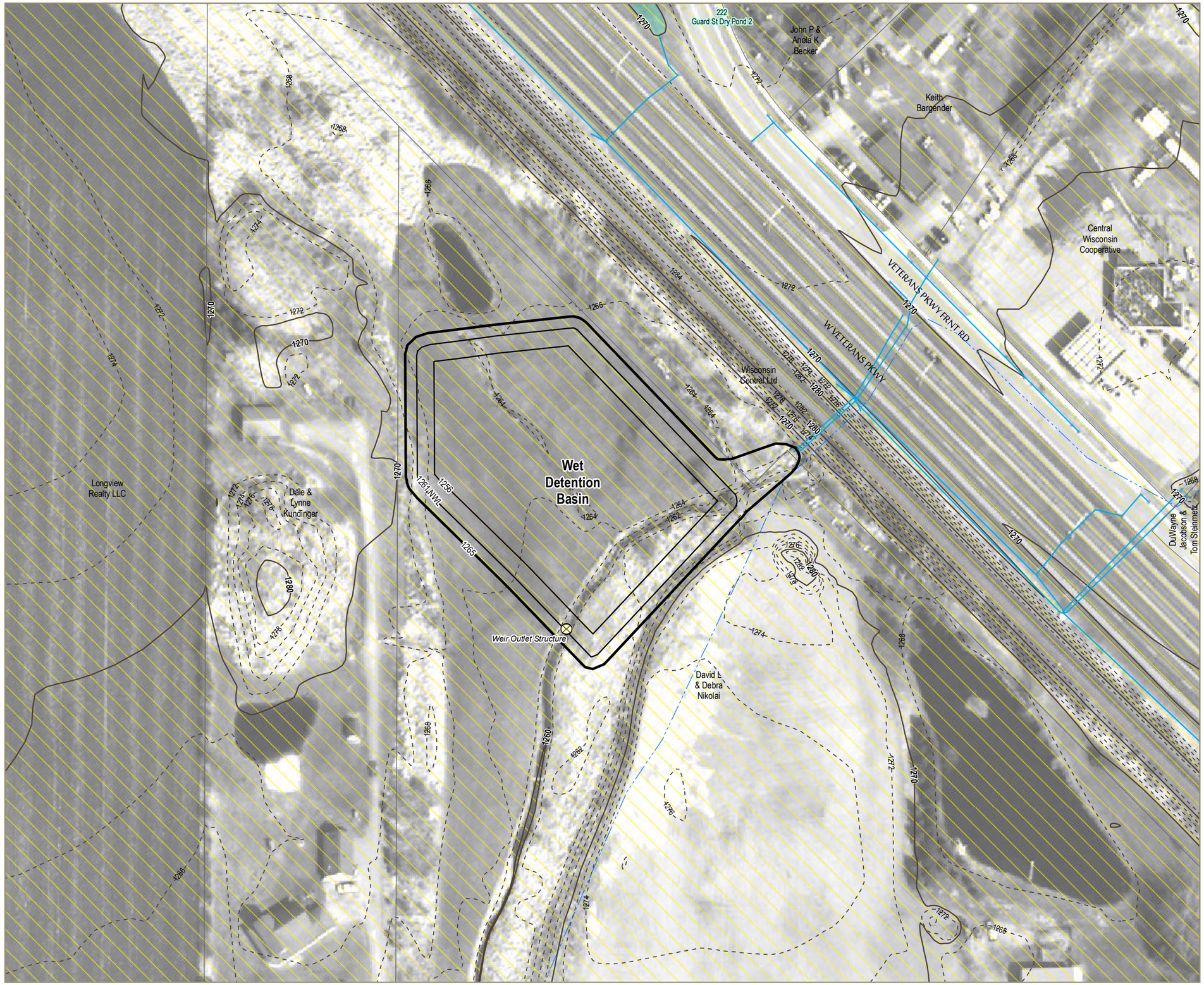
CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

