

Professional

Engineering

Services

Lake Wingra Watershed Management Plan

Report

City of

Madison, WI

in Cooperation with Friends of

Lake Wingra

November 2015



Photo Source: David Liebl



In 2009 the Friends of Lake Wingra published *Lake Wingra: A Vision for the Future*. This document listed a series of goals to improve Lake Wingra and the surrounding watershed. The goals included:

1. Clean, clear water.
2. Restored spring flow.
3. Abundant native plants and animals.
4. Stewardship and enjoyment.

The Friends of Lake Wingra then advocated for, and partnered with, the City of Madison Engineering Department to develop a watershed plan that worked toward achieving these goals. This report is a result of their persistent efforts. It is the product of 13 Steering Committee meetings, 3 issue team meetings, and other community engagement activities. It also includes a pilot project focusing on modified leaf collection methods (see Appendix G). The Steering Committee is made up of representatives from the City of Madison Engineering, Friends of Lake Wingra, Wisconsin Department of Natural Resources, UW Arboretum, and the UW Madison campus. Table 1 lists the representatives as of June 2015.

Genesis Steinhorst	City of Madison (Former)
Phil Gaebler	City of Madison
Greg Fries	City of Madison Engineering
Sara Eskrich	City of Madison, District 13 Alderperson
Sue Ellingson	City of Madison, Former District 13 Alderperson
Paul Dearlove	Friends of Lake Wingra & Clean Lakes Alliance
David Liebl	Friends of Lake Wingra
Jim Lorman	Friends of Lake Wingra
Rebecca Power	Friends of Lake Wingra
Jim Baumann	Friends of Lake Wingra
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)
Mark Wegener	UW-Madison Arboretum
Ben Jordan	UW-Madison
Bret Shaw, Social Marketing Consultant	UW-Madison

Table 1 Steering Committee Representatives

This watershed plan targets three critical issues: chlorides, infiltration, and phosphorus. Table 2 lists just some of the critical actions recommended for each.

Focus Area	Some Critical Actions
Chlorides	Commercial applicator training Commercial applicator certification Salt use guidelines Salt use ordinances Pilot use of alternate deicers Expanded use of anti-icing
Infiltration	Infiltration basins Downspout redirection Rain gardens Terrace rain gardens Permeable pavement pilot projects Rain barrels Project-based infiltration facilities (bioswales, infiltration basins)
Phosphorus ¹	Diversion to wet detention basins Modified leaf collection methods Greater erosion control enforcement Wetland harvesting Stream bank restoration Wet detention basins Alum treatment

Table 2 Critical Actions of Focus Areas

While this plan provides a solid foundation for measurable water quality improvement, unless the critical actions are implemented, no change will occur. The plan recommends that the Steering Committee continue as a body that provides active guidance to watershed improvement measures. The plan further recommends creating catalyst teams for chlorides, infiltration, and phosphorus. The catalyst teams would focus on the implementation of critical actions for their specific focus area. The use of catalyst teams has several advantages.

1. They are dynamic, allowing the team to capitalize on opportunities as they arise.
2. They are collaborative, partnering with organizations that have similar objectives.
3. They are focused, consistently advocating for the water quality issue they are tasked with.

Finally the plan recommends liberally using pilot projects within the watershed to test management measures. Most changes in legislation, policy, or management require a track record of success, both in implementation and effectiveness. Pilot projects are an excellent way to build this track record. Advantages of using the Lake Wingra Watershed for pilot projects include the following:

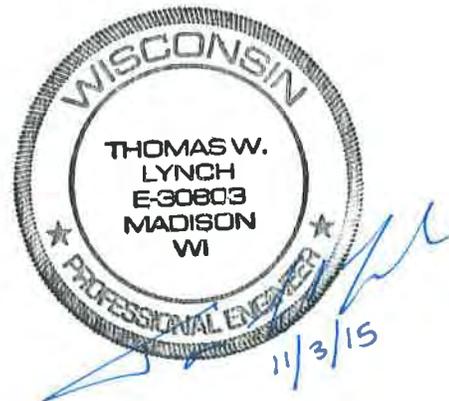
1. The watershed is made up of well-organized neighborhoods.
2. Many residents already have an environmental stewardship ethos.
3. The watershed has a dedicated advocacy organization focused on Lake Wingra watershed water quality.
4. The watershed provides a smaller water-body for evaluation.

¹Recommended phosphorus reduction actions to be determined.

