Surface Water Management Plan

2018 Second Generation Management Plan Update

Sartell, Minnesota

SARTE 143819 November 13, 2018

SEH

Building a Better World for All of Us®

Engineers | Architects | Planners | Scientists

Building a Better World for All of Us®

November 13, 2018

RE: 2018 Second Generation Management Plan Update
Surface Water Management Plan
Sartell, Minnesota
SEH No. SARTE 143819 4.00

Honorable Mayor and City Council
City of Sartell
125 Pinecone Road North
Sartell, Minnesota, 56377

Dear Mayor and City Council Members:

SEH Is pleased to provide the enclosed 2018 City of Sartell Surface Water Management Plan. This plan utilizes the framework established with the first generation 2008 Surface Water Management Plan and incorporates updates to address development that has occurred over the past ten years, new stormwater regulations and new stormwater policies.

The Surface Water Management Plan has two primary purposes. First, to help guide the management of the City's surface/storm water system. Second, to help plan for future storm water infrastructure needs, their costs, and options on financing.

We appreciate the opportunity to work with the City of Sartell on this comprehensive planning effort and look forward to helping the City implement its findings.

Please contact April Ryan at 320-229-4329 or Jon Halter at 320-229-4344 with any questions.

Sincerely,

April Ryan, PE
Project Manager, Sr. Project Engineer
Assistant City Engineer

Jon Halter, PE
Sartell City Engineer

aar/mrb

c:\users\mblommel\desktop\final sartell swmp 2018.11.13.docx

Surface Water Management Plan

2018 Second Generation Management Plan Update

Sartell, Minnesota

SEH No. SARTE 143819

November 13, 2018

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

April Ryan, PE

Date: November 13, 2018 License No.: 47121

Reviewed By: Brad Woznak, PE Date: Novemeber 13, 2018

Short Elliott Hendrickson Inc.
1200 25th Avenue South
P.O. Box 1717
St. Cloud, MN 56302-1717
320.229.4300

SEH

Acronym List

AMC	Antecedent Moisture Condition
BWSR	Minnesota Board of Water and Soil Resources
CMWEA	Central Minnesota Water Education Alliance
CN	Runoff Curve Number
DWSMA	Drinking Water Supply Management Area
EPA	Environmental Protection Agency
ESA	Environmentally Sensitive Area Ordinance
FEMA	Federal Emergency Management Agency
HSG	Hydrologic Soil Group
MDH	Minnesota Department of Health
MnDNR	Minnesota Department of Natural Resources
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MSL	Mean Sea Level
MS4	Municipal Separate Storm Sewer System
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OHW	Ordinary High Water Level
PFDS	NOAA Precipitation Frequency Data Server
SRWD	Sauk River Watershed District
SDWA	Safe Drinking Water Act
SWCD	Soil and Water Conservation District
SWMP	Surface Water Management Plan or Storm Water Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SWU	Stormwater Utility
TSS	Total Suspended Solids
TP	Total Phosphorous

SEH

Executive Summary

Background

The first generation Surface Water Management Plan (SWMP) was completed in 2008. This plan utilizes the framework established with the first generation and incorporates updates to address development that has occurred over the past ten years, new stormwater regulations and new stormwater policies.

This Surface Water Management Plan (SWMP) encompasses the current City boundary as well as growth areas (areas within LeSauk and Sauk Rapids Townships that will be annexed into the City as they are developed). The total drainage area considered within this SWMP encompasses approximately 21.9 square miles (14,000 acres).

Purpose and Scope:

The SWMP has two primary purposes. First, to help guide the management and establishment, of the City's surface/storm water system. Second, to help plan for future storm water infrastructure needs, their costs, and options on financing.

Stormwater management can generally be divided into two main areas, water quality (the condition) and water quantity (the amount). This SWMP focuses on water quantity, which encompasses the conveyance, rate control, and flood management of stormwater management.

Surface Water Regulation:

Over the past 10 years stormwater regulations have significantly increased at the federal, state and local levels. These regulations often overlap and require multiple permits depending on the type of activity. The numerous Local, State, and Federal agencies play a role in managing water resources within the City.

Physical Environment:

Two basic engineering principals, Hydrology and Hydraulics, are used to assess surface water management within a community. Hydrology is the study of the water cycle as well as the movement, distribution, and quality of water. Hydraulics is the study of liquid conveyance. These two principals rely on the physical characteristics of the environment. Provided below is a general list of the physical environment features within Sartell that are used in assessing surface water management:

- Climate / Precipitation
- Topography
- Soils
- Land Cover and Land Use
- Environmentally Sensitive Area Ordinance (ESA)
- Wellhead Protection
- Pollutant Sources

Surface Water Management:

Surface water management is a very strong component of the City's overall approach to protecting and preserving the community's natural resources and surface waters. The City of Sartell recognizes both the value and impact that surface water can have on the quality of life in the community.

Executive Summary (continued)

Surface water management must include an understanding of the surface waters that could potentially be impacted, an understanding of the City's existing stormwater management system, and an understanding of how the City may develop into the future.

Surface Waters:

Surface waters include wetlands, rivers, streams, water course, lakes, and other water bodies. Some surface waters are classified as public waters, where the MnDNR has regulatory jurisdiction.

There are several public waters in and near the City of Sartell, including the Mississippi River, Sauk River, Watab River, County Ditch 13, Bakers Lake, Davenport Lake and other unnamed public water wetlands. In additional to the classified public waters there are multiple other surface waters within Sartell, including ditches such as Ditch 16, un-named watercourses, un-named water bodies as well as numerous wetlands.

Existing Surface (Storm) Water Management System:

Storm water management is made up of both physical features and non-physical activities. The physical features include conveyances (ditch, storm sewer, etc.), catch basins, and treatment/management systems (ponds, rainwater gardens, etc.). It also includes none physical aspects, such as education, inspections, regulatory mechanisms, permitting processes, inventories, training and maintenance. All aspects of the City's storm water management program are permitted and included within the City's NPDES MS4 permit. This report focuses on the existing physical features of the storm water system to help determine the adequacy of the system and help identify existing and potential issues areas.

Existing System Analysis:

The existing major storm water system within the City of Sartell was analyzed using computer modeling software. The software evaluates the rainfall-runoff process so that runoff rates and volumes can be estimated for specific design storms. The major storm water system analyzed for this study included ponds, the most restrictive outlet pipe from each pond, ditches, culvert crossings, areas of known concern, and trunk storm sewer pipes greater than 30" in diameter.

Stormwater Treatment Ponds:

Stormwater treatment ponds are one of the most effective means of providing rate control and can also be an effective means for providing stormwater treatment. The storage volume above the normal water level provides the floodwater storage and rate control function. The permanent water volume of the pond below the pond outlet elevation provides the water quality treatment benefit for removal and storage of pollutants.

There are currently 106 existing stormwater treatment ponds that are owned and operated by the City of Sartell. These ponds require regular routine maintenance as well as long term more significant major maintenance, such as sediment removal and inlet/outlet structure repair. As a permitted MS4, the City of Sartell is required to complete certain activities to assess and maintain public owned and operated stormwater ponds.

Executive Summary (continued)

A desktop assessment was completed for each of the City's owned ponds. The assessment included a review of pond characteristics, estimated annual TSS and TP pollutant load, records of inspections and public concerns, and pond aesthetic priority. Pond data was compiled and organized in a worksheet format to be used as a tool for the City. This assessment tool helps the City meet their MS4 permit requirements and will be beneficial in prioritizing pond inspections and maintenance activities.

Ditches:

There are several existing ditches within the City that are owned and operated by the City of Sartell. The ditch system is an integral part of the City's conveyance. These ditches require inspection and maintenance to ensure proper function and to prevent flooding. Critical ditches within the City span approximately 68,706 feet throughout 9 major watersheds within the City. The critical ditches are summarized by major watershed in Table 5. It is recommended that the City develop a ditch management plan. This plan would set a standard profile and cross-section for each ditch, as well as outline an inspection and maintenance schedule.

Future Surface (Storm) Water Management System:

Simulating the stormwater conveyance and storage system is important to provide guidance as areas are developed. As rural areas become urbanized, the resulting increases in volume and peak discharges can adversely affect downstream conveyance systems and receiving waters. To mitigate these impacts, stormwater management facilities are required to treat and detain or hold back runoff.

The first generation plan included regional stormwater ponds to management surface water. With current volume control requirements, stormwater treatment is often more effective on a site by site basis. Future treatment/management facilities will likely be impacted and determined by the regulations at the time and development/site specific characteristics.

Past Analysis / Studies:

The City has previously completed the following analysis/modeling reports is listed below:

- 2008 First generation surface water management plan (Stantec 2008)
- Preliminary Engineering Report: Bakers Lake/North Storm Sewer Improvements (Stantec 2012)
- Memorandum: Pinecone Road and 2 ½ Street Intersection Flooding Analysis (WSB 2013)
- Memorandum: The Wilds Flooding Analysis (WSB 2013)

Major Watershed Summaries:

Based on the existing system analysis, future system analysis, and known past studies, an overview and recommendations for each of the major watersheds within the City was completed. There are 16 major watersheds identified within the City as listed in the table below.

Executive Summary (continued)

Major Watershed Summary

Major Watershed	Total Drainage Area (Acres)	Existing Developed Area[1] (Acres)	Low Land Area[2] (Acres)	Right of Way[3] (Acres)	Total Potential Developable Area[4] (Acres)
Bakers Lake*	1,498	111	443	225	719
North Trunk*	2,032	488	81	305	1,159
North Mississippi	331	87	0	50	194
Northwest Watab	289	107	80	43	58
North Central Watab	1,526	485	404	229	408
**North Pinecone	408	322	25	61	0
**Central Mississippi	1,005	843	11	151	0
North East Side	408	66	12	61	269
Central East Side*	1,274	149	176	191	757
**South East Side	408	264	5	61	78
Southwest Watab	669	0	45	100	523
Ditch 16	1,831	300	240	275	1,017
South Central Watab	310	78	70	47	115
**South Mississippi	185	133	0	28	24
Ditch 50	329	60	13	49	207
South Trunk	1,456	446	89	218	702
TOTAL	**13,959**	**3,939**	**1,697**	**2,094**	**6,230**

*Watershed total drainage area only includes acres from within the study area.

** Not a priority future development watershed.

[1] Existing developed area delineated from aerial photography, City parcel data, and as-built documents.

[2] Low land area includes existing ponds and NWI wetlands.

[3] Assumed to be 15% of total area.

[4] Total Potential Developable Area = Total Drainage Area – (Already Developed Area + Low Land Area + ROW)

Stormwater Management Financing:

There are several methods of financing surface water management. A list of the common methods is provided below. The most appropriate financing method should be chosen based on the specific aspects of stormwater management to be funded:

- General Taxation
- Storm Water Utility
- Special Assessments
- Grants
- Area or Development Charges

Executive Summary (continued)

Area or Development Charges

To help the City set trunk development fees a preliminary estimate of future trunk system costs based on the best available information was completed. The tables below include Major Watershed trunk conveyance costs to be use in determining trunk storm rates.

Trunk Area Summary

Major Watershed	Total Drainage Area (Acres)	Total Potential Developable Area[1] (Acres)	Equivalent Developable Area[2] (Acres)	Estimated Future Trunk System Costs[3]
Bakers Lake*	1,498	719	719	$3,507,000
North Trunk*	2,032	1159	1174	$5,853,000
North Mississippi	331	194	194	$728,000
Northwest Watab	289	58	58	$2,529,000
North Central Watab	1,526	408	439	$1,091,000
**North Pinecone	408	0	-	-
**Central Mississippi	1,005	0	-	-
North East Side	408	269	269	$1,171,000
Central East Side*	1,274	757	956	$262,000
**South East Side	408	78	-	-
Southwest Watab	669	523	550	$5,382,000
Ditch 16	1,831	1017	1100	$2,310,000
South Central Watab	310	115	141	$547,000
**South Mississippi	185	24	-	-
Ditch 50	329	207	237	$2,406,000
South Trunk	1,456	702	1210	$1,793,000
Total City	**13,959**	**6230**	**7047**	**$27,579,000**

*Watershed not including drainage from outside of the study area

** Not a priority future development watershed.

[1] Total Developable Area = Total Area – (Already Developed Area + Low Land Area + ROW)

[2] All land use areas pro-rated to equivalent single family acres based on C value

[3] System Cost are rounded up to the $1,000

Recommended Land Use Coefficient for Establishing Trunk Storm Sewer Rates

Land Use	Runoff Coefficient
Single Family	0.3
Multi Family	0.4
Commercial/Industrial	0.6

Executive Summary (continued)

Summary and Recommendations:

Recommendation Summary

Major Watershed	Recommendation	Recommended Schedule	Estimated Cost
All	NPDES MS4 Permit Compliance	Ongoing	NA
All	Conveyance System Inspection & Maintenance	Annually	NA
South Trunk	Inspection of South Trunk Storm Sewer	Within Next 1-2 Years (2019-2020)	$20,000
All	Ditch Management Plan	Within Next 1-2 Years (2019-2020)	$35,000
North Central Watab	North Central Watab / Celebration Area Drainage Study	Within Next 3-4 Years (2021-2022)	$40,000
All	Pond Sediment Evaluation & Testing	Odd Years Starting 2019 (Funding is Available)	$20,000
All	Pond Dredging (Sediment Removal)	Even Years Starting 2020 (as Funding is Available)	$200,000
Bakers Lake	New (second) Outlet From Bakers Lake	As Development Occurs	$2,053,000
North Central Watab	Clean & Maintain Ditch 13	Based on Ditch Management Plan And/or As Development Occurs	$120,000
All	Ditch Maintenance	Based on Ditch Management Plan & Inspections	$844,000
All	Future Trunk Conveyance	As Development Occurs	$27,579,000

Contents

Contents (continued)

List of Tables

Contents (continued)

List of Figures

List of Appendices

Surface Water Management Plan

Prepared for City of Sartell, Minnesota

1 Introduction

1.1 Background

The City of Sartell (City/Sartell) is divided by the Mississippi River, located in Stearns County and Benton County within central Minnesota, as shown in Figure 1. Sartell is approximately 10.4 square miles or 6,656 acres. This Surface Water Management Plan (SWMP) encompasses the current City boundary as well as growth areas (areas within LeSauk and Sauk Rapids Townships that will be annexed into the City as they are developed). The total drainage area considered within this SWMP encompasses approximately 21.9 square miles (14,000 acres).

The first generation Surface Water Management Plan (SWMP) was completed in 2008. This plan utilizes the framework established with the first generation and incorporates updates to address development that has occurred over the past ten years, new stormwater regulations and new stormwater policies.

1.2 Purpose and Scope

The SWMP has two primary purposes. First, to help guide the management and establishment, of the City's surface/storm water system. Second, to help plan for future storm water infrastructure need, their costs, and options on financing.

Stormwater management can generally be divided into two main areas, water quality (the condition) and water quantity (the amount). This SWMP focuses on water quantity, which encompasses the conveyance, rate control, and flood management of stormwater management.

The water quality aspect of stormwater management has been increasingly regulated by the Environmental Protection Agency (EPA) through the Minnesota Pollution Control Agency's (MPCA) NPDES Program. The City is required through their NPDES Municipal Separate Storm Sewer System (MS4) permit to develop and maintain an MS4 program for stormwater management, which primarily focuses on water quality. As to not duplicate information, this report will not cover the water quality aspect of stormwater management.

2 Surface Water Regulation

This section includes a synopsis of the current organizational entities whose programs and regulations are relevant to the management of surface water within Sartell. Over the past 10 years stormwater regulations have significantly increased at the federal, state and local levels. These regulations often overlap and require multiple permits depending on the type of activity. The numerous Local, State, and Federal agencies which play a role in managing water resources within the City are summarized below.

2.1 Federal Regulatory Agencies

2.1.1 United States Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) enforces the federal Clean Water Act, Safe Drinking Water Act, and National Pollutant Discharge Elimination Systems (NPDES) program. The NPDES program requires States to develop and enforce a program to address water pollution.

2.1.2 Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) operates the National Flood Insurance Program (NFIP). To participate in the NFIP and receive federally backed flood insurance, communities must adopt and enforce floodplain management ordinances to reduce future flood damage.

The City of Sartell has adopted Title 12 of the City Code which provides Flood Control Regulations to meet the NFIP.

2.1.3 United States Army Corps of Engineers (USACE)

The U.S. Army Corps of Engineers permits all work in, over, or under navigable waters of the US under Section 10 of the federal Rivers and Harbors Act. Under Section 404 of the federal CWA, a Corps permit is also required for the discharge of dredged or fill material into waters of the U.S.

2.2 State Regulatory Agencies

2.2.1 Minnesota Pollution Control Agency (MPCA)

The Minnesota Pollution Control Agency (MPCA) is charged with administering the federal Clean Water Act (CWA), monitoring and assessing water quality, listing impaired waters, conducting total maximum daily load studies/reports (TMDLs), and administrating the National Pollutant Discharge Elimination System (NPDES) program in Minnesota.

2.2.1.1 National Pollutant Discharge Elimination System (NPDES)

The NPDES permit program address water pollution through three State general permits. The Minnesota Pollution Control Agency (MPCA) is responsible for permitting, administrative, and enforcement aspects of each permit.

1) Municipal Separate Storm Sewer Systems (MS4) NPDES General Permit Program. The MS4 Permit requires all regulated MS4s to develop a Stormwater Pollution Prevention Plan (SWPPP) meeting standards under six minimum control measures:
    1. Public Education and Outreach
    2. Public Participation and Involvement
    3. Illicit Discharge Detection and Elimination (IDDE)
    4. Construction Site Stormwater Runoff Control
    5. Post-Construction Stormwater Management
    6. Pollution Prevention/Good Housekeeping for Municipal Operations

The City of Sartell is required to obtain and meet the MS4 permit requirements. The City's MS4 Permit and Stormwater Pollution Prevention Plan can be found in Appendix A.

2) Construction Stormwater NPDES General Permit Program. The Construction permit regulates any land disturbance of equal to or greater than one acre. The permit requires both construction activities as well as long term/permanent stormwater management.
3) Industrial Stormwater NPDES General Permit Program. The Industrial permit regulates stormwater discharges from industrial facilities.

2.2.2 Minnesota Department of Natural Resources (MnDNR).

The Minnesota Department of Natural Resources (MnDNR) is responsible for protecting public waters and managing water supply. It regulates activities below the ordinary high water level (OHW) of public waters and public waters wetlands through public water works permits. It also oversees and administers the National Flood Insurance Program (NFIP) for the State of Minnesota.

2.2.3 Minnesota Board of Soil and Water Resources (BWSR)

The Minnesota Board of Water and Soil Resources (BWSR) relevant core functions include water resource planning with comprehensive land use planning, implementing the comprehensive local water management acts, and administering the Wetland Conservation Act.

The City of Sartell is The Local Government Unit for wetland management within the City. The City of Sartell has adopted Title 10, Chapter 18 of the City Code to protect wetlands to the maximum extent possible while allowing a reasonable use of property.

2.2.4 1.1.1 Minnesota Department of Health (MDH)

The Minnesota Department of Health (MDH) is responsible for operating the state's drinking water protection program and implementing the federal Safe Drinking Water Act (SDWA) in Minnesota. The MDH produces source water assessments and Drinking Water Supply Management Areas (DWSMA) as well as aid in the development of local wellhead protection plans.

The City of Sartell has a Wellhead Protection Plan, which is designed to protect the groundwater aquifers that supply the Sartell municipal drinking water wells. The plan identifies potential sources of contamination that could pollute local groundwater wells and enter the community's water supply. Wellhead Protection Areas and DWSMA locations in the City of Sartell are shown in Figure 7

2.3 Local Regulatory Agencies

2.3.1 Soil and Water Conservation Districts (SWCD)

There are two Soil and Water Conservation Districts (SWCD) with jurisdiction within the City of Sartell; Stearns County SWCD and Benton County SWCD. Each SWCD manages and oversees local natural resource management amongst landowners and other units of government within their respective jurisdiction. Although the SWCD's do not have permitting authority within the City it will be important for the City to work with the SWCDs on projects as needed.

2.3.2 Watershed Districts

A small portion of southern Sartell is located within the jurisdictional boundaries of the Sauk River Watershed District (SRWD). The Sauk River Watershed covers over 667,183 acres extending over 5 counties. Approximately 420 of those acres are located within Sartell's South Trunk Major Watershed. The Sauk River Watershed District has permitting authority and specific stormwater management requirements within its jurisdiction.

2.3.3 Central Minnesota Water Education Alliance (CMWEA)

Central Minnesota Water Education Alliance (CMWEA) is a coalition of central Minnesota cities, counties and other organizations that provide educational outreach to promote water quality stewardship. The mission of CMWEA is to develop and implement educational programs that encourage individuals in Central Minnesota to protect water resources by increasing their knowledge and making simple behavioral changes.

Current CMWEA members include the cities of Cold Spring, Melrose, Paynesville, Richmond, Rockville, St. Cloud, St. Joseph, Sartell, Sauk Rapids and Waite Park; Stearns County; St. Joseph and Le Sauk townships; Sauk River Chain of Lakes and Koronis Lake associations; the Upper Mississippi River Source Water Protection Project, Sauk River Watershed District, Stearns County Soil & Water Conservation District and the Minnesota Rural Water Association.

2.3.4 City of Sartell

The City of Sartell has a responsibility to protect and preserve the community's natural resources. Surface water has a significant value and impact on the quality of life within the community. The City of Sartell properly manages surface water by implementing best practices to meet the applicable federal, state and local regulations. The establishment, implementation and enforcement of the Sartell City Code plays a significant role in surface water protection and regulatory compliance. The chapters and section of the Sartell City Code relevant to surface water management are included in Table 1. In addition to the City Code, the City of Sartell enforces stormwater design standards through development review, building permits and land disturbance permits.

Table 1 – Sartell City Code Related to Surface Water Management

City Code	Chapter	Section	Summary
Title 8: Water and Sewer	5. Storm Water Utility	All	Provide a method for funding services to protect and improve the quality of local water resources and to maintain compliance with NPDES permit requirements.
Title 10: Zoning Regulations	17. Site Design Standards	10-17-6. Site Drainage, Street and Utility Requirements	Refers to Title 11: Subdivision Regulations, Chapter 6.
Title 10: Zoning Regulations	18. Wetland District	All	Provide regulation to preserve and protect City nonpublic wetlands to maximum extent practicable.
Title 10: Zoning Regulations	20. Erosion and Sediment Control Ordinance	All	Provide regulation to protect disturbed areas from erosion and sedimentation during land disturbing activities.
Title 10: Zoning Regulations	21. Illicit Discharge and Connection Ordinance	All	Provide regulation of non-stormwater discharges to the storm drainage system to the maximum extent practicable.
Title 10: Zoning Regulations	22. Environmentally Sensitive Areas Ordinance	All	Provide regulation to protects ESAs and provide opportunity for equitable economic return in consideration of protection and preservation of ESAs.
Title 11: Subdivision Regulations	6. Required Improvements	11-6-7. Drainage Improvements	Provide volume, rate control, and post construction requirements for new development and redevelopment.
Title 12: Flood Control	All	All	Provide regulation for land within Floodway or Flood Fringe Districts to comply with the National Flood Insurance Program.

3 Physical Environment

Two basic engineering principals, Hydrology and Hydraulics, are used to assess surface water management within a community. Hydrology is the study of the water cycle as well as the movement, distribution, and quality of water. Hydraulics is the study of liquid conveyance. These two principals rely on the physical characteristics of the environment. This section provides a general description of the physical environment of Sartell, with the purpose of establishing a context for surface water management.

3.1 Climate / Precipitation

The National Weather Service (NWS) provide critical precipitation information used to assess hydrology, runoff and our surface waters. In 2013, the NWS released NOAA Atlas 14, Volume 8 precipitation data which updated the 1961 TP-40 precipitation frequency estimates for the Midwestern states. The new estimates are based on information with technical improvements, denser datasets, and longer term datasets to incorporate more recent precipitation trends, and advanced statistical methodologies.

According to the National Oceanic and Atmospheric Administration (NOAA), annual normal precipitation (1981-2010) for the weather station located at the St. Cloud Regional Airport is approximately 28 inches (National Average = 39 inches), of which about two-thirds occurs during the summer months of May - September. The annual snowfall in Sartell averages approximately 50 inches (National Average = 26 inches), with the most severe runoff conditions usually occurring in March and early April. Runoff conditions can have a significant impact on water quality and impacts to surface waters.

Table 2 summarizes the precipitation frequency estimates obtained from the NOAA Precipitation Frequency Data Server (PFDS) for central Sartell.

Table 2 – Atlas 14 Precipitation Frequency Estimates (in inches)

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3
10-min	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.9
15-min	0.6	0.8	1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.3
30-min	0.9	1.1	1.3	1.5	1.9	2.1	2.3	2.6	2.9	3.2
60-min	1.1	1.4	1.7	2.0	2.5	2.8	3.1	3.4	3.9	4.2
2-hr	1.3	1.6	2.1	2.5	3.1	3.5	3.9	4.3	4.8	5.2
3-hr	1.5	1.8	2.4	2.8	3.5	3.9	4.4	4.9	5.5	5.9
6-hr	1.7	2.1	2.7	3.3	4.0	4.6	5.1	5.7	6.5	7.1
12-hr	2.0	2.4	3.0	3.5	4.3	5.0	5.7	6.4	7.5	8.3
24-hr	2.3	2.7	3.3	3.9	4.8	5.5	6.3	7.2	8.4	9.3
2-day	2.6	3.0	3.8	4.5	5.5	6.3	7.1	8.0	9.2	10.2
3-day	2.8	3.3	4.1	4.8	5.8	6.6	7.5	8.4	9.6	10.6
4-day	3.1	3.5	4.3	5.0	6.0	6.9	7.7	8.7	9.9	10.9
7-day	3.6	4.1	5.0	5.8	6.9	7.8	8.7	9.6	11.0	12.1
10-day	4.1	4.7	5.6	6.5	7.6	8.5	9.5	10.5	11.9	12.9
20-day	5.7	6.4	7.5	8.4	9.6	10.6	11.6	12.6	13.9	14.9
30-day	7.0	7.8	9.1	10.1	11.5	12.5	13.5	14.5	15.9	16.8
45-day	8.7	9.7	11.2	12.4	14.0	15.2	16.3	17.4	18.8	19.7
60-day	10.0	11.2	13.1	14.5	16.4	17.8	19.0	20.2	21.6	22.5

Latitude 45.6237° Longitude -94.2034° Date/time (GMT): Mon Oct 23 19:55:45 2017

3.1.1 Precipitation Design Standards

In general surface water analysis utilizes a 24-hour storm duration with multiple average recurrence intervals depending on the area of analysis. The type of and frequency of precipitation events used to assess the different aspects of stormwater management are summarized below:

1) **Water Quality** – Utilizes small, more frequent rainfall events for analysis. Generally a 1-year or less average recurrence interval or 1-inch to 1.5-inch precipitation event. This is often referred to as the first flush, which characteristically carries the largest amount of pollution.
2) **Water Quantity** – Utilizes larger less frequent rainfall events. Depending on the type of analysis average recurrence intervals range from a 10-year (10% annual probability) to a 100-year (1% annual probability).
    a. **Rate Control**: both large and small rainfall events can produce runoff with significant downstream impacts. As such, rate control is typically design for a range of rainfall events including a 2-year, 10-year and 100-year average recurrence interval (50%, 10% and 1% annual probability). For Sartell this would equate to a 2.7, 3.9 and 6.3 inches of precipitation in 24 hours, respectively.
    b. **Minor Conveyances**: such as municipal storm sewer systems, are typically design to convey runoff from the 5-10 year average recurrence interval (10-20% annual probability) 24-hour precipitation event. For Sartell this would equate to a 3.3 to 3.9 inches of precipitation in 24 hours.
    c. **Major Conveyance**: such as ditches, overflows, and trunk conveyances, are typically designed to convey runoff from the 50-100 year average recurrence interval (1-2% annual probability) 24-hour precipitation event. For Sartell this would equate to a 5.5 to 6.3 inches of precipitation in 24 hours.
    d. **Flood Management**: focuses on large, infrequent events that may result in flood losses. Typically flood studies and design utilize the 100-year and 500-year average recurrence interval (1.0-0.2% annual probability) 24-hour precipitation event. For Sartell this would equate to a 6.3 to 8.4 inches of precipitation in 24 hours.

3.2 Topography

Land surface elevations within Sartell vary from a high point of about 1,100 feet above Mean Sea Level (MSL) in the northwest area of the City (Blackberry Neighborhood & Northside Park) to a low point of 990 feet MSL where the Sauk River meets the Mississippi River as shown in Figure 2. The northwest portion of the City includes some steep slopes with hills and depressions. These depressions/wetlands capture runoff, providing long term storage and natural rate control. The rest or majority of the City is relatively flat, with gently sloping land and minimal relief. All of Sartell slopes towards the Mississippi River. Runoff reaches the Mississippi River through multiple different routes.

- The north portion of the City is conveyed through trunk storm sewer directly to the Mississippi River.
- The western portion of the city drains through ditches and storm sewer to the Watab River prior to reaching the Mississippi River.
- A small southeast portion of the City drains to the Sauk River before discharging into the Mississippi River.

- The east, or Benton County portion of the City drains through ditches, ravines, and storm sewer to the Mississippi River.
- The south and central portions of the City drain overland or through storm sewer directly to the Mississippi River.

3.3 Soils

The soils throughout the City of Sartell vary in characteristics. Figure 3 show the different types of soils based on the Natural Resources Conservation Service (NRCS) Hydrologic Soil Group (HSG) Classification. These soil groups are typically used during surface water analysis to estimate runoff potential and infiltration rates. There are four HSG, which are generally described below:

- Hydrologic Soil Group A – Low runoff potential and high infiltration rate
- Hydrologic Soil Group B – Moderate runoff potential and moderate infiltration rate
- Hydrologic Soil Group C – High runoff potential and slow infiltration rate
- Hydrologic Soil Group D – High runoff potential and very slow infiltration rate

The identification and characteristics of soils is important to determine conveyance size and the type and size of stormwater management facilities. Soils found in Sartell are generally HSG A and HSG B soils. However, the central and Northwest portion of the City have high ground water elevations and/or highly compressed soils which increase runoff potential and decrease infiltration rates. Infiltration practices would not be recommended in these areas. The north and south portions of the City have deeper ground water levels with low runoff potential and high infiltration rates, making infiltration practices the favored stormwater treatment method.

When utilizing infiltration practices it is important to account for site specific characteristics, the presence of non-native soils, compaction of soils, potential for ground water contamination and other factors that may limit, restrict, or prohibit the use of infiltration. A site specific investigation should be completed prior to designing these facilities.

3.4 Land Cover and Land Use

Land cover (what covers the ground surface) and Land Use (how the land is being used) are critical aspects in analyzing runoff and surface water. Figure 4 illustrates the current land cover, while Figure 5 shows the City's Future Land Use.

When analyzing runoff and surface waters for future planning it is important to consider not only the current land cover and use, but what the future land use may be. Different types of land use have different impacts upon runoff and surface water quality. The amount of impervious cover (e.g., rooftop, parking lots, road, etc.) will impact the amount of runoff. Industrial and commercial land uses have large amounts of impervious surfaces with high runoff potential, while single family residential land use has less impervious surface and a lower runoff potential. In general the larger amount and density of impervious surface the larger amount of runoff and pollutants.

3.5 Environmental Considerations

The City of Sartell recognizes the importance of significant natural features that are present throughout the City and is committed to protecting its natural resources.

3.5.1 Environmentally Sensitive Area Ordinance (ESA).

In 2006, The City adopted an Environmentally Sensitive Area Ordinance (ESA). The ESA has two primary goals:

1) Protect ESAs. To provide and encourage measures of protection to those properties identified as Environmentally Sensitive Areas (ESA).
2) Equitable return to landowner. To provide an opportunity for equitable economic return in consideration of protection and preservation of ESAs.

In General, the ordinance requires all future development occurring in environmentally sensitive areas be guided to protect, conserve and enhance sensitive resources. The ESA Ordinance includes a Natural Resource Inventory. The inventory was established after an analysis and review of approximately 8660 acres of property within the City and portions of the growth boundary. Designated sensitive areas are based on: rock outcrop, species diversity, rivers and streams, forest and woodland and upland vegetation. Designated sensitive areas within the City are shown on Figure 6.

3.5.2 Wellhead Protection

The City of Sartell has a Wellhead Protection Plan, which is designed to protect the groundwater aquifers that supply the Sartell municipal drinking water wells. Surface water, when allowed to infiltrate, can connect surface pollutants to ground water. It is important to understand where and when infiltration practices should be restricted or prohibited to protect ground water aquifers and drinking water sources. The City's wellhead Protection Plan defines Wellhead Protection Areas and DWSMA locations, Figure 7 illustrates Sartell's Drink Water Source Management Area Vulnerability. When completing stormwater designs, these vulnerability area help define where infiltration practices within the City should be restricted and a "higher level of engineering review" is required (See the MN Stormwater Manual for more information on "higher level of review") and where infiltration practices should be not allowed at all.

3.5.3 Pollutant Sources

When precipitation events occur the water lands on surfaces and either soaks into the ground or runs off the land to downstream areas and surface waters. When this happens, the runoff can pick up pollutants and transport them downstream or into the ground. It is important to identify the sources and location of pollutants to help limit their interaction with precipitation and runoff. Information on permitted pollutant sources is available from the MPCA 'What's in My Neighborhood' online application. This application should be reviewed during stormwater design.

4 Surface Water Management

Surface water management is a very strong component of the City's overall approach to protecting and preserving the community's natural resources and surface waters. The City of Sartell recognizes both the value and impact that surface water can have on the quality of life in the community.

Surface water management must include an understanding of the surface waters that could potentially be impacted, an understanding of the City's existing stormwater management system, and an understanding of how the City may develop into the future.

4.1 Surface Waters

Surface waters include wetlands, rivers, streams, water course, lakes, and other water bodies. Some surface waters are classified as public waters, where the MnDNR has regulatory jurisdiction.

There are several public waters in and near the City of Sartell, including the Mississippi River, Sauk River, Watab River, County Ditch 13, Bakers Lake, Davenport Lake and other unnamed public water wetlands as shown on Figure 8. In additional to the classified public waters there are multiple other surface waters within Sartell, including ditches such as Ditch 16, un-named watercourses, un-named water bodies as well as numerous wetlands.

Every two years the MPCA updates an impaired waters list. This list identifies surface waters that do not meet water quality standards. Below are the surface waters within Sartell that are currently included on the impaired waters list:

- County Ditch 13 (from Baker's Lake to the Watab River) was added to the list in 2014 as impaired for Escherichia Coli (E. Coli), which affects aquatic recreation.
- Watab River was added to the list in 2014 as impaired for Escherichia Coli (E. Coli), which affects aquatic recreation.
- The Mississippi River north of the Sartell Dam is impaired for Mercury in fish tissue. The Mississippi River is part of Minnesota's Statewide Mercury Total Maximum Daily Load (TMDL).

4.2 Existing Surface (Storm) Water Management System

Storm water management is made up of both physical features and non-physical activities. The physical features include conveyances (ditch, storm sewer, etc.), catch basins, and treatment/management systems (ponds, rainwater gardens, etc.). It also includes none physical aspects, such as: education, inspections, regulatory mechanisms, permitting processes, inventories, training and maintenance. All aspects of the City's storm water management program are permitted and included within the City's NPDES MS4 permit. This section focuses on the existing physical features of the storm water system to help determine the adequacy of the system and help identify existing and potential issues areas.

4.3 Existing System Analysis

The existing major storm water system within the City of Sartell was analyzed using the computer modeling software XPSWMM 2017 Version 2.1. XPSMMM is a fully dynamic hydraulic and hydrologic modelling software that uses 1D calculations for upstream to downstream flow. The software evaluates the rainfall-runoff process so that runoff rates and volumes can be estimated for specific design storms. The major storm water system analyzed for this study included ponds, the most restrictive outlet pipe from each pond, ditches, culvert crossings, areas of known concern, and trunk storm sewer pipes greater than 30" in diameter. Results and recommendations from the existing system analysis can be found in each of the Major Watershed Summaries later within this report.

The analysis considered a number of key aspects that were input into the model to help assess the existing system, these include:

- Watershed characteristics:
  - Watersheds or drainage areas were delineated using LIDAR topography, aerial images, record drawing information, and other city storm sewer information available through the City's GIS system and staff knowledge.
- Watershed land cover (soil types and curve number);
  - The soil type and infiltration characteristics for the soil were classified for each major watershed. Hydrologic Soil Groups, as described in Section 3.3 of this report, were chosen using the USDA Web Soil Survey. The Hydrologic Soil Group for each major watershed used within the analysis can be found in Table 3.

Table 3 – Major Watershed Soil Groups

Major Watershed	HSG Soil Group
Bakers Lake Watershed	D
North Trunk Watershed	A
North Mississippi Watershed	A
Northwest Watab Watershed	D
North Central Watab Watershed	D
North Pinecone Watershed	B
Central Mississippi Watershed	B
North East Side Watershed	B
Central East Side Watershed	C
South East Side Watershed	B
Southwest Watab Watershed	B
Ditch 16 Watershed	B
South Central Watab Watershed	B
South Mississippi Watershed	B
Ditch 50 Watershed	B
South Trunk Watershed	B

- A runoff curve number (CN) is given to each type of land cover and soil type. A high CN is associated with high runoff impermeable surfaces, while a lower curve number is associated with low runoff permeable surfaces (i.e. Roadway CN=98; woods CN= 39). The curve number is used to calculate the amount of runoff from a particular surface type during a rainfall event. Curve numbers utilized for this study under normal soil moisture conditions (Antecedent Moisture Condition (AMC) II) for various land uses and soil groups are shown in Table 4.

Table 4 – Runoff Curve Numbers

Land Use	Runoff Curve Number			
	HSG A	HSG B	HSG C	HSG D
Woods, Brush, Meadow	39	61	73	80
Open Space Landscaped	49	69	79	84
Commercial (85% imp)	89	92	94	95
Industrial (72% imp)	81	88	91	93
Residential - Low Density	53	69	80	85
Residential - Medium Density	57	72	81	86
Residential - High Density	77	85	90	92
Impervious Areas	98	98	98	98
Agricultural - Row Crops	67	78	85	89
Agricultural - Pasture	39	61	73	80

- The time for water to travel across the land cover (time of concentration);
  - The time of concentration is the time required for runoff from a storm to travel from the most remote point of the watershed to the point of input into the conveyance system. The time of concentration varies with the type, slope, and distance of land cover within a watershed.
- Characteristics of existing stormwater storage areas throughout the City. This includes the area, volumes, normal water levels, and outlets of stormwater ponds, wetlands, and low areas.
- Existing conveyance system characteristics, including size, slope, and material of the ditches and pipes.

4.4 Stormwater Treatment Ponds

Stormwater treatment ponds are one of the most effective means of attenuating flow and providing subsequent rate control. Additionally, properly designed stormwater treatment ponds, also commonly referred to as wet detention basins or wet ponds, can also be an effective means for providing stormwater treatment. The storage volume above the normal water level provides the floodwater storage and rate control function. This is often referred to as the live storage. The permanent water volume of the pond below the pond outlet elevation is often referred to as the dead storage. The dead storage provides the water quality treatment benefit for removal and storage of pollutants.

The pollutant removal efficiency of ponds is dependent on the detention time of runoff. Meaning the time the runoff is held in the pond. Ponds are an effective way to settle out particles and remove particulate pollutants. The longer the detention time the higher the removal efficiency of sediments and fine sediments. Even though ponds can be effective at providing water quality, most stormwater treatment ponds are not able to satisfy current water quality treatment requirements on their own.

There are currently 106 existing stormwater treatment ponds that are owned and operated by the City of Sartell, as shown in Figure 9. In order for stormwater ponds to remain effective and operate as intended on a long-term basis they require regular maintenance.

- Routine maintenance often includes mowing and removal of debris/trash.