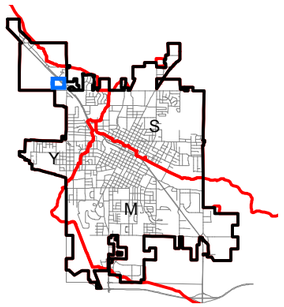
0 25 50 100 Feet

Y - 20006: NIKOLAI (MCMILLAN AND VETERAN'S)



PROPOSED POND
EXISTING POND
PARCEL
WETLAND INDICATOR SOILS
PROPOSED OUTLET STRUCTURE
EXISTING STORM SEWER
RIVER/STREAM

PAGE 7 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

S - 30002: 1701 N CENTRAL

PROPOSED POND

PARCEL

WETLAND INDICATOR SOILS

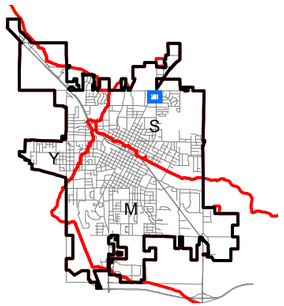
NEW STORM SEWER (INLET)

NEW STORM SEWER (OUTLET)

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

PAGE 8 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

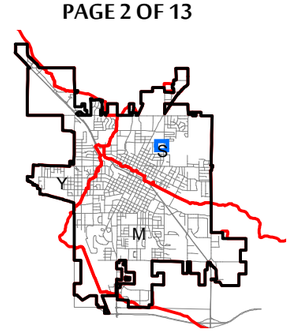
MSA PROFESSIONAL SERVICES

0 25 50 100 Feet

S - 30004: BRAEM'S PARK NORTH

PROPOSED POND
EXISTING POND
PARCEL
WETLAND
WETLAND INDICATOR SOILS
NEW STORM SEWER (INLET)
SWALE/STREAM DIVERSION
PROPOSED OUTLET STRUCTURE
EXISTING STORM SEWER
RIVER/STREAM

PAGE 2 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

S - 30006: BRAEM'S PARK SOUTH

PROPOSED POND

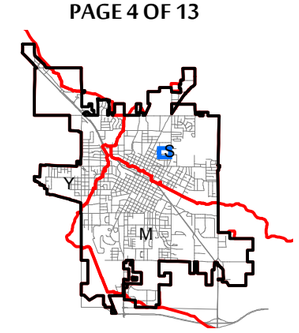
PARCEL

WETLAND INDICATOR SOILS

PROPOSED OUTLET STRUCTURE

EXISTING STORM SEWER

PAGE 4 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

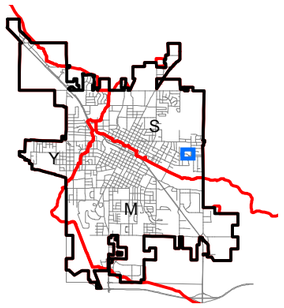
MSA PROFESSIONAL SERVICES

0 25 50 100 Feet

S - 30008: FILMORE GREENWAY

PROPOSED POND
PARCEL
WETLAND
WETLAND INDICATOR SOILS
NEW STORM SEWER (INLET)
SWALE/STREAM DIVERSION
PROPOSED OUTLET STRUCTURE
EXISTING STORM SEWER
RIVER/STREAM

PAGE 9 OF 13



DATA SOURCES:
PARCELS, STREET NAMES AND STORM LINES PROVIDED BY THE CITY.
RIVER/STREAMS PROVIDED BY THE USGS (NHD).
WETLAND DATA PROVIDED BY WOOD COUNTY. WETLANDS IN MARATHON COUNTY INTERPRETED FROM THE WISCONSIN SURFACE WATER DATA VIEWER AND SHOULD BE ASSUMED APPROXIMATE.
WETLAND INDICATOR SOILS BASED ON USDA-NRCS SOILS DATA IN DRAINAGE CLASSES OF SOMEWHAT POORLY, PORRLY AND VERY POORLY DRAINED SOILS.
AERIAL IMAGERY PROVIDED BY WISCONSIN REGIONAL ORTHOPHOTOGRAPHY CONSORTIUM (WROC, 2010).