While the challenges in implementing the recommendations listed in this report are numerous, the opportunity for success is great. The watershed is made up of environmentally minded neighborhoods that have a history of effective advocacy. Few other watersheds in Madison, or even the state, have the benefit of such an active constituency. Community leaders, coupled with engaged residents, have the power to both make and influence change. Eventually these changes will provide an environmental legacy within the watershed for generations to enjoy.

Report for
City of Madison, Wisconsin
in Cooperation with Friends of Lake Wingra

Lake Wingra Watershed Management Plan



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City of Madison Engineering



Friends of Lake Wingra

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SECTION 1
INTRODUCTION

1.01 INTRODUCTION

This report summarizes the methods and results of the Lake Wingra Watershed Management Plan commissioned by the City of Madison (City) and the Friends of Lake Wingra (FOLW) to develop a Lake Wingra Watershed Management Plan. More information regarding the FOLW is included in Section 1.05. Figure 1.01-1 shows the location of the study area. The Lake Wingra watershed is predominantly a fully developed urban watershed home to diverse land uses including the UW-Madison Arboretum that surrounds much of the lake. Table 1.01-1 provides important Lake Wingra facts.

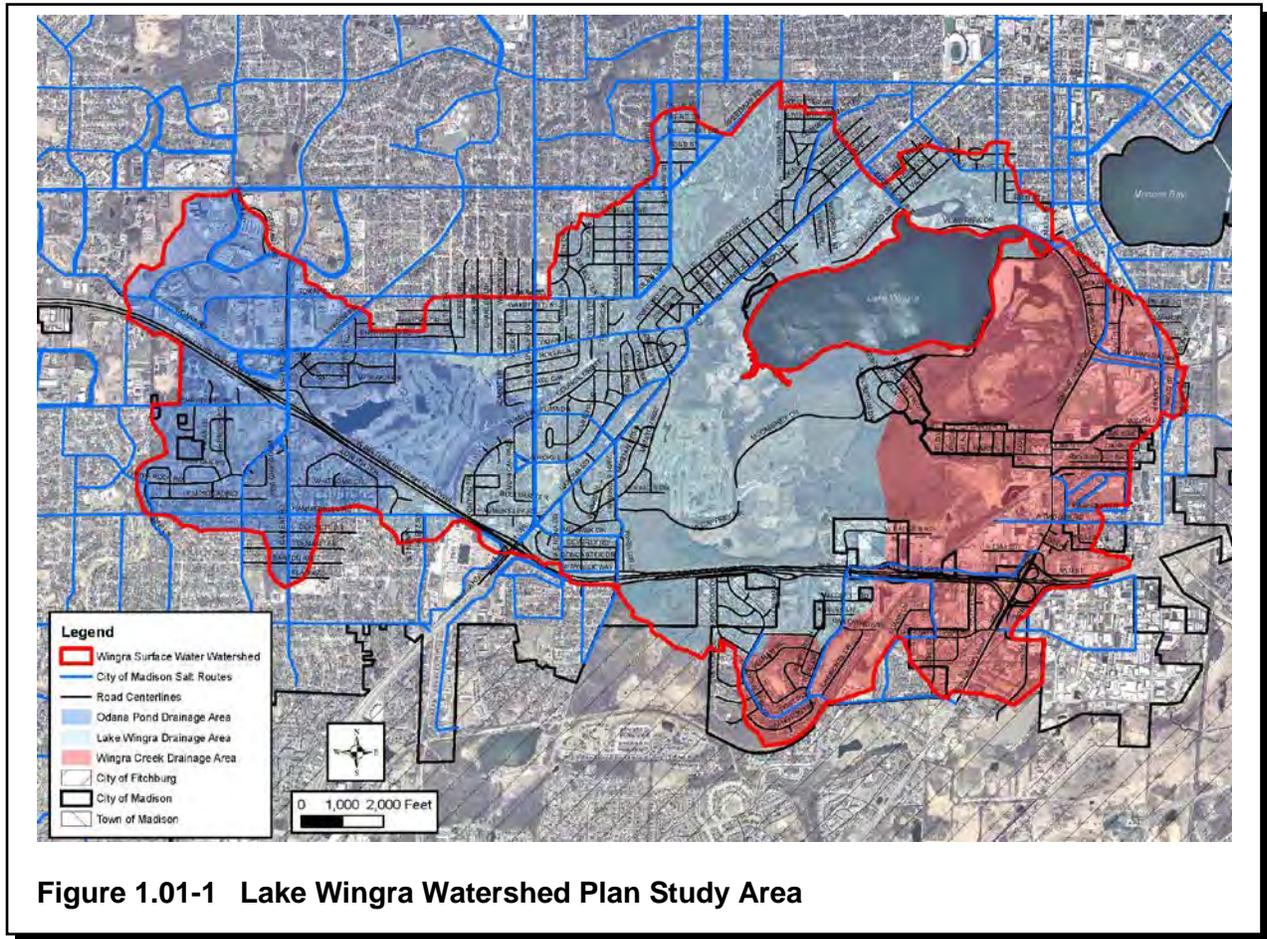


Figure 1.01-1 Lake Wingra Watershed Plan Study Area

Parameter	Fact
Lake Surface Area	339 acres
Maximum Depth	14 feet
Average Depth	7 feet
Lake Volume	103 million cubic feet (2,363 ac-ft)
Total Phosphorus Concentration: Long-Term Median (1996-2007)	0.056 mg/L
Secchi Visibility: Long-Term Median (1996-2007)	2.0 feet
Watershed Draining To Lake	3,636 acres (5.68 sq. mi.)
Common Fish Species	Bluegill, Largemouth Bass, Muskellunge, Common Carp
WDNR Designation	303(d) Listed Impaired Water for Phosphorus and PCBs

Source: 2014 State of the Lakes Annual Report, Clean Lakes Alliance

Table 1.01-1 Lake Wingra Parameters and Facts

The lake suffers from degraded surface water quality and decreased spring flow that affect the lake ecosystem and recreational use of the lake environs. This plan seeks to increase infiltration and decrease total phosphorus (TP) and chloride inputs to Lake Wingra by identifying the contributing factors to each, analyzing alternatives to do so, and providing an implementation plan backed by social marketing principles to foster behavior change in the watershed. The plan has as its inspiration the Friends of Lake Wingra’s 2009 *Lake Wingra; A Vision for the Future* document (<http://www.lakewingra.org/wp-content/uploads/2014/03/wingravisoin.pdf>).