Less regular and more significant maintenance may include sediment removal and inlet/outlet structure repair. As a permitted MS4, the City of Sartell is required to complete certain activities to assess and maintain public owned and operated stormwater ponds. There are two major MS4 requirements related to existing ponds.

- The first is to inspect each pond within the 5-year permit cycle to determine structural integrity, proper function, and maintenance needs. The City of Sartell last inspected all of their ponds in 2015.
- The second is to develop a pond assessment procedure and schedule to determine the Total Suspended Solids (TSS) and Total Phosphorous (TP) treatment effectiveness of existing ponds. A pond assessment, as described below, has been completed as part of this Surface Water Management Plan.

4.4.1 Pond Assessment / Prioritization

A review of the City's available pond data was utilized to complete a desktop evaluation of each pond. The assessment included a review of pond characteristics, estimated annual TSS and TP pollutant load, records of inspections and public concerns, and pond aesthetic priority. Pond data was compiled and organized in a worksheet format to be used as a tool for the City. This assessment tool helps the City meet their MS4 permit requirements and will be beneficial in prioritizing pond inspections and maintenance activities. The assessment will also provide the framework for demonstrating compliance with inevitable TMDL Waste Load Allocations (WLA) in the future.

The following information was evaluated and used to complete the desktop assessment:

- Record drawings
- Current aerial photography
- Current LIDAR information
- Past inspection reports
- City storm sewer maps
- City GIS data

Based on the available information obtained from the sources listed above, the following information was determined, calculated and summarized within the pond assessment worksheet. A copy of the pond assessment worksheet is available in Appendix B.

- List of each pond in order of inspection/evaluation priority.
- SmartConnect ID / XPSWMM Modeling ID
- Location Description / Development
- Year Constructed / Years in Service
- Contributing Drainage Area (in acres)
- Annual Total Suspended Solids (TSS) Loading (Based on MPCA Calculator Data)
- Annual Total Phosphorous (TP) Loading (based on MPCA Calculator Data)
- Pond Characteristics
- Inspection and Maintenance History
- Known Public Concerns
- Aesthetics Priority

4.4.2 Pond Inspections and Maintenance

The City is required by their MS4 Permit to inspect every City owned and maintained pond at least once every five years. As inspections are completed, the City will need to identify and complete necessary maintenance activities to ensure the function and integrity of the ponds. Provide below is a list of the estimate pond inspection and maintenance needs.

- Annual inspections: 20-25 ponds
- Annual minor maintenance based on inspections: 10-15 ponds
- Annual major (dredging) maintenance based on inspections: 2-5 ponds

4.4.3 Pond Dredging

The MPCA updated their Managing Stormwater Sediment Best Management Practices Guidance in May of 2017. The guide outlines the following process for sediment removal (dredging):

1) **Inventory and maintenance needs.** The guide recommends starting with an inventory and a maintenance prioritization process, which has been completed as part of this report.
2) **Evaluating and testing sediment.** Sediment samples from high priority ponds are collected and compared to MPCA's Remediation Division soil reference values (SRVs) to determine where excavated sediment may be beneficially used or disposed.
3) **Engineering, contracting, and work plans.** Many factors need to be considered when developing the work plan and contract documents to remove sediment. These include, but not limited to, accessibility, sediment sample results/disposal requirements, cost/benefit, alternatives to dredging (i.e. expanding the pond, re-routing), dewatering, sediment transport, permits, logistics, administrative, coordination, notification, etc.

4) **Excavating sediment.** Sediment removal can occur during the winter or summer. Considerations for winter removal include, lower erosion potential, frozen ground for equipment, shorter workdays. Considerations for summer removal include, rainfall impacts, higher sediment erosion and transport concerns, alternate methods such as hydraulic dredging, impacts to wildlife, etc. The goal to removing sediment is to restore the pond to its original designed capacity. During the removal, survey will be required to determine the amount of sediment removed and depth of excavation.

5) **Site restoration.** Site restoration should be provided as soon as possible after sediment removal is completed. Erosion and sediment control needs to be provided during and after removal to stabilize the site and limit sediment loss and erosion.

6) **Records and documentation to keep on file.** Records of all ponds in inspections and maintenance should be kept. At a minimum the required documentation outlined within the NPDES MS4 permit is required.

4.5 Ditches

There are several existing ditches within the City that are owned and operated by the City of Sartell. The ditch system is an integral part of the City's conveyance. These ditches require inspection and maintenance to ensure proper function and to prevent flooding. The critical ditches within the City are shown on Figure 10, along with potential future ditches that may be needed as the City continues to develop. Critical ditches within the City span approximately 68,706 feet throughout 9 major watersheds within the City. The critical ditches are summarized by major watershed in Table 5. A more detailed breakdown of the existing critical ditches and estimated maintenance costs can be found in Appendix C. It is recommended that the City develop a ditch management plan. This plan would set a standard profile and cross-section for each ditch, as well as outline an inspection and maintenance schedule.

Table 5 – City of Sartell Critical Ditches

Major Watershed	Ditch Length (feet)
Bakers Lake Watershed	10,963
Northwest Watab Watershed	1,688
North Central Watab Watershed	18,544
Central Mississippi Watershed	498
Central East Side Watershed	15,872
South East Side Watershed	3,130
Southwest Watab	3,613
Ditch 16 Watershed	11,424
South Trunk Watershed	2,974
TOTAL	**68,706**

Table 6 lists potential future ditches that may be needed as the City continues to develop. In area that are relatively flat, the use of a trunk storm sewer system could be expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Drainage ditches can be a cost effective ways of convey large amounts of stormwater and help to provide a level of rate control.

Table 6 – City of Sartell Potential Future Ditches

Major Watershed	Ditch Length (feet)
Bakers Lake	540
North East Side	809
Ditch 50	3,888
TOTAL	**5,237**

4.6 Future Surface (Storm) Water Management System

The City's future storm water management system will be directly impacted by the current and future stormwater regulations. The NPDES permit program requires that the MS4, Construction and Industrial permits be updated every five years, as such regulations can also change every five years. Since the first generation of this plan, completed in 2008, storm water regulations have changed significantly. Current regulations require volume reduction in additional to rate/flood control.

4.7 Future System Analysis

Simulating the stormwater conveyance and storage system is important to provide guidance as areas are developed. A hydrologic model simulates the rainfall-runoff process so that runoff rates and volumes from specific design storms can be estimated for different stormwater configurations and land use conditions.

The rate and volume of stormwater runoff is heavily dependent on several factors, including:

- The intensity and duration of the precipitation event;
- The total amount of precipitation;
- Soil moisture conditions immediately preceding the event;
- The infiltration characteristics of the soil;
- The amount and type of vegetative cover;
- The amount of impervious coverage and the extent to which it is connected; and
- The size and slope of the contributing drainage area.

For each future priority development watershed, the drainage area information and estimated volumes for potential stormwater treatment systems is provided in Appendix D. Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type, size, and location will be determined based on specific future development characteristics.

4.8 Future Treatment/Management Facilities

As rural areas become urbanized, the resulting increases in volume and peak discharges can adversely affect downstream conveyance systems and receiving waters. To mitigate these impacts, stormwater management facilities are required to detain or hold back runoff. In general detention basins, or ponds, are used to control peak discharge rates. However, with ever changing storm water requirements, other types of stormwater management systems are also being utilized.

The first generation plan included regional stormwater ponds to management surface water. With current volume control requirements, stormwater treatment is often more effective on a site by site basis. This plan identifies potential future stormwater treatment or pond locations and estimated sizes. However, future treatment/management facilities will likely be impacted and determined by the regulations at the time and development/site specific characteristics.

For this planning level analysis, the live storage volumes for future development areas were calculated using Technical Release 55 Urban Hydrology for Small Watersheds Storage Volume for Detention Basins Method. This method is used for estimating the effects of temporary detention on peak discharges using two ratios: peak outflow to peak inflow discharge and storage volume to runoff volume for all rainfall distributions defined in the document.

Parameters used were calculated on a major watershed basis and a respective live storage volume was assigned to each future ponding contributing area, on an area-weighted basis.

Dead storage volumes were determined based on the MPCA requirements for wet sedimentation basins requiring a permanent volume (dead storage) of 1,800 cubic feet for each acre draining to the pond.

4.8.1.1 Future Conveyance / Trunk Storm Sewer Routing

The location of future trunk conveyances are critical to ensure that runoff can be directed to surface waters without creating adverse impacts to adjacent and downstream property. For this analysis, preliminary trunk conveyance locations and sizes were identified to convey surface/storm water from development treatment facilities to existing trunk conveyance systems or directly to surface waters.

Future trunk conveyance sizes were estimated using the rational method and rainfall data based on NOAA Atlas 14 rainfall intensity-duration-frequency regions created by the Minnesota Department of Transportation (MnDOT) for use with the rational method. A maximum time of concentration of 120 minutes was used and peak discharge rates were reduced by 40% to account for natural pond attenuation and rate control. Slopes were assumed based on the average land slope of the proposed trunk line path and estimated inverts at the downstream point of discharge. For areas in which minimal downstream elevation change exists, minimum pipe slopes were used based on recommendations within the MnDOT Drainage Manual.

Potential future trunk conveyances for each major Watershed is shown in Figures 12-27. Details and costs for the future trunk stormwater conveyances is provided in Appendix E.

4.9 Past Analysis / Studies

In addition to the first generation surface water management plan, the City has completed site specific modeling/analysis for a few issues areas. The analysis/modeling reports are listed below and included in Appendix F.

- Preliminary Engineering Report: Bakers Lake/North Storm Sewer Improvements (Stantec 2012)
- Memorandum: Pinecone Road and 2 ½ Street Intersection Flooding Analysis (WSB 2013)
- Memorandum: The Wilds Flooding Analysis (WSB 2013)

5 Major Watershed Summaries

Based on the existing system analysis, future system analysis, and known past studies, an overview and recommendations for each of the major watersheds within the City was completed. There are 16 major watersheds identified within the City. Major watersheds were delineated using a combination of the first generation plan, existing storm sewer data, topographic data, and major discharge points. The major watersheds as listed below and also shown in Figure 11.

1. Bakers Lake Watershed
2. North Trunk Watershed
3. North Mississippi Watershed
4. Northwest Watab Watershed
5. North Central Watab Watershed
6. North Pinecone Watershed
7. Central Mississippi Watershed
8. North East Side Watershed
9. Central East Side Watershed
10. South East Side Watershed
11. Southwest Watab Watershed
12. Ditch 16 Watershed
13. South Central Watab Watershed
14. South Mississippi Watershed
15. Ditch 50 Watershed
16. South Trunk Watershed

5.1 Bakers Lake Watershed

Drainage Area: 1,498 acres

Existing City Owned Ponds: 0

The Bakers Lake Watershed is located in the northwest portion of the City. The watershed is bounded by Le Sauk Township on the north and west and the North Trunk and North Central Watab Major Watersheds on the east and south. The watershed is largely undeveloped with a designated future land use of very low density residential. Topography in the watershed is steeper to the northwest and it flattens as it nears Ditch 13, Bakers Lake and the surrounding lowland areas. Bakers Lake Watershed s shown on Figure 12.

5.1.1 Bakers Lake Watershed Critical Aspects

5.1.1.1 County Ditch 13

Ditch 13 is a protected DNR public water. The ditch runs through the watershed and is a primary conveyance. After draining into Bakers Lake, Ditch 13 drains through the North Central Watab Watershed into Watab Creek. Due to the large contributing drainage area and relatively flat topography, Ditch 13 provides a significant amount of rate control which will need to be accounted for and maintained as the area develops. Ditch 13 will need to be maintained in the future to provide a similar level of conveyance and rate of flow as being provided today.

5.1.1.2 Bakers Lake

Bakers Lake is a protected DNR public water. Bakers Lake is approximately 34 acres in size and is located in the southeast corner of the watershed. Bakers Lake is an important feature of the watershed, providing natural ponding and rate control.

Modifications to the Bakers Lake outlet as well as alternate outlets have been proposed by past studies to help provide flood relieve for the downstream watershed. A second outlet is recommended and should be installed as the area develops. The proposed trunk storm sewer (102,102,103) drains to the east into the existing 60-inch trunk storm sewer located in the North Trunk Major Watershed and discharges into the Mississippi River.

5.1.1.3 Tail Water Effect

Due to the flat topography within the Bakers Lake, North Central Watab, and Northwest Watab watersheds, high water levels in the Watab River, create a tail water effect, which can greatly impact the capacity and flow within the drainage system. Due to this tail water effect the discharge rates and volumes from proposed development will need to be strictly controlled, likely resulting in larger ponds, use of existing wetland areas, and the use of drainage ditches for conveyance

5.1.1.4 Drainage from Outside of the Study Area

Approximately 2,845 acres of agriculture and wooded land drains into the Bakers Lake watershed from the northwest. For the purposes of this study, only the primary growth area for the City of Sartell was evaluated, however, future conveyances will need to take into consideration the entire drainage area to account for capacity and rate control.

5.1.1.5 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas and Bakers Lake. These provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

Due to the flat topography and low land areas located in southern part of the watershed, extreme runoff events have the potential for Bakers Lake to rise to a level that would result in discharge to the southwest, towards the Celebration Neighborhood. The Celebration Neighborhood is known to have high ground water and drainage concerns (see North Central Watab Watershed). Additional runoff from the Bakers Lake to this area would result in increased drainage and flooding concerns within and adjacent to the Celebration Neighborhood. The installation of a new outlet to Bakers Lake, as mentioned, would help with this concern, however, another potential option may need to also be considered, such as the construction of a berm through the low area to cut off drainage to the Celebration Neighborhood. Any option would require further investigation and analysis prior to construction to further determine level of benefit and feasibility.

5.1.1.6 Stormwater Conveyance within the Watershed

The southern part of the Watershed is relatively flat, as such the use of a trunk storm sewer system may be expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Drainage ditches can be a cost effective way of convey large amounts of stormwater and help to attenuate flow.

5.2 North Trunk Watershed

Drainage Area: 2,032 acres

Existing City Owned Ponds: 8

The North Trunk Watershed is located in the northeast portion of Sartell, bounded by Bakers Lake Watershed on the east, Brockway Township on the north, North Mississippi Watershed on the east, and the North Central Watab, North Pinecone, and Central Mississippi Watersheds on the south. The watershed is primarily undeveloped with a planned evenly mixed land use of low density residential and very low density residential. The primary conveyance for the watershed includes an existing trunk storm sewer system that runs from the Savanna Oaks Development to the Mississippi River.

The watershed topography is generally flat, sloping east, towards the Mississippi River. The Mississippi River is significantly lower than the North Trunk Watershed, which allows depth on the trunk storm sewer to serve the watershed. North Trunk Watershed Map is shown in Figure 13.

5.2.1 North Trunk Watershed Critical Aspects

5.2.1.1 Trunk Storm Sewer System

The North Trunk Watershed relies entirely on the trunk storm sewer system to drain the watershed. As the watershed develops, peak discharge rates and runoff volumes will need to be controlled to remain within the trunk storm sewer capacity. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

5.2.1.2 Well Drained Soils

The North Trunk Watershed has primarily well drained soils, minus some areas to the south where high ground water elevations exist. Well drained soils allow for the use of infiltration to manage stormwater. Infiltration should be required and utilized as much as possible to reduce runoff rates and runoff volumes. Of significance, a portion of the North Trunk Watershed is located within the City's Drinking Water Supply Management Area (DWSMA). Infiltration should be restricted and possibly prohibited within certain areas of the DWSMA. The Minnesota Stormwater Manual and MPCA guidance should be consulted to complete a "higher level of engineering review" within the DWSMA Emergency Response Area and Capture Zone. Figure 7 shows the City's DWSMA.

5.2.1.3 Drainage from Outside of the Study Area

Approximately 932 acres of primarily agriculture and wooded land drains into the North Trunk watershed from the north. For the purposes of this study, only the primary growth area for the City of Sartell was evaluated, however, future conveyances will need to take into consideration the entire drainage area to account for capacity and rate control.

5.3 North Mississippi Watershed

Drainage Area: 331 acres

Existing City Owned Ponds: 0

The North Mississippi Watershed is located in the northwest corner of the City and is bounded by Brockway Township on the north, North Trunk Watershed on the west, Central Mississippi Watershed on the south, and the Mississippi River on the east. The Watershed is partially developed with very low density residential areas and is planned to continue to develop as very low density residential area. The topography of the watershed slopes east towards the Mississippi River. North Mississippi Watershed Map is shown in Figure 14.

5.3.1 North Mississippi Watershed Critical Aspects

5.3.1.1 Water Quantity

Areas of future development and redevelopment will be required to manage and treat stormwater before discharging to the Mississippi River. Development not directly adjacent to the Mississippi River will require future trunk storm sewer to convey treated stormwater to the River. This will likely require additional easements and access through already developed property.

5.3.1.2 Water Quality

Existing development within the watershed established before stormwater treatment requirements, therefore the runoff from these areas drain directly to the Mississippi River with no treatment. As areas are redeveloped water quality treatment will need to be provided.

5.4 Northwest Watab Watershed

Drainage Area: 289 acres

Existing City Owned Ponds: 5

The Northwest Watab Watershed is located on the west edge of the City, north of the Watab River. The watershed is bounded by North Central Watab Watershed to the north and east and Watab River to the South. The east half of the watershed is partially developed with residential land use. The west half of the watershed is undeveloped with a planned land use of low density residential. The topography of the watershed generally slopes south towards the Watab River. The Northwest Watab Watershed Map is shown in Figure 15.

5.4.1 Northwest Watab Critical Aspects

5.4.1.1 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas which provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.4.1.2 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas and is adjacent to several large wetlands. These provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

Due to the know drainage concerns within the North Central Watab Watershed, the use of an additional trunk storm sewer system and/or regional ditches from the wetlands to the north through this watershed and into Watab River, could help to provide relieve for the existing system and some of the drainage concerns. The proposed trunk storm sewer (4.3, 4.4) shown on Figure 15 is one possible trunk conveyance route. Further investigation as to the best and most effective route will need to be investigated as the area develops.

5.4.1.3 Stormwater Conveyance within the Watershed

The Watershed is relatively flat, as such the use of a trunk storm sewer system may be expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Drainage ditches can be a cost effective way of convey large amounts of stormwater and help to attenuate flow.

5.5 North Central Watab Watershed

Drainage Area: 1,526 acres

Existing City Owned Ponds: 35

The North Central Watab Watershed is located in the northeast portion of the City. The watershed is bounded by the Bakers Lake and the North Trunk watershed to the north, North Pinecone watershed to the east, North West Watab Watershed and Le Sauk Township to the west and the South Central Watershed to the south. The east half of the North Central Watab Watershed is developed with medium density residential areas and park land. The undeveloped area to the west is planned for low and very low density residential land use. The watershed is drained by County Ditch 13, which runs from Bakers Lake to the Watab River. The topography of the watershed is generally flat, sloping southeast towards County Ditch 13 and Watab River. The watershed is relatively flat with areas of high ground water. Due to the drainage concerns within this watershed, it is recommended to complete a watershed specific drainage analysis to define options to maintain and improve drainage as development continues. The Northwest Watab Watershed Map is shown in Figure 16.

5.5.1 North Central Watab Critical Aspects

5.5.1.1 County Ditch 13

Ditch 13 is a protected DNR public water. The ditch runs through the watershed and is a primary conveyance to the Watab River. During periods of extreme runoff, the ditch system becomes full and causes backwater concerns in the upstream stormwater system. It is recommended that the ditch be kept clean and properly maintained to ensure adequate capacity. As mentioned, a second outlet for Bakers Lake is recommended and should be installed as development occurs to relieve some of the drainage burdened from Ditch 13.

There are two areas along Ditch 13 where the ditch transitions from open channel flow to culvert flow. Two 48-inch RCP culverts are located just north of the intersection of Grizzly Lane and 13th Ave N intersection. A 169-inch span RCP-Arch culvert is located underneath 2 ½ Street North just west of City Hall. Both of these culvert sections are critical to the function of the Ditch 13 system. The Grizzly Lane culverts include a 90-degree bend which has been modified to improve conveyance efficiency and flow through the culverts. It is recommended that the City inspect and maintain these culverts on a regular basis to ensure culvert capacity is maximized.

5.5.1.2 Tail Water Effect

Due to the flat topography of the watershed, high water levels in the Watab River, create a tail water effect, which can greatly impact the capacity and flow within the drainage system. Due to this tail water effect the discharge rates and volumes from proposed development will need to be strictly controlled, likely resulting in larger ponds, use of existing wetland areas, and the use of drainage ditches for conveyance

5.5.1.3 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas which provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.5.1.4 Stormwater Conveyance within the Watershed

Due to the flat nature of the watershed, multiple ditches, including Ditch 13, have been utilized to convey runoff downstream to Watab River. It is critical to the performance of the watershed system that these ditches be inspected and maintained. As mentioned, it is recommended that the City develop a ditch management plan to help define ditch profiles and cross-sections. Drainage ditches can be a cost effective way to convey large amounts of stormwater and should continue to be considered within the watershed as an alternative to storm sewer.

5.5.1.5 Celebration Neighborhood

The Celebration Neighborhood is located in the northwest corner of the currently developed area within the North Central Watab Watershed. There are large wetlands and undeveloped low-land areas to the west and north of the Celebration Neighborhood. This area is inundated with water during and after significant precipitation event. This area is drained through the Celebration Neighborhood storm system before entering Ditch 13 and Watab River. Due to the limited capacity of the downstream system, high water table, flat grades and size of the upstream drainage area, it is recommended that additional analysis be completed for this area to identify alternate options for attenuating and conveying stormwater as the area continues to develop. Potential options could include construction of a large detention pond, creation of a wetland bank, and/or rerouting drainage to the north or south. All options may have design challenges with flat grades, large wetlands, and distances to potential discharge points. All potential options will require further investigation and analysis to determine level of benefit and feasibility.

5.5.1.6 Localized Flooding

The Wilds Development experiences localized flooding adjacent to County Ditch 13 and within the Grizzly Lane roadway. This area was previously studied by the City in 2012 & 2013. Flooding is related to tail water effects within County Ditch 13, upstream of two 48-inch RCP culverts. Previous studies of this area included multiple options to improve drainage within this area. One solution includes a second outlet for Bakers Lake, this option is recommended and should be installed as development occurs to relieve some of the drainage burdened from Ditch 13. Another solution includes making modifications to the 48-inch culverts to improve efficiency, this solution has been completed by the City and has provided some improvement. Additional solutions should be considered as part of the recommended watershed specific drainage analysis.

5.6 North Pinecone Watershed

Drainage Area: 408 acres

Existing City Owned Ponds: 6

The Pinecone Road North Watershed is located in the central part of the City, just north of the Watab River. It is bounded by the Watab River to the south, North Central Watab to the west, North Trunk watershed to the north and Central Mississippi Watershed to the east. The North Pinecone Watershed is fully developed, consisting mostly of residential areas with some school and small commercial properties. Runoff from the watershed drains through a trunk storm sewer system located along Pinecone Road to the Watab River. The topography of the Watershed is generally flat, sloping to the south toward the Watab River. The North Pinecone Watershed Map is shown in Figure 17.

5.6.1 North Pinecone Critical Aspects

5.6.1.1 Localized Flooding

The watershed previously experienced localized street flooding at the intersection of Pinecone Road and 2 ½ Street during large and intense precipitation events and during periods of high water levels in Watab River. The City added a curb cut and drainage swale at the southwest corner of the Pinecone Road and 2 ½ Street intersection. This allows runoff from the road to drain overland into a nearby wetland. According to staff the solution seems to be working well.

5.6.1.2 Trunk Storm Sewer System

The North Pinecone Watershed relies heavily on the trunk storm sewer system to drain the watershed. As the watershed develops, peak discharge rates and runoff volumes will need to be controlled to remain within the trunk storm sewer capacity. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed. Redevelopment within the watershed should also look to reduce the rate of discharge prior to entering the trunk storm sewer system.

5.6.1.3 Water Quality

The watershed was primarily developed prior to water quality standards, as such there is minimal stormwater treatment provided within the watershed. Current treatment includes six ponds and a sediment structure located on the downstream end of the trunk storm sewer system, near Watab River. As areas are redeveloped water quality treatment will need to be provided. Treatment shall provide volume reduction and extended detention to the maximum extent possible, providing water quality treatment and increased rate control into the trunk storm system.

5.7 Central Mississippi Watershed

Drainage Area: 1,005 acres

Existing City Owned Ponds: 1

The Central Mississippi Watershed is located in the central part of the City along the west side of the Mississippi River. The watershed is bounded by the South Mississippi Watershed to south, North Pinecone Watershed to the west, and North Trunk and North Mississippi Watersheds to the north. The Central Mississippi Watershed is fully developed, consisting mostly of residential areas with some school and small commercial/industrial properties. The watershed is drained by several short stretches of trunk storm sewer that discharge directly to the Mississippi River. The topography of the Watershed slopes east toward the Mississippi River. The southwest portion of the watershed is higher in elevation, sloping to the east, where watershed is relatively flat. The Central Mississippi Watershed Map is shown in Figure 18.

5.7.1 Central Mississippi Watershed Critical Aspects

5.7.1.1 Trunk Storm Sewer System

The Central Mississippi Watershed relies on the trunk storm sewer systems to drain the watershed. Redevelopment within the watershed should look to reduce peak discharge rates and runoff volumes. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

5.7.1.2 Water Quality

The watershed was primarily developed prior to water quality standards, as such there is minimal stormwater treatment provided within the watershed. Current treatment includes one pond located in Morningstar Addition. As areas are redeveloped water quality treatment will need to be provided. Treatment shall provide volume reduction and extended detention to the maximum extent possible, providing water quality treatment and increased rate control into the trunk storm system.

5.8 North East Side Watershed

Drainage Area: 408 acres

Existing City Owned Ponds: 0

The North East Side Watershed is located on the north end of the City east of the Mississippi River. The watershed is partially developed and is comprised of very low density residential land use. Topography in the watershed generally slopes west towards the Mississippi River. Runoff is captured in small depressions or drains into the railroad ditch prior to discharging to the Mississippi River. The North East Side Watershed Map is shown in Figure 19.

5.8.1 North East Side Critical Aspects

5.8.1.1 Stormwater Conveyance within the Watershed

The North East Side Watershed relies on existing overland drainage and natural ponding to manage runoff. As the area develops trunk storm sewer and/or ditches will be required to route and direct runoff.

5.8.1.2 Water Quality

As areas within the watershed are developed, stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.9 Central East Side Watershed

Drainage Area: 1,274 acres

Existing City Owned Ponds: 4

The Central East Side Watershed is located in the central part of the city, east of the Mississippi River. The watershed is largely undeveloped with a few residential developments on the west side of the watershed and some office/warehouse development in the south portion of the watershed. The watershed is planned for varying densities of residential land use and office/warehouse land use on the east side of the watershed along Highway 10.

The watershed is drained by a ditches and a ravine that discharge to the Mississippi River. Topography in the watershed is mainly flat but steepens near the ravine and Mississippi River. The Central East Side Watershed Map is shown in Figure 20.

5.9.1 Central East Side Critical Aspects

5.9.1.1 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas which provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.9.1.2 Stormwater Conveyance with the Watershed

The watershed is primarily drained by existing ditches and a ravine which discharge to the Mississippi River. The ravine is steep in areas and could be susceptible to erosion. As the area develops, the rate of runoff and runoff volume should be controlled to limit erosion within ditches and the ravine. Areas with existing erosion or a reasonable risk of erosion should be stabilized.

5.9.1.3 Drainage from Outside of the Study Area

Approximately 1,995 acres of primarily agriculture and wooded land drains into the Central East Side watershed from the east, under Highway 10. For the purposes of this study, only the primary growth area for the City of Sartell was evaluated, however, future conveyances will need to take into consideration the entire drainage area to account for capacity and rate control.

5.9.1.4 Water Quality

As areas within the watershed are developed stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.10 South East Side Watershed

Drainage Area: 408 acres

Existing City Owned Ponds: 5

The South East Side Watershed is located on the south side of the City, east of the Mississippi River. The watershed is primarily developed and is comprised of varying density residential areas, Val Smith Park, and some commercial/industrial properties. Topography in the watershed slopes west toward the Mississippi River. The watershed is mainly flat, but steepens near the Mississippi River. The South East Side Watershed Map is shown in Figure 21.

5.10.1 South East Side Critical Aspects

5.10.1.1 Trunk Storm Sewer System

The South East Side Watershed relies heavily on trunk storm sewer and ditches owned by Benton County to drain the watershed. Development within the watershed will need to control peak discharge rates and runoff volumes to remain within the trunk storm sewer capacity. Redevelopment within the watershed should look to reduce peak discharge rates and runoff volumes. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

5.10.1.2 Ravine Drainage

A portion of the watershed is drained by an existing ravine which discharges into the Benton Drive ditch system and ultimately the Mississippi River. The ravine is steep and is susceptible to erosion. As redevelop occurs, the rate of runoff and runoff volume should be controlled to prevent erosion within the ravine. Additionally, the City should work with Benton County and adjacent property owners to stabilize areas of the ravine with existing erosion or areas with a reasonable risk of erosion.

5.10.1.3 Water Quality

Portions of the watershed are routed to existing storm ponds for treatment, however other areas of the watershed are not treated and drain directly to the Mississippi River. Current treatment includes five ponds. As areas are developed/redeveloped stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.11 Southwest Watab Watershed

Drainage Area: 669 acres

Existing City Owned Ponds: 0

The Southwest Watab Watershed is located on the west side of the City. The watershed is bounded by the Watab River to the north, South Central Watershed to the east, Ditch 16 Watershed to the south and St. Wendel Township on the west. The watershed is undeveloped and is primarily comprised of agricultural fields and farmsteads. Proposed land use within the watershed consists primarily of low density residential with a small amount of limited business at the intersection of County Road 4 and 6th Street. The topography of the watershed is flat sloping generally to the northeast toward the Watab River. The Southwest Watab Watershed Map is shown in Figure 22.

5.11.1 Southwest Watab Watershed Critical Aspects

5.11.1.1 Stormwater Conveyance with the Watershed

The watershed is primarily drained by existing ditches and a small amount of storm sewer along 19th Ave. The watershed is relatively flat and relies on existing overland drainage and natural ponding to manage runoff. As the area develops trunk storm sewer and/or ditches will be required to route and direct runoff. Due to the flat nature of watershed, the use of a trunk storm sewer system may be expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Additionally, existing ditches if utilized for conveyance will need to be located within an easement and will need to be maintained and cleaned with a defined slope and cross-section to establish a design capacity. Drainage ditches can be a cost effective way of convey large amounts of stormwater and help to attenuate flow.

5.11.1.2 Trunk Storm Sewer System

As the Watershed develops, the storm sewer along 19th Avenue should be closely monitored to ensure the capacity is adequate to convey drainage. As the area adjacent to 19th Avenue develops, peak discharge rates and runoff volumes will need to be controlled to maintain capacity within the system. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed. Redevelopment within the watershed should also look to reduce the rate of discharge prior to entering the trunk storm sewer system.

5.11.1.3 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas which provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.12 Ditch 16 Watershed

Drainage Area: 1,831 acres

Existing City Owned Ponds: 17

The Ditch 16 Watershed is location in the southwest part of Sartell. The watershed is bounded by the South Trunk Watershed to the east, Watab River, Southwest Watab Watershed and South Central Watab Watersheds to the north and township to the south. The watershed includes a mix of varying density residential land use and business land use. The topography of the watershed is generally flat, sloping from the southwest to the northeast, toward the Watab River. The Ditch 16 Watershed Map is shown in Figure 23.

5.12.1 Ditch 16 Watershed Critical Aspects

5.12.1.1 Ditch 16

Ditch 16 was originally constructed by Stearns County to drain agricultural fields. The operation and maintenance of Ditch 16 has since been turned over to the City. The Ditch runs through the watershed and discharges directly to the Watab River. The ditch is a primary conveyance that takes runoff from multiple other ditches, ponds and storm sewer. During periods of extreme runoff, the ditch system becomes full and can causes backwater concerns in the upstream stormwater system. It is recommended that the ditch be kept clean and properly maintained to ensure adequate capacity.

5.12.1.2 Donavon Lake – Day Break Development

Donavon Lake is a pond located in the southwest portion of the Ditch 16 Watershed. This pond is the discharge point for the surrounding neighborhood stormwater treatment ponds. Due to its large size, this pond could impact the surrounding water levels if not managed properly. It is recommended that the City inspect and maintain the Donavon Lake pond outlet to ensure proper function.

5.12.1.3 Wetlands and Low Land within the Watershed

The watershed is comprised of several large wetland areas that provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.12.1.4 Tail Water Effect

Due to the flat nature of the watershed, high water levels in the Watab River, create a tail water effect, which can greatly impact the capacity and flow within the drainage system. Due to this tail water effect the discharge rates and volumes from proposed development will need to be strictly controlled, likely resulting in larger ponds, use of existing wetland areas, and the use of drainage ditches for conveyance.

5.12.1.5 Stormwater Conveyance within the Watershed

The Watershed is relatively flat making the use of a trunk storm sewer systems expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Drainage ditches can be a cost effective way of convey large amounts of stormwater and help to attenuate flow.

5.13 South Central Watab Watershed

Drainage Area: 310 acres

Existing City Owned Ponds: 5

The South Central Watab Watershed is located just to the west of Pinecone Road and north of 6th Street S. The watershed is bounded by the Southwest Watab Watershed to the west, Ditch 16 Watershed to the south and east, and Watab River to the north. The watershed is partially developed and is comprised of residential, business and city park land use. The topography of the watershed generally slopes from the south to the north towards the Watab River. The South Central Watab Watershed Map is shown in Figure 24.

5.13.1 South Central Watab Watershed Critical Aspects

5.13.1.1 Wetlands and Low Land within the Watershed

The northwest corner of the watershed is predominantly wetlands that provide significant natural storage. As development occurs, the wetlands should be protected and restored to the maximum extent practical to retain stormwater after it has been treated. Maintaining and restoring the wetlands will help to provide flood control and will have downstream water quality benefits.

5.13.1.2 Water Quality

As areas within the watershed are developed stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.14 South Mississippi Watershed

Drainage Area: 185 acres

Existing City Owned Ponds: 1

The South Mississippi Watershed is located in the south central part of the City. The watershed is bounded by the Watab River on the north, Ditch 16 Watershed to the west, Ditch 50 Watershed on the south and the Mississippi River to the east. The watershed is primarily developed with business areas and varying density residential areas. The topography of the watershed slopes east towards the Mississippi River. The South Mississippi Watershed Map is shown in Figure 25.

5.14.1 South Mississippi Watershed Critical Aspects

5.14.1.1 Trunk Storm Sewer System

The South Mississippi Watershed relies on the trunk storm sewer systems to drain the watershed. Redevelopment within the watershed should look to reduce peak discharge rates and runoff volumes. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

5.14.1.2 Water Quality

The watershed was mostly developed prior to water quality standards, as such there are is minimal treatment provided within the watershed. Current treatment includes one pond. As areas are developed/redeveloped, stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.15 Ditch 50 Watershed

Drainage Area: 329 acres

Existing City Owned Ponds: 2

The Ditch 50 Watershed is located in the south central part of the City. The watershed is bounded by the South Trunk Watershed to the south, Ditch 16 Watersheds to the west, the South Mississippi Watershed to the north and Mississippi River on the east. Most of the watershed is undeveloped with a small residential development (Bridgeport Development) located in the southeast corner of the watershed. Planned future land use consists primary of mixed density residential land use and a small area of warehouse land use located in the in northwest corner of the watershed. Topography in the watershed generally slopes east toward County Road 1 and the Mississippi River. The Ditch 50 Watershed Map is shown in Figure 26.

5.15.1 Ditch 50 Watershed Special Issues

5.15.1.1 Ditch 50 System Trunk Storm Sewer

The City of Sartell took over as ditch authority for County Ditch 50 (Ditch 50) on July 12, 2016. Ditch 50 consisted of a single wall, 15-inch perforated and solid wall pipe. Due to the age, condition, and performance of the existing pipe, the City completed a 2018 Ditch 50 Improvement Project. The project replaces the existing pipe with a 24-inch RCP. A portion of the Ditch/Pipe is relocated within the Bridgeport Development. The City will need to complete regular inspections and maintenance to ensure the system continues to function as designed.

5.15.1.2 Stormwater Conveyance within the Watershed

As the watershed develops, peak discharge rates and runoff volumes will need to be controlled. Future trunk conveyances will likely include an additional outlet to the Mississippi River. The Watershed is relatively flat, as such the use of a trunk storm sewer system may be expensive and potentially infeasible. Ditches should be considered as an alternative to trunk storm sewer. Drainage ditches can be a cost effective way of convey large amounts of stormwater and help to attenuate flow.

5.15.1.3 Water Quality

Current treatment within the watershed includes two ponds, one for the Bridgeport Development and one for the north end of 4th Avenue South. As areas within the watershed are developed stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.16 South Trunk Watershed

Drainage Area: 1,456 acres

Existing City Owned Ponds: 27

The South Trunk Watershed is located on the south end of the City. The watershed is bounded by the Ditch 16 Watershed to the west, Ditch 50 Watershed to the north, County Road 120 to the south and the Mississippi River to the east. The watershed is partially developed and is planned for a wide range of land uses including mixed density residential, town square area, businesses, and medical. The topography of the watershed is relatively flat, generally sloping east toward the Mississippi River. The South Trunk Watershed Map is shown in Figure 21.

5.16.1 South Trunk Watershed Special Issues

5.16.1.1 Pinecone Trunk Storm Sewer System

The west portion of the watershed is drained by a trunk storm sewer located within Pinecone Road. This trunk system outlets to a stormwater pond, known as Lake Francis. As the watershed develops, peak discharge rates and runoff volumes will need to be controlled to remain within the trunk storm sewer capacity. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

5.16.1.2 Trunk Storm Sewer System

The South Trunk Watershed relies entirely on a trunk storm sewer system to drain the watershed. The trunk system starts as the outlet to the Lake Francis pond and discharges to the Mississippi River on the east side of the watershed, near the Bridge of Hope. The trunk system is made up of a range of pipe sizes and material from 48-inch to 72-inch pipe of either HDPE or RCP material. As the watershed develops, peak discharge rates and runoff volumes will need to be controlled to remain within the trunk storm sewer capacity. Excess runoff above the trunk system capacity could result in the inundation of the storm sewer and cause flooding within the watershed.

The proper function and available capacity is essential for this trunk conveyance. It is recommended that the trunk storm sewer system be inspected on a regular basis. It is recommended that the HDPE portions of the trunk system be inspected to verify pipe integrity and performance.

5.16.1.3 Water Quality

As areas within the watershed are developed stormwater management will need to be provided. Stormwater management shall provide volume reduction and extended detention to provide water quality treatment and rate control.

5.16.1.4 Well Drained Soils

The Watershed has primarily well drained soils, minus some areas where high ground water elevations exists. Well drained soils allow for the use of infiltration to manage stormwater. Infiltration should be required and utilized as much as possible to reduce runoff rates and runoff volumes.

5.16.1.5 Ditches

The South Trunk Watershed has two existing ditches, one just south of Huntington Drive through a wetland and one along 23rd Street S. It is recommended that the ditches be kept clean and properly maintained to ensure adequate capacity.

5.17 Major Watershed Summary

Table 7 – Major Watershed Summary

Major Watershed	Total Drainage Area (Acres)	Existing Developed Area[1] (Acres)	Low Land Area[2] (Acres)	Right of Way[3] (Acres)	Total Potential Developable Area[4] (Acres)
Bakers Lake*	1,498	111	443	225	719
North Trunk*	2,032	488	81	305	1,159
North Mississippi	331	87	0	50	194
Northwest Watab	289	107	80	43	58
North Central Watab	1,526	485	404	229	408
**North Pinecone	408	322	25	61	0
**Central Mississippi	1,005	843	11	151	0
North East Side	408	66	12	61	269
Central East Side*	1,274	149	176	191	757
**South East Side	408	264	5	61	78
Southwest Watab	669	0	45	100	523
Ditch 16	1,831	300	240	275	1,017
South Central Watab	310	78	70	47	115
**South Mississippi	185	133	0	28	24
Ditch 50	329	60	13	49	207
South Trunk	1,456	446	89	218	702
TOTAL	**13,959**	**3,939**	**1,697**	**2,094**	**6,230**

*Watershed total drainage area only includes acres from within the study area.