CITY OF MARSHFIELD
WOOD AND MARATHON COUNTIES, WI

MSA PROFESSIONAL SERVICES

N

0 25 50 100 Feet

APPENDIX J

CONCEPT PLAN PRELIMINARY COST ESTIMATES

© June 2014 MSA Professional Services, Inc.

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP M_118 - Wet Pond
Figi's (S. Central)
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	2,500.00	$	2,500.00
2.	Dewatering	1	LS	$	3,500.00	$	3,500.00
3.	Unclassified Excavation	4,500	CY	$	9.00	$	40,500.00
4.	Construction Site Erosion Control	1	LS	$	2,500.00	$	2,500.00
5.	Site Restoration	1,000	SY	$	3.00	$	3,000.00
6.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
			30% Contingency			$	18,000.00
			Estimated Total Construction Costs			$	78,000.00

Estimated TSS Performance (Tons/Year)	3.85
Estimated Cost Per Ton of TSS Captured	$20,259.74

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP M_10002 - Wet Pond
29th Street Site #1
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	11,000.00	$	11,000.00
2.	Unclassified Excavation	28,000	CY	$	8.00	$	224,000.00
3.	Construction Site Erosion Control	1	LS	$	2,500.00	$	2,500.00
4.	Salvage Topsoil	12,600	SY	$	1.00	$	12,600.00
5.	Site Restoration	8,000	SY	$	3.00	$	24,000.00
6.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
7.	24-Inch Dia. RCP Storm Sewer	500	LF	$	60.00	$	30,000.00
8.	36-Inch dia. RCP Storm Sewer	80	LF	$	65.00	$	5,200.00
9.	Pavement Removal and Replacement	600	SF	$	6.00	$	3,600.00
			30% Contingency			$	96,270.00
			Estimated Total Construction Costs			$	417,170.00

Estimated TSS Performance (Tons/Year)	9.47
Estimated Cost Per Ton of TSS Captured	$44,051.74

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP M_10004 - Wet Pond
29th Street Site #2
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	5,500.00	$	5,500.00
2.	Unclassified Excavation	11,300	CY	$	8.00	$	90,400.00
3.	Ditching	700	LF	$	8.00	$	5,600.00
4.	Clearing and Grubbing	1.5	ACRE	$	7,500.00	$	11,250.00
5.	Construction Site Erosion Control	1	LS	$	10,000.00	$	10,000.00
6.	Salvage Topsoil	8,000	SY	$	1.00	$	8,000.00
7.	Site Restoration	6,500	SY	$	3.00	$	19,500.00
8.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
			30% Contingency			$	47,475.00
			Estimated Total Construction Costs			$	205,725.00

Estimated TSS Performance (Tons/Year)	2.39
Estimated Cost Per Ton of TSS Captured	$86,077.41

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP M_10006 - Wet Pond
18th and Veterans
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	8,000.00	$	8,000.00
2.	Unclassified Excavation	17,500	CY	$	8.00	$	140,000.00
3.	Construction Site Erosion Control	1	LS	$	7,500.00	$	7,500.00
4.	Clearing and Grubbing	1.5	ACRE	$	7,500.00	$	11,250.00
5.	Salvage Topsoil	7,500	SY	$	1.00	$	7,500.00
6.	Site Restoration	5,500	SY	$	3.00	$	16,500.00
7.	Outlet Control Structure	1	LS	$	15,000.00	$	15,000.00
8.	36-inch dia. RCP Storm Sewer	125	LF	$	75.00	$	9,375.00
9.	6-ft. dia. Manhole	1	EA	$	4,500.00	$	4,500.00
10.	Pavement Removal and Replacement	200	SF	$	6.00	$	1,200.00
			30% Contingency			$	66,247.50
			Estimated Total Construction Costs			$	287,072.50

Estimated TSS Performance (Tons/Year)	15.07
Estimated Cost Per Ton of TSS Captured	$19,049.27