Impacts of strategies to meet the infiltration, phosphorus, and chloride goals for the project may work at cross purposes with each other but also provide synergistic opportunities. For example, increasing infiltration in the watershed may increase chloride inputs via groundwater to the lake. However, reducing chloride usage may allow more infiltration to occur. In this case, a potential strategy to reduce chlorides in the Odana Pond watershed may allow more infiltration to occur in the MG&E Infiltration Facility located in the Odana Golf Course. This plan seeks to identify these issues and take advantage of these synergistic opportunities.

1.02 SCOPE OF STUDY

The following is a summary of key elements included in the plan. Strand has been assisted by UW-Madison Professor Brett Shaw, the City’s Social Marketing Consultant, to align the project with social science methods.

A. Steering Team and Issue Team Meetings

Thirteen Steering Team Meetings were held approximately every six weeks during the course of this project to obtain input from project stakeholders. Three Issue Team Meetings were held during the course of the project as needed. Meeting summaries are included in Appendix A.

B. Identification of Critical Actions

Analysis was completed for the following parameters to estimate existing levels, analyze critical actions (alternatives/strategies) for improvement seeking to meet identified goals, estimate costs of the alternatives/strategies, and provide a prioritized implementation plan. From this analysis, a pilot project plan for one critical action (leaf bagging related to TP) was developed after consideration of identified critical actions for each of the three parameters.

1. Chlorides (Section 2)
2. Infiltration (Section 3)
3. Total Phosphorus (Section 4)

C. Stakeholder Engagement

A summary of stakeholder engagement efforts is included in Section 5 of this report including the following scope items.

1. Identify/Interact With Target Audiences–Identify, communicate with, and interact with target audiences, and identify those responsible for critical actions.
2. Develop Social Marketing Strategy–Identify potential behavior change strategies, develop written strategy for engagement with those responsible for critical actions, and develop a framework for a social marketing pilot project.
3. Implementation Plan–Using the Social Marketing Strategy, provide engagement activities with those responsible for critical actions to understand techniques most likely to be effective in creating behavior change. From these activities, provide an implementation plan for plan components including a roles and responsibilities memorandum.

D. Draft and Final Plan

A draft and final plan was submitted to the City documenting the results of the plan. An implementation plan is included as Section 6 of this report.

E. Final Report Presentation

Upon completion of the plan, a final presentation was given on the plan.