** Not a priority future development watershed.

[1] Existing developed area delineated from aerial photography, City parcel data, and as-built documents.

[2] Low land area includes existing ponds and NWI wetlands.

[3] Assumed to be 15% of total area.

[4] Total Potential Developable Area = Total Drainage Area – (Already Developed Area + Low Land Area + ROW)

6 Stormwater Management Financing

There are several methods of financing surface water management. To help guide the City in determining what financing method is most appropriate for the different aspects of stormwater management, a summary of the most common methods is provided below.

6.1 General Taxation

General taxation is the most common revenue source used to finance government services including minor maintenance measures for drainage and water quality facilities. Using property tax has the effect of spreading the cost over the entire tax base of a community.

6.2 Storm Water Utility

Minnesota Statues, Chapter 444 allows for the creation of a Storm Water utility. A Stormwater Utility (SWU) is a service charge or fee applied to existing properties within the City. The City of Sartell initiated its Storm Water Utility (SWU) in 2004. Properties are billed every second month based on their land use and impervious surface. The revenues collected are dedicated to managing the surface water system. The SWU fees and funds should be evaluated on an annual basis to assure adequate funding is in place to meet the City's needs. Storm Water Utilities can fund any aspect of surface water management, including but not limited to:

1. Administration, planning, and engineering for stormwater management.
2. MS4 Permit compliance
3. Education, monitoring, testing, compliance and enforcement for the stormwater management.
4. Inspection, operation and maintenance of the stormwater system.
5. Street sweeping
6. Pond maintenance
7. Construction, installation and replacement of stormwater the stormwater system.

6.3 Special Assessments

Minnesota Statutes, Chapter 429 gives the authority to assess for public improvements. All or a portion of the cost of an improvement are levied against properties benefited by the improvement. An assessment can be levied to acquire, develop, construct, reconstruct, extend, and maintain storm sewers and storm sewer systems.

Special Assessments are often used within The City of Sartell to help finance storm sewer, stormwater management systems for City reconstruction projects.

6.4 Grants

Grants are available for surface water management and nonpoint source pollution through a number of federal and state programs. This source of revenue is not dependable and requires constant speculation as to its availability. Grants are useful but should only be used to supplement a planned local revenue source.

6.5 Area or Development Charges

As land develops, surface water runoff and pollution loading increases. Area charges are development fees on an area (cost per acre) basis. These charges are used to ensure that new development pays for facilities required to serve it. Administrative and capital costs for trunk systems can be recovered at the time of building permit issuance or land development approval.

The challenge in utilizing development charges comes with developing an adequate policy foundation and determining the proportionate share of costs to be borne by new development. The area charge is typically based on land use types. Land use with densities greater than single-family residential have higher rates. The higher rate is justified because land uses with larger percentages of impervious surfaces produce a larger volume of runoff and require a higher level of rate control and larger trunk storm sewer system.

Planning becomes extremely important both from a land use and a surface water management perspective. One of the main objectives of this plan is to estimate the total cost of future trunk conveyances and propose a storm sewer trunk rates.

6.5.1 Trunk Rate Calculation

This section presents a preliminary estimate of future trunk system costs based on the best available information. It is important to note that the costs are preliminary planning level cost and are designed for long- term budget planning purposes. The costs presented are not based on detailed reports (such as a feasibility study) Feasibility-level technical assessments and cost estimates will be completed for individual improvements as development occurs or as requested by the city. Trunk conveyance and cost information is available in Appendix E.

The first generation plan included regional stormwater pond costs within the trunk rate calculation. With current stormwater regulations, stormwater management is typically more cost effective if provided on a site by site or development by development basis. The cost for stormwater treatment facilities and stormwater laterals is assumed to be part of the development costs and, therefore, have not been included as part of the trunk rate calculation. Development driven storm sewer systems are also assumed to be included with the development cost and is not included in the trunk rate cost estimates.

Trunk rates are to be based on the costs of trunk conveyances needed to provide connections between development treatment facilities and public waters, wetlands, rivers and lakes. Trunk conveyances should be constructed as develop occurs or when facing imminent development pressure. Table 8 below scales the acres of higher density land uses (commercial, industrial, etc.) to reflect a number of equivalent single family residential acres by the ratio of their 10-year runoff coefficient values. Table 8 lists each Major Watershed total acres, total equivalent single family residential acres, and estimated future trunk conveyance costs. Table 9 shows land use coefficient values recommended for use in determining the trunk sewer rates.

Table 8 – Trunk Area Summary

Major Watershed	Total Drainage Area (Acres)	Total Potential Developable Area[1] (Acres)	Equivalent Developable Area[2] (acres)	Estimated Future Trunk System Costs[3]
Bakers Lake*	1,498	719	719	$3,507,000
North Trunk*	2,032	1159	1174	$5,853,000
North Mississippi	331	194	194	$728,000
Northwest Watab	289	58	58	$2,529,000
North Central Watab	1,526	408	439	$1,091,000
**North Pinecone	408	0	-	-
**Central Mississippi	1,005	0	-	-
North East Side	408	269	269	$1,171,000
Central East Side*	1,274	757	956	$262,000
**South East Side	408	78	-	-
Southwest Watab	669	523	550	$5,382,000
Ditch 16	1,831	1017	1100	$2,310,000
South Central Watab	310	115	141	$547,000
**South Mississippi	185	24	-	-
Ditch 50	329	207	237	$2,406,000
South Trunk	1,456	702	1210	$1,793,000
Total City	**13,959**	**6230**	**7047**	**$27,579,000**

*Watershed not including drainage from outside of the study area

** Not a priority future development watershed.

[1] Total Developable Area = Total Area – (Already Developed Area + Low Land Area + ROW)

[2] All land use areas pro-rated to equivalent single family acres based on C value

[3] System Cost are rounded up to the $1,000

Table 9 – Land Use Coefficient for Establishing Trunk Storm Sewer Rates

Land Use	Runoff Coefficient
Single Family	0.3
Multi Family	0.4
Commercial/Industrial	0.6

7 Summary and Recommendations

7.1 Summary

This surface water management plan analyzed the existing stormwater system and potential future system both within the City limits as well as the primary growth areas. Proper surface/storm water management is essential to protect the environmental and quality of life within the City of Sartell. Surface and storm water management includes the planning, design, construction, inspection and maintenance of stormwater systems. The City will need to closely manage their resources and funds to maintain the City's economic well-being while properly manage their stormwater system and program, now and into the future.

7.2 Recommendations

Table 10 below, lists recommendations to maintain a successful surface/stormwater management system.

Table 10 – Trunk Area Summary

Major Watershed	Recommendation	Description	Recommended Schedule	Estimated Cost
All	NPDES MS4 Permit Compliance	Meet the standards and requirements outlined within the City's NPDES MS4 permit program.	Ongoing	NA
All	Conveyance System Inspection & Maintenance	Complete system inspection and maintenance in accordance with the City's MS4 permit requirements.	Annually	NA
South Trunk	Inspection of South Trunk Storm Sewer	Complete an inspection of the HDPE portions of the trunk storm sewer system to verify pipe integrity and performance.	Within Next 1-2 Years (2019-2020)	$20,000
All	Ditch Management Plan	Complete a ditch plan to evaluate the condition of each critical ditch within the City. The plan would establish a standard profile and cross-section, and outline an inspection and maintenance schedule for each critical ditch.	Within Next 1-2 Years (2019-2020)	$35,000
North Central Watab	North Central Watab / Celebration Area Drainage Study	Complete additional analysis be completed for the Celebration Neighborhood and North Central Watab Watershed to identify alternate options for improving stormwater conveyance. Potential options could include construction of a large detention pond, creation of a wetland bank, and/or rerouting drainage to the north or south.	Within Next 3-4 Years (2021-2022)	$40,000
All	Pond Sediment Evaluation & Testing	A site evaluation of the sediment depth and sediment testing should be completed for 5-10 ponds. Ponds should be chosen based on the pond prioritization assessment tool (developed with this report).	Odd Years Starting 2019 (Funding is Available)	$20,000
All	Pond Dredging (Sediment Removal)	Complete the engineering, contracting, work plan, and sediment removal for 1-2 ponds. Ponds should be chosen based on the sediment evaluation & testing completed the year previously.	Even Years Starting 2020 (as Funding is Available)	$200,000

Major Watershed	Recommendation	Description	Recommended Schedule	Estimated Cost
Bakers Lake	New (second) Outlet From Bakers Lake	Construct a second trunk storm sewer outlet for Bakers Lake. The trunk storm sewer (Fig 12: 102,102,103) drains to the east into the existing 60-inch trunk storm sewer located in the North Trunk Major Watershed and discharges into the Mississippi River.	As Development Occurs	$2,053,000
North Central Watab	Clean & Maintain Ditch 13	As development occurs, require the needed maintenance and cleaning of Ditch 13 to ensure adequate capacity.	Based on Ditch Management Plan and/or As Development Occurs	$120,000
All	Ditch Maintenance	Maintain critical ditches to ensure adequate capacity.	Based on Ditch Management Plan & Inspections	$844,000
All	Future Trunk Conveyance	Construct future trunk stormwater conveyances (sewer & ditches) to allow for future development.	As Development Occurs	$27,579,000

7.3 Implementation Actions over Next 3 Years

7.3.1 2019

- NPDES MS4 Permit Compliance
- Conveyance System Inspection & Maintenance
- Pond Sediment Evaluation & Testing
- Ditch Management Plan
- Inspection of South Trunk Storm Sewer

7.3.2 2020

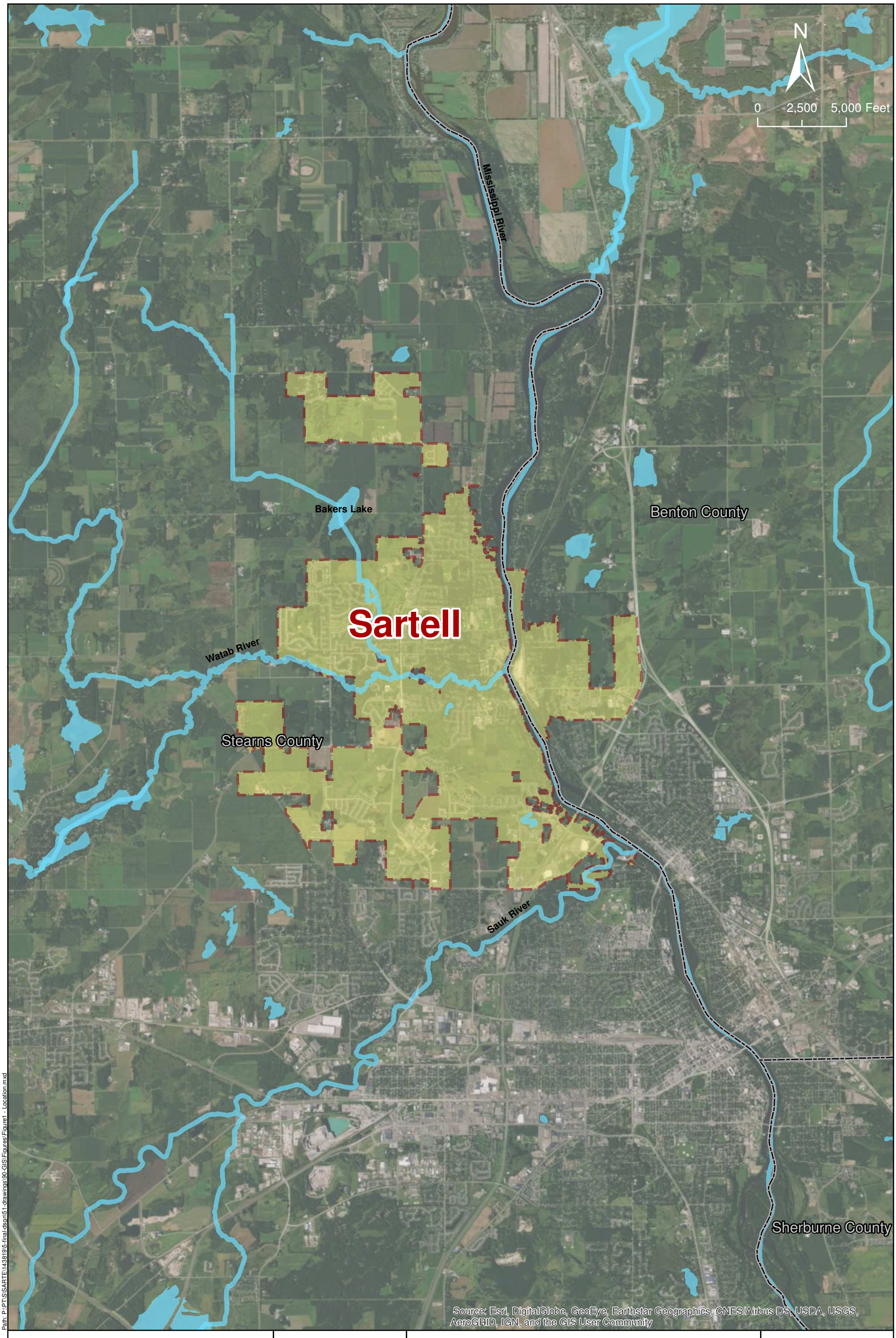
- NPDES MS4 Permit Compliance
- Conveyance System Inspection & Maintenance
- Pond Dredging (Sediment Removal)

7.3.3 2021

- NPDES MS4 Permit Compliance
- Conveyance System Inspection & Maintenance
- Pond Sediment Evaluation & Testing
- North Central Watab / Celebration Area Drainage Study

.

Figures



Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure1 - Location.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

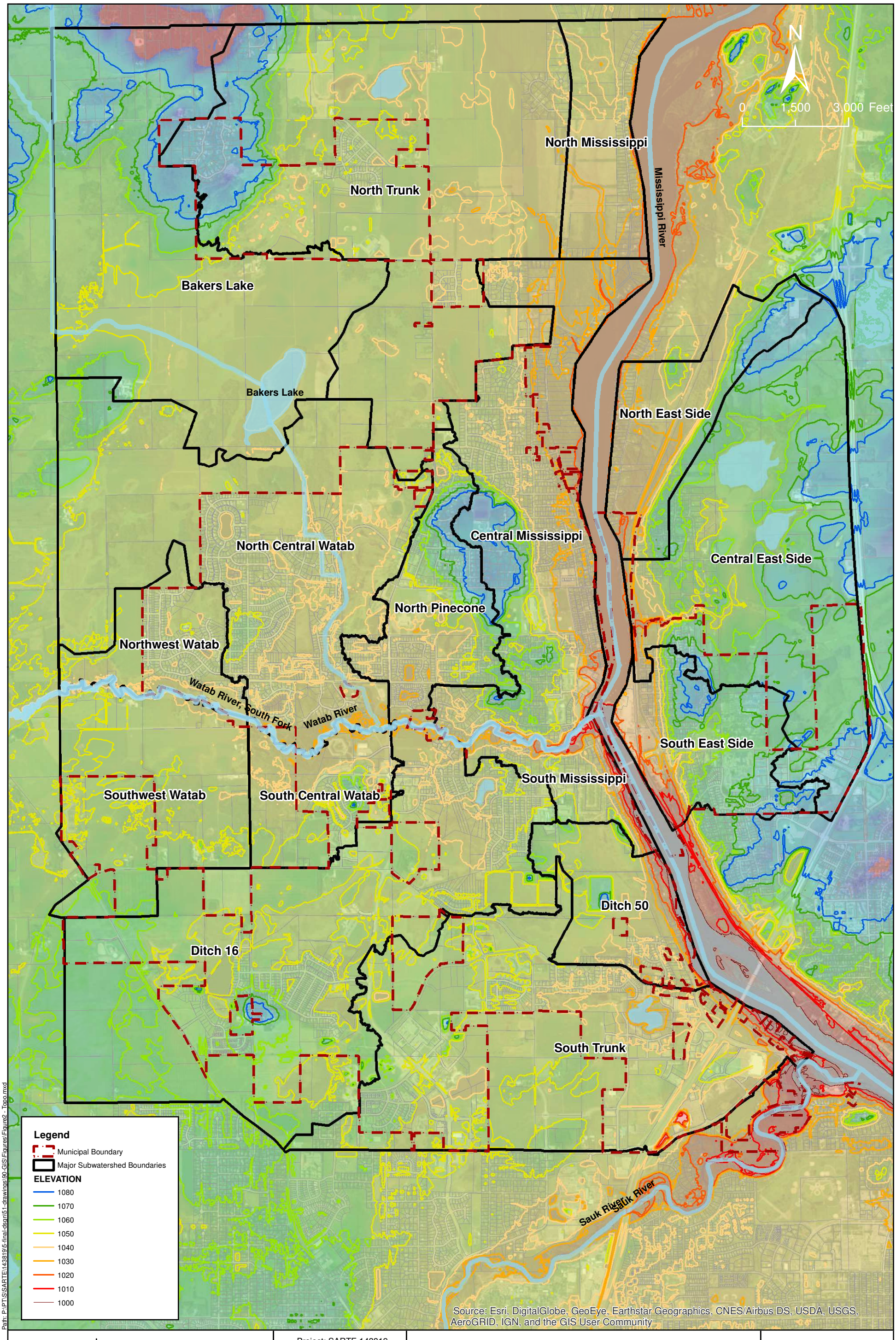
Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Location

City of Sartell Surface Water Management Plan

Figure 1



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure2 - Topo.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

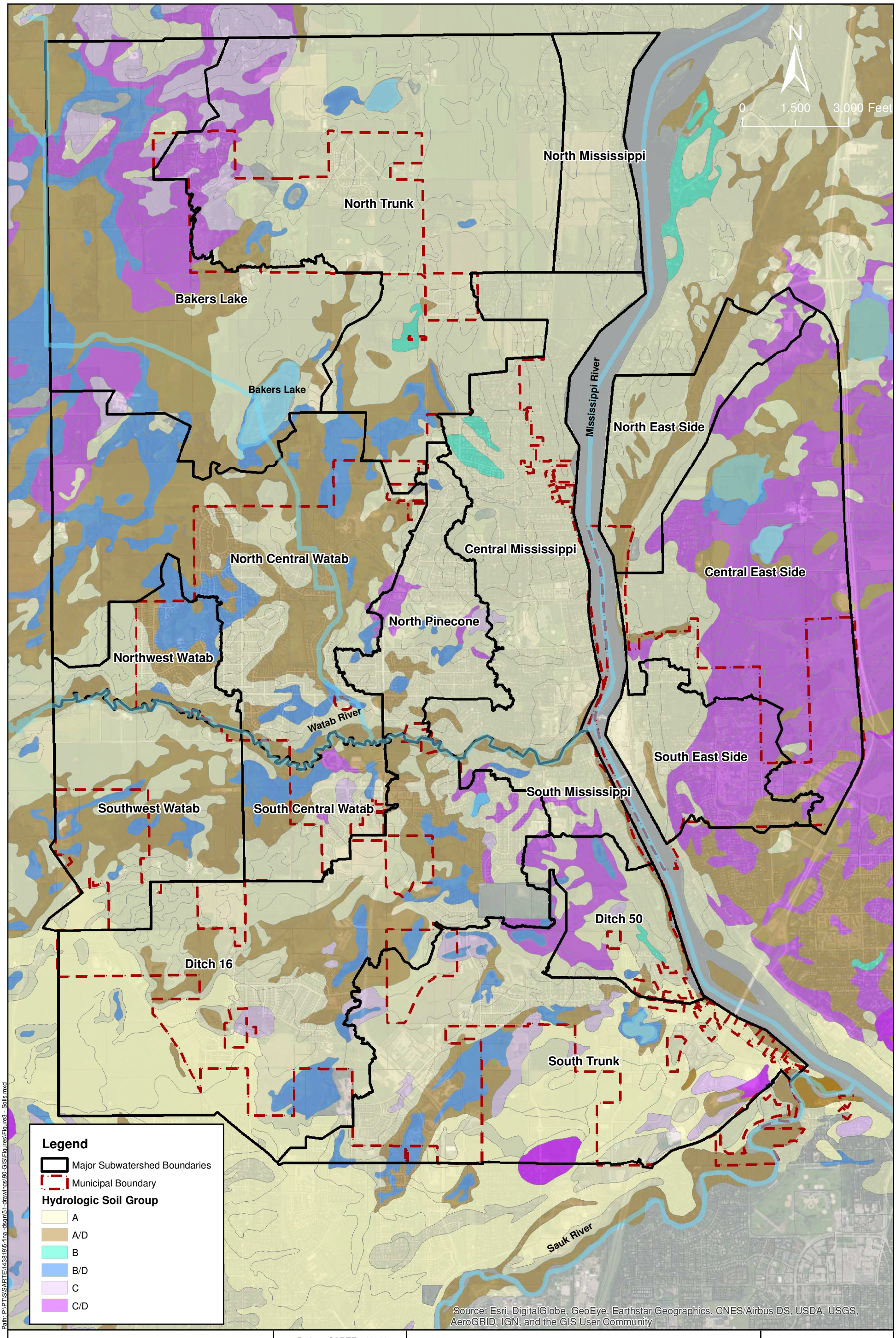
Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Topography

City of Sartell Surface
Water Management Plan

Figure
2



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure3 - Soils.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

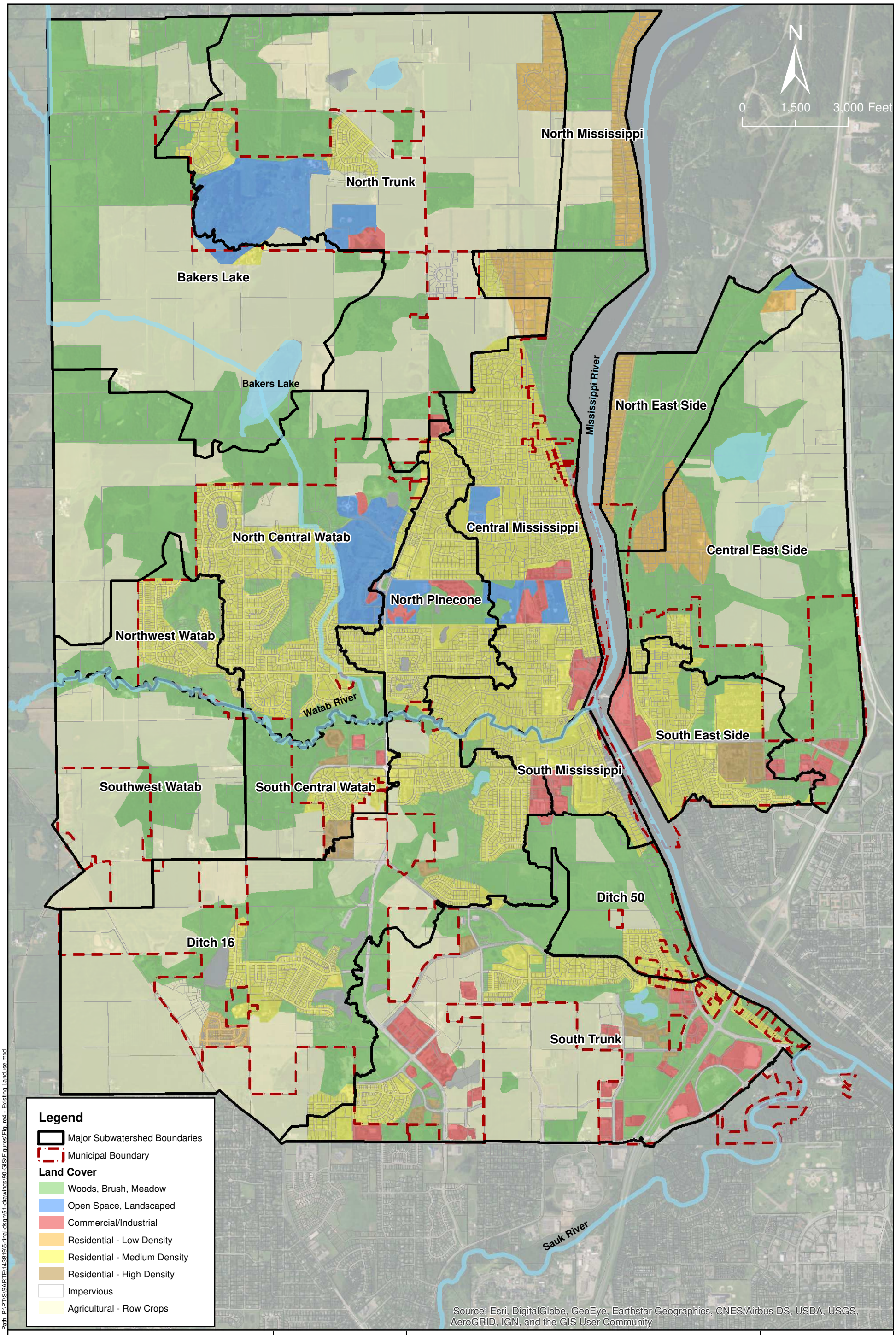
Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Hydrologic Soil Group

City of Sartell Surface Water Management Plan

Figure 3



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure4 - Existing Landuse.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Existing Land Cover

City of Sartell Surface
Water Management Plan

Figure
4

N

0 1,500 3,000 Feet

North Mississippi

North Trunk

Bakers Lake

Bakers Lake

Mississippi River

North East Side

North Central Watab

Central Mississippi

Central East Side

North Pinecone

Northwest Watab

Watab River

South East Side

South Mississippi

Southwest Watab

South Central Watab

Ditch 50

Ditch 16

South Trunk

Sauk River

Legend

- Major Subwatershed Boundaries
- Municipal Boundary

Proposed Land Use

- Very Low Density Residential (VLDR)
- Low Density Residential (LDR)
- Medium Density Residential (MDR)
- High Density Residential (HDR)
- Limited Business (LB)
- General Business (GB)
- Town Square (TS)
- Medical Professional Mix (HP)
- Office_Warehouse (OI)
- Industrial (I)
- Park
- Public (PUB)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure5 - Proposed Landuse.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Future Land Use
City of Sartell Surface
Water Management Plan

Figure
5

N

0 1,500 3,000 Feet

North Mississippi

North Trunk

Bakers Lake

Bakers Lake

Mississippi River

North East Side

North Central Watab

Central Mississippi

Central East Side

North Pinecone

Northwest Watab

Watab River

South East Side

South Mississippi

Southwest Watab

South Central Watab

Ditch 50

Ditch 16

South Trunk

Sauk River

Legend

Municipal Boundary

Major Subwatershed Boundaries

Public Waters

Biodiversity Significance

MCBS site below minimum biodiversity significance threshold

MCBS site with moderate biodiversity significance

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure6 - ESA.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

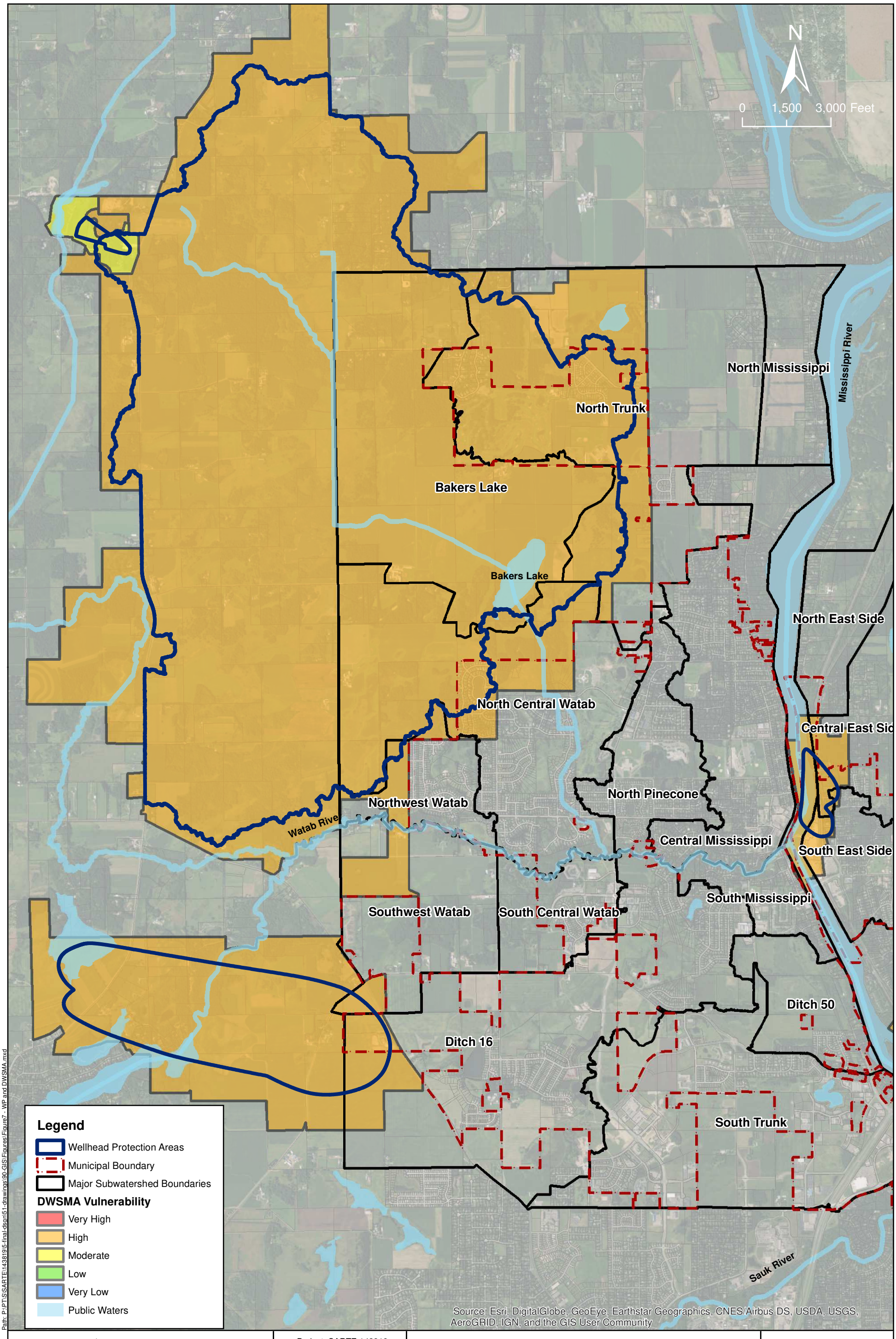
Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Environmentally Sensitive Areas

City of Sartell Surface
Water Management Plan

Figure
6



Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure7 - WP and DWSMA.mxd

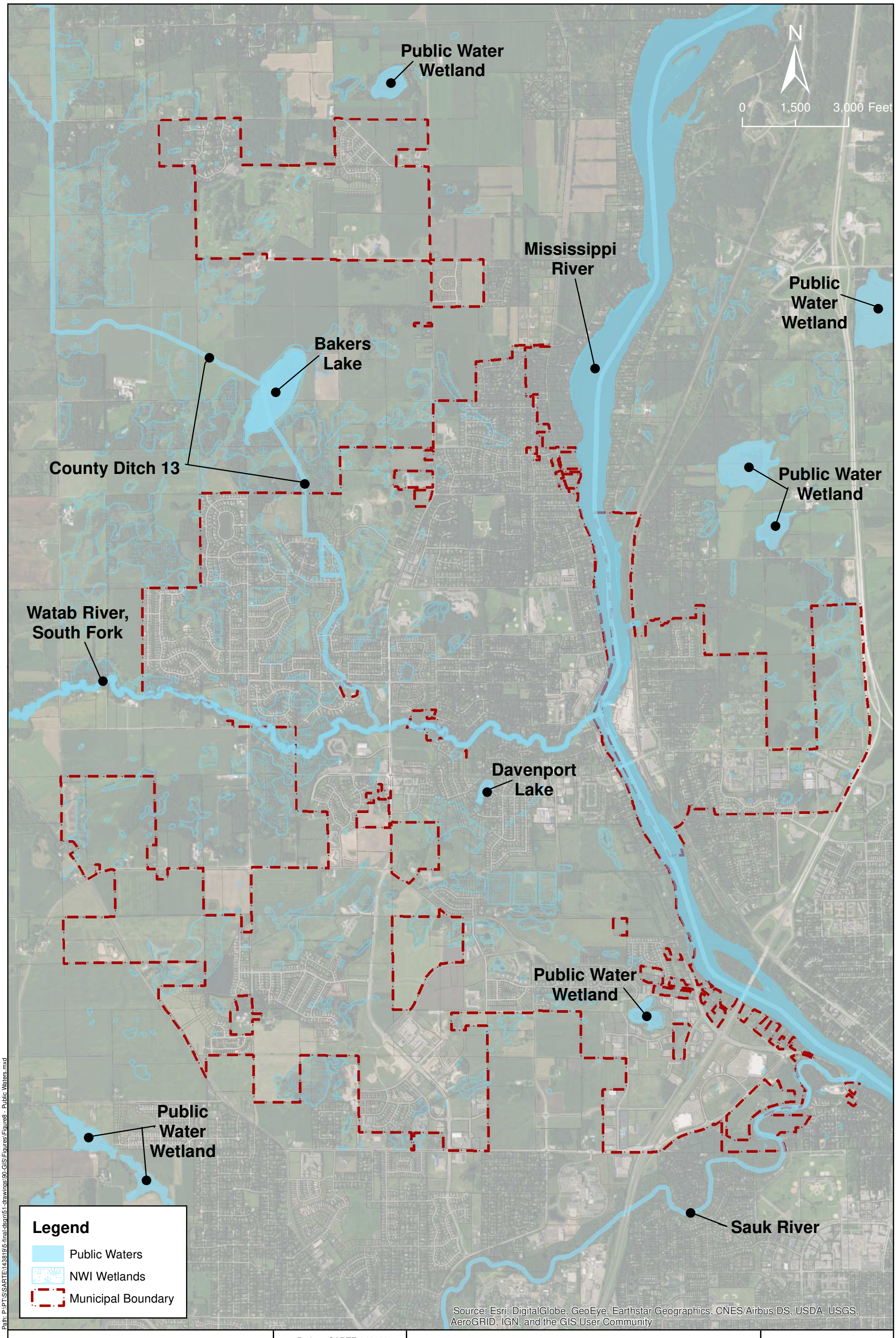
SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/18/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Wellhead Protection and DWSMA
City of Sartell Surface Water Management Plan

Figure 7



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure8 - Public Waters.mxd

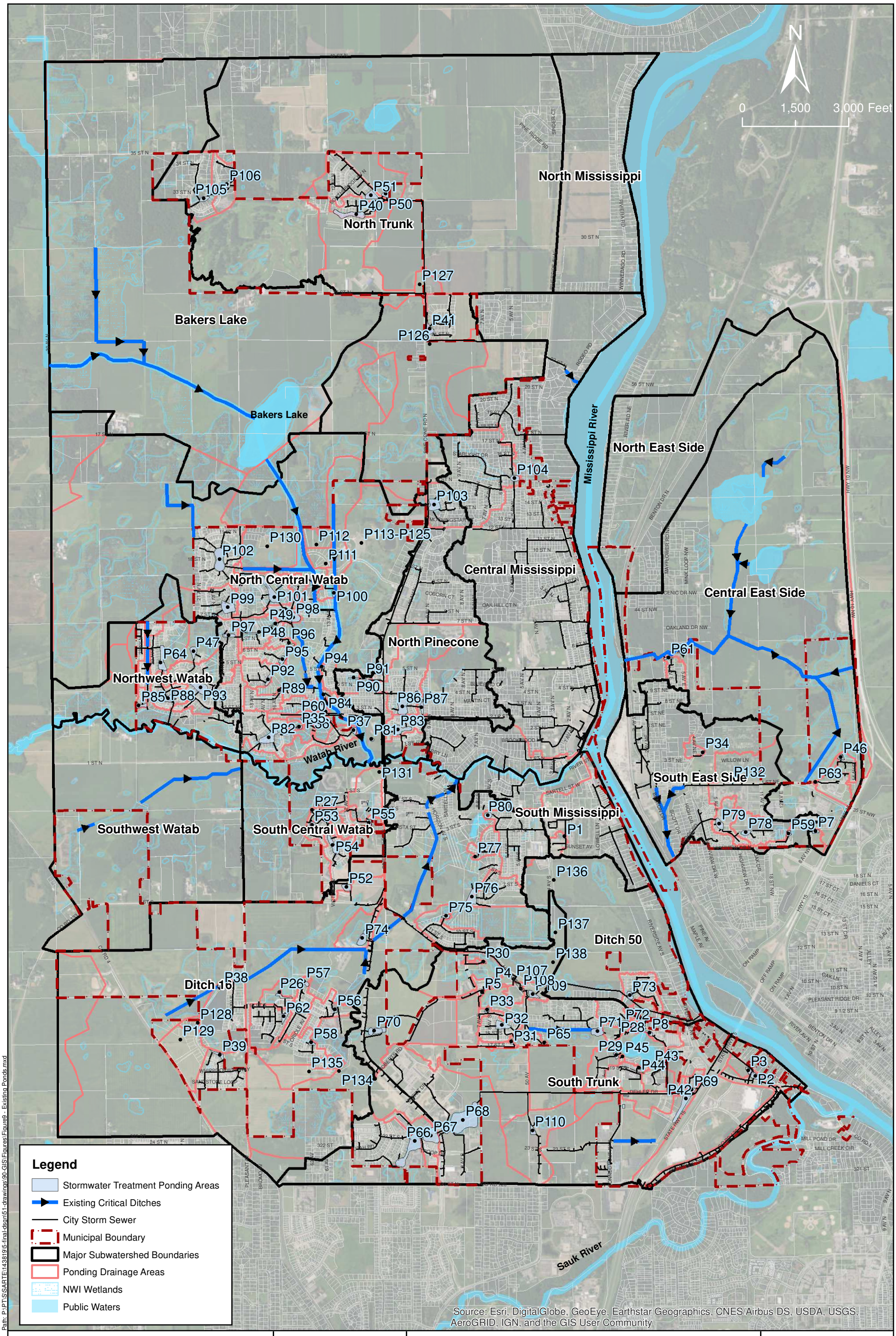
SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Public Waters
City of Sartell Surface Water Management Plan

Figure 8



Path: P:\PT\S\SARTE\143819\5-final-dsn\51-drawings\90-GIS\Figures\Figure9 - Existing Ponds.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