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP M_10008 - Wet Pond
American Legion
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	5,500.00	$	5,500.00
2.	Unclassified Excavation	7,500	CY	$	8.00	$	60,000.00
3.	Construction Site Erosion Control	1	LS	$	6,000.00	$	6,000.00
4.	Clearing and Grubbing	0.6	ACRE	$	7,500.00	$	4,500.00
5.	Salvage Topsoil	3,200	SY	$	1.00	$	3,200.00
6.	Site Restoration	2,500	SY	$	3.00	$	7,500.00
7.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
8.	30-inch dia. RCP Storm Sewer	300	LF	$	65.00	$	19,500.00
9.	24-inch dia. RCP Storm Sewer	150	LF	$	60.00	$	9,000.00
10.	Pavement Removal and Replacement	1,400	SF	$	6.00	$	8,400.00
			30% Contingency			$	39,480.00
			Estimated Total Construction Costs			$	171,080.00

Estimated TSS Performance (Tons/Year)	1.52
Estimated Cost Per Ton of TSS Captured	$112,552.63

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP Y_228 - Wet Pond Ration - Berg
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	1,000.00	$	1,000.00
2.	Clearing and Grubbing	0.2	ACRE	$	7,500.00	$	1,500.00
3.	Ditching	800	LF	$	8.00	$	6,400.00
4.	Construction Site Erosion Control	1	LS	$	2,500.00	$	2,500.00
5.	Salvage Topsoil	1,500	SY	$	1.00	$	1,500.00
6.	Site Restoration	1,800	SY	$	3.00	$	5,400.00
7.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
			30% Contingency			$	7,890.00
			Estimated Total Construction Costs			$	34,190.00

Estimated TSS Performance (Tons/Year)	0.82
Estimated Cost Per Ton of TSS Captured	$41,695.12

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP Y_20002 - Wet Pond
Forest Ridge Park
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	2,500.00	$	2,500.00
2.	Unclassified Excavation	3,400	CY	$	8.00	$	27,200.00
3.	Construction Site Erosion Control	1	LS	$	6,000.00	$	6,000.00
4.	Salvage Topsoil	3,400	SY	$	1.00	$	3,400.00
5.	Site Restoration	3,500	SY	$	3.00	$	10,500.00
6.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
			30% Contingency			$	17,280.00
			Estimated Total Construction Costs			$	74,880.00

Estimated TSS Performance (Tons/Year)	2.47
Estimated Cost Per Ton of TSS Captured	$30,315.79

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP Y_20004 - Wet Pond
Veterans and Upham
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	13,000.00	$	13,000.00
2.	Unclassified Excavation	36,000	CY	$	7.00	$	252,000.00
3.	Construction Site Erosion Control	1	LS	$	20,000.00	$	20,000.00
4.	Salvage Topsoil	16,000	SY	$	1.00	$	16,000.00
5.	Site Restoration	7,800	SY	$	3.00	$	23,400.00
6.	Outlet Control Structure	1	LS	$	15,000.00	$	15,000.00
			30% Contingency			$	101,820.00
			Estimated Total Construction Costs			$	441,220.00

Estimated TSS Performance (Tons/Year)	11.29
Estimated Cost Per Ton of TSS Captured	$39,080.60

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP Y_20006 - Wet Pond
Nikolai (McMillan and Veterans)
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	10,000.00	$	10,000.00
2.	Unclassified Excavation	26,300	CY	$	7.00	$	184,100.00
3.	Construction Site Erosion Control	1	LS	$	15,000.00	$	15,000.00
4.	Salvage Topsoil	13,000	SY	$	1.00	$	13,000.00
5.	Site Restoration	6,500	SY	$	3.00	$	19,500.00
6.	Outlet Control Structure	1	LS	$	15,000.00	$	15,000.00
			30% Contingency			$	76,980.00
			Estimated Total Construction Costs			$	333,580.00

Estimated TSS Performance (Tons/Year)	9.80
Estimated Cost Per Ton of TSS Captured	$34,038.78