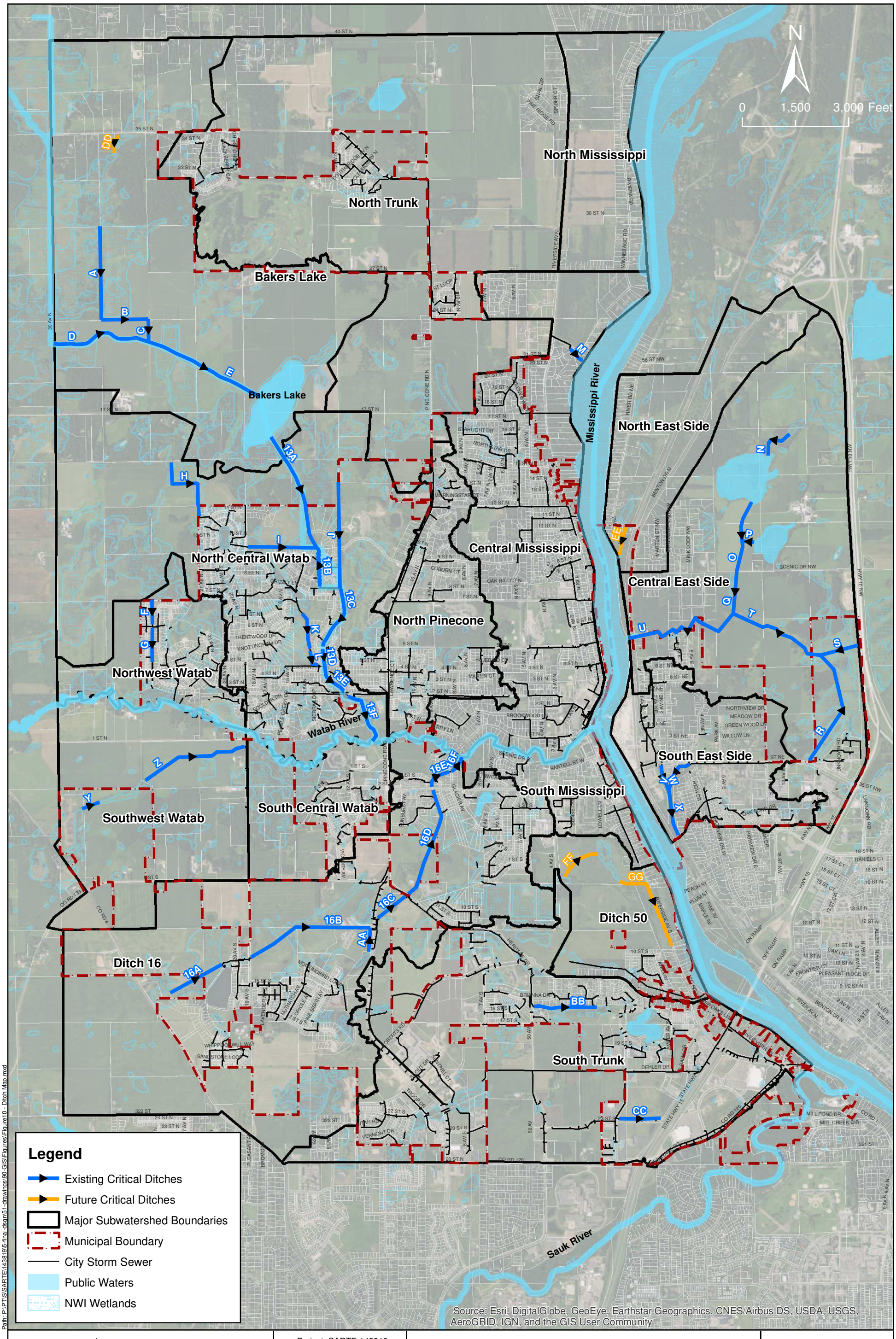
Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Stormwater Treatment Ponds

City of Sartell Surface Water Management Plan

Figure 9



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure10 - Ditch Map.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Critical Ditch Map
City of Sartell Surface Water Management Plan

Figure 10

N

0 1,500 3,000 Feet

North Mississippi

North Trunk

Bakers Lake

Bakers Lake

Mississippi River

North East Side

North Central Watab

Central Mississippi

Central East Side

North Pinecone

Northwest Watab

Watab River

South East Side

South Mississippi

Southwest Watab

South Central Watab

Ditch 50

Ditch 16

South Trunk

Sauk River

Legend

- Municipal Boundary
- Major Subwatershed Boundaries
- Public Waters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Figures\Figure11 - Major Subs.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Major Watersheds

City of Sartell Surface Water Management Plan

Figure 11

N

0 500 1,000 Feet

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Existing Trunk Storm Sewer
- Future Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Developed Area
- Public Waters
- NWI Wetlands
- Parcels

BL1 BL2 BL3 BL4 BL5 BL6 BL7 BL8 BL9 BL10 BL11 BL12 BL13 BL14 BL15 BL16 BL17 BL18 BL19 BL20 BL21

7.1 DD 1.1 1.2 1.3 1.4 1.5 5.1 2.3

A B C D E H J

101 102 103

P105 P106 P50 P112 P113-P125

Bakers Lake

MAJESTIC POND DR

33 ST N 34 ST N 17 ST N

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\BakersLake.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Bakers Lake Watershed

City of Sartell Surface
Water Management Plan

Figure
12

N

0 750 1,500 Feet

NT1 NT2 NT3 NT4 NT5 NT6 NT7 NT8 NT9 NT10 NT11 NT12 NT13 NT14 NT15 NT16 NT17 NT18 NT19

2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10

1.1 1.2 1.3 1.4

101 102 103

P40 P41 P50 P51 P100 P103 P104 P105 P106 P111 P112 P113-P125 P126 P127

A B D E F J M

13B 13C

Bakers Lake

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Existing Trunk Storm Sewer
- Future Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Developed Area
- Public Waters
- NWI Wetlands
- Parcels

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\NorthTrunk_mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

North Trunk Watershed

City of Sartell Surface
Water Management Plan

Figure
13

N

0 250 500 Feet

NM1

3.1

NM2

3.2

NM3

2.9

2.10

PINE RIDGE RD

SNAIL DR

SPIDER CT

RIVER RD

Mississippi River

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Future Trunk Storm Sewer
- Existing Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Developed Area
- Public Waters
- NWI Wetlands
- Parcels

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\NorthMississippi.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

North Mississippi Watershed

City of Sartell Surface
Water Management Plan

Figure
14

N

0 400 800 Feet

5.1

H

I

P102

P99

P48

P97

4.3

F

NWW1

P47

P64

G

4.1

4.4

NWW2

NWW3

P85

P88

P93

4.2

Watab River

11.9

11.8

11.3

11.4

11.7

Z

11.6

11.2

11.5

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Existing Trunk Storm Sewer
- Future Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Developed Area
- Public Waters
- NWI Wetlands
- Parcels

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\NorthWestWatab.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

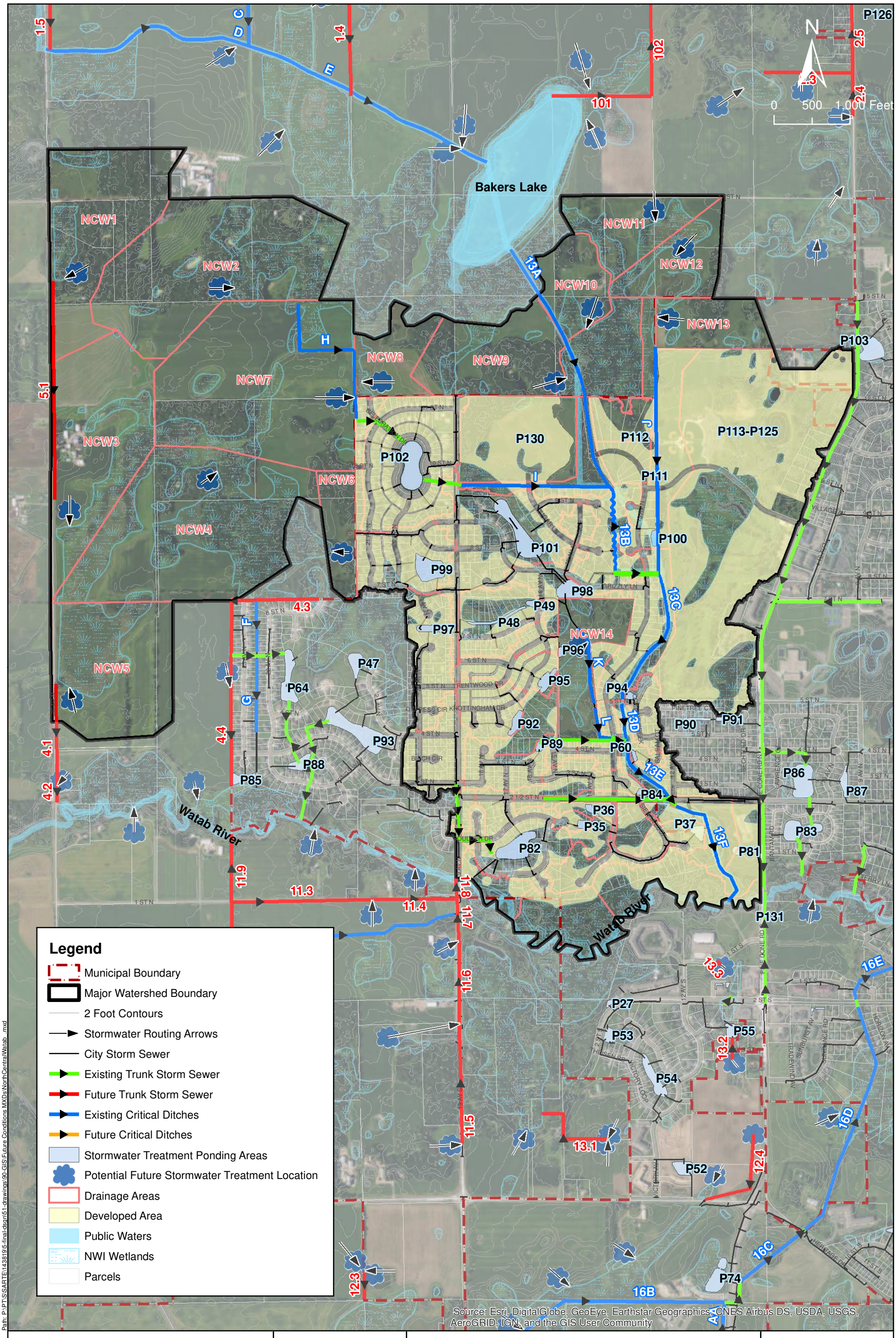
Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Northwest Watab Watershed

City of Sartell Surface
Water Management Plan

Figure
15



Path: P:\PT\S\SARTE\143819\5-final-dsn\51-drawings\90-GIS\Future Conditions MXDs\NorthCentralWatab_mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

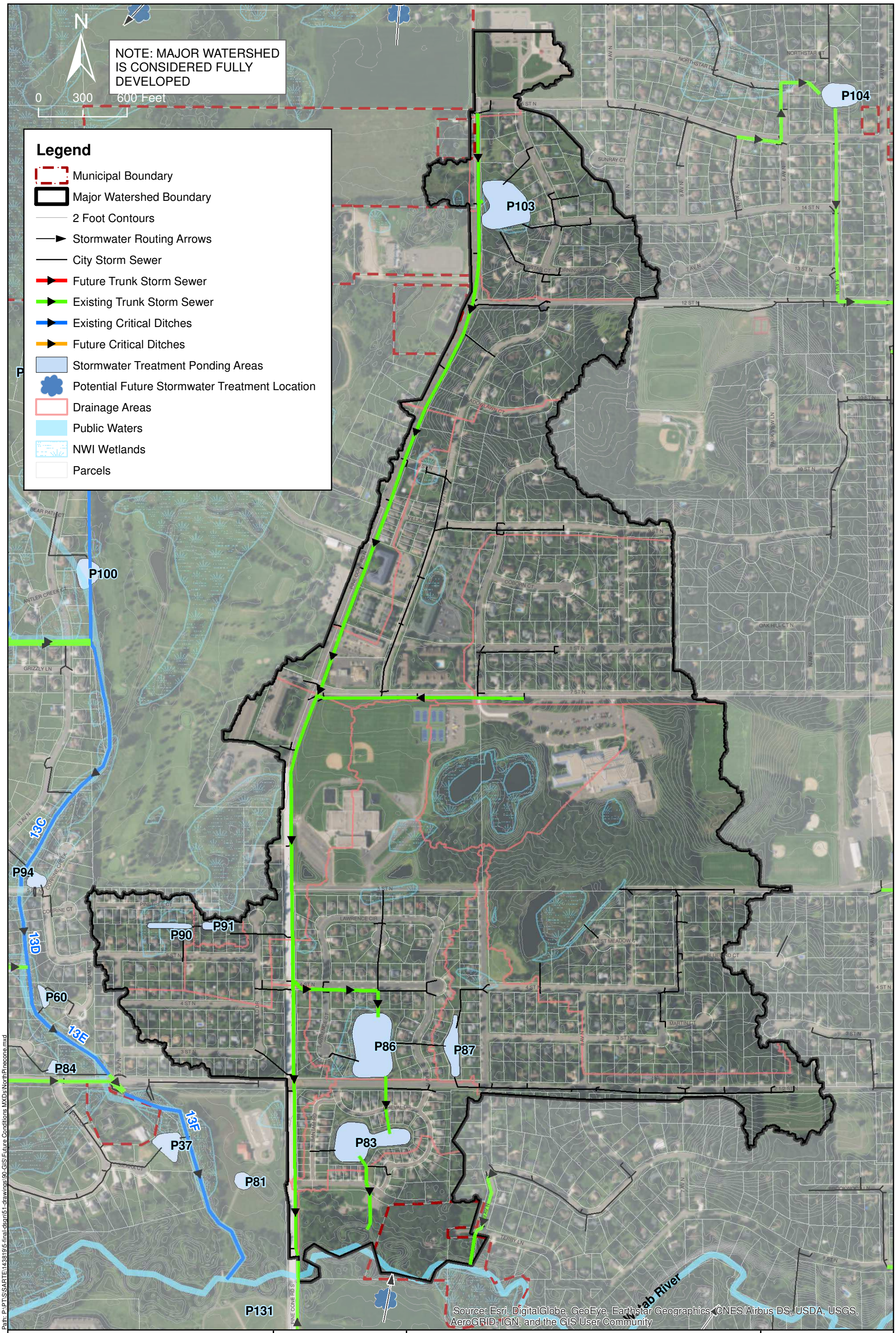
Project: SARTE 143819
Print Date: 9/26/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

North Central Watab Watershed

City of Sartell Surface
Water Management Plan

Figure
16



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\NorthPinecone.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

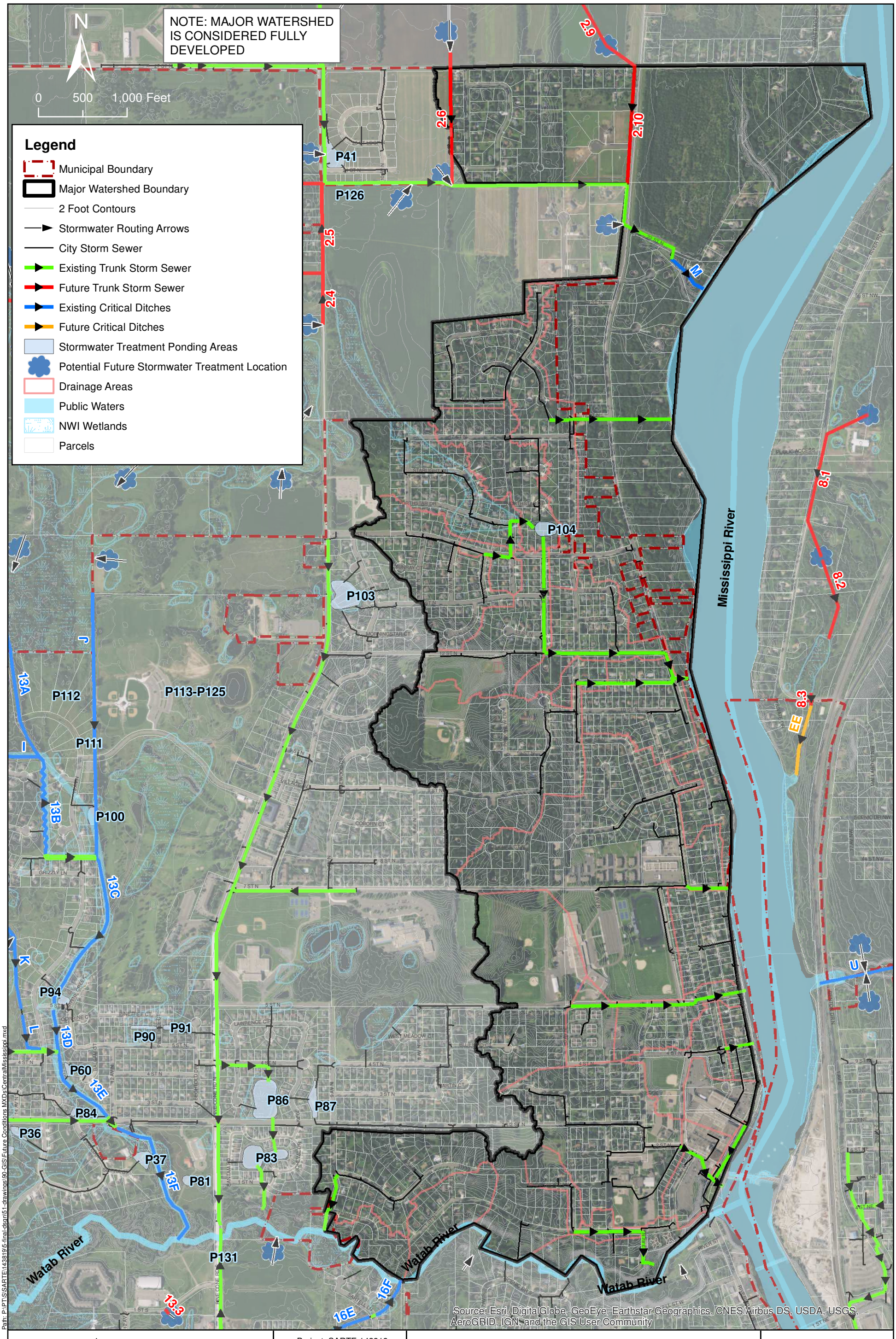
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

North Pinecone Watershed

City of Sartell Surface Water Management Plan

Figure 17



Path: P:\PT\S\SARTE\143819\5-final-dsn\51-drawings\90-GIS\Future Conditions MXDs\CentralMississippi.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Central Mississippi Watershed

City of Sartell Surface Water Management Plan

Figure 18

N

0 400 800 Feet

Mississippi River

NE1

NE2

8.1

8.2

8.3

EE

Z

U

P61

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Existing Trunk Storm Sewer
- Future Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Developed Area
- Public Waters
- NWI Wetlands
- Parcels

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: P:\PTS\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\NorthEastSide.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

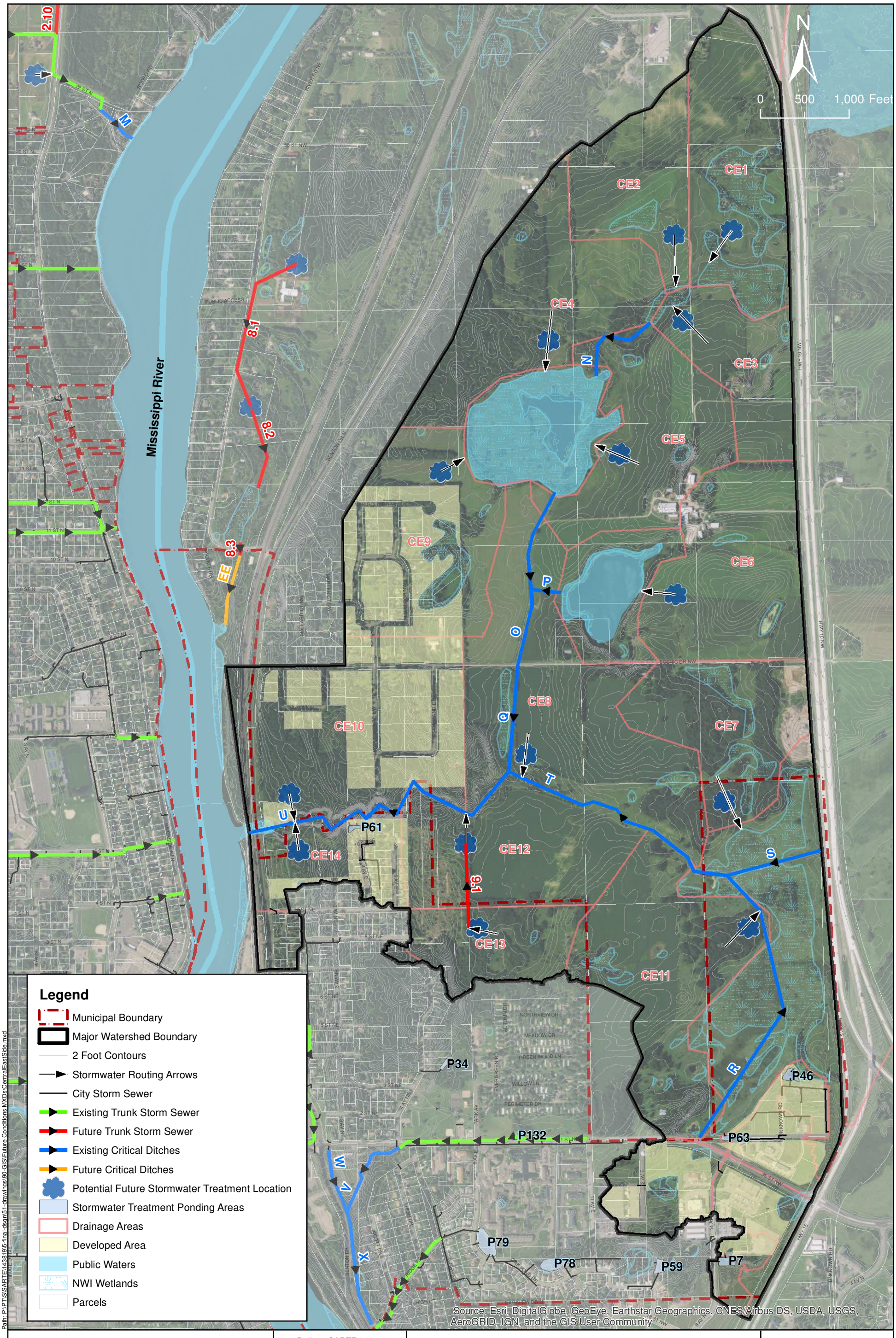
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

North East Side Watershed

City of Sartell Surface
Water Management Plan

Figure
19



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\CentralEastSide.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

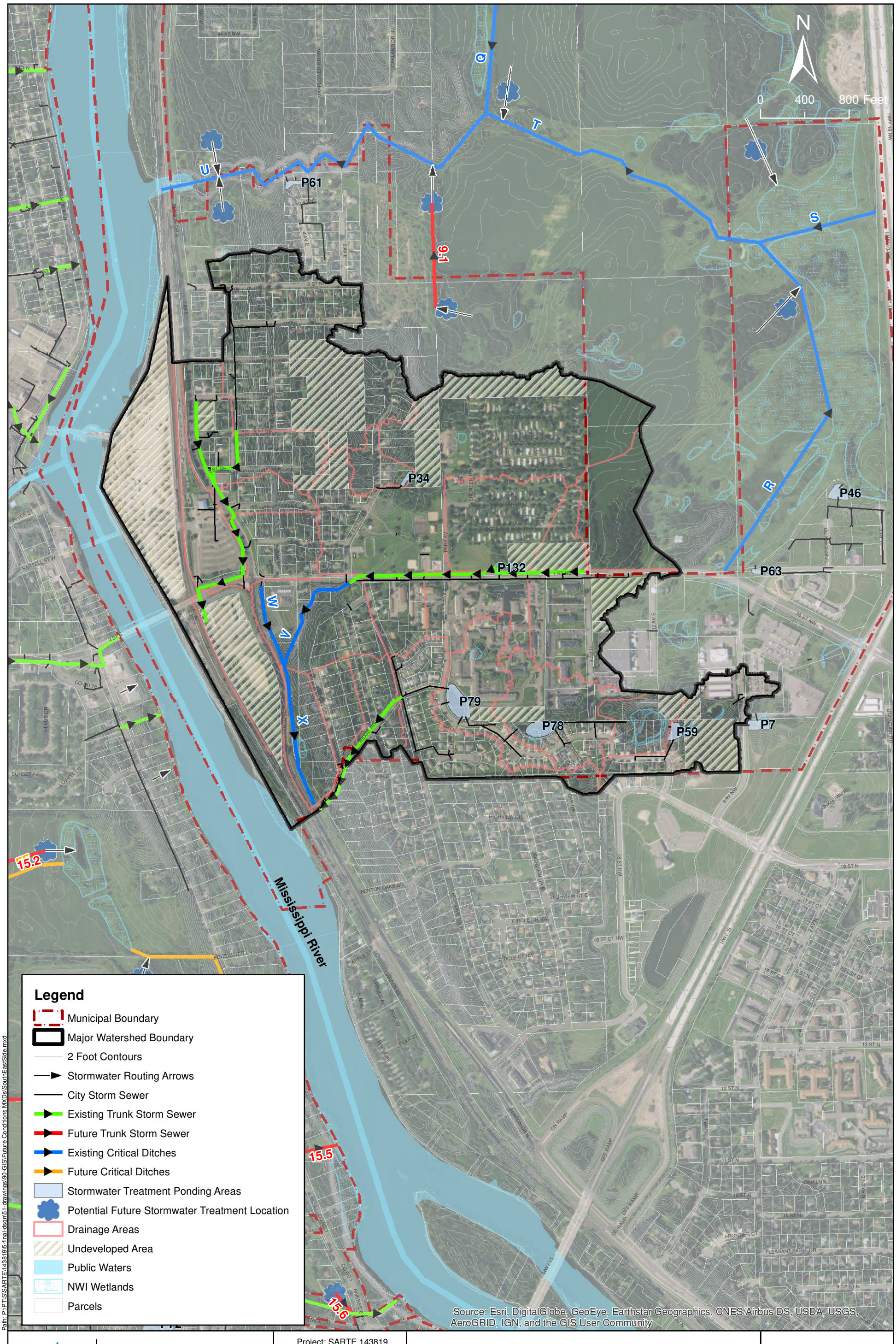
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Central East Side Watershed

City of Sartell Surface Water Management Plan

Figure 20



Path: P:\PT\S\SARTE\143819\5-final-dsn\51-drawings\90-GIS\Future Conditions MXDs\SouthEastSide.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

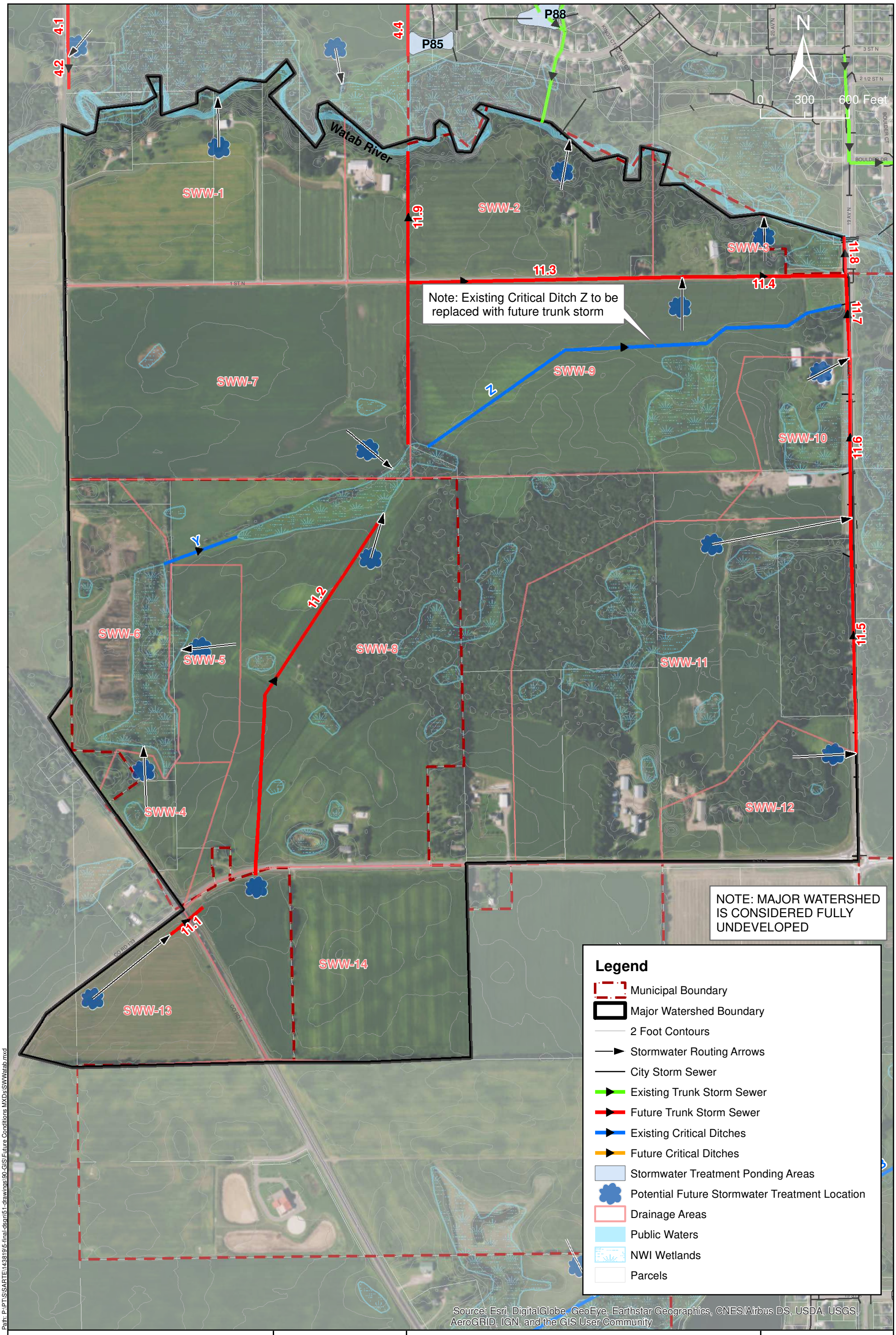
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

South East Side Watershed

City of Sartell Surface
Water Management Plan

Figure
21



SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

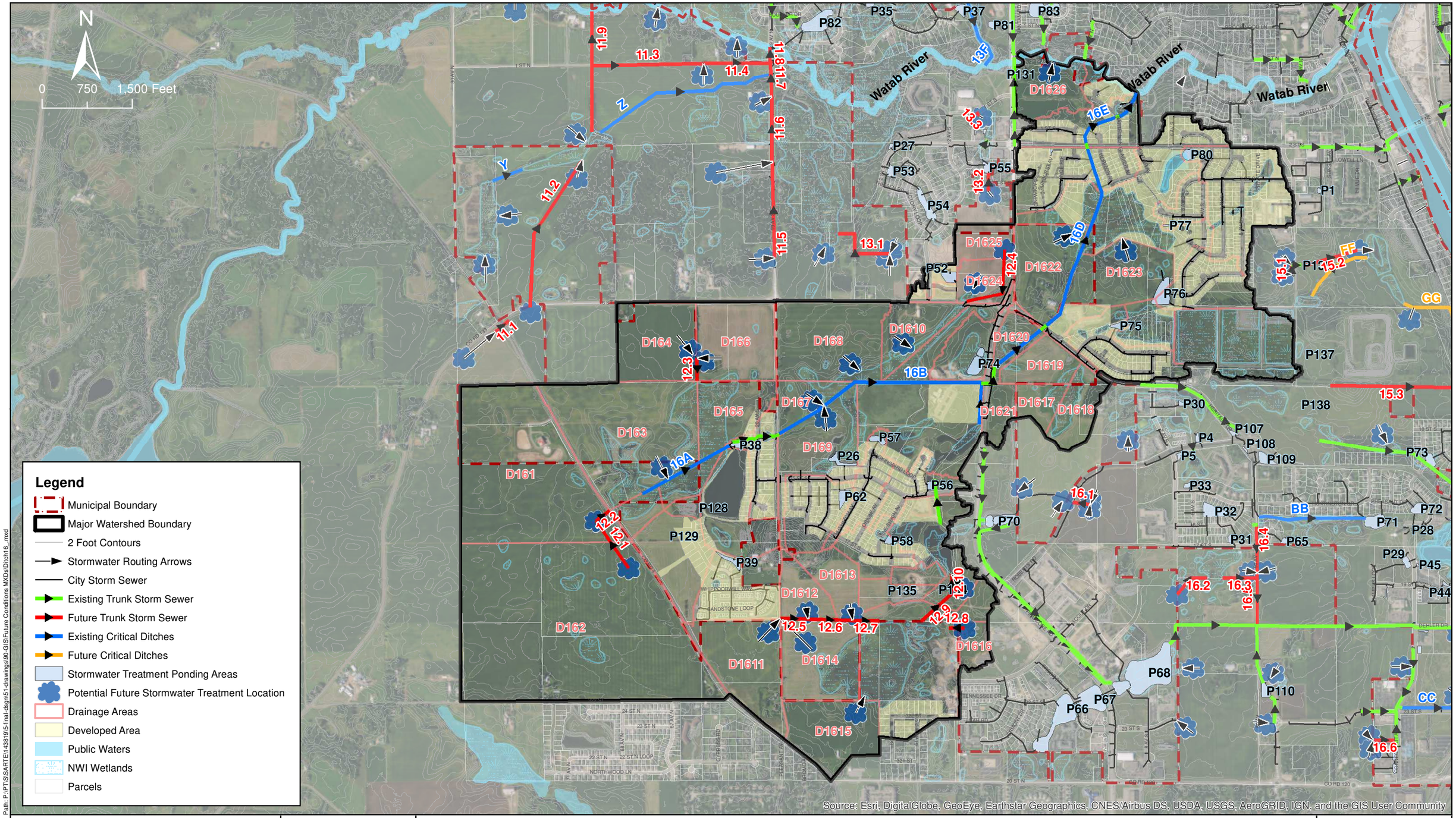
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Southwest Watab Watershed

City of Sartell Surface Water Management Plan

Figure 22



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\Ditch16_.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

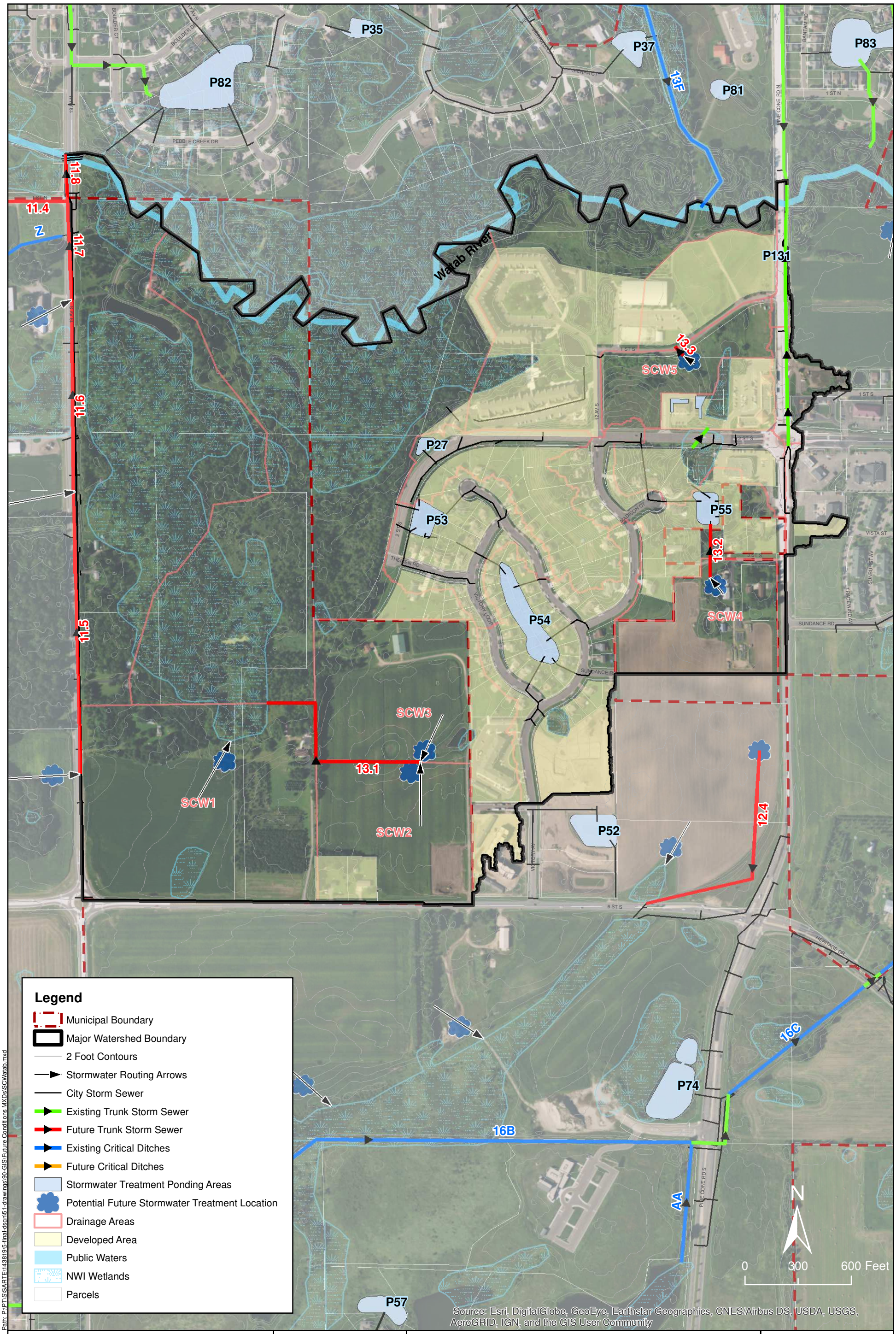
Project: SARTE 143819
Print Date: 9/27/2018

User Name: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Ditch 16 Watershed

City of Sartell Suface
Water Management Plan

Figure
23



Path: P:\PT\S\SARTE\143819\5-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\SCWatab.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

South Central Watab Watershed

City of Sartell Surface
Water Management Plan

Figure
24

N

0 300 600 Feet

Watab River

Watab River

16F

P80

P1

P77

P76

P136

15.1

15.2

FF

GG

P137

15.3

P138

P108

P109

P73

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Municipal Boundary
- Major Watershed Boundary
- 2 Foot Contours
- Stormwater Routing Arrows
- City Storm Sewer
- Existing Trunk Storm Sewer
- Future Trunk Storm Sewer
- Existing Critical Ditches
- Future Critical Ditches
- Stormwater Treatment Ponding Areas
- Potential Future Stormwater Treatment Location
- Drainage Areas
- Undeveloped Area
- Public Waters
- NWI Wetlands
- Parcels

Path: P:\PT\S\SARTE\1438195-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\SouthMississippi.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

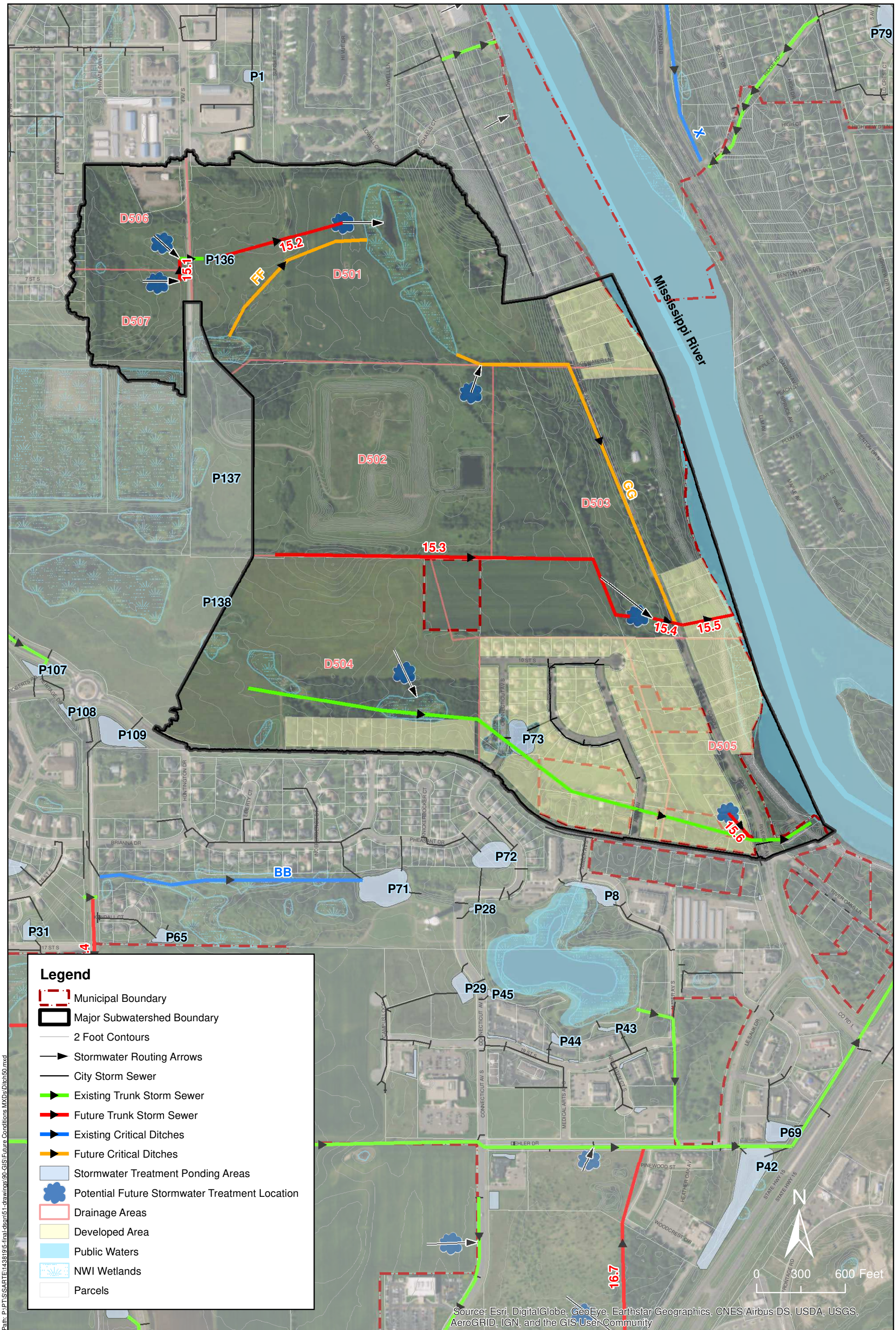
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

South Mississippi Watershed

City of Sartell Surface
Water Management Plan

Figure
25



Path: P:\PT\S\SARTE\1438195-final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\Ditch50.mxd

SEH
1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

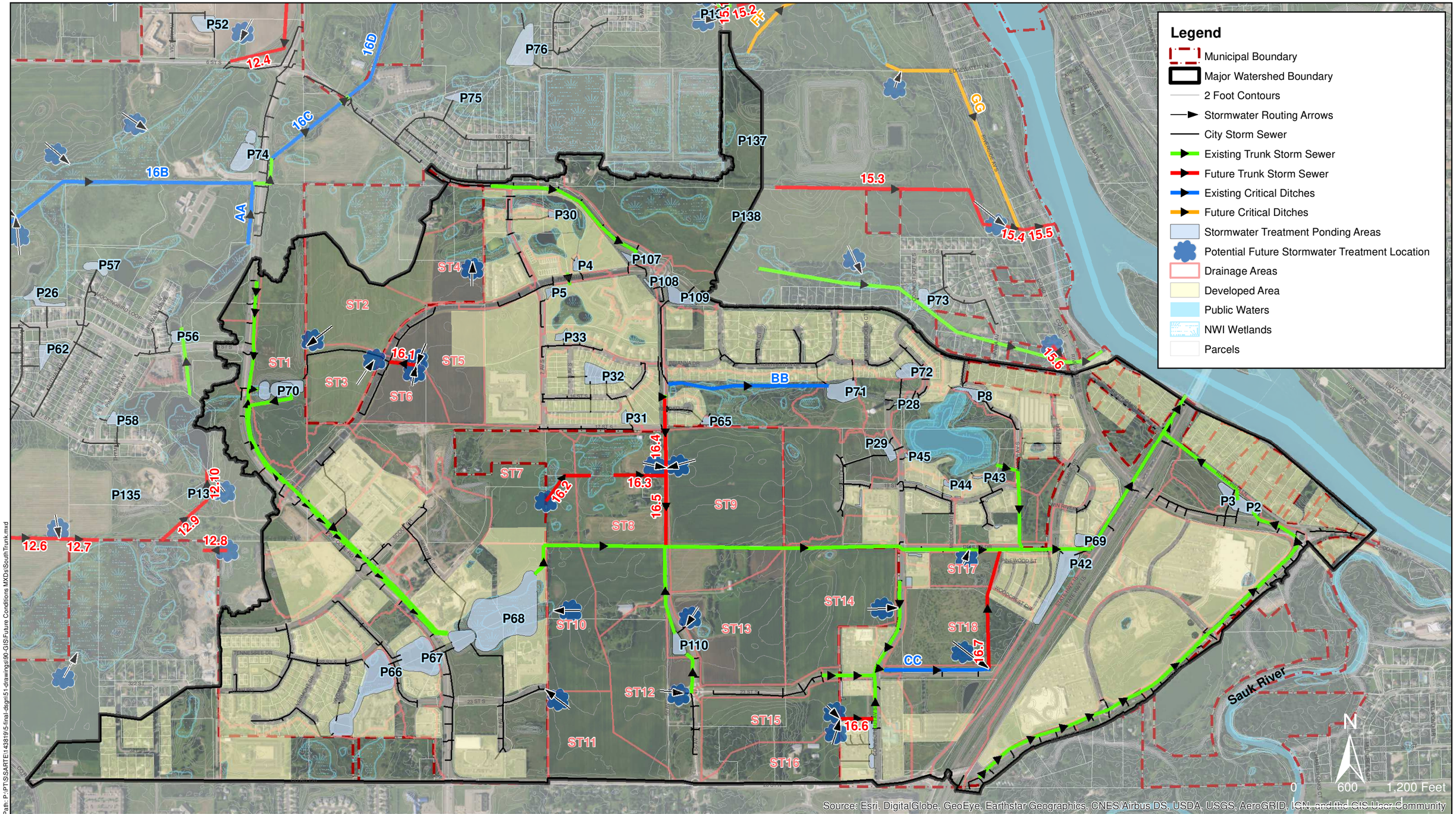
Project: SARTE 143819
Print Date: 9/27/2018

Map by: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

Ditch 50 Watershed

City of Sartell Surface
Water Management Plan

Figure
26



Path: P:\PTS\SARTE\143819-5\final-dsgn\51-drawings\90-GIS\Future Conditions MXDs\SouthTrunk.mxd

SEH

1200 25TH AVENUE SOUTH
ST. CLOUD, MN 55110
PHONE: (320) 229-4300
FAX: (888) 908-8166
TF: (800) 572-0617
www.sehinc.com

Project: SARTE 143819
Print Date: 9/28/2018

User Name: jschmitz
Projection: Stearns County, Feet
Source: Mn Geo, City of Sartell

South Trunk Watershed

City of Sartell Surface
Water Management Plan

Figure
27

Appendix A

MS4 SWPPP

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

MS4 SWPPP Application for Reauthorization

for the NPDES/SDS General Small Municipal Separate Storm Sewer System (MS4) Permit MNR040000 reissued with an effective date of August 1, 2013

Stormwater Pollution Prevention Program (SWPPP) Document

Doc Type: Permit Application

Instructions: This application is for authorization to discharge stormwater associated with Municipal Separate Storm Sewer Systems (MS4s) under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Permit Program. **No fee** is required with the submittal of this application. Please refer to "Example" for detailed instructions found on the Minnesota Pollution Control Agency (MPCA) MS4 website at http://www.pca.state.mn.us/ms4.

Submittal: This *MS4 SWPPP Application for Reauthorization* form must be submitted electronically via e-mail to the MPCA at ms4permitprogram.pca@state.mn.us from the person that is duly authorized to certify this form. All questions with an asterisk (*) are required fields. All applications will be returned if required fields are not completed.

Questions: Contact Claudia Hochstein at 651-757-2881 or claudia.hochstein@state.mn.us, Dan Miller at 651-757-2246 or daniel.miller@state.mn.us, or call toll-free at 800-657-3864.

General Contact Information (*Required fields)

MS4 Owner (with ownership or operational responsibility, or control of the MS4)

*MS4 permittee name: City of Sartell *County: Stearns and Benton
(city, county, municipality, government agency or other entity)

*Mailing address: 125 Pinecone Road North

*City: Sartell *State: MN *Zip code: 56377

*Phone (including area code): 320-253-2171 *E-mail: info@sartellmn.com

MS4 General contact (with Stormwater Pollution Prevention Program [SWPPP] implementation responsibility)

*Last name: Borders *First name: Brad
(department head, MS4 coordinator, consultant, etc.)

*Title: Public Works Director

*Mailing address: 125 Pinecone Road North

*City: Sartell *State: MN *Zip code: 56377

*Phone (including area code): 320-253-2171 *E-mail: brad@sartellmn.com

Preparer information (complete if SWPPP application is prepared by a party other than MS4 General contact)

Last name: Rasmussen First name: Anita
(department head, MS4 coordinator, consultant, etc.)

Title: Planning and Community Development Director

Mailing address: 125 Pinecone Road North

City: Sartell State: MN Zip code: 56377

Phone (including area code): 320-258-7306 E-mail: anita@sartellmn.com

Verification

1. I seek to continue discharging stormwater associated with a small MS4 after the effective date of this Permit, and shall submit this *MS4 SWPPP Application for Reauthorization* form, in accordance with the schedule in Appendix A, Table 1, with the SWPPP document completed in accordance with the Permit (Part II.D.). ☒ Yes
2. I have read and understand the NPDES/SDS MS4 General Permit and certify that we intend to comply with all requirements of the Permit. ☒ Yes

Certification (All fields are required)

☒ Yes - *I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted.*

I certify that based on my inquiry of the person, or persons, who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of civil and criminal penalties.

This certification is required by Minn. Stat. §§ 7001.0070 and 7001.0540. The authorized person with overall, MS4 legal responsibility must certify the application (principal executive officer or a ranking elected official).

By typing my name in the following box, I certify the above statements to be true and correct, to the best of my knowledge, and that this information can be used for the purpose of processing my application.

Name: Anita Rasmussen
(This document has been electronically signed)

Title: Planning and Community Development Director Date (mm/dd/yyyy): 10/30/2013

Mailing address: 125 Pinecone Road North

City: Sartell State: MN Zip code: 56377

Phone (including area code): 320-258-7306 E-mail: anita@sartellmn.com

***Note:** The application will not be processed without certification.*

Stormwater Pollution Prevention Program Document

I. Partnerships: (Part II.D.1)

A. List the **regulated small MS4(s)** with which you have established a partnership in order to satisfy one or more requirements of this Permit. Indicate which Minimum Control Measure (MCM) requirements or other program components that each partnership helps to accomplish (List all that apply). Check the box below if you currently have no established partnerships with other regulated MS4s. If you have more than five partnerships, hit the tab key after the last line to generate a new row.

☐ No partnerships with regulated small MS4s

Name and description of partnership	MCM/Other permit requirements involved
Central Minnesota Water Education Alliance (CMWEA) which includes collaboration with 16 other MS4's.	CMWEA activities assisted members to meet education and outreach requirements in Wellhead Protection Plans and the National Pollution Discharge Elimination System (NPDES) MS4 Stormwater Permit
Mn Cities Stormwater Coalition	Assist members to meet education, outreach and training requirements.

B. If you have additional information that you would like to communicate about your partnerships with other regulated small MS4(s), provide it in the space below, or include an attachment to the SWPPP Document, with the following file naming convention: *MS4NameHere_Partnerships.*

The link to the website for our educational partnership is www.mnwaterconnection.com

II. Description of Regulatory Mechanisms: (Part II.D.2)

Illicit discharges

A. Do you have a regulatory mechanism(s) that effectively prohibits non-stormwater discharges into your small MS4, except those non-stormwater discharges authorized under the Permit (Part III.D.3.b.)? ☒ Yes ☒ No

1. If **yes:**

   a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):

   ☒ Ordinance ☐ Contract language
   ☐ Policy/Standards ☐ Permits
   ☐ Rules
   ☐ Other, explain: _____

   b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

   Citation:

   Direct link:

   ☒ Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: *MS4NameHere_IDDEreg.*

2. If **no:**

   Describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

Construction site stormwater runoff control

A. Do you have a regulatory mechanism(s) that establishes requirements for erosion and sediment controls and waste controls? ☒ Yes ☐ No

1. If **yes:**

a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):

☒ Ordinance ☐ Contract language
☐ Policy/Standards ☐ Permits
☐ Rules
☐ Other, explain: _____

b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

Citation:

Direct link:

☒ Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: *MS4NameHere_CSWreg.*

B. Is your regulatory mechanism at least as stringent as the MPCA general permit to Discharge Stormwater Associated with Construction Activity (as of the effective date of the MS4 Permit)? ☐Yes ☒ No

If you answered **yes** to the above question, proceed to C.

If you answered **no** to either of the above permit requirements listed in A. or B., describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

We will review and update our construction site stormwater runoff control regulatory mechanism to be at least as stringent as the MPCA CSW permit. This effort will be completed within 12 months of the date permit coverage is extended.

C. Answer **yes** or **no** to indicate whether your regulatory mechanism(s) requires owners and operators of construction activity to develop site plans that incorporate the following erosion and sediment controls and waste controls as described in the Permit (Part III.D.4.a.(1)-(8)), and as listed below:

1.	Best Management Practices (BMPs) to minimize erosion.	☒ Yes	☐ No
2.	BMPs to minimize the discharge of sediment and other pollutants.	☒ Yes	☐ No
3.	BMPs for dewatering activities.	☐ Yes	☒ No
4.	Site inspections and records of rainfall events	☒ Yes	☐ No
5.	BMP maintenance	☒ Yes	☐ No
6.	Management of solid and hazardous wastes on each project site.	☒ Yes	☐ No
7.	Final stabilization upon the completion of construction activity, including the use of perennial vegetative cover on all exposed soils or other equivalent means.	☒ Yes	☐ No
8.	Criteria for the use of temporary sediment basins.	☐ Yes	☒ No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

We will review and update our construction site stormwater runoff control regulatory mechanism, along with C1-8 to be at least as stringent as the MPCA CSW permit. This effort will be completed within 12 months of the date permit coverage is extended.

C3-We currently have limited guidance for dewatering activities and encourage contractors and developers to take proper care. However, it is not part of any official ordinance. We will draft the amendment using language from the MPCA model ESC ordinance as a guideline, hold a public hearing and adopt an ordinance within 12 months of the date permit coverage is extended.

C-8-Following the same procedure as for (3), the ordinance will be amended to include critera for the use of temporary sediment basins.

Post-construction stormwater management

A. Do you have a regulatory mechanism(s) to address post-construction stormwater management activities?
☒ Yes ☐ No

1. If **yes:**

   a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):
      ☒ Ordinance ☐ Contract language
      ☐ Policy/Standards ☐ Permits
      ☐ Rules
      ☐ Other, explain: _____

   b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

      Citation:

      Direct link:

      ☒ Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: *MS4NameHere_PostCSWreg.*

B. Answer **yes** or **no** below to indicate whether you have a regulatory mechanism(s) in place that meets the following requirements as described in the Permit (Part III.D.5.a.):

1. **Site plan review:** Requirements that owners and/or operators of construction activity submit site plans with post-construction stormwater management BMPs to the permittee for review and approval, prior to start of construction activity. ☒ Yes ☐ No

2. **Conditions for post construction stormwater management:** Requires the use of any combination of BMPs, with highest preference given to Green Infrastructure techniques and practices (e.g., infiltration, evapotranspiration, reuse/harvesting, conservation design, urban forestry, green roofs, etc.), necessary to meet the following conditions on the site of a construction activity to the Maximum Extent Practicable (MEP):

   a. For new development projects – no net increase from pre-project conditions (on an annual average basis) of: ☐ Yes ☒ No
      1) Stormwater discharge volume, unless precluded by the stormwater management limitations in the Permit (Part III.D.5.a(3)(a)).
      2) Stormwater discharges of Total Suspended Solids (TSS).
      3) Stormwater discharges of Total Phosphorus (TP).

   b. For redevelopment projects – a net reduction from pre-project conditions (on an annual average basis) of: ☐ Yes ☒ No
      1) Stormwater discharge volume, unless precluded by the stormwater management limitations in the Permit (Part III.D.5.a(3)(a)).
      2) Stormwater discharges of TSS.
      3) Stormwater discharges of TP.

3. **Stormwater management limitations and exceptions:**

   a. Limitations

      1) Prohibit the use of infiltration techniques to achieve the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)) when the infiltration structural stormwater BMP will receive discharges from, or be constructed in areas: ☐ Yes ☒ No
         a) Where industrial facilities are not authorized to infiltrate industrial stormwater under an NPDES/SDS Industrial Stormwater Permit issued by the MPCA.
         b) Where vehicle fueling and maintenance occur.
         c) With less than three (3) feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of bedrock.
         d) Where high levels of contaminants in soil or groundwater will be mobilized by the infiltrating stormwater.

      2) Restrict the use of infiltration techniques to achieve the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)), without higher engineering review, sufficient to provide a functioning treatment system and prevent adverse impacts to groundwater, when the infiltration device will be constructed in areas: ☐ Yes ☒ No
         a) With predominately Hydrologic Soil Group D (clay) soils.
         b) Within 1,000 feet up-gradient, or 100 feet down-gradient of active karst features.

c) Within a Drinking Water Supply Management Area (DWSMA) as defined in Minn. R. 4720.5100, subp. 13.
d) Where soil infiltration rates are more than 8.3 inches per hour.

3) For linear projects where the lack of right-of-way precludes the installation of volume control practices that meet the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)), the permittee's regulatory mechanism(s) may allow exceptions as described in the Permit (Part III.D.5.a(3)(b)). The permittee's regulatory mechanism(s) shall ensure that a reasonable attempt be made to obtain right-of-way during the project planning process. ☐ Yes ☒ No

4. **Mitigation provisions:** The permittee's regulatory mechanism(s) shall ensure that any stormwater discharges of TSS and/or TP not addressed on the site of the original construction activity are addressed through mitigation and, at a minimum, shall ensure the following requirements are met:

a. Mitigation project areas are selected in the following order of preference: ☐ Yes ☒ No
   1) Locations that yield benefits to the same receiving water that receives runoff from the original construction activity.
   2) Locations within the same Minnesota Department of Natural Resource (DNR) catchment area as the original construction activity.
   3) Locations in the next adjacent DNR catchment area up-stream
   4) Locations anywhere within the permittee's jurisdiction.

b. Mitigation projects must involve the creation of new structural stormwater BMPs or the retrofit of existing structural stormwater BMPs, or the use of a properly designed regional structural stormwater BMP. ☐ Yes ☒ No

c. Routine maintenance of structural stormwater BMPs already required by this permit cannot be used to meet mitigation requirements of this part. ☐ Yes ☒ No

d. Mitigation projects shall be completed within 24 months after the start of the original construction activity. ☐ Yes ☒ No

e. The permittee shall determine, and document, who will be responsible for long-term maintenance on all mitigation projects of this part. ☐ Yes ☒ No

f. If the permittee receives payment from the owner and/or operator of a construction activity for mitigation purposes in lieu of the owner or operator of that construction activity meeting the conditions for post-construction stormwater management in Part III.D.5.a(2), the permittee shall apply any such payment received to a public stormwater project, and all projects must be in compliance with Part III.D.5.a(4)(a)-(e). ☐ Yes ☒ No

5. **Long-term maintenance of structural stormwater BMPs:** The permittee's regulatory mechanism(s) shall provide for the establishment of legal mechanisms between the permittee and owners or operators responsible for the long-term maintenance of structural stormwater BMPs not owned or operated by the permittee, that have been implemented to meet the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)). This only includes structural stormwater BMPs constructed after the effective date of this permit and that are directly connected to the permittee's MS4, and that are in the permittee's jurisdiction. The legal mechanism shall include provisions that, at a minimum:

a. Allow the permittee to conduct inspections of structural stormwater BMPs not owned or operated by the permittee, perform necessary maintenance, and assess costs for those structural stormwater BMPs when the permittee determines that the owner and/or operator of that structural stormwater BMP has not conducted maintenance. ☐ Yes ☒ No

b. Include conditions that are designed to preserve the permittee's right to ensure maintenance responsibility, for structural stormwater BMPs not owned or operated by the permittee, when those responsibilities are legally transferred to another party. ☐ Yes ☒ No

c. Include conditions that are designed to protect/preserve structural stormwater BMPs and site features that are implemented to comply with the Permit (Part III.D.5.a(2)). If site configurations or structural stormwater BMPs change, causing decreased structural stormwater BMP effectiveness, new or improved structural stormwater BMPs must be implemented to ensure the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)) continue to be met. ☐ Yes ☒ No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within twelve (12) months of the date permit coverage is extended, these permit requirements are met:

We will review and update our post construction site stormwater runoff control regulatory mechanism to be at least as stringent as the MPCA PCSW permit. This effort will be completed within 12 months of the date permit coverage is extended.

B-2 (a-b): Amend current post-construction stormwater ordinance, which does not include anything related to volume-control, to incorporate Permit requirements. Our Engineer will identify potential partners (Stearns County Watershed District, etc) for guidance on how to craft an ordinance. The City Engineer will draft an ordinance that is at least as stringent as the MPCA permit, a public hearing will be held and the adoption of an ordinance will occur within 12 months of the date permit coverage is extended.

B-3(1-3) Amend current post-construction stormwater ordinance to include the prohibition, restriction and preclusions of infiltration techniques to achieve the conditions for post-construction stormwater management, as determined by the MPCA PCSW permit within 12 months of the date permit coverage is extended.

B-4 (a-f) Amend and include regulatory mechanisms which will ensure that stormwater discharges of TSS and/or TP not addressed on the construction site are addressed through mitigation in accordance with the MPCA PCSW permit. This effort will be addressed in the same time frame as identified above.

B-5(a-c) On the same schedule as listed above, we will review and draft amendments to our post-construction stormwater ordinance to ensure maintenance responsibility on structural stormwater BMP's that we do not own or operate, inspections of structural stormwater BMP's we do not own or operate and include conditions that are designed to protect/preserve structural stormwater BMP's to comply with the provisions of the MPCA PCSW permit.

III. Enforcement Response Procedures (ERPs): (Part II.D.3)

A. Do you have existing ERPs that satisfy the requirements of the Permit (Part III.B.)? ☐ Yes ☒ No

1. If **yes**, attach them to this form as an electronic document, with the following file naming convention: *MS4NameHere_ERPs.*
2. If **no**, describe the tasks and corresponding schedules that will be taken to assure that, with twelve (12) months of the date permit coverage is extended, these permit requirements are met:

   We will confer with Public Works, Engineering and Building Inspections departments with any enforcement requirements, to provide a written procedure that will satisfy these requirements. We will develop a plan within the first 6 months of the date of reissuance of this permit.

B. Describe your ERPs:

IV. Storm Sewer System Map and Inventory: (Part II.D.4.)

A. Describe how you manage your storm sewer system map and inventory:

Our consulting engineers make and manage the system map and inventory.

B. Answer **yes** or **no** to indicate whether your storm sewer system map addresses the following requirements from the Permit (Part III.C.1.a-d), as listed below:

1. The permittee's entire small MS4 as a goal, but at a minimum, all pipes 12 inches or greater in diameter, including stormwater flow direction in those pipes. ☒ Yes ☐ No
2. Outfalls, including a unique identification (ID) number assigned by the permittee, and an associated geographic coordinate. ☐ Yes ☒ No
3. Structural stormwater BMPs that are part of the permittee's small MS4. ☒ Yes ☐ No
4. All receiving waters. ☒ Yes ☐ No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

We will review and update our storm sewer system GIS map and inventory with all the necessary documentation as required within the permit. Currently, the map is updated by our consulting engineers as new improvements are constructed. We will use a GPS to field mark all additional pipline needed to be added and integrate them into the map. This effort will be completed within 12 months of the date permit coverage is extended

C. Answer **yes** or **no** to indicate whether you have completed the requirements of 2009 Minnesota Session Law, Ch. 172. Sec. 28: with the following inventories, according to the specifications of the Permit (Part III.C.2.a.-b.), including:

1. All ponds within the permittee's jurisdiction that are constructed and operated for purposes of water quality treatment, stormwater detention, and flood control, and that are used for the collection of stormwater via constructed conveyances. ☒ Yes ☐ No
2. All wetlands and lakes, within the permittee's jurisdiction, that collect stormwater via constructed conveyances. ☒ Yes ☐ No

D. Answer **yes** or **no** to indicate whether you have completed the following information for each feature inventoried.

1. A unique identification (ID) number assigned by the permittee. ☒ Yes ☐ No
2. A geographic coordinate. ☐ Yes ☒ No
3. Type of feature (e.g., pond, wetland, or lake). This may be determined by using best professional judgment. ☒ Yes ☐ No

If you have answered **yes** to all above requirements, and you have already submitted the Pond Inventory Form to the MPCA, then you do not need to resubmit the inventory form below.

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

We will review and update our storm sewer system map and inventory with all the necessary documentation as required within the permit. We are gathering the information of all of our ponds, including new ones and filling this into our inventory form to submit to the Commission. This effort will be completed within 12 months of the date permit coverage is extended

E. Answer **yes** or **no** to indicate if you are attaching your pond, wetland and lake inventory to the MPCA on the form provided on the MPCA website at: http://www.pca.state.mn.us/ms4 , according to the specifications of Permit (Part III.C.2.b.(1)-(3)). Attach with the following file naming convention: *MS4NameHere_inventory*. ☐ Yes ☒ No

If you answered **no,** the inventory form must be submitted to the MPCA MS4 Permit Program within 12 months of the date permit coverage is extended.

V. Minimum Control Measures (MCMs) (Part II.D.5)

A. MCM1: Public education and outreach

1. The Permit requires that, within 12 months of the date permit coverage is extended, existing permittees revise their education and outreach program that focuses on illicit discharge recognition and reporting, as well as other specifically selected stormwater-related issue(s) of high priority to the permittee during this permit term. Describe your **current** educational program, including **any high-priority topics included**:

   Our City is primarily residential with growing commercial and office districts. We partner with CMWEA to provide education to our residents and businesses.

2. List the categories of BMPs that address your public education and outreach program, including the distribution of educational materials and a program implementation plan. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the U.S. Environmental Protection Agency's (EPA) *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf).

   If you have more than five categories, hit the tab key after the last line to generate a new row.

Established BMP categories	**Measurable goals and timeframes**
Basic public distribution outreach educational materials for dispersal through newspaper articles (CMWEA)	We will continue to track how many materials are distributed and evaluate our future needs and new content development based on feedback.
Website	We will continue to track how many hits are received on the CMWEA website (and City's website) and evaluate any feedback for new content ideas.
Billboards	With our partners, continue to display large messages in various locations through out the central MN region.

BMP categories to be implemented	**Measurable goals and timeframes**
Program Evaluation	During the yearly SWPPP review, consider which materials are most effective for our program and audiences. Consider information from comprehensive planning process and other public input.
Social Media	Provide stormwater tips on the City's Facebook page. Track views and comments.

3. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

   Therese Haffner, Planning Associate

B. MCM2: Public participation and involvement

1. The Permit (Part III.D.2.a.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement a public participation/involvement program to solicit public input on the SWPPP. Describe your current program:

   Every year, we present and hear comments on our Stormwater Pollution Prevention Program during a regular City Council meeting. We usually complete that meeting in May or June. We post the public hearing 30 days in advance of the meeting in the local paper.

2. List the categories of BMPs that address your public participation/involvement program, including solicitation and documentation of public input on the SWPPP. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

Established BMP categories	**Measurable goals and timeframes**
Annual Meeting	Hold meeting in May or June. Attempt to get at least one public comment.
Appropriate public notice	Post the annual meeting 30 days in advance of the public meeting. Also place the notice on the City's website.
Availability of Stormwater Pollution Prevention Program Document	Provide a copy of the SWPPP documents at City hall for viewing.

BMP categories to be implemented	**Measurable goals and timeframes**
Online availability of Stormwater Pollution Prevention Plan Document	Provide an electronic document of the SWPPP online to allow easier access to the document immediately.
Coordination Meeting	The City will annually hold a coordination meeting with stakeholders and developers in discussing progress of permit implementation
Storm Drain Stenciling	We hope to engage community groups in a storm drain stenciling effort. We hope to stencil at least 50 drains in the next 5 years.

3. Do you have a process for receiving and documenting citizen input? ☒ Yes ☐ No

   If you answered **no** to the above permit requirement, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

4. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

   Anita Rasmussen, Planning and Community Development Director

C. MCM 3: Illicit discharge detection and elimination

1. The Permit (Part III.D.3.) requires that, within 12 months of the date permit coverage is extended, existing permittees revise their current program as necessary, and continue to implement and enforce a program to detect and eliminate illicit discharges into the small MS4. Describe your current program:

   We have an ordinance that prohibits illicit discharges but we are not confident it meets the requirements of the new permit. The Public Works department are trained to look for any signs of an illicit discharge while on the job or as a result of a complant.

2. Does your Illicit Discharge Detection and Elimination Program meet the following requirements, as found in the Permit (Part III.D.3.c.-g.)?

   a. Incorporation of illicit discharge detection into all inspection and maintenance activities conducted under the Permit (Part III.D.6.e.-f.)Where feasible, illicit discharge inspections shall be conducted during dry-weather conditions (e.g., periods of 72 or more hours of no precipitation). ☐ Yes ☒ No

   b. Detecting and tracking the source of illicit discharges using visual inspections. The permittee may also include use of mobile cameras, collecting and analyzing water samples, and/or other detailed procedures that may be effective investigative tools. ☐ Yes ☒ No

   c. Training of all field staff, in accordance with the requirements of the Permit (Part III.D.6.g.(2)), in illicit discharge recognition (including conditions which could cause illicit discharges), and reporting illicit discharges for further investigation. ☒ Yes ☐ No

   d. Identification of priority areas likely to have illicit discharges, including at a minimum, evaluating land use associated with business/industrial activities, areas where illicit discharges have been identified in the past, and areas with storage of large quantities of significant materials that could result in an illicit discharge. ☐ Yes ☒ No

   e. Procedures for the timely response to known, suspected, and reported illicit discharges. ☒ Yes ☐ No

   f. Procedures for investigating, locating, and eliminating the source of illicit discharges. ☒ Yes ☐ No

   g. Procedures for responding to spills, including emergency response procedures to prevent spills from entering the small MS4. The procedures shall also include the immediate notification of the Minnesota Department of Public Safety Duty Officer, if the source of the illicit discharge is a spill or leak as defined in Minn. Stat. § 115.061. ☒ Yes ☐ No

   h. When the source of the illicit discharge is found, the permittee shall use the ERPs required by the Permit (Part III.B.) to eliminate the illicit discharge and require any needed corrective action(s). ☒ Yes ☐ No

   If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

   We have an ordinance that prohibits illicit discharges and connections, but will be revising our program to include inspections being completed during dryweather conditions, other modes of detection where possible, identification of priority areas within 12 months of when the permit coverage is extended.

3. List the categories of BMPs that address your illicit discharge, detection and elimination program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf).

   If you have more than five categories, hit the tab key after the last line to generate a new row.

Established BMP categories	**Measurable goals and timeframes**
Ordinance	Review and revise ordinance yearly, or as needed, so that it continues to meet the needs of the City and legal requirements
Inspections	City employees are on the lookout for illicit discharges while they perform their normal duties and inspections occur when we receive reports of an illicit discharge. Document number of illicit discharges spotted.
Training	Appropriate city employees will participate in training for spotting and handling illicit discharges on a yearly or as needed basis.

BMP categories to be implemented	**Measurable goals and timeframes**
Inspections	Yearly inspections of high-priority outfalls and around high-risk establishments. Make as many dryweather inspections as

	possible.
Storm Sewer Televising	On a yearly basis, determine if and where sections of our sewer system should be televised to find illicit connections to the system as well as leaks and cracks that might exist. This will happen, if necessary, in the summer or early fall of each year.
Establish Illicit Discharge Reporting Hotline/Link	Allow citizens to enter a message 24/7 reporting illicit discharges to the City. This will be implemented within 6 months of the date we receive permit coverage. All messages will be documented in a data management system.

4. Do you have procedures for record-keeping within your Illicit Discharge Detection and Elimination (IDDE) program as specified within the Permit (Part III.D.3.h.)? ☐ Yes ☒ No

   If you answered **no**, indicate how you will develop procedures for record-keeping of your Illicit Discharge, Detection and Elimination Program, within 12 months of the date permit coverage is extended:

   We intend to have the funds and software for employees to put reports of illicit discharges and connections into our GIS System and Property Data Management system. Each report will contain an address, type of discharge/connection and if it was associated with a business.

5. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

   John Kothenbeutel

D. MCM 4: Construction site stormwater runoff control

1. The Permit (Part III.D.4) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement and enforce a construction site stormwater runoff control program. Describe your current program:

   We have a permit application required for any construction site that disturbs 1 acre or more. We require review of construction site erosion and sediment control plans before projects begin, and work with contractors to ensure appropriate and correct use of erosion and sediment control BMP's on sites. All checklists are retained in the building file.

2. Does your program address the following BMPs for construction stormwater erosion and sediment control as required in the Permit (Part III.D.4.b.):
   a. Have you established written procedures for site plan reviews that you conduct prior to the start of construction activity? ☒ Yes ☐ No
   b. Does the site plan review procedure include notification to owners and operators proposing construction activity that they need to apply for and obtain coverage under the MPCA's general permit to *Discharge Stormwater Associated with Construction Activity No. MN R100001*? ☐ Yes ☒ No
   c. Does your program include written procedures for receipt and consideration of reports of noncompliance or other stormwater related information on construction activity submitted by the public to the permittee? ☒ Yes ☐ No
   d. Have you included written procedures for the following aspects of site inspections to determine compliance with your regulatory mechanism(s):
      1) Does your program include procedures for identifying priority sites for inspection? ☐ Yes ☒ No
      2) Does your program identify a frequency at which you will conduct construction site inspections? ☒ Yes ☐ No
      3) Does your program identify the names of individual(s) or position titles of those responsible for conducting construction site inspections? ☒ Yes ☐ No
      4) Does your program include a checklist or other written means to document construction site inspections when determining compliance? ☒ Yes ☐ No
   e. Does your program document and retain construction project name, location, total acreage to be disturbed, and owner/operator information? ☒ Yes ☐ No
   f. Does your program document stormwater-related comments and/or supporting information used to determine project approval or denial? ☒ Yes ☐ No
   g. Does your program retain construction site inspection checklists or other written materials used to document site inspections? ☒ Yes ☐ No

   If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met.

   2.b. We will notify owners and operators proposing construction activity to apply for and obtain coverage for the MPCA general permit for construction activity within 6 months after the coverage is extended.

2d.1. We plan to develop written procedures to explain our prioritization of inspections in the field. We plan on developing this with our Construction Site Stormwater Control program within 6 months after the permit coverage is extended.

3. List the categories of BMPs that address your construction site stormwater runoff control program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

Established BMP categories	**Measurable goals and timeframes**
Permit Application System	Process all applications within 60 days of receipt.
Inspections	Conduct inspections as needed and regularly to all sites within the City.
Education	Provide educational workshop on permit requirements for contractors yearly.
Ordinance	The City currently has on the records an erosion and sediment control ordinance.

BMP categories to be implemented	**Measurable goals and timeframes**
Permit Update	Update our city permit and ordinance to meet MPCA General Permit to Discharge Stormwater Associated with construction activity. This will happen within 12 months of receiving Permit coverage.
Checklist	Update procedures for site plan review on an annual basis and incorporate into the Checklist.
Prioritize Inspections	Ensure at least 10% of inspections conducted annually are performed at deemed high priority inspection sites (near sensitive receiving waters, greater than 5 acre sites).
Factsheet	Consider developing a factsheet to accompany permit application to assist contractors with understanding permit regulations. We will consider this factsheet within 6 months of permit coverage.

4. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

   Building Official

E. MCM 5: Post-construction stormwater management

1. The Permit (Part III.D.5.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement and enforce a post-construction stormwater management program. Describe your current program:

   We will develop and adopt a post construction stormwater management ordinance to encourage the utilization of BMP's for strom water runoff from new and redevelopment projects, as well as to ensure the maintenance and operation of the existing stormwater BMP's.

2. Have you established written procedures for site plan reviews that you will conduct prior to the start of construction activity? ☒ Yes ☐ No

3. Answer **yes** or **no** to indicate whether you have the following listed procedures for documentation of post-construction stormwater management according to the specifications of Permit (Part III.D.5.c.):

   a. Any supporting documentation that you use to determine compliance with the Permit (Part III.D.5.a), including the project name, location, owner and operator of the construction activity, any checklists used for conducting site plan reviews, and any calculations used to determine compliance? ☐ Yes ☒ No

   b. All supporting documentation associated with mitigation projects that you authorize? ☐ Yes ☒ No

c. Payments received and used in accordance with Permit (Part III.D.5.a.(4)(f))? ☐ Yes ☒ No

d. All legal mechanisms drafted in accordance with the Permit (Part III.D.5.a.(5)), including date(s) of the agreement(s) and names of all responsible parties involved? ☐ Yes ☒ No

If you answered **no** to any of the above permit requirements, describe the steps that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met.

We will develop procedures to document our compliance with the new permit, mitigation projects authorized by the City, payments received and all legal mechanisms implemented through our post-construction stormwater management regulatory mechanism. This effort will be completed within 12 months after our permit coverage is extended.

4. List the categories of BMPs that address your post-construction stormwater management program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

Established BMP categories	Measurable goals and timeframes
Inspections to verify proper maintenance of stormwater BMP's	Annual inspections of 20% of completed City-owned BMP's
Ordinance regulating new projects	Consider the evaluation of past permits to determine how well they met or exceeded requirement.

BMP categories to be implemented	Measurable goals and timeframes
Update ordinance to meet new permit requirements	Within 12 months of extension of permit coverage, revise ordinance to meet permit requirements.
Develop written procedures for site plan review	Within 12 months of extension of permit coverage, develop site plan review procedures that must be completed prior to the start of construction activity.
Document pertinent information	Maintain all related documents pertaining to each new or redevelopment project in a more user-friendly filing system within 12 months of permit issuance.
BMP Construction Guidance	Develop BMP Construction Guidance documents for developers and contractors within 12 months of permit coverage extension. Distribute to developers who have pulled a permit in the past 3 years.

5. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

   Planning Director and Building Official

F. MCM 6: Pollution prevention/good housekeeping for municipal operations

1. The Permit (Part III.D.6.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement an operations and maintenance program that prevents or reduces the discharge of pollutants from the permittee owned/operated facilities and operations to the small MS4. Describe your current program:

   We currently inspect our structural control devices on an annual basis. The City inspects stockpiles, storage and material handling areas at the maintenance yard for potential discharges and maintenance of BMP's. The City will continue to evaluate the use of road salt for winter road maintenance activities. The City sweeps the streets in the fall and spring. Maintenance staff is trained on various topics related to pollution prevention during maintenance activities.

2. Do you have a facilities inventory as outlined in the Permit (Part III.D.6.a.)? ☐ Yes ☒ No

3. If you answered **no** to the above permit requirement in question 2, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

   We will evaluate our facilities inventory to determine if it is in compliance with the Permit. If not, a revised inventory will be completed within 12 months of the issuance of the permit.

4. List the categories of BMPs that address your pollution prevention/good housekeeping for municipal operations program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

   Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. For an explanation of measurable goals, refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (http://www.epa.gov/npdes/pubs/measurablegoals.pdf).

   If you have more than five categories, hit the tab key after the last line to generate a new row.

Established BMP categories	**Measurable goals and timeframes**
Street Sweeping	Twice a year
Inspect maintenance yard	After large rain events
Internal Training Programs	Training is made available where staff utilize training materials in their daily activities. Consider and research the ability to develop a pollution prevention workshop in the first year. Research the feasibility of the reduction in fertilizer and pesticide use in year two.

BMP categories to be implemented	**Measurable goals and timeframes**
Develop Spill Prevention and Control Plans for Municipal Facilities	Consider developing plans describing spill prevention and control procedures in year 1, develop the plans in year 2 and distribute materials to each facility by the end of year 2.
Facility Inventory	In year 1, develop a facility inventory of city-owned properties and buildings including the compost site. Update as necessary.
Pond Assessment Procedures and Schedule	In year 1, develop procedures for determining TSS and TP treatment effectiveness of city –owned ponds used for treatment of stormwater. Implement schedule in year 2-5.
Review Alternatives for Roadway Deicing	In year 1, examine cost effective alternatives to roadway salt applied to roadways.