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP S_30002 - Wet Pond
1701 N. Central
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	3,500.00	$	3,500.00
2.	Unclassified Excavation	6,900	CY	$	8.00	$	55,200.00
3.	Clearing and Grubbing	0.20	ACRE	$	7,500.00	$	1,500.00
4.	Construction Site Erosion Control	1	LS	$	4,500.00	$	4,500.00
5.	Salvage Topsoil	4,000	SY	$	1.00	$	4,000.00
6.	Site Restoration	3,000	SY	$	3.00	$	9,000.00
7.	Outlet Control Structure	1	LS	$	8,000.00	$	8,000.00
8.	24-Inch dia. RCP Storm Sewer	80	LF	$	60.00	$	4,800.00
9.	36-Inch dia. RCP Storm Sewer	30	LF	$	75.00	$	2,250.00
10.	4-ft dia. Manhole	1	EA	$	3,000.00	$	3,000.00
11.	Pavement Removal and Replacement	600	SF	$	6.00	$	3,600.00
			30% Contingency			$	29,805.00
			Estimated Total Construction Costs			$	129,155.00

Estimated TSS Performance (Tons/Year)	2.32
Estimated Cost Per Ton of TSS Captured	$55,670.26

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP S_30004 - Wet Pond
Braem Park North
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	19,000.00	$	19,000.00
2.	Unclassified Excavation	50,000	CY	$	8.00	$	400,000.00
3.	Clearing and Grubbing	5.00	ACRE	$	7,500.00	$	37,500.00
4.	Construction Site Erosion Control	1	LS	$	20,000.00	$	20,000.00
5.	Salvage Topsoil	24,000	SY	$	1.00	$	24,000.00
6.	Site Restoration	12,000	SY	$	3.00	$	36,000.00
7.	Outlet Control Structure	1	LS	$	15,000.00	$	15,000.00
			30% Contingency			$	165,450.00
			Estimated Total Construction Costs			$	716,950.00

Estimated TSS Performance (Tons/Year)	17.81
Estimated Cost Per Ton of TSS Captured	$40,255.47

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP S_30006 - Wet Pond
Braem Park South
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	6,500.00	$	6,500.00
2.	Unclassified Excavation	16,300	CY	$	8.00	$	130,400.00
3.	Clearing and Grubbing	1.75	ACRE	$	7,500.00	$	13,125.00
4.	Construction Site Erosion Control	1	LS	$	10,000.00	$	10,000.00
5.	Salvage Topsoil	8,500	SY	$	1.00	$	8,500.00
6.	Site Restoration	5,000	SY	$	3.00	$	15,000.00
7.	Outlet Control Structure	1	LS	$	10,000.00	$	10,000.00
			30% Contingency			$	58,057.50
			Estimated Total Construction Costs			$	251,582.50

Estimated TSS Performance (Tons/Year)	5.60
Estimated Cost Per Ton of TSS Captured	$44,925.45

Engineer's Estimate of Probable Construction Costs - Conceptual
Proposed BMP S_30008 - Wet Pond
Fillmore Greenway
City of Marshfield
February, 2014

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS		UNIT PRICE		TOTAL PRICE
1.	Mobilization, Performance & Payment Bonds	1	LS	$	2,500.00	$	2,500.00
2.	Unclassified Excavation	3,200	CY	$	8.00	$	25,600.00
3.	Ditching	500	LF	$	8.00	$	4,000.00
4.	Construction Site Erosion Control	1	LS	$	5,000.00	$	5,000.00
5.	Salvage Topsoil	5,000	SY	$	1.00	$	5,000.00
6.	Site Restoration	4,000	SY	$	3.00	$	12,000.00
7.	Outlet Control Structure	1	LS	$	15,000.00	$	15,000.00
			30% Contingency			$	20,730.00
			Estimated Total Construction Costs			$	89,830.00

Estimated TSS Performance (Tons/Year)	2.71
Estimated Cost Per Ton of TSS Captured	$33,147.60

Engineer's Estimate of Probable Construction Costs - Conceptual Dry Pond Conversions

City of Marshfield

February, 2014

ITEM NO.	POND DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
132	Wick Building Systems	1,280	CY	$ 20.00	$ 25,600.00
142	Fairgrounds	900	CY	$ 20.00	$ 18,000.00
202	Midstate Technical College	305	CY	$ 20.00	$ 6,100.00
204	Sycamore	515	CY	$ 20.00	$ 10,300.00
206	First Presbyterian Church	475	CY	$ 20.00	$ 9,500.00
310	Walmart NW	2,640	CY	$ 20.00	$ 52,800.00
312	Walmart	1,260	CY	$ 20.00	$ 25,200.00
344/346/348	Fig	2,720	CY	$ 20.00	$ 54,400.00

APPENDIX K

SUMMARY OUTPUT TABLES

© June 2014 MSA Professional Services, Inc.