5. Does discharge from your MS4 affect a Source Water Protection Area (Permit Part III.D.6.c.)? ☒ Yes ☐ No

   a. If **no**, continue to 6.

   b. If **yes**, the Minnesota Department of Health (MDH) is in the process of mapping the following items. Maps are available at http://www.health.state.mn.us/divs/eh/water/swp/maps/index.htm. Is a map including the following items available for your MS4:

      1) Wells and source waters for drinking water supply management areas identified as vulnerable under Minn. R. 4720.5205, 4720.5210, and 4720.5330? ☒ Yes ☐ No

      2) Source water protection areas for surface intakes identified in the source water assessments conducted by or for the Minnesota Department of Health under the federal Safe Drinking Water Act, U.S.C. §§ 300j – 13? ☒ Yes ☐ No

   c. Have you developed and implemented BMPs to protect any of the above drinking water sources? ☒ Yes ☐ No

6. Have you developed procedures and a schedule for the purpose of determining the TSS and TP treatment effectiveness of all permittee owned/operated ponds constructed and used for the collection and treatment of stormwater, according to the Permit (Part III.D.6.d.)? ☐ Yes ☒ No

7. Do you have inspection procedures that meet the requirements of the Permit (Part III.D.6.e.(1)-(3)) for structural stormwater BMPs, ponds and outfalls, and stockpile, storage and material handling areas? ☐ Yes ☒ No

8. Have you developed and implemented a stormwater management training program commensurate with each employee's job duties that:

   a. Addresses the importance of protecting water quality? ☐ Yes ☒ No

   b. Covers the requirements of the permit relevant to the duties of the employee? ☐ Yes ☒ No

   c. Includes a schedule that establishes initial training for new and/or seasonal employees and recurring training intervals for existing employees to address changes in procedures, practices, techniques, or requirements? ☐ Yes ☒ No

9. Do you keep documentation of inspections, maintenance, and training as required by the Permit (Part III.D.6.h.(1)-(5))? ☐ Yes ☒ No

   If you answered **no** to any of the above permit requirements listed in **Questions 5 – 9**, then describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

   We are currently examining methods for assessing ponds to determine TSS and TP effectiveness. A schedule will be determined in year 2-5. We will also re-evaluate employee/management training programs to ensure they address the importance of protecting water quality, cover the requirements of the duties of the employee, and include a training schedule.

10. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

    Public Works Director

VI. Compliance Schedule for an Approved Total Maximum Daily Load (TMDL) with an Applicable Waste Load Allocation (WLA) (Part II.D.6.)

A. Do you have an approved TMDL with a Waste Load Allocation (WLA) prior to the effective date of the Permit? ☐ Yes ☒ No

   1. If **no**, continue to section VII.

   2. If **yes**, fill out and attach the MS4 Permit TMDL Attachment Spreadsheet with the following naming convention**:** *MS4NameHere_TMDL.*

      This form is found on the MPCA MS4 website: http://www.pca.state.mn.us/ms4.

VII. Alum or Ferric Chloride Phosphorus Treatment Systems (Part II.D.7.)

A. Do you own and/or operate any Alum or Ferric Chloride Phosphorus Treatment Systems which are regulated by this Permit (Part III.F.)? ☐ Yes ☒ No

   1. If **no**, this section requires no further information.

   2. If **yes**, you own and/or operate an Alum or Ferric Chloride Phosphorus Treatment System within your small MS4, then you must submit the Alum or Ferric Chloride Phosphorus Treatment Systems Form supplement to this document, with the following naming convention: *MS4NameHere_TreatmentSystem*.

      This form is found on the MPCA MS4 website: http://www.pca.state.mn.us/ms4.

VIII. Add any Additional Comments to Describe Your Program

CHAPTER 21

ILLICIT DISCHARGE AND CONNECTION ORDINANCE

SECTION:

10-21-1: PURPOSE AND INTENT: The purpose of this ordinance is provide for the health, safety, and general welfare of the citizens of Sartell through the regulation of non-storm water discharges to the storm drainage system to the maximum extent practicable as required by federal and state law. This ordinance establishes methods for controlling the introduction of pollutants into the municipal separate storm sewer system (MS4) in order to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process. The objectives of this ordinance are:

A. To regulate the contribution of pollutants to the municipal separate storm sewer system (MS4) by stormwater discharges by any user,

B. To prohibit Illicit Connections and Discharges to the municipal separate storm sewer system, and

C. To establish legal authority to carry out all inspection, surveillance, enforcement, and monitoring procedures necessary to ensure compliance with this ordinance.

10-21-2: DEFINITIONS:

ACCIDENTAL DISCHARGE: means a discharge prohibited by this ordinance and without planning or thought prior to occurrence.

AUTHORIZED ENFORCEMENT AGENCY: employees or designees of the City of Sartell designated to enforce this ordinance.

BEST MANAGEMENT PRACTICES (BMPs): schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

CLEAN WATER ACT: the Federal Water Pollution Control Act (33 U.S. C. § 1251 et seq.), and any subsequent amendments thereto.

CONSTRUCTION ACTIVITY: Activities subject to the NDPES Construction Permits. Currently these include construction projects resulting in land disturbance of 1 acre or more. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

HAZARDOUS MATERIALS: Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

ILLICIT DISCHARGE: Any direct or indirect non-storm water discharge to the storm drain system, except as exempted in Section 7 of this ordinance.

ILLICIT CONNECTIONS: An illicit connection is defined as either of the following:
Any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge including sewage, process wastewater, and wash water to enter the storm drain system, including any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by an authorized enforcement agency or, Any drain or conveyance connected from a commercial or industrial land use to the storm drain system which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

INDUSTRIAL ACTIVITY: Activities subject to NDPES Industrial Permits as defined in 40 CFR, Section 122.26 (b)(14).

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4): A stormwater conveyance or unified stormwater conveyance system (including without limitation: roads with drainage systems, municipal streets, catch basins, stormwater detention facilities, curbs, gutters, ditches, natural or man-made channels, or storm drains), that:

A. Is located within the corporate limits of Sartell, MN; and
B. Is owned or operated by the State, County, the City, or other public body; and
C. Discharges to Waters of the State and/or United States, excluding publicly owned treatment works, and lawful connections thereto, which in turn discharge into the Waters of the State and/or United States.

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT: Any permit or requirement enforced pursuant to the clean water act as amended for the purposes of regulating storm water discharge.

NON-STORM WATER DISCHARGE: Any discharge to the storm drain system that is not composed entirely of storm water.

PERSON: means any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner or as the owner's agent.

POLLUTANT: Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects, ordinances, and accumulations, so that same may cause or contribute to pollution; floatables, pesticides, herbicides; hazardous substances and wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; and noxious or offensive matter of any kind.

POLLUTION: Man-made or man-induced alteration of the chemical, physical, biological, thermal, and/or radiological integrity of water.

PREMISES: Any buildings, lot, parcel of land or portion or land whether improved or unimproved including adjacent sidewalks and parking strips.

STORM DRAINAGE SYSTEM: Publicly-owned facilities by which storm water is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage channels, reservoirs, and other drainage structures.

STORM WATER: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

STORMWATER POLLUTION PREVENTION PLAN (SWPPP): A document which describes the Best Management Practices and activities to be implemented by a person or business to identify sources of pollution or contamination at a site and the actions to eliminate or reduce pollutant discharges and/or Receiving Waters to the Maximum Extent Practicable.

WASTEWATER: any water or other liquid, other than uncontaminated storm water, discharged from a facility.

WATERCOURSES: any natural or engineered wetland, raingarden, river, lake, ditch.

WATERS OF THE STATE AND/OR UNITED STATES: All water bodies regulated by the State and/or United States including streams, lakes, ponds, wetlands, marshes, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations or water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state of Minnesota or any portion thereof, or which may be susceptible to use in interstate or foreign commerce.

10-21-3: APPLICABILITY: This ordinance shall apply to all water entering the storm drain system generated on any developed and undeveloped lands unless explicitly exempted by an authorized enforcement agency.

10-21-4: RESPONSIBILITY FOR ADMINISTRATION: The City of Sartell shall administer, implement, and enforce the provisions of this ordinance. Any powers granted or duties imposed upon the authorized enforcement agency may be delegated in writing by the Director of the authorized enforcement agency to persons or entities acting in the beneficial interest of or in the employ of the agency.

10-21-5: SEVERABILITY: The provisions of this ordinance are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this Ordinance or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or applications of this Ordinance.

10-21-6: ULTIMATE RESPONSIBILITY: The standards set forth herein and promulgated pursuant to this ordinance are minimum standards: therefore this ordinance does not intend nor imply that compliance by any person will ensure that there will be no contamination, pollution, nor unauthorized discharge of pollutants.

10-21-7: DISCHARGE PROHIBITIONS: Prohibition of Illicit Discharges. No person shall discharge or cause to be discharged into the municipal storm drain system or watercourses any materials, including but not limited to pollutants or waters containing any pollutants that cause or contribute to a violation of applicable water quality standards, other than storm water. The commencement, conduct or continuance of any illicit discharge to the storm drain system is prohibited except as described as follows:

A. The following discharges are exempt from discharge prohibitions established by this ordinance: water line flushing or other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising

ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, non-commercial washing of vehicles, natural riparian habitat or wet-land flows, swimming pools (if chlorinated – typically less than one PPM chlorine), fire fighting activities, and any other water source not containing Pollutants.

B. Discharges specified in writing by the authorized enforcement agency as being necessary to protect public health and safety.
C. Dye testing is an allowable discharge, but requires a verbal notification to the authorized enforcement agency prior to the time of the test.
D. The prohibition shall not apply to any non-storm water discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal Environmental Protection Agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the storm drain system.

Prohibition of Illicit Connections.

A. The construction, use, maintenance or continued existence of illicit connections to the storm drain system is prohibited.
B. This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection.
C. A person is considered to be in violation of this ordinance if the person connects a line conveying sewage to the MS4, or allows such a connection to continue.

10-21-8: SUSPENSION OF MS4 ACCESS:

A. Suspension due to Illicit Discharges in Emergency Situations: The City of Sartell may, without prior notice, suspend MS4 discharge access to a person when such suspension is necessary to stop an actual or threatened discharge which presents or may present imminent and substantial danger to the environment, or to the health or welfare of persons, or to the MS4 or Waters of the State and/or United States. If the violator fails to comply with a suspension order issued in an emergency, the authorized enforcement agency may take such steps as deemed necessary to prevent or minimize damage to the MS4 or Waters of the State and/or United States, or to minimize danger to persons.

B. Suspension due to the Detection of Illicit Discharge: Any person discharging to the MS4 in violation of this ordinance may have their MS4 access terminated if such termination would abate or reduce an illicit discharge. The authorized enforcement agency will notify a violator of the proposed termination of its MS4 access. The violator may petition the authorized enforcement agency for a reconsideration and hearing.

   A person commits an offense if the person reinstates MS4 access to premises terminated pursuant to this Section, without the prior approval of the authorized enforcement agency.

10-21-9: INDUSTRIAL OR CONSTRUCTION ACTIVITY DISCHARGES: Any person subject to an industrial or construction activity NPDES storm water discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the City of Sartell prior to the allowing of discharges to the MS4.

10-21-10: MONITORING OF DISCHARGES:

A. Applicability: This section applies to all facilities that have storm water discharges associated with industrial activity, including construction activity.

B. Access to Facilities

1. The City of Sartell shall be permitted to enter and inspect facilities subject to regulation under this ordinance as often as may be necessary to determine compliance with this ordinance. If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to representatives of the authorized enforcement agency.

2. Facility operators shall allow the City of Sartell ready access to all parts of the premises for the purposes of inspection, sampling, examination, and copying of records that must be kept under the conditions of an NPDES permit to discharge storm water, and the performance of any additional duties as defined by state and federal law.

3. The City of Sartell shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the authorized enforcement agency to conduct monitoring and/or sampling of the facility's storm water discharge.

4. The City of Sartell has the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the discharger at its own expense. All devices used to measure stormwater flow and quality shall be calibrated to ensure their accuracy.

5. Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the City of Sartell and shall not be replaced. The costs of clearing such access shall be borne by the operator.

6. Unreasonable delays in allowing the City of Sartell access to a permitted facility is a violation of a storm water discharge permit and of this ordinance. A person who is the operator of a facility with a NPDES permit to discharge storm water associated with industrial activity commits an offense if the person denies the authorized enforcement agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this ordinance.

7. If the City of Sartell has been refused access to any part of the premises from which stormwater is discharged, and he/she is able to demonstrate probable cause to believe that there may be a violation of this ordinance, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this ordinance or any order issued hereunder, or to protect the overall public health, safety, and welfare of the community, then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction.

10-21-11: REQUIREMENTS TO PREVENT, CONTROL, AND REDUCE STORM WATER POLLUTANTS BY THE USE OF BEST MANAGEMENT PRACTICES: The City of Sartell endorses the MPCA's requirements identifying Best Management Practices for any activity, operation, or facility which may cause or contribute to pollution or contamination of storm water, the storm drain system, or waters of the State and/or United States. The owner or operator of a commercial or industrial establishment shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the municipal storm drain system or watercourses through the use of these structural and non-structural BMPs. Further, any person responsible for a property or premise, which is, or may be, the source of an illicit discharge, may be required to implement, at said person's expense, additional structural and non-structural BMPs to prevent the further discharge of pollutants to the municipal separate storm sewer system. Compliance with all terms and conditions of a valid NPDES permit authorizing the discharge of storm water associated with industrial activity, to the extent practicable, shall be deemed compliance with the provisions of this section. These BMPs shall be part of a stormwater pollution prevention plan (SWPPP) as necessary for compliance with requirements of the NPDES permit.

10-21-12: WATERCOURSE PROTECTION: Every person owning property through which a watercourse passes, or such person's lessee, shall keep and maintain that part of the watercourse within the property free of trash, debris, excessive vegetation, and other obstacles that would pollute, contaminate, or significantly retard the flow of water through or infiltrate within the watercourse. In addition, the owner or lessee shall maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse.

10-21-13: NOTIFICATION OF SPILLS: Notwithstanding other requirements of law, as soon as any person responsible for a facility or operation, or responsible for emergency response for a facility or operation has information of any known or suspected release of materials which are resulting or may result in illicit discharges or pollutants discharging into storm water, the storm drain system, or water of the State and/or United States said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of hazardous materials said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify the authorized enforcement agency in person or by phone or facsimile no later than the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the Public Works Director, City of Sartell within three business days of the phone notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

10-21-14: ENFORCEMENT:

A. Notice of Violation: Whenever the City of Sartell finds a person has violated a prohibition or failed to meet a requirement of this Ordinance, the authorized enforcement agency may order compliance by written notice of violation to the responsible person. Such notice may require without limitation:

    1. Monitoring, analyses, and reporting;
    2. Elimination of illicit connections or discharges;
    3. Abatement of pollution and hazards;
    4. Restoration of affected property;
    5. Payment of fine to cover administrative and remediation costs;
    6. Implementation of source control or treatment BMPs; and
    7. Other actions as deemed necessary by the City.

B. If abatement of a violation and/or restoration of affected property is required, the notice shall set forth a deadline within which such remediation or restoration must be completed. Said notice shall further advise that, should the violator fail to remediate or restore within the established deadline, the work will be done by a designated governmental agency or a contractor and the expense thereof shall be charged to the violator.

10-21-15: INJUNCTIVE RELIEF: It shall be unlawful for any person to violate any provision or fail to comply with any of the requirements of this Ordinance. If a person has violated or continues to violate the provisions of this ordinance, the authorized enforcement agency may petition for a preliminary or permanent injunction restraining the person from activities which would create further violations or compelling the person to perform abatement or remediation of the violation.

10-21-16: COMPENSATORY ACTION: In lieu of enforcement proceedings, penalties, and remedies authorized by this Ordinance, the authorized enforcement agency may impose upon a violator alternative compensatory actions, such as storm drain stenciling, attendance at compliance workshops, creek cleanup, etc.

10-21-17: VIOLATIONS DEEMED A PUBLIC NUISANCE: In addition to the enforcement of processes and penalties provided, any condition caused or permitted to exist in violation of any of the provisions of this Ordinance is a threat to public health, safety, and welfare, and is declared and deemed a nuisance, and may be summarily abated or restored at the violator's expense, and/or a civil action to abate, enjoin, or otherwise compel the cessation of such nuisance may be taken.

10-21-18: CRIMINAL PROSECUTION: Any person that has violated or continues to violate this ordinance shall be liable to criminal prosecution to the fullest extent of the law. The enforcement agency may recover all attorney's fees court costs and other expenses associated with enforcement of this ordinance, including sampling and monitoring expenses.

10-21-19: REMEDIES NOT EXCLUSIVE: The remedies listed in this ordinance are not exclusive of any other remedies available under any applicable federal, state or local law and it is within the discretion of the authorized enforcement agency to seek cumulative remedies.

CHAPTER 20
ENVIRONMENTAL ORDINANCE
EROSION AND SEDIMENT CONTROL ORDINANCE
SECTION:

10-20-1: Intent, Purpose: During the construction (roadway, utility and building) process, soil is highly vulnerable to erosion by wind and water. Eroded soil endangers water resources by reducing water quality and causing the siltation of aquatic habitat for fish and other desirable species. Eroded soil also necessitates repair of sewers and ditches and the dredging of lakes.
As a result, the purpose of this local regulation is to safeguard persons, protect property, and prevent damage to the environment in the City of Sartell. This ordinance will also promote the public welfare by guiding, regulating, and controlling the design, construction, use and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land in the City of Sartell.

10-20-2: Definitions
Certified Contractor: A person who has received training to inspect and maintain erosion and sediment control practices.
Clearing: Any activity that removes ground cover and exposes topsoil material.
Drainage way: Any channel that conveys surface runoff throughout the site.
Erosion Control: A measure that prevents soil particle exposure and detachment.
Erosion and Sediment Control Plan: Otherwise known as a storm water pollution prevention plan (SWPPP) which is a set of plans prepared by or under the direction of a licensed professional engineer or certified contractor indicating the specific measures and sequencing to be used to control the sediment and erosion on a development site during and after construction.
Grading: Excavation or fill of material.
Perimeter Control: A barrier that prevents sediment from leaving a site by filtering sediment-laden runoff or diverting it to a sediment trap or basin.
Sediment Control: Measures that prevent eroded sediment from leaving the site.
Site: A parcel of land or a contiguous combination thereof, where grading work is preformed as a single unified operation.
Land Disturbing: Any project or activity, including excavations, clearing and grading that directly or indirectly affects slopes, water bodies or the moving of ground cover**.**
Land Disturbance Permit: A permit issued by the City for the construction or alteration of ground cover improvement and structures for the control of erosion, runoff and grading.
Primary Structure: A structure in which a principal use of the lot on which the structure is located is conducted.
Stabilization: The use of practices that prevent exposed soil from eroding. Otherwise known as Best Management Practices (BMP's)
Start of Construction: The first land disturbing activity associated with a development, including land preparation such as ground clearing (grubbing), grading, and filling. Installation of streets and walkways,

excavation for basements, footings, piers or foundations; erection of temporary forms; and installation of accessory buildings such as garages.

10-20-3: Required Land Disturbance Permits:

A. Residential, Commercial and Industrial Site Construction Plans. All persons wishing to start a land disturbance project on an existing lot of record (see Section 11, Chapter 3 of the Subdivision Code), for the purposes of the construction of a residential, commercial or industrial primary structure, shall submit a Land Disturbance Permit at the time of obtaining a building permit. See also Chapter 9, General Regulations on grading/drainage protection.

B. Roadway and Utility Installation Construction Plans. All persons wishing to start a land disturbance project on an existing lot of record (see Section 11, Chapter 3 of the Subdivision Code), for the purposes of the construction of any roadway or utilities, shall submit a Land Disturbance Permit to the City Engineer at the time of roadway and utility plan.

C. Any Persons wishing to disturb any land greater than one acre prior to the City approving a final plat and final grading plan for the property may submit an application for a conditional use permit.

D. The following activities are not required to obtain a Land Disturbance Permit:

1. Any emergency activity that is immediately necessary for the protection of life, property, or natural resources.
2. Existing nursery, as long as the activity does not exceed 43,560 square feet (one acre) and agricultural operations conducted as a permitted main or accessory use.

10-20-4: Land Disturbance Permit Process and Data Requirements

A. Residential, Commercial and Industrial Site Construction Plans. An application and applicable application fee for a land disturbance permit for each property, which has been platted, shall be filed with the Building Inspector on an approved form and accompanied documents.

B. Roadway and Utility Installation Construction Plans. An application for a land disturbance permit for property has been platted shall be filed with the City Engineer on an approved form and accompanied documents.

C. Each application shall bear the name(s) and address (es) of the owner or developer of the site, and of any consulting firm retained by the applicant together with the name of the applicant's principal contact at such firm and shall be accompanied by an application fee as set by the Ordinance, Storm Water Pollution Prevention Plan and outlined in section 10-20-5.

D. The City of Sartell's building department will review each residential, commercial and industrial land disturbance permit application for site construction (which shall include a site drawing of all structures and stabilization methods) to determine its conformance with the provisions of this regulation. The City of Sartell's engineering department will review each roadway and utility land disturbance permit application for site construction to determine its conformance with the provisions of this regulation. Most land disturbance permits for building site plans will be issued within the same time period as the building permit. Within 60 days of the receipt of a roadway and utility land disturbance permit application, unless extended to 120 days or waived by the applicant, the City of Sartell shall in writing:

1. Approve the permit applications;
2. Approve the permit application subject to such reasonable conditions as may be necessary to secure substantially the objectives of this regulation, and issue the permit subject to these conditions; or
3. Disapprove the permit applications, indicating the reason(s) and procedure for submitting a revised application and/or submission.

E. Failure of the City of Sartell to act on an original or revised Land Disturbance Permit application within 60 days of receipt shall authorize the applicant to proceed in accordance with the plans as filed unless such time is extended by agreement between the applicant and the City of Sartell. Pending preparation and approval of a revised plan, development activities shall be allowed to proceed in accordance with the conditions established by the City of Sartell.

10-20-5: Storm Water Pollution Prevention Plan

A. The Storm Water Pollution Prevention Plan (Erosion and Sediment Control Plan) shall be consistent with the requirements as established and utilized by the Minnesota Pollution Control Agency and include the following:

1 A sequencing of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation of temporary erosion and sediment control measures, and establishment of permanent vegetation.

2. All erosion and sediment control measures necessary to meet the objectives of this local regulation throughout all phases of construction and after completion of development of the site. Grading, erosion control practices, sediment control practices, and waterway crossing shall be designed to adequately prevent the transportation of sediment from the site to the satisfaction of the intent and purpose of this ordinance. Depending upon the complexity of the project, the drafting of intermediate plans may be required at the close of each session. At a minimum, the following shall be automatically implemented:

a. Silt fencing or other sediment control practices shall be installed on all down gradient perimeters prior to the release of a building permit.

b. Rock mixture (as specified by the City Engineer and as recommended by the Minnesota Pollution Control Agency (MPCA) in its publication Protecting Water Quality in Urban Areas) shall be placed at the entrance to prevent sediment tracking.

B. Modifications to the plan shall be processed and approved or disapproved in the same manner as Section 10-20-4 of this regulation, may be authorized by the City of Sartell by written authorization to the permitee, and shall include:

1. Major amendments of the land disturbance permit or storm water pollution prevention plan submitted to the City of Sartell. Major amendments include a change in structure location and drainage patterns.

10-20-7 Stabilization Design

A. Stabilization and use of Best Management Practices shall be in accordance with approved BMP's as recommended by the Minnesota Pollution Control Agency (MPCA) in its publication Protecting Water Quality in Urban Areas, or as amended and approved by the City by policy.

B. Erosion control requirements shall include the following:

1. Soil stabilization shall be completed within 7 days of clearing or inactivity in construction.
2. If seeding or another erosion control measure is used, it shall become established within three weeks or the City of Sartell may require the site to be reseeded or a no vegetative option employed.
3. Soil stockpiles must be stabilized or covered at the frequency as all other stabilization activities.

4. The entire site must be stabilized, using a heavy mulch layer or another method that does not require germination to control erosion.

5. Techniques shall be employed to prevent the blowing of dust or sediment from the site to the maximum extent possible.

6. Technique that diverts upland runoff past disturbed slopes shall be employed to the maximum extent possible.

7. Other best management principals in order to ensure that sediment is not tracked onto public streets by construction vehicles or washed into storm drains such as rock construction entrances.

8. Removal of all debris, dirt and soil from impervious ground surfaces, including abutting public or private roadways and sideways, sediment basins, catch basins and in connection with the subject property,

10-20-8 Inspection:
A. The City Engineer and/or Building Inspector or designated agent shall make inspections as hereinafter required and either shall approve that portion of the work completed or shall notify the permittee wherein the work fails to comply with the Storm Water Pollution Prevention Plan as approved. Plans for grading, stripping, excavating and filling work bearing shall be maintained at the site during the progress of the work.

B. The permittee or his/her agent shall make regular inspections of all control measures once every seven (7) days during active construction and within 24 hours after a rainfall event greater than .5 inches in 24 hours. The purpose of such inspections will be to determine the overall effectiveness of the control plan and the need for additional control measures. All inspections shall be documented in written form and available upon request to the City Engineer and/or Building Inspector.

C. The City Engineer and/or the Building Inspector or designated agent shall enter the property of the applicant as deemed necessary to make regular inspections to ensure the validity and compliance of the permit filed.

10-20-9: Enforcement

A. Compliance required. The applicant shall implement and comply with the land disturbance permit prior to and during any construction of land disturbing activity under the land-disturbing permit. All stabilization measures shall be implemented and maintained until all grading, excavation and construction work has ended.

B. Stop-Work Order: Revocation of Permit. In the event that any person holding a land disturbance permit pursuant to this ordinance violates the terms of the permit and in found non-compliant with the permit or implements site development construction practices in such a manner as to materially adversely affect the health, welfare, or safety of persons residing or working in the neighborhood or development site so as to be materially detrimental to the public welfare or injurious to property or improvements in the neighborhood, the City of Sartell may suspend or revoke the site development permit. The City shall serve upon the property manager, or other responsible persons and by US Mail, notice of the violation of the approved Land Disturbance Permit.

C. Violation and Penalties. No person shall construct, enlarge, alter, repair or maintain any grading, excavation, or fill or cause the same to be done, contrary to or in violation of any terms of this ordinance. Any person violating any of the provisions of this ordinance shall be deemed quality of a misdemeanor and each day during which any violation of any of the provisions of his ordinance is committed, continued, or permitted, shall constitute a separate offence. Upon conviction of any such violation, a fine to be determined by the City of Sartell for each offense shall punish such person, partnership or corporation. In addition to any other penalty authorized by this section, any person, partnership, or corporation convicted of violating any of the provisions of this ordinance shall be required to bear the expense of such restoration.

CHAPTER 17
SITE DESIGN STANDARDS
SECTION:
10-17 1: Purpose and Intent
10-17-3: Screening Requirements
10-17-4: Site Lighting
10-17-5: Site Signage
10-17-6: Site Drainage, Street and Utility Requirements
10-17-7: Site Parking Requirements
10-17-8: Site Landscaping Requirements

10-17-1: PURPOSE AND INTENT: It is the intent of this section to promote consistent and high standards of design and construction for the commercial, public, and industrial uses in the City. These standards are set forth in order to enhance the visual appearance of the commercial, public and industrial areas within the City. This section is to ensure the high quality of development, redevelopment, and compatibility with evolving architectural or planning themes that contribute to a community image of quality. Site plans will be required for any development other than a single family home in any zoning district. Each site plan where land use is business, residential (with the exception of single family units)or industrial in nature must conform to the following standards and demonstrated in each site plan application.

10-17-2: **SCREENING REQUIREMENTS:** The screening requirements contained in this section shall be satisfied in addition to other screening and landscaping requirements of the Sartell Zoning Code.
A. Rooftop and Perimeter Utilities Screening: All mechanical equipment located on the roof or around the perimeter of the building shall be screened as to not be seen by view on the property line by the following means and with materials that are comparable and compatible with that of the exterior building materials. If due to factors unique to the property or the project, it is physically impossible or impractical to screen these utilities, the City Council, may approve alternative solutions that render them aesthetically compatible with the principal structure.
1. A raised parapet or other architectural feature that is an integral part of the building as a method of screening for rooftop mechanical equipment or to soften the rooftop view.
2. Screening for rooftop mechanical equipment shall incorporate similar architectural features of the building and/or be constructed of a material and color compatible with other elements of the building.
B. Loading Dock and Garage Entrance Screening (Residential, Industrial and Commercial): Loading docks and garage entrances and exits shall be prohibited in the front yard. However, where allowed, they shall be screened to minimize visibility from any public street, from adjacent building structures front or side yard viewing point, and away from any residential uses through the following means.

1. Planting screens shall consist of healthy, hardy plant materials at least 4 to 6 feet in height and an 80% opaqueness at the time of maturity. Berms shall be a minimum of 3 feet in height and shall have a maximum slope ratio of 3:1. See also Section 10, Chapter 12-4.
2. Screen fences that are in disrepair shall be repaired. Planting screens shall be maintained in a neat and healthful condition. Plantings that have died shall be promptly replaced.

Waste Handling Screening: All waste, recycling and related handling equipment shall be stored and kept in a four sided enclosure constructed of a brick, stone, decorative concrete material or a material compatible with the material of the principle structure. Any changes to trash handling once the building is constructed shall comply with City Codes, ordinances, standards and policies. (i.e. new tenants).
D. Outdoor Storage: No storage trailers allowed. All storage shall be screened, except for the following:
1. Merchandise being displayed for sale in accordance with the zoning districts requirements.
2. Materials and equipment currently being used for construction on the premises.
F. Parking Area/Lot Screening: All areas of land other than that occupied by building and improved surfaces (parking areas and driveways) shall be landscaped by a licensed landscape architect and follow the provisions set forth in Section 10, chapter 12 and Section 10, Chapter 10 of the Sartell Zoning Ordinance, in addition to the following requirements:

1. In addition to Section 10, Chapter 12, Subsection 5-6, Parking lots shall be screened from the public right-of-way. Screening shall consist of the berming that is 3 feet in height and shall have a maximum slope ratio of 3:1.
2. Landscape plans and screening plantings shall be completed within one year from the date of the certificate of occupancy. All plantings shall be maintained in a neat and healthful condition. All plantings that have died shall be promptly replaced.
G. Buffer Zone:
1. Abuts R-1, R-2 or R-3, CDZ or PUD residential District or use: Where a business development abuts upon Residential District or use, or is separated from such residential district or use only by an alley, there shall be a protective strip of not less than twenty-five feet (25') in width established as a buffer zone. This buffer zone shall contain no structures, shall not be used for parking, off-street loading or storage and shall be landscaped. The landscape treatment shall contain a compact evergreen hedge or fence, but such hedge or fence shall not extend with fifteen feet (15') of a street right of way. The planting or fence design must be approved by the Zoning Administrator as being in harmony with a residential neighborhood and providing sufficient screening of the commercial area. The hedge or fence shall not be less than four feet (4') and not more than six feet (6') in height.

2. Abuts R-4 District: Where a business development (B-1 or B-2) abuts an R-4 District, there shall be a buffer strip at least fifteen feet (15') wide screened in accordance with subsection G1 of this Section.

10-17-4: SITE LIGHTING:
A. In All Districts: Any lighting used to illuminate an off-street parking area, sign, structure, or other area shall be arranged so as to deflect light away from any adjoining property or from the public streets. Direct or sky-reflected glare, from high temperature processes such as combustion, shall not be directed into any adjoining property. All luminaries shall be full cut off style lens and shall be parallel with the pavement and ground, except for decorative fixtures and ground mounted lighting, which shall be permitted. Any light or combination of light shall not exceed 0.5 foot candles (meter reading) as measured at any property line.

B. Exemptions: The provisions of this section shall not apply to the following:

1. Temporary outdoor lighting used during customary holiday seasons.
2. Temporary outdoor lighting used for civic celebrations and promotions.
3. Emergency lighting by police, fire, and rescue authorities.

4. Outdoor recreational uses, such as, but not limited to, baseball fields, football fields, hockey rinks, and tennis courts. No outdoor recreation facility shall be illuminated from 11 PM to 7AM, unless it meets 10-17-4:A.

C. Lighting Plan: Except for single family dwellings, plans for required parking lot and security lighting shall be approved by Zoning Administrator prior to approvals for or the issuance of permits for the activities requiring compliance under subdivision of this section. The plans, at appropriate scale, shall be based on accurate, approved final site plans and shall include the following information:
1. Layout of proposed luminaries locations.

2. Photometric Plan.

3. Location and uses of adjacent properties.

4. Cut sheets that provide a description of the luminaries, including glare reduction/control devices, lamps, on-off cycle control devices and mounting devices.

5. Statement of proposed hours.

D. Inspection of Lighting: As part of the subdivision process, the City will conduct a post-installation inspection of lighting installations to ensure compliance with the ordinance requirements, and may require, at the City's discretion, any corrective action for any lighting installation that fails to meet ordinance –cited safety, and or security luminance criteria, or that produces unacceptable levels of light trespass, light pollution and/or glare.

10-17-5: SITE SIGNAGE: A signage plan must be submitted as part of the site plan review process, which provides diagrams, and proposed materials of the signage to be installed within the site. The Sign must conform to the requirements set forth in Section 10. Chapter 11 of the Sartell Zoning Ordinance.

10-17-6: SITE DRAINAGE, STREET AND UTILITY REQUIREMENTS: At the time of a site plan application, the applicant must provide a detailed drainage and utility plan for the site. At a minimum the plan must identify the existing and proposed two foot topographic contours, streets and street rights of ways, easements, storm water management ponds, drainage ditches and drainage patterns. The application must also provide a detailed drainage analysis including a storm water run-off model and a grading plan showing the finished grade elevations for the site. A copy of the MPCA Stormwater Pollution Prevention Plan shall be submitted to the City at the time of a site plan application. A land disturbance permit shall be submitted at the time of a building permit.

10-17-7: ADDITIONS AND ALTERATIONS: All subsequent additions and exterior alterations constructed after the erection of an original building or buildings shall be of the same materials as those used in the original building and shall be designed in a manner conforming to the original architectural concept and general appearance.

10-17-8: SITE PARKING REQUIREMENTS: The parking requirements contained in Section 10, Chapter 10 of the Sartell Zoning Ordinance shall be satisfied in each site plan.

10-17-9: LANDSCAPING REQUIREMENTS: The landscaping Requirements contained in Section 10, Chapter 12, of the Sartell Zoning Ordinance shall be satisfied in each site.

Appendix B

Pond Prioritization

APPENDIX B

City of Sartell Pond Assessment Worksheet

Date: 10/2/2018

MPCA Estimator			
MPCA Estimator Land use	**Land use**	**TSS (lbs/yr/ac)**	**TP (lbs/yr/ac)**
Open Space	Woods, Brush, Meadow	245	0.17
Open Space	Open Space Landscaped	245	0.17
Commercial	Commercial/Industrial	1119	1.39
Low Density Res	Low Density Res.	312	0.95
Med. Density Res.	Med. Density Res.	367	1.11
High Density Res.	High Density Res.	404	1.22
Commercial	Impervious Areas	1119	1.39
Open Space	Agricultural	245	0.17

Pounds of Sediment Conversions to Volume of Sediment		
1 pound of sediment =	**0.01281**	**cf**
USDA Bulk Density of Sandy Clay Loam =	1.25	g/cc
USDA Bulk Density of Sandy Clay Loam =	78.04	lbs/cf
1 cf =	28317	cc
1 lb =	453.59	g

COLOR KEY	
	Pond Assessment Ranking
	Calculated Value
	Input Data
	Smart Connect Data
	XPswmm Model Data
	Record Drawing Data
	Educated Estimate
XXXXXX	NEED UPDATING

SARTELL POND SUMMARY & ASSESSMENT

PONDS LISTED IN ORDER OF INSPECTION/EVALUATION PRIORITY

																	RANK PRIORITY LEVEL				
																	Listed in Order of Priority Level				
																	1	2	3	4	
					CONTRIBUTI	TSS ANNUAL	TP ANNUAL	POND CHARACTERISTICS													
SMART CONNECT FACILITY ID	**MODELLING FACILITY ID**	**DESCRIPTION/DEVELOPMENT NAME**	**YEAR CONSTRUCTED**	**ULTIMATE RECEIVING WATER**	**TOTAL (ACRE)**	**TSS ANNUAL LOAD (lbs/yr)**	**TP ANNUAL LOAD (lbs/yr)**	**POND AREA (ACRE)**	**BOTTOM ELEVATION**	**NWL / OUTLET ELEVATION**	**SURFACE OVERFLOW ELEV**	**H_NWL (FT)**	**DEAD STORAGE (CF)**	**YEARS IN SERVICE**	**LAST YEAR INSPECTED**	**LAST YEAR OF MAJOR MAINTENANCE**	**INSPECTION / MAINTENANCE NOTES**	**PUBLIC WORKS / PUBLIC CONCERN**	**AGE 0-4yr = 5 5 to 9yr = 4 10 to 14yr = 3 15 to 19yr = 2 20+ years = 1**	**SEDIMENT ACCUMULATION CONCERN (1=HIGH, 3=LOW)**	**ASTHETICS RATING (1=HIGH, 3=LOW)**	**SMART CONNECT FACILITY ID**
77	P77	SABER OAKS	1996	Watab River	11.220	4083	12.19	0.115	1,034.80	1,037.10	1,037.50	2.30	2,649	22	2009	2003	Cleaned, shallow & does not drain	X	2	1	3	77
78	P78	OAK POND DR	2001	Mississippi River	17.629	6895	18.02	0.722	1,062.00	1,065.88	1068	3.88	28,051	17	2009			X	2	2	3	78
82	P82	STONEBROOK ESTATES	2003	Mississippi River	26.900	9593	27.70	2.528	1,029.00	1,032.00	1,037.00	3.00	75,942	15	2009			X	2	3	3	82
84	P84	PINE TREE POND PLAT 4	1996	Watab River	11.671	4283	12.95	0.119	1,029.00	1,030.99	1,033.00	1.99	2,371	22	2009	2008	Cleaned	X	3	1	2	84
51	P51	SAVANNA OAKS 1ST ADDITION	2006	Mississippi River	33.976	11140	27.47	1.449	1,033.71	1,038.50	1,042.00	4.79	69,500	12	2010			X	3	2	2	51
1	P1	GREAT RIVER BOWL 2	1994	Mississippi River	6.140	5796	7.03	0.119	1,045.10	1,046.30	1054	1.20	1,430	24					1	1	3	1
80	P80	SABER OAKS	1996	Watab River	54.088	31227	62.89	0.748	1,035.00	1,037.00	1042	2.00	14,980	22	2008				1	1	3	80
90	P90	PINE TREE POND	1992	Watab River	9.565	3510	10.62	0.262	1,035.28	1,035.28	1,038.00	3.00	7,871	26	2008				1	2	3	90
104	P104	MORNINGSTAR PLAT 02	1992	Mississippi River	25.028	9185	27.78	0.789	1,028.50	1,031.90	1,036.00	3.40	26,862	26	2008				1	2	3	104
97	P97	THE WOODS	1998	Watab River	20.320	7457	22.55	0.705	1,034.00	1,038.00	1040	4.00	28,238	20	2008				1	2	3	97
71	P71	HUNTINGTON RIDGE PLAT 4	1998	Mississippi River	40.841	13911	35.63	1.567	1,026.00	1,031.00	1,037.00	5.00	78,455	20	2008				1	2	3	71
91	P91	PINE TREE POND	1992	Mississippi River	1.545	567	1.71	0.138	1,034.93	1,034.93	1038	3.00	4,146	26	2008				1	3	3	91
79	P79	OAK POND DR	1998	Mississippi River	14.333	5535	16.73	1.093	1,058.10	1,062.10	1,067.00	4.00	43,779	20	2009				1	3	3	79
101	P101	THE WILDS	1998	Watab River	44.061	17261	49.03	3.538	1,031.00	1,035.40	1039	4.40	155,881	20	2008				1	3	3	101
98	P98	THE WILDS	1998	Watab River	13.840	5550	14.89	1.677	1,031.00	1,034.65	1,038.00	3.65	61,293	20	2008				1	3	3	98
69	P69	TWIN RIVERS RIDGE 2ND SUBDIVISION	2000	Mississippi River	5.030	4669	5.65	0.503	1,034.29	1,037.29	1,042.00	3.00	15,110	18	2008				2	2	1	69
70	P70	PINECONE RD	2002	Mississippi River	99.291	29196	23.68	1.385	1,032.00	1,039.00	1050	7.00	97,080	16	2008				2	2	1	70
100	P100	THE WILDS PLAT 3	2002	Watab River	59.227	15177	15.20	0.593	1,031.00	1,034.00	1,036.00	3.00	17,814	16	2009				2	2	2	100
87	P87	ROLLING MEADOWS	1999	Watab River	30.129	11014	33.11	0.671	1,025.00	1,030.50	1035	5.50	36,954	19	2008				2	2	2	87
73	P73	BRIDGEPORT	1999	Mississippi River	19.319	7088	21.43	0.744	1,024.00	1,029.00	1,035.00	5.00	37,250	19	2008				2	2	2	73
105	P105	BLACKBERRY RIDGE ESTATES PLAT 4	2003	Mississippi River	52.451	17059	41.35	0.666	1,081.00	1,085.00	1089	4.00	26,676	15	2009				2	2	3	105
94	P94	CORRINE CREEK	1999	Watab River	8.352	3059	9.23	0.268	1,027.00	1,031.00	1,034.00	4.00	10,734	19	2009				2	2	3	94
75	P75	MEADOWLAKE PLAT 2	2000	Mississippi River	29.507	10407	28.65	0.444	1,036.00	1,044.50	1,045.50	8.50	37,791	18	2009				2	2	3	75
106	P106	BLACKBERRY RIDGE ESTATES	2003	Mississippi River	19.989	6635	16.79	0.605	1,073.00	1,078.50	1,084.00	5.50	33,320	15	2009				2	2	3	106
68	P68	FERCHE SOUTH	2003	Mississippi River	146.492	76093	81.25	10.633	1,029.50	1,035.00	1045	5.50	585,599	15	2008				2	3	1	68
103	P103	MORNINGSTAR PLAT 09	2000	Watab River	27.319	10026	30.32	1.963	1,036.50	1,041.30	1046	4.80	94,350	18	2008				2	3	1	103
74	P74	PINECONE RD	2003	Watab River	20.874	9022	9.00	1.754	1,036.00	1,042.00	1045	6.00	105,381	15	2008				2	3	1	74
67	P67	FERCHE SOUTH PINECONE PLAT 2	2003	Mississippi River	20.201	11020	17.16	3.347	1,034.00	1,038.00	1,045.00	4.00	134,060	15	2010				2	3	1	67
42	P42	HIGHWAY 15	2003	Mississippi River	13.075	5451	5.46	2.540	1,027.00	1,032.00	1043	5.00	127,170	15	2010				2	3	1	42
72	P72	MAGNOLIA PLACE	2002	Mississippi River	13.102	4769	13.61	0.898	1,027.00	1,031.00	1038	4.00	35,968	16	2009				2	3	2	72
86	P86	ROLLING MEADOWS	1999	Watab River	47.720	19637	41.75	2.504	1,018.00	1,029.50	1,035.00	11.50	288,346	19	2008				2	3	2	86
66	P66	FERCHE SOUTH PINECONE PLAT 2	2003	Mississippi River	52.473	21502	53.01	5.155	1,037.00	1,041.00	1044	4.00	206,477	15	2010				2	3	3	66
93	P93	AVALON VILLAGE	2003	Watab River	41.698	15514	35.35	4.058	1,033.00	1,036.83	1042.12	3.83	155,630	15	2009				2	3	3	93
99	P99	THE WOODS	2000	Watab River	31.465	10565	27.36	2.285	1,032.00	1,037.00	1040	5.00	114,403	18	2009				2	3	3	99
76	P76	SARTELL HEIGHTS SOUTH	2000	Watab River	26.081	8367	19.66	2.247	1,031.50	1,037.10	1041	5.60	126,001	18	2008				2	3	3	76
102	P102	CELEBRATION OF SARTELL 3	2003	Watab River	47.051	20054	51.10	3.511	1,022.00	1,037.00	1,042.00	15.00	527,356	15	2009				2	3	3	102
83	P83	WATAB SPRINGS PLAT 2	1999	Watab River	13.563	5900	15.40	1.946	1,020.00	1,028.00	1033	8.00	155,889	19	2008				2	3	3	83
63	P63	14TH AVE E	2005	Mississippi River	16.759	11422	13.06	0.147	1,068.50	1,069.50	1,072.00	1.00	1,472	13	2010				3	1	1	63
28	P28	HUNTINGTON RIDGE PLAT 4	2007	Mississippi River	8.042	2661	3.65	0.025	1,029.00	1,030.50	1030.5	1.50	376	11	2012				3	1	2	28
45	P45	REGIONAL MEDICAL ARTS CAMPUS	2005	Mississippi River	0.684	447	0.78	0.037	1,030.00	1,030.50	1,031.50	0.50	185	13	2012				3	1	2	45
44	P44	REGIONAL MEDICAL ARTS CAMPUS	2005	Mississippi River	15.179	7973	13.27	0.167	1,030.00	1,030.50	1031.5	0.50	836	13	2012				3	1	3	44
43	P43	REGIONAL MEDICAL ARTS CAMPUS	2005	Mississippi River	13.347	4361	9.25	0.122	1,030.00	1,030.50	1,031.50	0.50	611	13	2012				3	1	3	43
27	P27	MADISON CROSSING PLAT 2	2006	Watab River	11.322	5606	12.70	0.145	1,034.00	1,038.00	1,040.00	4.00	5,808	12	2012				3	2	1	27
41	P41	OAK RIDGE CROSSING THE FIRST	2007	Mississippi River	38.649	13098	11.64	1.051	1,024.00	1,031.00	1,039.00	7.00	73,669	11	2012				3	2	1	41
53	P53	MADISON CROSSING	2005	Watab River	10.184	4147	11.37	0.591	1,038.00	1,042.00	1,045.50	4.00	23,672	13	2011				3	2	1	53
49	P49	NEWPORT PLAT 2	2006	Watab River	18.806	5919	13.30	0.244	1,035.00	1,039.00	1,042.00	4.00	9,773	12					3	2	2	49
56	P56	PINE LAKES PLAT 1	2005	Watab River	16.542	6056	15.29	0.295	1,040.00	1,044.40	1045	4.40	12,997	13	2010				3	2	2	56
29	P29	REGIONAL MEDICAL ARTS CAMPUS 2	2007	Mississippi River	16.125	5722	5.21	0.434	1,029.00	1,033.00	1,037.00	4.00	17,383	11	2012				3	2	2	29
48	P48	NEWPORT PLAT 2	2006	Watab River	18.806	5919	13.30	0.646	1,039.00	1,039.00	1041	3.00	19,406	12	2011				3	2	2	48
50	P50	SAVANNA OAKS 1ST ADDITION	2006	Mississippi River	30.408	7558	6.00	0.710	1,033.86	1,038.50	1042	4.64	32,988	12	2010				3	2	2	50
55	P55	MADISON CROSSING	2005	Watab River	43.613	14543	26.55	0.540	1,034.00	1,038.00	1,042.00	4.00	21,629	13	2011				3	2	3	55
8	P8	KEENLAND VILLAGE PLAT 2	2005	Mississippi River	17.401	9119	19.14	0.537	1025	1,028.00	1,029.00	3.00	16,132	13					3	2	3	8
59	P59	OAK POND DR	2005	Mississippi River	15.663	7847	11.83	0.362	1,068.00	1,072.00	1,075.00	4.00	14,499	13	2011				3	2	3	59
31	P31	HERITAGE PLACE	2007	Mississippi River	5.172	3047	4.79	0.192	1,039.00	1,043.00	1,044.00	4.00	7,690	11	2011				3	2	3	31
92	P92	KNOTTINGHAM VILLAGE	2004	Watab River	13.905	5000	14.64	0.693	1,036.00	1,038.00	1,038.00	2.00	13,879	14	2010				3	2	3	92
58	P58	PINE LAKES PLAT 1	2005	Watab River	27.329	8989	20.15	0.413	1,040.00	1,046.25	1046.5	6.25	25,847	13	2010				3	2	3	58
34	P34	4TH AVE NE	2007	Mississippi River	4.514	1555	4.23	0.148	1,058.50	1,061.50	1062	3.00	4,446	11	2012				3	2	3	34
62	P62	CREEKVIEW PRESERVE PLAT 1	2005	Watab River	26.754	9819	29.70	0.744	1,045.00	1,049.00	1052	4.00	29,800	13	2010				3	2	3	62
61	P61	10TH ST NE	2005	Mississippi River	10.069	3687	11.11	0.273	1,043.00	1,047.73	1,049.50	4.73	12,930	13	2011				3	2	3	61
38	P38	SANDSTONE VILLAGE	2007	Watab River	16.565	5626	14.57	0.553	1,042.00	1,046.00	1047.5	4.00	22,150	11	2012				3	2	3	38
33	P33	HERITAGE PLACE	2007	Mississippi River	3.687	1924	3.41	0.259	1,043.00	1,046.00	1,047.00	3.00	7,780	11	2011				3	2	3	33
39	P39	SANDSTONE VILLAGE	2007	Watab River	32.500	9930	26.93	0.667	1,042.00	1,049.00	1,050.50	7.00	46,753	11	2012				3	2	3	39
57	P57	PINE LAKES PLAT 1	2005	Watab River	18.768	6679	19.21	0.611	1,040.00	1,045.25	1,046.00	5.25	32,121	13	2010				3	2	3	57

City of Sartell Pond Assessment Worksheet

Date: 10/2/2018

MPCA Estimator			
MPCA Estimator Land use	Land use	TSS (lbs/yr/ac)	TP (lbs/yr/ac)
Open Space	Woods, Brush, Meadow	245	0.17
Open Space	Open Space Landscaped	245	0.17
Commercial	Commercial/Industrial	1119	1.39
Low Density Res	Low Density Res.	312	0.95
Med. Density Res.	Med. Density Res.	367	1.11
High Density Res.	High Density Res.	404	1.22
Commercial	Impervious Areas	1119	1.39
Open Space	Agricultural	245	0.17

Pounds of Sediment Conversions to Volume of Sediment		
1 pound of sediment =	0.01281	cf
USDA Bulk Density of Sandy Clay Loam =	1.25	g/cc
USDA Bulk Density of Sandy Clay Loam =	78.04	lbs/cf
1 cf =	28317	cc
1 lb =	453.59	g

COLOR KEY	
	Pond Assessment Ranking
	Calculated Value
	Input Data
	Smart Connect Data
	XPswmm Model Data
	Record Drawing Data
	Educated Estimate
XXXXXX	NEED UPDATING

SARTELL POND SUMMARY & ASSESSMENT

PONDS LISTED IN ORDER OF INSPECTION/EVALUATION PRIORITY

					CONTRIBUTI	TSS ANNUAL	TP ANNUAL	POND CHARACTERISTICS										RANK PRIORITY LEVEL Listed in Order of Priority Level				
																		1	2	3	4	
SMART CONNECT FACILITY ID	MODELLING FACILITY ID	DESCRIPTION/DEVELOPMENT NAME	YEAR CONSTRUCTED	ULTIMATE RECEIVING WATER	TOTAL (ACRE)	TSS ANNUAL LOAD (lbs/yr)	TP ANNUAL LOAD (lbs/yr)	POND AREA (ACRE)	BOTTOM ELEVATION	NWL / OUTLET ELEVATION	SURFACE OVERFLOW ELEV	H_NWL (FT)	DEAD STORAGE (CF)	YEARS IN SERVICE	LAST YEAR INSPECTED	LAST YEAR OF MAJOR MAINTENANCE	INSPECTION / MAINTENANCE NOTES	PUBLIC WORKS / PUBLIC CONCERN	AGE 0-4yr = 5 5 to 9yr = 4 10 to 14yr = 3 15 to 19yr = 2 20+ years = 1	SEDIMENT ACCUMULATION CONCERN (1=HIGH, 3=LOW)	ASTHETICS RATING (1=HIGH, 3=LOW)	SMART CONNECT FACILITY ID
30	P30	HERITAGE PLACE 3	2007	Mississippi River	1.493	1110	1.29	0.177	1,044.00	1,047.00	1048	3.00	5,317	11	2011				3	2	3	30
37	P37	SIERRA COVE	2007	Watab River	17.105	5587	13.67	0.603	1,025.00	1,030.00	1,036.00	5.00	30,190	11	2012				3	2	3	37
88	P88	AVALON VILLAGE PLAT 3	2004	Watab River	15.444	5668	17.14	0.971	1,032.00	1,035.28	1,043.00	3.28	31,892	14	2010				3	2	3	88
46	P46	UNKNOWN	2006	Mississippi River	7.777	2910	2.73	0.429	1,066.00	1,070.00	1074	4.00	17,183	12	2012				3	2	3	46
32	P32	HERITAGE PLACE	2007	Mississippi River	16.865	6350	17.45	1.594	1,040.00	1,042.45	1048	2.45	39,105	11	2011				3	2	3	32
96	P96	KNOTTINGHAM VILLAGE PLAT 2	2004	Watab River	5.271	1804	4.85	0.376	1,035.00	1,035.00	1,038.00	3.00	11,295	14	2010				3	2	3	96
95	P95	KNOTTINGHAM VILLAGE	2004	Watab River	12.029	4244	12.04	0.899	1,036.00	1,036.00	1038	3.00	27,006	14	2010				3	2	3	95
65	P65	HUNTINGTON RIDGE PLAT 4	2005	Mississippi River	3.398	1169	3.17	0.250	1,034.00	1,037.00	1,038.00	3.00	7,510	13	2011				3	2	3	65
36	P36	SIERRA COVE	2007	Watab River	3.496	1099	2.46	0.276	1,031.00	1,035.50	1036	4.50	12,437	11	2012				3	3	2	36
60	P60	SCHAEFER PINES	2005	Watab River	2.409	884	2.67	0.168	1,030.00	1,034.00	1036.5	4.00	6,729	13	2011				3	3	3	60
54	P54	MADISON CROSSING	2005	Watab River	19.994	7563	22.86	1.549	1,040.00	1,044.00	1050	4.00	62,043	13	2011				3	3	3	54
26	P26	CREEKVIEW PRESERVE PLAT 1	2005	Watab River	9.544	2820	5.33	0.666	1,043.00	1,047.50	1050	4.50	30,010	13	2010				3	3	3	26
35	P35	SIERRA COVE	2007	Watab River	2.435	745	1.56	0.342	1,032.00	1,035.50	1,036.00	3.50	11,986	11	2012				3	3	3	35
85	P85	FOX RUN OF AVALON VILLAGE	2004	Watab River	3.354	1139	3.02	0.671	1,036.00	1,039.00	1041.5	3.00	20,157	14	2011				3	3	3	85
52	P52	GRANDVIEW CROSSING	2005	Watab River	4.546	1820	5.44	0.951	1,044.00	1,048.00	1055	4.00	38,091	13	2011				3	3	3	52
47	P47	AVALON VILLAGE 9	2006	Watab River	23.525	6230	7.59	1.001	1,024.00	1,037.50	1,042.50	13.50	135,316	12	2012				3	3	3	47
40	P40	EAGLE RIDGE ESTATES	2007	Watab River	12.883	4572	13.10	2.591	1,034.80	1,039.00	1044	4.20	108,968	11	2012				3	3	3	40
6	P6	PINECONE RD	2010	Mississippi River	99.291	29196	23.68	0.426	1,035.00	1,039.00	1,039.00	4.00	17,063	8					4	1	1	6
108	P108	HERATIGE PLACE	2011	Mississippi River	6.090	2574	6.37	0.085	1,040.00	1,041.25	1,048.00	1.25	1,064	7					4	1	2	108
89	P89	PINETREE POND PLAT 5	1997	Watab River	13.106	4806	14.52	0.232	1,031.00	1,032.40	1036	1.40	3,252	21	2008	2013	Cleaned		4	1	3	89
2	P2	COUNTY RD 1	2010	Mississippi River	14.419	10727	12.58	0.982	1,008.00	1,015.00	1,025.00	7.00	68,832	8					4	2	1	2
110	P110	LEANDER AVE	2011	Mississippi River	42.087	13460	11.55	0.680	1,038.28	1,041.28	1,048.00	3.00	20,427	7					4	2	2	110
5	P5	HERITAGE PLACE 2	2010	Mississippi River	5.338	3542	4.19	0.190	1,041.10	1,045.10	1047.5	4.00	7,610	8					4	2	2	5
107	P107	HERATIGE PLACE	2011	Mississippi River	5.813	2958	3.13	0.208	1,037.60	1,041.75	1047	4.15	8,644	7					4	2	2	107
3	P3	COUNTY RD 1	2010	Mississippi River	5.674	1451	1.38	0.491	1,017.00	1,021.00	1025	4.00	19,666	8					4	3	1	3
4	P4	HERITAGE PLACE 3	2010	Mississippi River	1.209	901	1.05	0.183	1,042.10	1,046.10	1,048.50	4.00	7,330	8					4	3	2	4
109	P109	HERATIGE DR	2011	Mississippi River	6.819	3108	4.89	0.863	1,036.90	1,040.90	1047	4.00	34,566	7					4	3	2	109
7	P7	14TH AVE E	2009	Mississippi River	4.929	1829	1.71	0.398	1,079.00	1,083.00	1086.5	4.00	15,941	9					4	3	3	7
NO GIS	P111	PINECONE RD N	2018	Mississippi River	74.468	19234	14.684	0.997	1,032.00	1,032.00	1041	3.00	29,950	0					5	2	1	NO GIS
TBD	TBD	4TH AVE S (Middle)	2018	Mississippi River		6819	8.217					4.00	14,113	0					5	2	1	TBD
TBD	TBD	4TH AVE S (South)	2018	Mississippi River		3624	4.368					4.00	8,450	0					5	2	1	TBD
NO GIS	P117	COUNTY RD 29	2018	Mississippi River	13.630	11258	13.370	0.634	1,050.00	1,054.50	1060.4	4.50	28,568	0					5	2	1	NO GIS
TBD	TBD	4TH AVE S (North)	2018	Mississippi River		2094	2.521					4.00	5,706	0					5	2	1	TBD
NO GIS	P116	BERNICK'S AR ADDITION	2017	Watab River	8.151	3769	3.859	0.370	1,027.00	1,030.00	1,034.50	3.00	11,115	1					5	2	1	NO GIS
NO GIS	P121	PINE LAKES PLAT 3	2016	Watab River	6.077	2230	6.745	0.115	1,047.00	1,049.00	1048.5	2.00	2,299	2					5	2	3	NO GIS
NO GIS	P122	PINE LAKES PLAT 3	2016	Watab River	17.870	6558	19.836	0.918	1,045.00	1,048.70		3.70	34,022	2					5	2	3	NO GIS
NO GIS	P115	PROVIDENCE PLAT 2	2017	Watab River	38.316	9387	6.514	1.387	1,034.00	1,037.50	1043	3.50	48,610	1					5	2	3	NO GIS
NO GIS	P114	ARBOR TRAILS 2	2017	Watab River	31.940	7835	5.538	1.600	1,048.50	1,048.50	1,055.30	3.00	48,064	1					5	2	3	NO GIS
NO GIS	P112	PINECONE RD N	2018	Groundwater	10.231	3007	2.437	1.362	1,035.00	1,035.00	1,039.50	3.00	40,915	0					5	3	1	NO GIS
64	P64	AVALON VILLAGE 4	2005	Watab River	32.689	9679	18.43	2.120	1,032.30	1,038.30	1044	6.00	127,371	13	2011	2016	2016 Dredge Pond		5	3	3	64
111	P120	PROVIDENCE PLAT 1	2016	Watab River	7.796	2386	4.989	1.377	1,032.00	1,037.00	1,039.52	5.00	91,953	2					5	3	3	111
112	P119	PROVIDENCE PLAT 1	2016	Watab River	9.800	2999	6.272	1.377	1,031.50	1,038.00	1042.52	6.50	119,536	2					5	3	3	112
NO GIS	P113	ARBOR TRAILS 2	2017	Watab River	3.816	935	0.649	0.803	1,038.00	1,045.00	1050	7.00	56,285	1					5	3	3	NO GIS

Appendix C

Existing Critical Ditches

Appendix C
Existing Critical Ditches

Major Watershed	Major Watershed Total Length (ft)	Major Watershed Ditch Segment	Length (ft)	Estimated Maintenance Costs ($12.00/LF)
Bakers Lake	10,963	A	2,648	$32,000
		B	1,329	$16,000
		C	641	$8,000
		D	2,841	$35,000
		E	3,504	$43,000
Northwest Watab	1,688	F	710	$9,000
		G	978	$12,000
North Central Watab	18,544	H	2,241	$27,000
		I	1,955	$24,000
		J	3,004	$37,000
		K	1,042	$13,000
		L	535	$7,000
		13A	3,447	$42,000
		13B	1,312	$16,000
		13C	1,863	$23,000
		13D	488	$6,000
		13E	973	$12,000
		13F	1,683	$21,000
Central Mississippi	498	M	498	$6,000
Central East Side	15,872	N	1,076	$13,000
		O	2,044	$25,000
		P	342	$5,000
		Q	1,208	$15,000
		R	3,436	$42,000
		S	1,095	$14,000
		T	2,865	$35,000
		U	3,805	$46,000
South East Side	3,130	V	1,080	$13,000
		W	751	$10,000
		X	1,298	$16,000
Southwest Watab	3,613	Y	534	$7,000
		Z	3,079	$37,000
Ditch 16	11,424	AA	681	$9,000
		16A	1,660	$20,000
		16B	3,645	$44,000
		16C	979	$12,000
		16D	3,209	$39,000
		16E	735	$9,000
		16F	515	$7,000
South Trunk	2,974	BB	1,791	$22,000
		CC	1,183	$15,000
TOTAL	**68,706**			**$844,000**

Note: Costs are rounded up to the $1,000

Appendix D

Future Drainage Area Information

Appendix D

Future Priority Development Watershed Drainage Area Information

Bakers Lake Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
BL 1	68.6	0.0	68.6	85	Wetland	2.8	15.5	18.4
BL 2	13.3	0.0	13.3	85	Wetland	0.5	3.0	3.6
BL 3	34.4	0.0	34.4	85	Wetland	1.4	7.8	9.2
BL 4	122.5	0.0	122.5	85	Wetland	5.1	27.7	32.8
BL 5	51.0	0.0	51.0	85	Wetland	2.1	11.5	13.7
BL 6	19.9	0.0	19.9	85	Wetland	0.8	4.5	5.3
BL 7	28.6	0.0	28.6	85	Wetland	1.2	6.5	7.7
BL 8	44.6	0.0	44.6	85	Wetland	1.8	10.1	12.0
BL 9	42.2	0.0	42.2	85	Wetland	1.7	9.6	11.3
BL 10	45.8	0.0	45.8	85	Future Trunk	1.9	10.4	12.3
BL 11	20.7	0.0	20.7	85	Wetland	0.9	4.7	5.5
BL 12	112.1	0.0	112.1	85	Wetland	4.6	25.4	30.0
BL 13	49.3	0.0	49.3	85	Existing Ditch	2.0	11.2	13.2
BL 14	75.2	39.1	114.3	85	Wetland	3.1	17.0	20.2
BL 15	39.1	0.0	39.1	85	Future Pond	1.6	8.9	10.5
BL 16	46.5	0.0	46.5	85	Future Trunk	1.9	10.5	12.5
BL 17	107.9	0.0	107.9	85	Wetland	4.5	24.4	28.9
BL 18	60.2	0.0	60.2	85	Wetland	2.5	13.6	16.1
BL 19	53.2	0.0	53.2	85	Wetland	2.2	12.1	14.3
BL 20	43.7	0.0	43.7	85	Existing Ditch	1.8	9.9	11.7
BL 21	13.4	0.0	13.4	85	Bakers Lake	0.6	3.0	3.6
TOTAL	**1092.2**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

North Trunk Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
NT 1	200.4	0.0	200.4	53	Future Trunk	8.3	6.9	15.2
NT 2	58.7	0.0	58.7	53	Wetland	2.4	2.0	4.5
NT 3	70.2	0.0	70.2	53	Future Trunk	2.9	2.4	5.3
NT 4	155.8	0.0	155.8	53	Future Trunk	6.4	5.4	11.8
NT 5	137.9	0.0	137.9	53	Future Trunk	5.7	4.8	10.5
NT 6	44.9	0.0	44.9	53	Existing Pond	1.9	1.6	3.4
NT 7	120.5	137.9	258.4	53	Future Trunk	5.0	4.2	9.1
NT 8	71.0	258.4	329.4	53	Future Trunk	2.9	2.5	5.4
NT 9	139.4	0.0	139.4	53	Future Trunk	5.8	4.8	10.6
NT 10	15.7	0.0	15.7	53	Existing Storm	0.6	0.5	1.2
NT 11	16.6	0.0	16.6	53	Existing Storm	0.7	0.6	1.3
NT 12	57.1	0.0	57.1	53	Existing Storm	2.4	2.0	4.3
NT 13	69.7	0.0	69.7	53	Wetland	2.9	2.4	5.3
NT 14	42.2	0.0	42.2	53	Future Trunk	1.7	1.5	3.2
NT 15	29.9	0.0	29.9	53	Wetland	1.2	1.0	2.3
NT 16	78.7	0.0	78.7	53	Wetland	3.3	2.7	6.0
NT 17	109.9	0.0	109.9	53	Existing Storm	4.5	3.8	8.3
NT 18	37.3	0.0	37.3	53	Existing Storm	1.5	1.3	2.8
NT 19	79.2	0.0	79.2	53	Future Trunk	3.3	2.7	6.0
TOTAL	**1535.2**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

North Mississippi Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
NM 1	93.5	0.0	93.5	53	Future Trunk	3.9	5.6	9.5
NM 2	70.8	0.0	70.8	53	Future Trunk	2.9	4.3	7.2
NM 3	51.8	70.8	122.6	53	Future Trunk	2.1	3.1	5.3
TOTAL	**216.1**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

North West Watab Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
NM 1	26.0	0.0	26.0	85	Future Trunk	1.1	3.0	4.1
NM 2	30.8	0.0	30.8	85	Watab River	1.3	3.5	4.8
NM 3	30.9	0.0	30.9	85	Watab River	1.3	3.5	4.8
TOTAL	**87.7**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

North Central Watab Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
NCW 1	66.3	0.0	66.3	85	Future Trunk	2.7	10.2	13.0
NCW 2	102.4	0.0	102.4	85	Wetland	4.2	15.8	20.1
NCW 3	73.8	0.0	73.8	85	Wetland	3.0	11.4	14.5
NCW 4	112.5	0.0	112.5	85	Wetland	4.7	17.4	22.0
NCW 5	64.2	0.0	64.2	85	Wetland	2.7	9.9	12.6
NCW 6	16.2	0.0	16.2	85	Wetland	0.7	2.5	3.2
NCW 7	116.4	0.0	116.4	85	Existing Ditch	4.8	18.0	22.8
NCW 8	20.4	0.0	20.4	85	Existing Ditch	0.8	3.2	4.0
NCW 9	42.6	0.0	42.6	85	Existing Ditch	1.8	6.6	8.3
NCW 10	22.0	0.0	22.0	85	Wetland	0.9	3.4	4.3
NCW 11	29.0	0.0	29.0	85	Wetland	1.2	4.5	5.7
NCW 12	25.0	0.0	25.0	85	Wetland	1.0	3.9	4.9
NCW 13	22.0	0.0	22.0	85	Wetland	0.9	3.4	4.3
NCW 14	27.4	0.0	27.4	85	Existing Ditch	1.1	4.2	5.4
TOTAL	**740.0**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

North East Side Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
NE 1	76.36	0.00	76.36	69	Future Trunk	3.2	11.7	14.9
NE 2	94.02	76.36	170.38	69	Future Trunk	3.9	14.4	18.3
TOTAL	**170.4**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

Central East Side Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
CE 1	75.1	0.0	75.1	80	Wetland	3.1	15.9	19.0
CE 2	48.5	0.0	48.5	80	Wetland	2.0	10.2	12.3
CE 3	42.6	0.0	42.6	80	Wetland	1.8	9.0	10.8
CE 4	85.0	0.0	85.0	80	Wetland	3.5	18.0	21.5
CE 5	72.0	0.0	72.0	80	Wetland	3.0	15.2	18.2
CE 6	77.3	0.0	77.3	80	Wetland	3.2	16.3	19.5
CE 7	59.9	0.0	59.9	80	Existing Ditch	2.5	12.6	15.1
CE 8	122.6	0.0	122.6	80	Existing Ditch	5.1	25.9	31.0
CE 9	81.5	0.0	81.5	80	Wetland	3.4	17.2	20.6
CE 10	109.2	0.0	109.2	80	Existing Ditch	4.5	23.1	27.6
CE 11	89.6	0.0	89.6	80	Wetland	3.7	18.9	22.6
CE 12	71.4	34.9	106.4	80	Existing Ditch	3.0	15.1	18.0
CE 13	34.9	0.0	34.9	80	Future Trunk	2.2	11.2	13.4
CE 14	33.8	0.0	33.8	80	Existing Ditch	1.4	7.4	8.9
TOTAL	**1003.4**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

South West Watab Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
SWW 1	53.8	0.0	53.8	69	Watab River	2.2	2.6	4.9
SWW 2	46.7	0.0	46.7	69	Watab River	1.9	2.3	4.2
SWW 3	14.0	0.0	14.0	69	Watab River	0.6	0.7	1.3
SWW 4	11.5	0.0	11.5	69	Wetland	0.5	0.6	1.0
SWW 5	14.1	0.0	14.1	69	Wetland	0.6	0.7	1.3
SWW 6	29.5	0.0	29.5	69	Wetland	1.2	1.5	2.7
SWW 7	70.8	0.0	70.8	69	Wetland	2.9	3.5	6.4
SWW 8	141.3	0.0	141.3	69	Wetland	5.8	7.0	12.8
SWW 9	77.9	0.0	77.9	69	Future Trunk	3.2	3.8	7.1
SWW 10	18.0	0.0	18.0	69	Future Trunk	0.7	0.9	1.6
SWW 11	96.8	0.0	96.8	69	Future Trunk	4.0	4.8	8.8
SWW 12	21.2	0.0	21.2	69	Future Trunk	0.9	1.0	1.9
SWW 13	22.5	0.0	22.5	69	Future Trunk	0.9	2.6	3.5
SWW 14	50.5	0.0	50.5	69	Future Trunk	2.1	5.7	7.8
TOTAL	**668.5**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

Ditch 16 Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
D16 1	121.6	222.8	344.4	72	Future Trunk	5.0	15.5	20.5
D16 2	222.8	0.0	222.8	69	Existing Ditch	9.2	28.4	37.6
D16 3	90.7	0.0	90.7	69	Existing Ditch	3.7	11.6	15.3
D16 4	39.5	0.0	39.5	69	Existing Ditch	1.6	5.0	6.7
D16 5	27.5	0.0	27.5	69	Existing Ditch	1.1	3.5	4.6
D16 6	39.2	0.0	39.2	69	Existing Ditch	1.6	5.0	6.6
D16 7	17.8	0.0	17.8	69	Existing Ditch	0.7	2.3	3.0
D16 8	55.1	0.0	55.1	69	Existing Ditch	2.3	7.0	9.3
D16 9	38.0	0.0	38.0	69	Existing Ditch	1.6	4.8	6.4
D16 10	22.0	0.0	22.0	69	Existing Ditch	0.9	2.8	3.7
D16 11	45.0	0.0	45.0	85	Future Trunk	1.9	5.7	7.6
D16 12	16.0	0.0	16.0	70.5	Future Trunk	0.7	2.0	2.7
D16 13	17.2	0.0	17.2	72	Future Trunk	0.7	2.2	2.9
D16 14	40.2	0.0	40.2	72	Future Trunk	1.7	5.1	6.8
D16 15	35.6	0.0	35.6	85	Wetland	1.5	4.5	6.0
D16 16	8.7	0.0	8.7	85	Future Trunk	0.4	1.1	1.5
D16 17	10.7	0.0	10.7	72	Wetland	0.4	1.4	1.8
D16 18	18.6	0.0	18.6	72	Wetland	0.8	2.4	3.1
D16 19	16.6	0.0	16.6	72	Wetland	0.7	2.1	2.8
D16 20	12.2	0.0	12.2	92	Existing Ditch	0.5	1.6	2.1
D16 21	11.2	0.0	11.2	72	Existing Storm	0.5	1.4	1.9
D16 22	34.5	0.0	34.5	79	Wetland	1.4	4.4	5.8
D16 23	35.3	0.0	35.3	72	Wetland	1.5	4.5	6.0
D16 24	15.4	0.0	15.4	92	Wetland	0.6	2.0	2.6
D16 25	13.7	0.0	13.7	72	Future Trunk	0.6	1.7	2.3
D16 26	25.0	0.0	25.0	72	Watab River	1.0	3.2	4.2
TOTAL	**1030.1**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

South Central Watab Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
SCW 1	33.9	0.0	33.9	71	Wetland	1.4	5.5	6.9
SCW 2	16.0	0.0	16.0	72	Future Trunk	0.7	2.6	3.3
SCW 3	22.6	0.0	22.6	69	Future Trunk	0.9	3.7	4.6
SCW 4	10.7	0.0	10.7	69	Future Trunk	0.4	1.7	2.2
SCW 5	7.5	0.0	7.5	69	Future Trunk	0.3	1.2	1.5
TOTAL	**90.8**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

Ditch 50 Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
D50 1	74.2	0.0	74.2	72	Wetland	3.1	7.1	10.2
D50 2	49.6	0.0	49.6	69	Wetland	2.1	4.8	6.8
D50 3	64.3	0.0	64.3	69	Future Trunk	2.7	6.2	8.8
D50 4	53.7	0.0	53.7	69	Wetland	2.2	5.2	7.4
D50 5	30.3	0.0	30.3	69	Future Trunk	1.3	2.9	4.2
D50 6	12.3	0.0	12.3	92	Existing Storm	0.5	1.2	1.7
D50 7	12.1	0.0	12.1	92	Future Trunk	0.5	1.2	1.7
TOTAL	**296.4**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix D

Future Priority Development Watershed Drainage Area Information

South Trunk Watershed

Name	Watershed Area (acres)			Direct Watershed CN	Discharge Point	Potential Stormwater Treatment (storage as wet pond) (ac-ft)		
	Direct	From Upstream Watershed	Total			Dead Storage	Live Storage	Total Storage
ST 1	27.7	0.0	27.7	80	Existing Pond	1.1	10.7	11.9
ST 2	23.8	0.0	23.8	72	Existing Storm	1.0	9.2	10.2
ST 3	13.7	0.0	13.7	88	Existing Storm	0.6	5.3	5.9
ST 4	16.1	0.0	16.1	72	Wetland	0.7	6.2	6.9
ST 5	21.5	0.0	21.5	81	Future Trunk	0.9	8.3	9.2
ST 6	12.5	0.0	12.5	81	Future Trunk	0.5	4.9	5.4
ST 7	46.3	0.0	46.3	81	Future Trunk	1.9	17.9	19.8
ST 8	44.5	0.0	44.5	72	Future Trunk	1.8	17.2	19.0
ST 9	49.9	0.0	49.9	92	Future Trunk	2.1	19.3	21.4
ST 10	20.9	0.0	20.9	88	Existing Pond	0.9	8.1	8.9
ST 11	21.1	0.0	21.1	88	Existing Storm	0.9	8.2	9.0
ST 12	34.3	0.0	34.3	88	Existing Storm	1.4	13.3	14.7
ST 13	28.8	0.0	28.8	92	Existing Pond	1.2	11.1	12.3
ST 14	32.6	0.0	32.6	92	Existing Storm	1.3	12.6	13.9
ST 15	20.5	0.0	20.5	92	Future Trunk	0.8	7.9	8.8
ST 16	14.3	0.0	14.3	92	Future Trunk	0.6	5.5	6.1
ST 17	6.4	0.0	6.4	92	Existing Storm	0.3	2.5	2.7
ST 18	26.1	0.0	26.1	92	Future Trunk	1.1	10.1	11.2
TOTAL	**461.1**							

Note: Potential Stormwater Treatment storage is estimated based on a wet pond facility design. The actual treatment facility type size, and location will be determined based on future development characteristics.