City of Marshfield TSS Reduction Summaries

Mill Creek	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices		TSS Removed by Proposed Ponds		
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%
Total Watershed	**4136.6**	418.0	202.1	33.2	7.9%	23.5	5.6%	74.7	17.9%		45.3	10.8%	176.7	42.3%		N/A	N/A
City Limits	**4034.9**	416.8	206.6	33.2	8.0%	23.5	5.6%	74.7	17.9%	36	44.6	10.7%	175.9	42.2%	5	32.3	7.8%
NR151 Regulated Area	**3377.2**	390.1	231.0	33.2	8.5%	22.1	5.7%	71.7	18.4%		40.0	10.2%	167.1	42.8%		N/A	N/A

1. Two sets of four existing biofilters modeled as single BMPs (actual model BMP count = 28)

Upper Yellow River	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices		TSS Removed by Proposed Ponds		
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs[1]	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%
Total Watershed	**2078.2**	148.7	143.1	6.8	4.6%	8.6	5.8%	30.7	20.7%		6.8	4.6%	52.9	35.6%		N/A	N/A
City Limits	**1982.9**	144.3	145.6	6.8	4.7%	8.6	6.0%	30.7	21.3%	13	5.7	4.0%	51.9	35.9%	4	24.4	16.9%
NR151 Regulated Area	**1645.0**	136.1	165.5	6.8	5.0%	8.5	6.2%	29.6	21.7%		5.7	4.2%	50.6	37.2%		N/A	N/A

1. Three existing biofilters modeled as one BMP (actual model BMP count = 11)

Little Eau Pleine	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices		TSS Removed by Proposed Ponds		
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs[1]	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%
Total Watershed	**2590.1**	429.8	331.9	17.7	4.1%	19.1	4.4%	35.3	8.2%		20.3	4.7%	92.4	21.5%		N/A	N/A
City Limits	**2550.8**	425.5	333.6	17.7	4.2%	19.1	4.5%	35.3	8.3%	34	19.5	4.6%	91.6	21.5%	4	28.4	6.7%
NR151 Regulated Area	**1990.4**	424.1	426.1	17.7	4.2%	18.8	4.4%	34.3	8.1%		19.5	4.6%	90.4	21.3%		N/A	N/A

1. Four existing drp ponds modeled as one BMP; two existing biofilters modeled as one BMP; two existing wet ponds modeled as one BMP; one biofilter and dry pond modeled as one BMP; two dry ponds modeled as one BMP; and three wet ponds modeled as one BMP (actual model BMP count = 25)

Combined Study Area	Area	Total Load		TSS Removed by Street Sweeping		TSS Removed by Catch Basins		TSS Removed by Swales		TSS Removed by Existing Ponds			TSS Removed by All Existing Practices		TSS Removed by Proposed Ponds		
	acres	tons/yr	lbs/ac/yr	tons/yr	%	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%	tons/yr	%	Number of BMPs	tons/yr	%
Total All Watersheds	**8804.9**	996.6	226.4	57.7	5.8%	51.2	5.1%	140.7	14.1%		72.5	7.3%	322.0	32.3%		N/A	N/A
City Limits	**8568.7**	986.5	230.3	57.7	5.8%	51.2	5.2%	140.7	14.3%	83	69.8	7.1%	319.4	32.4%	13	85.1	8.6%
NR151 Regulated Area	**7012.6**	950.3	271.0	57.7	6.1%	49.5	5.2%	135.6	14.3%		65.3	6.9%	308.0	32.4%		N/A	N/A