Appendix E

Future Trunk Information

Appendix E

Future Watershed Trunk System Information & Costs

Bakers Lake Watershed Future Trunk Information

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
1.1	BL 3	Ditch	50	36	0.75	58	213	$255	$55,000	$27,000	$82,000
1.2	BL 10	Pipe 1.4	15	36	0.10	21	481	$255	$123,000	$60,000	$183,000
1.3	BL 14	Pipe 1.4	36	42	0.20	45	419	$270	$114,000	$55,000	$169,000
1.4	Junction	Co. Ditch 13	51	54	0.10	62	1488	$285	$425,000	$204,000	$629,000
1.5	Wetland	Wetland	26	36	0.15	26	722	$255	$185,000	$89,000	$274,000
101	Bakers Lake	Pipe 102	(*)	48		(*)	1015	$275	$280,000	$135,000	$415,000
102	NT 13	Pipe 103	(*)	48		(*)	1330	$275	$366,000	$176,000	$542,000
103	BL 17	North Trunk	(*)	48		(*)	2690	$275	$740,000	$356,000	$1,096,000
DD	Potential Future Trunk System Ditch						540	$145	$79,000	$38,000	$117,000
						Total	**8898**		**$2,367,000**	**$1,140,000**	**$3,507,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

(*)See 2012 Bakers Lake / North Storm Sewer Improvements Preliminary Engineering Report

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

North Trunk Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
2.1	NT 1, NT 19	Existing Storm	66	54	0.15	76	659	$285	$188,000	$91,000	$279,000
2.2	NT 3	Existing Storm	31	42	0.15	39	159	$270	$43,000	$21,000	$64,000
2.3	NT 14	Pipe 2.5	27	42	0.15	39	1170	$270	$316,000	$152,000	$468,000
2.4	NT 13	Pipe 2.5	32	42	0.15	39	581	$270	$157,000	$76,000	$233,000
2.5	Junction	North Trunk	58	48	0.20	64	1020	$275	$281,000	$135,000	$416,000
2.6	NT 9	North Trunk	44	48	0.10	45	1507	$275	$415,000	$200,000	$615,000
2.7	NT 5	Pipe 2.8	44	48	0.10	45	907	$275	$250,000	$120,000	$370,000
2.8	NT 4	Pipe 2.9	81	60	0.10	82	2208	$325	$718,000	$345,000	$1,063,000
2.9	NT 7	Pipe 2.11	109	72	0.10	134	2171	$405	$880,000	$423,000	$1,303,000
2.10	NT 8	North Trunk	131	72	0.10	134	1738	$405	$704,000	$338,000	$1,042,000
						Total	**12120**		**$3,952,000**	**$1,901,000**	**$5,853,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

North Mississippi Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
3.1	NM 1	Mississippi River	30	36	0.25	33	819	$255	$209,000	$101,000	$310,000
3.2	NM 2	Mississippi River	68	36	1.20	73	1104	$255	$282,000	$136,000	$418,000
						Total	**1923**		**$491,000**	**$237,000**	**$728,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

North West Watab Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
4.1	NCW 5	Pipe 4.2	43	48	0.10	45	1285	$275	$354,000	$170,000	$524,000
4.2	NWW 2	Watab River	55	54	0.10	62	282	$285	$81,000	$39,000	$120,000
4.3	Wetland	Pipe 4.3	87	66	0.10	106	2255	$355	$801,000	$385,000	$1,186,000
4.4	NWW 1	Watab River	97	66	0.10	106	1328	$355	$472,000	$227,000	$699,000
						Total	**5150**		**$1,708,000**	**$821,000**	**$2,529,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

North Central Watab Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
5.1	NCW 1	NCW 3	21	36	0.10	21	2890	$255	$737,000	$354,000	$1,091,000
						Total	**2890**		**$737,000**	**$354,000**	**$1,091,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

North East Side Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
8.1	NE 1	NE 2	18	30	0.40	26	1956	$195	$382,000	$184,000	$566,000
8.2	NE 2	Wetland	40	42	0.20	45	935	$270	$253,000	$122,000	$375,000
8.3	Wetland	Mississippi River	40	36	0.60	52	145	$255	$37,000	$18,000	$55,000
EE	Potential Future Trunk System Ditch						809	$145	$118,000	$57,000	$175,000
						Total	**3845**		**$790,000**	**$381,000**	**$1,171,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

Central East Side Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
9.1	CE 13	Existing Ditch	14	24	1.00	23	952	$185	$177,000	$85,000	$262,000
						Total	**952**		**$177,000**	**$85,000**	**$262,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

South West Watab Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
11.1	SWW 13	Roadside Ditch	11	30	0.11	14	290	$195	$57,000	$28,000	$85,000
11.2	SWW 14	Wetland	31	42	0.10	32	2706	$270	$731,000	$351,000	$1,082,000
11.3	Wetland	Pipe 11.4	136	72	0.11	140	2954	$405	$1,197,000	$575,000	$1,772,000
11.4	SWW 9	Pipe 11.8	167	72	0.16	169	1110	$405	$450,000	$216,000	$666,000
11.5	SWW 12	Pipe 11.6	8	30	0.11	14	1610	$195	$314,000	$151,000	$465,000
11.6	SWW 11	Pipe 11.6	47	48	0.11	48	1076	$275	$296,000	$143,000	$439,000
11.7	SWW 10	Pipe 11.8	54	54	0.08	56	603	$285	$172,000	$83,000	$255,000
11.8	Junction	Watab River	221	90	0.08	243	217	$585	$127,000	$61,000	$188,000
11.9	Pipe 11.3	Watab River	136	60	0.40	165	892	$325	$290,000	$140,000	$430,000
						Total	**11458**		**$3,634,000**	**$1,748,000**	**$5,382,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

Ditch 16 Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
12.1	D16 2	D16 1	106	66	0.10	106	954	$355	$339,000	$163,000	$502,000
12.2	D16 1	Co. Ditch 16	154	66	0.25	168	291	$355	$104,000	$50,000	$154,000
12.3	D16 4, D16 6	Wetland	31	30	1.00	41	379	$195	$74,000	$36,000	$110,000
12.4	D16 25	Wetland	8	24	0.15	9	1339	$185	$248,000	$120,000	$368,000
12.5	D16 11, D16 14	Pipe 12.6	40	48	0.15	56	469	$275	$129,000	$62,000	$191,000
12.6	D16 12	Pipe 12.7	48	48	0.15	56	739	$275	$204,000	$98,000	$302,000
12.7	D16 13	Wetland	56	48	0.50	102	444	$275	$123,000	$60,000	$183,000
12.8	D16 16	Wetland	5	18	0.50	7	267	$180	$49,000	$24,000	$73,000
12.9	Wetland	Pipe 12.10	78	54	0.25	98	696	$285	$199,000	$96,000	$295,000
12.10	Junction	Wetland	78	54	0.25	98	311	$285	$89,000	$43,000	$132,000
						Total	**5889**		**$1,558,000**	**$752,000**	**$2,310,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

South Central Watab Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
13.1	SCW 2, SCW 3	Wetland	17	36	0.10	21	1190	$255	$304,000	$146,000	$450,000
13.2	SCW 4	Existing Pond	4	15	1.00	6	299	$175	$53,000	$26,000	$79,000
13.3	SCW 5	Existing Ditch	3	12	1.00	4	72	$165	$12,000	$6,000	$18,000
						Total	**1561**		**$369,000**	**$178,000**	**$547,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

Ditch 50 Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
15.1	D50 7	Existing Storm	5	15	1.00	6	151	$175	$27,000	$13,000	$40,000
15.2	D50 6	Existing Storm	10	24	0.50	16	921	$185	$171,000	$83,000	$254,000
15.3	4th Ave Area	Pipe 15.4	47	36	0.50	47	2658	$255	$678,000	$326,000	$1,004,000
15.4	D50 3	Pipe 15.5	25	30	0.50	29	207	$195	$41,000	$20,000	$61,000
15.5	Future Ditch	Mississippi River	141	42	3.00	174	350	$270	$95,000	$46,000	$141,000
15.6	D50 5	Ditch 50 System	12	24	8.00	20	247	$185	$46,000	$23,000	$69,000
FF	Potential Future Trunk System Ditch						1,218	$145	$177,000	$85,000	$262,000
GG	Potential Future Trunk System Ditch						2,669	$145	$388,000	$187,000	$575,000
						Total	**8421**		**$1,623,000**	**$783,000**	**$2,406,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix E

Future Watershed Trunk System Information & Costs

South Trunk Watershed

Trunk Storm/Ditch ID	Drainage Area Inflow From	Drainage Area Flows To	10-year Flow (cfs)[1]	Size (in)	Slope (%)	Full Flow Capacity (cfs)	Length (lin ft)	Construction & Land Cost[2] ($/LF)	SubTotal	Contingency & Soft Costs[3]	Total Trunk Pipe/Ditch Cost
16.1	ST 5, ST 6	Existing Storm	19	24	0.70	19	303	$185	$57,000	$28,000	$85,000
16.2	ST 7	Wetland	26	42	0.07	27	642	$270	$174,000	$84,000	$258,000
16.3	Wetland	Pipe 16.5	26	42	0.07	27	589	$270	$160,000	$77,000	$237,000
16.4	Existing Storm	Pipe 16.5	5	24	0.15	9	795	$185	$148,000	$72,000	$220,000
16.5	ST 8, ST 9	South Trunk	79	48	0.50	102	854	$275	$235,000	$113,000	$348,000
16.6	ST 15, ST 16	Existing Storm	19	24	0.75	20	392	$185	$73,000	$36,000	$109,000
16.7	ST 18	Existing Storm	75	42	1.00	101	1339	$270	$362,000	$174,000	$536,000
						Total	**4914**		**$1,209,000**	**$584,000**	**$1,793,000**

[1]10-year peak design flow assuming pond attenuation and rate control

[2]Includes construction, restoration, and land/easement costs. (assumed $20,000 per acre & 50 ft wide easement)

[3]Includes 20% Contingency, 18% Engineering, 10% Administrative & Legal

Cost are rounded up to the $1,000

Appendix F

Past Studies

WSB & Associates, Inc.
engineering · planning · environmental · construction

701 Xenia Avenue South
Suite 300
Minneapolis, MN 55416
Tel: 763-541-4800
Fax: 763-541-1700

Memorandum

To: ***Mike Nielson***

From: ***Earth Evans***

Date: ***08/28/13***

Re: ***The Wilds Flooding Analysis***
WSB Project No. 2174-17

This memo summarizes our analysis of options to reduce the flooding that occurs in the rear yards of several properties in the Wilds development in the City of Sartell. The properties are located adjacent to County Ditch 13 which meanders through the rear lots prior to discharging through dual existing 48-inch pipes to the Watab River (Figure 2). The properties have reported issues with high water levels in the ditch, particularly during the spring snowmelt.

Background
Baker Lake discharges to County Ditch 13 (Figure 1). The lake has a large tributary area, approximately 3.3 square miles. At the lake outlet, the ditch is approximately 20-feet wide at the bottom and 4-feet deep. The ditch narrows to 4-feet wide at the bottom through The Wilds development (Point A to Point B).

The City of Sartell previously studied the area in 2012 Preliminary Engineering Report, Bakers Lake/North Storm Sewer Improvements. That analysis recommended constructing an outlet from Bakers Lake to the east. Due to the cost and need to acquire nearly a mile of easement, the City requested that additional options be evaluated for addressing the flooding that occurs in The Wilds development.

Analysis
Two options were evaluated for reducing the water levels in the ditch.

1. Restrict the outlet from Baker Lake to reduce the discharge into County Ditch 13.
2. Modify the dual outlets from County Ditch 13 to provide additional capacity.

<u>Baker Lake Outlet Modification</u>
Several options were evaluated for restricting the outlet from Baker Lake in order to reduce the flow in the channel and consequently lower the high water level in the ditch. Table 1 lists the existing modeled high water levels in the lake. The tributary area is primarily agricultural row crop. The runoff from this land use type varies considerably based on the season and crop growth. An average row crop land use curve number was used to estimate high water levels.

Table 1 – Baker Lake Existing High Water Levels

Storm Event	Baker Lake HWL
2-Year	1039.0
10-Year	1040.4
100-Year (6")	1042.4
Atlas 14 (6.4")	1042.8

Figure 1 shows the topography of Baker Lake. The surrounding agricultural area is very flat, generally 0.5% slope. The existing high water level extends through the drainage ditch to the northwest approximately 200-feet.

There are two constraints to raising the water level in the lake:

- Easement would be required surrounding the lake for the additional land area from the increase in high water level. Due to the flat adjacent topography, these easements could be significant.
- Baker Lake is a Department of Natural Resources (DNR) Public Water and would require a permit for modifications to the outlet.

These constraints greatly limit the viability of this option and it was not further evaluated.

County Ditch 13 Outlet Modification

Two options were evaluated for modifying the existing dual 48-inch outlets from County Ditch 13:

1. Replace one existing 48-inch with 60-inch diameter pipe
2. Replace both pipes with 60-inch diameter pipes

The following table lists the results.

Table 2 – Ditch HWL Analysis

	Ditch HWL (Pt A)			Ditch HWL (Pt B)		
Storm Event	Existing	48 & 60	dual 60	Existing	48 & 60	dual 60
2-year	1036.6	1036.6	1036.6	1034.2	1034.1	1034.1
10-year	1037.3	1037.3	1037.3	1036.2	1035.8	1035.6
100-year	1040.9	1039.7	1038.8	1040.8	1039.6	1038.5
6.4"	1041.5	1040.4	1039.4	1041.5	1040.3	1039.2

For reference, the existing low home is at elevation 1042+/-, and the rear yards are approximately 1038.0. Increasing the outlet capacity to a 48-inch and 60-inch pipe reduces the 100-year HWL by 1.2-feet in the ditch. Constructing two 60-inch diameter pipes reduces the 100-year HWL by 2.1-feet.

Additionally, an option was evaluated to construct a headwall on the upstream end of the existing dual 48-inch pipes. The existing inlet is a 48-inch flared end section. Long radius bends were used to turn 90 degrees to the east in order to discharge into the Watab River. A headwall reduces the entrance losses, but only reduces the HWL in the ditch 0.2-feet for the 100-year rainfall depth.

A cost estimate was completed for both options (see attached). The cost to replace the 48-inch with a 60-inch diameter pipe is $110,175 and the dual 60-inch pipes is 219,000. The costs include 10% contingency cost and 10% indirect costs.

Aug, 28 2013 10:26:42 AM K:\02174-170\GIS\Maps\Pinecone road2.mxd By: eevans

Sartell

Figure 1
Baker Lake Topography

1 inch = 150 feet

N

WSB

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

BAKER LAKE

CD 13

Point A

Point B

Dual 48" RCP

Sartell

Figure 2
Baker Lake Location Map

1 inch = 200 feet

N

WSB

Aug, 28 2013 11:54:30 AM K:\02174-170\GIS\Maps\Baker Lake Figure2.mxd By: eevans

Opinion of Probable Cost

CD 13 Outlet Modification
City of Sartell

Design By: Kboggs
Checked By: EAE

02174-170

Date: 8/27/2013

Item No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
	48-inch and 60-inch Outlet Pipes				
1	MOBILIZATION	EACH	1	$ 5,000.00	$5,000.00
2	EROSION CONTROL	LS	1	$2,000.00	$2,000.00
3	60" RCP	CY	570	$150.00	$85,500.00
4	60" FES	EACH	2	$2,000.00	$4,000.00
				Subtotal=	**$91,500.00**
				+ 10% Contingency Cost	$9,150.00
				Subtotal	**$100,650.00**
				+ 10% Indirect Cost	$10,065.00
				Total =	**$110,715.00**

Item No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
	Dual 60-inch Outlet Pipes				
1	MOBILIZATION	EACH	1	$ 5,000.00	$5,000.00
2	EROSION CONTROL	LS	1	$2,000.00	$2,000.00
3	60" RCP	CY	1140	$150.00	$171,000.00
4	60" FES	EACH	4	$2,000.00	$8,000.00
				Subtotal Outlet and Grading Improvements =	**$181,000.00**
				+ 10% Contingency Cost	$18,100.00
				Subtotal	**$199,100.00**
				+ 10% Indirect Cost	$19,910.00
				Total Outlet and Grading Improvements =	**$219,010.00**

WSB & Associates, Inc.
engineering · planning · environmental · construction

701 Xenia Avenue South
Suite 300
Minneapolis, MN 55416
Tel: 763-541-4800
Fax: 763-541-1700

Memorandum

To: ***Mike Nielson***

From: ***Earth Evans***

Date: ***Pinecone Road and 2 ½ Street Intersection Flooding Analysis***

Re: ***WSB Project No. 2174-17***

This memo summarizes our analysis of options to reduce the flooding that occurs at the intersection of Pinecone Road and 2 ½ Street in the City of Sartell (see Figure 1). The storm sewer in the intersection conveys runoff from approximately 215 acres prior to discharging to the Watab River. Flooding in the intersection is a result of the stage of the Watab River and the capacity of the 54-inch pipe downstream of the intersection.

Two options were modeled to alleviate the high water levels in the intersection. Both options utilize the existing green space owned by the City adjacent to City Hall, located in the southwest quadrant of the intersection.

- **Option 1** – Construct a 10-foot curb cut in the southwest corner of the intersection (adjacent to the existing catch basins) to divert runoff into a narrow swale parallel to Pinecone Road. South of the trail near 1st Street North, 3 – 24" culverts convey the runoff to an expanded existing pond.
- **Option 2** – Same as option 1 with a 20-foot curb cut.

In addition, the Watab River was modeled at high (elevation 1029) and low (1024 elevation) stage.

The results are presented in Tables 1 and 2.

Table 1 – Model Results (Watab River at Low Stage)

	Pinecone Rd & 2 1/2 St intersection HWL		
Storm Event	Existing	Option 1 (10' curb cut)	Option 2 (20' curb cut)
2-year	1028.3	1028.3	1028.3
10-year	1033.0	1033.0	1033.0
100-year	1034.8	1034.3	1033.9
Atlas 14	1035.0	1034.4	1034.1

There is a 0.9-foot reduction in the high water level in the intersection for the 100-year (6.0") rainfall and updated Atlas 14 (6.4") depth. The low point of the intersection is 1032.5. Therefore with option 2, there is approximately 1.4-feet of water in the street, versus 2.3-feet.

Additionally, there is a slight reduction in the inundation time above elevation 1033.0 from 2.5 hours existing to 2 hours with options 1 and 2.

Table 2 – Model Results (Watab River at High Stage)

	Pinecone Rd & 2 1/2 St intersection HWL		
Storm Event	Existing	Option 1 (10' curb cut)	Option 2 (20' curb cut)
2-year	1029.4	1029.4	1029.4
10-year	1033.3	1033.3	1033.2
100-year	1035.1	1034.4	1034.0
Atlas 14	1035.3	1034.5	1034.2

With the river at high stage, there is a 1.1-foot reduction in the high water level for the 100-year storm event with option 2. The inundation time above elevation 1033.0 is reduced from 3 hours to 1.5 hours.

The engineer's estimate is $61,776, including 30% indirect and contingencies (see attached). The primary purpose of the project is flood control. However, the project also provides a water quality benefit for a larger untreated subwatershed upstream of the Watab River.

Proposed Curb Cut
Elevation 1032.5

Proposed Swale

Proposed 3 - 24" Pipes
Inv 1029+/-

Proposed Pond
Expansion
NWL = 1029
HWL = 1031+/-

48" RCP

54" RCP

2 1/2 STREET

PINECONE ROAD

WATAB RIVER

BECHTOLD

3RD

LAWRENCE

CHEVAL

BANTAM

PINE CONE

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Aug, 27 2013 2:13:42 PM K:\02174-170\GIS\Maps\Pinecone Figure1.mxd By: eevans

Sartell

0 20 40 80
Feet

Figure 1
Pinecone Road and 2 1/2 Intersection

N

WSB

Opinion of Probable Cost

Pinecone Road and 2 1/2 Street Intersection
City of Sartell

Design By: Kboggs
Checked By: EAE

02174-170

Date: 8/27/2013

Item No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1	MOBILIZATION	EACH	1	$ 10,000.00	$10,000.00
2	EROSION CONTROL	LS	1	$2,000.00	$2,000.00
3	COMMON EXCAVATION	CY	3000	$13.00	$39,000.00
4	CURB CUT	EACH	1	$500.00	$500.00
5	24" RCP	LF	90	$30.00	$2,700.00
6	FLARED ENDS	EACH	6	$200.00	$1,200.00
7	SEEDING	ACRE	0.7	$2,000.00	$1,400.00
				Subtotal Outlet and Grading Improvements =	**$46,800.00**
				+ 10% Contingency Cost	$4,680.00
				Subtotal	**$51,480.00**
				+ 20% Indirect Cost	$10,296.00
				Total Outlet and Grading Improvements =	**$61,776.00**

Preliminary Engineering Report

Bakers Lake / North Storm Sewer Improvements

City of Sartell

November 26, 2012

Project Number: 193801551

Stantec

Preliminary Engineering Report
For
Bakers Lake / North Storm Sewer Improvements
Sartell, Minnesota

Council Meeting Date:	November 26, 2012
Project No.:	193801551
Mayor:	Joe Perske
Council Members:	Sandra Cordie Steve Hennes Sarah Nicoll David Peterson
Administrator/Clerk:	Patti Gartland
Public Works Director:	Brad Borders

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Jeremy B. Mathiasen

Jeremy B. Mathiasen, P.E.

Date: 11/21/12 Reg. No. 42334

Table of Contents

Stantec 3717 23rd Street South St. Cloud, MN 56301 (320) 251-4553	**City of Sartell** **2012 Baker's Lake** **Storm Sewer** Sartell, MN	**Project Location Map**		
		Date 11/13/2012	Job No. 1938-01551	Scale 1" = 1000'

Introduction

The Sartell City Council has directed our firm, Stantec, to conduct a feasibility study and prepare a Preliminary Engineering Report for the potential storm sewer improvements at Bakers Lake and other areas located in the northern part of the City. This Preliminary Engineering Report is being prepared pursuant to Minnesota Statute 429.

Scope

There has been a history of high water levels and occasional flooding along Ditch 13 (which conveys flows from Bakers Lake and the adjacent agricultural land north of Sartell), and at some roadway intersections along Pinecone Road. The purpose of this feasibility study is to identify and evaluate storm sewer improvements that would help reduce the high water levels and occasional flooding that have been witnessed in the spring of the year and during large rain events.

As shown on the attached location map Bakers Lake is located north of the Wild's neighborhood and Pinecone Central Park, west of Pinecone Road, and south of 27th Street North. The Lake itself is approximately 50 acres and is part of a large drainage basin that collects water from over 2,100 acres of adjacent property. The existing outlet of Bakers Lake is a ditch, commonly referred to as Ditch 13, and is classified as a water of the State. At the outlet, the ditch is approximately twenty feet wide at the base and three to four feet in depth. Ditch 13 directs water south towards the Wild's neighborhood, then past the Pine Ridge Golf Course, and ultimately connects in to the Watab River just west of Pinecone Road.

Due to the large drainage area for Bakers Lake, the spring thaw and other large rain events often lead to high water levels in Ditch 13 along multiple residential properties. Depending on the spring thaw weather and specifically the speed at which the snow melts and the frost comes out of the ground, it isn't unusual to have adjacent residents sandbagging around the back of their homes to prevent Ditch 13 waters from causing damage to their property.

The water elevation of the Watab River plays a significant role in the ability of Ditch 13 to convey water. When the river is high (100-yr elevation of 1034.0 at Pinecone Road), Ditch 13 will back up and can cause flooding of both the residential properties and the City owned Pine Ridge golf course. The purpose of this study is to evaluate what can be done near the source of the Ditch 13, Bakers Lake, in order to reduce the threat of flooding. Managing flows through Ditch 13 will reduce some of the burdens placed on the Public Works Department and may provide long awaited peace of mind for property owners along Ditch 13.

This report also includes a look at what could be done to help reduce the temporary intersection flooding that has been occurring along Pinecone Road and specifically at the intersection of 2 ½ Street North. As presented in the City's Storm Water Management Plan, re-directing a portion of the Pinecone road drainage area into the City owned golf course property can reduce storm water flows in the Pinecone Road storm sewer system, and also provide rate control and storm water treatment that doesn't currently exist for some of the adjacent residential areas.

Design Considerations

TRUNK STORM SEWER – BAKERS LAKE

The Bakers Lake area is being targeted because it is the source of the Ditch 13 flow and is critical to making long term reductions in the flooding risks to the City and residents. Temporary measures such as sandbagging or berming along the properties provide temporary relief but don't address the source of the problem. It is unrealistic to try and limit the flow into Bakers Lake but it would be possible to introduce a second outlet from the Lake to reduce the flow in Ditch 13.

As noted in the City's Surface Water Management Plan, there is a large trunk storm sewer line northwest of Bakers Lake that takes water directly to the Mississippi River. The elevations are such that water could be conveyed from Bakers Lake to that existing north trunk storm sewer line. There are however two significant obstacles with this approach. The first is simply the cost to install a large diameter storm sewer pipe from Bakers Lake to the existing line. The total distance is approximately 5035 feet or just short of a mile. The second obstacle is that a good portion of the proposed route is along privately owned property and would require the acquisition of utility easements. The City does currently have a utility easement covering roughly 25% of the proposed route that was acquired for the trunk sanitary sewer and water main lines that were previously extended to the north. The proposed storm sewer route would maximize the use of the existing easements.

The connection point to the existing 60 inch north trunk line is immediately east of Pinecone Road, south of the Oak Ridge Commons plat, and would require the removal and repair of a section of Pinecone Road. It is likely that the Contractor could complete the storm sewer installation across Pinecone Road with minimal disruption to traffic by doing one half of the street at a time, keeping one lane open at all times.

Hydrology calculations were completed for Bakers Lake to illustrate the existing flow versus

the flow after installing the second outlet, and that information can be found in the appendix section of this report. The results showed that in a 100 year storm event (5.75 inches of rain within a 24 hour period) that the flows into Ditch 13 could be reduced by 45-50 cubic feet of water per second, for a reduction of approximately 30% from the existing condition. To reduce the flow further, the installation of a control structure at the north end of Ditch 13 could be considered that would slow the rate of flow from Bakers Lake into the ditch. This would have the ability to reduce the Ditch 13 flow by approximately 60% from the existing condition. The other benefit to this approach would be the opportunity to restore some of the wetlands surrounding Bakers Lake to their previous condition. By slowing the rate of flow into Ditch 13, the water level of Bakers Lake would rise and help restore the hydrology of the adjacent area. Permitting though the DNR would be required for this approach and public involvement and buy in from the adjacent property owners will be critical. Restoration of wetlands is important work and a partnership should be explored with the Stearns County Soil and Water Conservation group that could potentially provide both technical and financial support to the project.

As mentioned above, funding the improvements will be a challenge. Instead of fronting the costs to install the additional storm sewer the City may choose to install the trunk storm sewer extension as the adjacent property develops. The obvious downside to this approach is that the development timeline is unknown and relief for the homeowners along Ditch 13 may be needed sooner.

The proposed storm sewer would be 48 inches in diameter. Manholes should be installed approximately every 500 feet and will range in size between 66 inches and 96 inches in diameter. The rate control structure for the north end of the Ditch 13 mentioned above could include the construction of an earth dike with a 48 inch diameter pipe.

Stantec

3717 23rd Street South
St. Cloud, MN 56301
(320) 251-4553

City of Sartell
2012 Baker's Lake Storm Sewer
Sartell, MN

Project Map - Bakers Lake

Date	Job No.	
11/13/2012	1938-01551	0 237.5 475 Feet

PINECONE ROAD STORM SEWER IMPROVEMENTS

There is approximately 160 Acres in the Pinecone Road North drainage basin. The flow, which originates mainly from adjacent residential neighborhoods and the Pinecone road right of way, drains through the storm sewer system underneath Pinecone Road and into the Watab River. Before discharging into the river the water goes through an underground sedimentation structure located just north of the Watab. During large rain events and occasions when the Watab water level is high, there is flooding that occurs along Pinecone Road and specifically at the intersection of 2 ½ Street North.

Two recommendations were provided in the Storm Water Surface Management plan to help minimize flooding of Pinecone Road within this drainage district. The first was to encourage and implement flow reduction elements such as rain gardens, underground storage, or pervious pavements. This would reduce the total amount and rate of flow from the neighborhoods into the Pinecone storm sewer. Unlike the City's newer developments, these neighborhoods were largely developed prior to the City requiring local ponding and treatment, which results in flow entering directly into the system without rate control or treatment. In 2012 the City and the Stearns County Soil and Water Conservation team submitted a grant application to BWSR that would provide funding to begin implementing some of the infiltration measures mentioned above. The results of the application have not yet been announced.

Another alternative that was proposed was to connect and redirect approximately 60 acres of the North Pinecone Road storm water into the City owned golf course where it could be ponded, providing rate control and treatment. The idea of additional ponding (approximately a 1.5 acre pond) on the golf course had been preliminarily discussed with the current lease tenants of the golf course and the feedback has been positive. The preliminary estimated cost for this alternative in included in the following pages.

Stantec 3717 23rd Street South St. Cloud, MN 56301 (320) 251-4553	**City of Sartell** **2012 Baker's Lake Storm Sewer** Sartell, MN	**Project Map - Pinecone Central Park**	
		Date 11/13/2012	Job No. 1938-01551

0 120 240 Feet

ANCILLARY WORK ITEMS

Ancillary work items are costs associated with the project, but are not direct road/city utility construction related items. The ancillary work for both the Bakers Lake and Pinecone Road improvements discussed above would include the utility and temporary construction easement acquisitions. Please note that the cost of this work item as presented in the cost estimate is only intended to determine an order of magnitude. Total costs may vary as land prices and property owners change.

ADDITIONAL NOTES

- As the property adjacent to Bakers Lake develops, the City should consider efforts to secure drainage easements and/or park land in that area. Much like Central Park, the Bakers Lake area provides an opportunity to preserve a large area of open space and natural resources that may come at a reduced cost due to the presence of wetlands and other undevelopable areas. Creating a park corridor that extends from Central Park to the Bakers Lake area would be a great asset to the City and its residents.

- It has recently been announced that the National Oceanic and Atmospheric Administration (NOAA) is revising their data on rainfall events and specifically what amount of rain will constitute a 100 year rain event, which is the basis for storm water pond design. The Central Minnesota area will see a 5% increase meaning the previous 100 year rain event of 5.8 inches over a 24 hour period will now increase to 6.1 inches. Strom sewer design moving forward will need to be adjusted accordingly.

- The underground sedimentation structure located along Pinecone Road just north of the Watab River should be targeted for regular cleaning and maintenance. This will help to make sure that the structure is functioning at full capacity and not restricting storm water from entering the river.

Project Cost Estimates

The information below provides our best estimates of costs associated with the project. These estimates are the result of our experience and previous exposure to many of these types of projects. However, these estimates should not be considered as the final cost of the project as some of the items, unit costs, and quantities will change during the course of detailed design, bidding, and development of the final project.

Bakers Lake Improvements

Item	Unit	Quantity	Est. Unit Price	Est. item Price
Mobilization	LS	1.00	$ 5,000.00	$ 5,000.00
Remove Bituminous Pavement	SY	80.00	5.00	400.00
Sawing Bituminous Pavement	LF	60.00	3.50	210.00
Aggregate Base Class V (LV)	CY	30.00	20.00	600.00
Bituminous Patching	TN	20.00	95.00	1,900.00
Traffic Control	LS	1.00	1,500.00	1,500.00
48" Storm Sewer	LF	5,035.00	90.00	453,150.00
48" Apron w/ Trash Guard	EA	1.00	850.00	850.00
Construct Drainage Structure Design 4020-66	EA	8.00	5,000.00	40,000.00
Construct Drainage Structure Design 4020-96	EA	2.00	9,000.00	18,000.00
Connect to Existing Storm Manhole	EA	1.00	2,000.00	2,000.00
Construct Outlet Structure @ Bakers Lake	EA	1.00	10,000.00	10,000.00
Hydro Seeding and Mulch	AC	3.60	2,000.00	7,200.00
			Est. Construction Cost	540,810.00
			Design/Bid/Construction Observation/Management (13%)	70,310.00
			Subtotal	$ 611,120.00

Easements Acquisition	Width	Total Area	Cost per SF	Est. Total Cost
Station 0+00 to 10+05	20.00	20,100.00	1.00	20,100.00
Station 10+05 to 23+35 - Existing Utility Easement	-	-	1.00	-
Station 23+35 to 49+35	20.00	52,000.00	1.00	52,000.00
Temporary Construction Easements (full length)	20.00	100,700.00	0.25	25,175.00
			Estimated Easement Costs	97,275.00
			Indirect Costs (3% of Construction)	16,220.00
			Est. Total Land Costs	$ 113,495.00

Est. Total Project Costs For Bakers Lake $ 724,615.00

Pinecone Road Storm Sewer Improvements

Item	Unit	Quantity	Est. Unit Price	Est. item Price
Mobilization	LS	1.00	$ 5,000.00	$ 5,000.00
Clearing & Grubbing	EA	5.00	300.00	1,500.00
Remove Curb & Gutter	LF	20.00	6.00	120.00
Pond Excavation	CY	12,000.00	6.00	72,000.00
Concrete Curb & Gutter, Des. B618	LF	20.00	15.00	300.00
Connect to Existing Storm Catch Basin	EA	1.00	1,000.00	1,000.00
36" Storm Sewer	LF	995.00	65.00	64,675.00
15" Storm Sewer	LF	100.00	30.00	3,000.00
15" Apron w/Trash Guard	EA	2.00	450.00	900.00
36" Apron w/ Trash Guard	EA	1.00	1,000.00	1,000.00
Pond Sedimentation Structure	EA	1.00	5,000.00	5,000.00
Rip Rap, CL II	CY	10.00	50.00	500.00
Hydro Seeding and Mulch	AC	1.80	2,500.00	4,500.00

Est. Construction Cost	159,495.00
Design/Bid/Construction Observation/Management (13%)	20,730.00
Utility & Construction Easements (3%)	4,780.00
Est. Total Design/Construction Costs	**$ 185,005.00**

Project Financing

Project costs are often offset by specially assessing benefiting property owners. The benefitting property owners in this case are the residential property owners located along Ditch 13, the City of Sartell, and the general traveling public. The City Council and Staff should work together to determine if a percentage of the Bakers Lake project costs provide substantial benefit to property owners in order justify special assessments. The storm sewer re-routing and additional ponding for the Pinecone Road drainage basin is needed to treat and control runoff from property owners within the basin. Although it may prove difficult to show the benefit to these property owners considering their existing runoff is already being conveyed away from the property, a neighborhood or area assessment would be beneficial to help defray the costs to the City.

The costs not covered by special assessments will likely need to be covered by the City's trunk storm sewer fund and/or City secured grant dollars.

Conclusion

Maintaining the City's storm sewer system can be challenging and expensive. As new regulations continue to be proposed and implemented, more and more burden is placed on cities and their budgets. As with many capital improvement project candidates, the upfront costs are often overwhelming and the long term payback needs to be evaluated. Some of the long term benefits of the storm sewer improvements discussed in this report include reduced flooding along select city streets and residential properties, and environmental benefits that stem from better treatment of city storm water. City resources of time, labor and materials are expended by public works and fire department teams during large rain events and during other high runoff situations. Maintaining safe and accessible streets throughout the year is important to the City of Sartell.

Future neighborhood reconstruction projects and new development are opportunities that need to be analyzed to determine if certain retrofitting and upgrades can be coordinated, but unfortunately the timing of those projects is often unknown. It is our recommendation that the improvements discussed in this report be carefully considered for inclusion in the City's Capital Improvement budgeting and planning. The work described in this report is feasible and will lead to cost benefits for the City. The construction costs are based on estimates consistent with construction industry standards. Costs will vary depending on circumstances prevalent at the time of bidding and construction.

Appendix

Summary for Pond 119P: BAKER LAKE Ex Outlet

Inflow Area = 2,145.000 ac, 0.00% Impervious, Inflow Depth > 3.32" for 100 Yr event
Inflow = 175.10 cfs @ 46.55 hrs, Volume= 593.384 af
Outflow = 169.69 cfs @ 50.23 hrs, Volume= 563.245 af, Atten= 3%, Lag= 220.3 min
Primary = 169.69 cfs @ 50.23 hrs, Volume= 563.245 af

Routing by Stor-Ind method, Time Span= 10.00-100.00 hrs, dt= 0.30 hrs
Peak Elev= 1,039.70' @ 50.23 hrs Surf.Area= 47.410 ac Storage= 76.638 af

Plug-Flow detention time= 395.4 min calculated for 563.245 af (95% of inflow)
Center-of-Mass det. time= 272.1 min (3,447.1 - 3,175.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,038.00'	192.964 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,038.00	42.670	0.000	0.000
1,042.00	53.812	192.964	192.964

Device	Routing	Invert	Outlet Devices
#1	Primary	1,038.00'	**32.0' 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

Primary OutFlow Max=169.68 cfs @ 50.23 hrs HW=1,039.70' TW=1,038.65' (Fixed TW Elev= 1,038.65')
1=Broad-Crested Rectangular Weir (Weir Controls 169.68 cfs @ 3.12 fps)

Summary for Pond 33P: BAKER LAKE Sec Outlet

Inflow Area = 2,255.000 ac, 0.00% Impervious, Inflow Depth > 3.27" for 100 Yr event
Inflow = 175.10 cfs @ 46.55 hrs, Volume= 614.861 af
Outflow = 172.03 cfs @ 48.91 hrs, Volume= 585.551 af, Atten= 2%, Lag= 141.3 min
Primary = 120.11 cfs @ 48.91 hrs, Volume= 425.425 af
Secondary = 51.92 cfs @ 48.91 hrs, Volume= 160.126 af

Routing by Stor-Ind method, Time Span= 10.00-100.00 hrs, dt= 0.30 hrs
Peak Elev= 1,039.39' @ 48.91 hrs Surf.Area= 46.547 ac Storage= 62.087 af

Plug-Flow detention time= 350.2 min calculated for 583.605 af (95% of inflow)
Center-of-Mass det. time= 230.9 min (3,325.5 - 3,094.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,038.00'	192.964 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,038.00	42.670	0.000	0.000
1,042.00	53.812	192.964	192.964

Device	Routing	Invert	Outlet Devices
#1	Primary	1,038.00'	**32.0' 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	Secondary	1,035.50'	**48.0" Round Culvert** L= 5,035.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,035.50' / 1,027.95' S= 0.0015 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf
#3	Device 2	1,038.50'	**72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=120.10 cfs @ 48.91 hrs HW=1,039.39' TW=1,038.65' (Fixed TW Elev= 1,038.65')
└**1=Broad-Crested Rectangular Weir** (Weir Controls 120.10 cfs @ 2.70 fps)

Secondary OutFlow Max=51.91 cfs @ 48.91 hrs HW=1,039.39' (Free Discharge)
└**2=Culvert** (Passes 51.91 cfs of 54.02 cfs potential flow)
└**3=Orifice/Grate** (Weir Controls 51.91 cfs @ 3.09 fps)

Summary for Pond 120P: BAKER LAKE Control Outlet

Inflow Area = 2,145.000 ac, 0.00% Impervious, Inflow Depth > 3.32" for 100 Yr event
Inflow = 175.10 cfs @ 46.55 hrs, Volume= 593.384 af
Outflow = 129.01 cfs @ 60.35 hrs, Volume= 546.495 af, Atten= 26%, Lag= 827.7 min
Primary = 63.21 cfs @ 60.35 hrs, Volume= 202.975 af
Secondary = 67.06 cfs @ 79.37 hrs, Volume= 343.521 af

Routing by Stor-Ind method, Time Span= 10.00-100.00 hrs, dt= 0.30 hrs
Peak Elev= 1,041.62' @ 60.35 hrs Surf.Area= 52.766 ac Storage= 172.944 af

Plug-Flow detention time= 840.9 min calculated for 546.495 af (92% of inflow)
Center-of-Mass det. time= 659.3 min (3,834.3 - 3,175.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,038.00'	192.964 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,038.00	42.670	0.000	0.000
1,042.00	53.812	192.964	192.964

Device	Routing	Invert	Outlet Devices
#1	Primary	1,038.00'	**48.0" Round RCP_Round 48"** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 1,038.00' / 1,037.75' S= 0.0025 '/' Cc= 0.900 n= 0.012, Flow Area= 12.57 sf
#2	Secondary	1,035.50'	**48.0" Round Culvert** L= 5,035.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,035.50' / 1,027.95' S= 0.0015 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf
#3	Device 2	1,038.50'	**72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=63.21 cfs @ 60.35 hrs HW=1,041.62' TW=1,038.65' (Fixed TW Elev= 1,038.65')
└─**1=RCP_Round 48"** (Barrel Controls 63.21 cfs @ 6.95 fps)

Secondary OutFlow Max=67.06 cfs @ 79.37 hrs HW=1,040.54' (Free Discharge)
└─**2=Culvert** (Barrel Controls 67.06 cfs @ 5.45 fps)
└─**3=Orifice/Grate** (Passes 67.06 cfs of 180.19 cfs potential flow)

Summary for Pond 2P: Proposed Golf Course Pond

Inflow Area = 64.180 ac, 39.74% Impervious, Inflow Depth > 3.11"
Inflow = 142.32 cfs @ 12.12 hrs, Volume= 16.632 af
Outflow = 10.92 cfs @ 14.64 hrs, Volume= 16.541 af, Atten= 92%, Lag= 150.9 min
Primary = 10.92 cfs @ 14.64 hrs, Volume= 16.541 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Starting Elev= 1,032.00' Surf.Area= 28,120 sf Storage= 75,996 cf
Peak Elev= 1,037.71' @ 14.64 hrs Surf.Area= 68,589 sf Storage= 348,517 cf (272,521 cf above start)

Plug-Flow detention time= 820.8 min calculated for 14.795 af (89% of inflow)
Center-of-Mass det. time= 475.9 min (1,693.0 - 1,217.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,026.00'	443,167 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,026.00	4,364	0	0
1,027.00	6,543	5,454	5,454
1,028.00	9,008	7,776	13,229
1,029.00	11,657	10,333	23,562
1,030.00	14,558	13,108	36,669
1,031.00	17,988	16,273	52,942
1,032.00	28,120	23,054	75,996
1,033.00	34,604	31,362	107,358
1,034.00	41,345	37,975	145,333
1,035.00	48,343	44,844	190,177
1,036.00	55,587	51,965	242,142
1,037.00	63,072	59,330	301,471
1,038.00	70,792	66,932	368,403
1,039.00	78,735	74,764	443,167

Device	Routing	Invert	Outlet Devices
#1	Primary	1,032.00'	**15.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,032.00' / 1,031.75' S= 0.0025 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	1,036.00'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,032.00'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=10.92 cfs @ 14.64 hrs HW=1,037.71' (Free Discharge)
└**1=Culvert** (Barrel Controls 10.92 cfs @ 8.90 fps)
└**2=Orifice/Grate** (Passes < 79.23 cfs potential flow)
└**3=Orifice/Grate** (Passes < 3.90 cfs potential flow)

Building a Better World for All of Us®

Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a companywide commitment to act in the best interests of our clients and the world around us.

We’re confident in our ability to balance these requirements.

SEH