F. Social Marketing Strategies (Pilot Project)

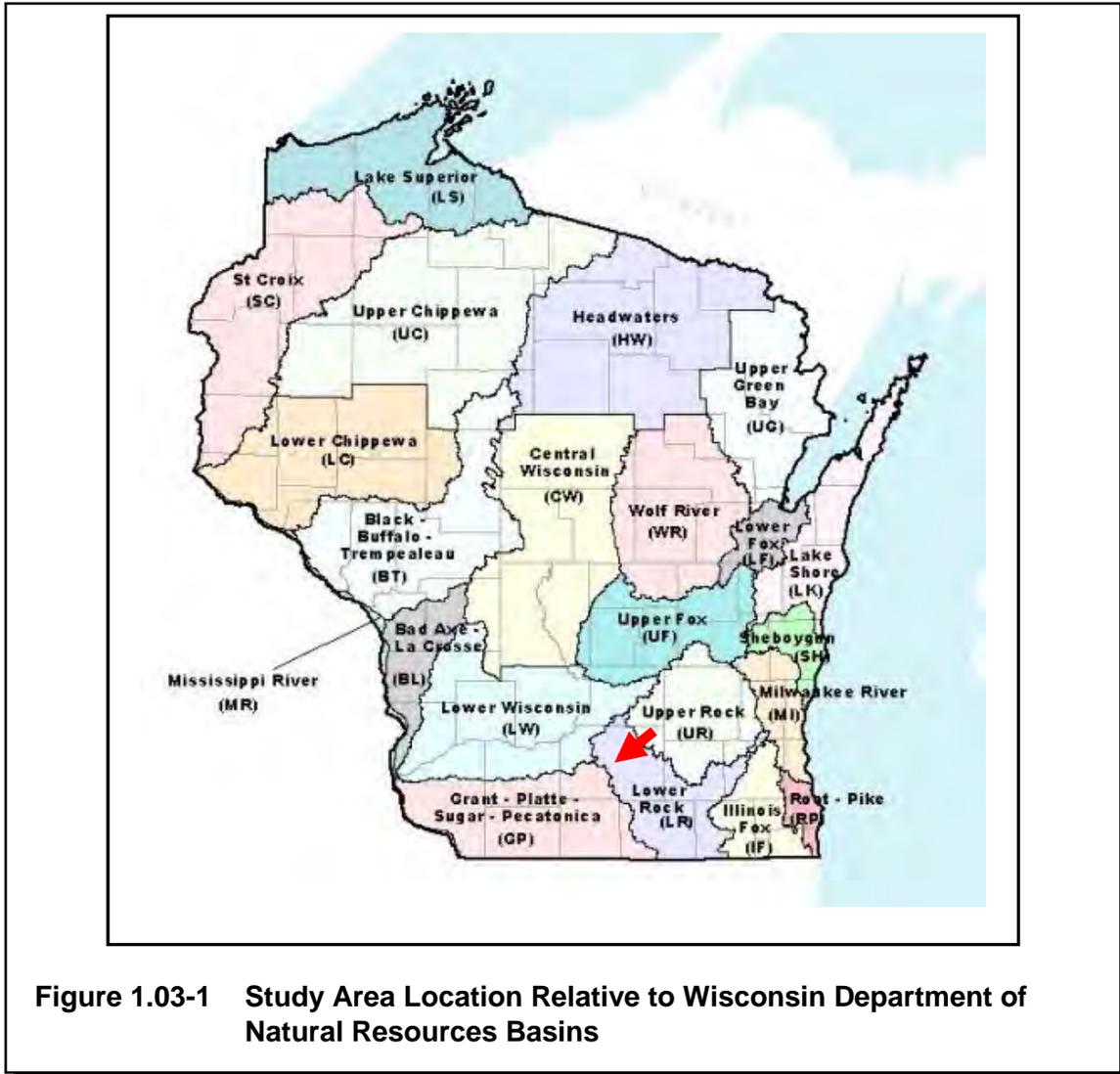
A leaf bagging pilot project has been created and will be managed and tracked as part of this plan.

G. Grant Application

An Urban Nonpoint Source and Stormwater Grant Application was submitted for an “early success” project identified in the plan.

1.03 LOCATION OF STUDY AREA

The location of the Lake Wingra Watershed Management Plan study area, which is in the Lower Rock River Basin, is shown in Figure 1.03-1.



1.04 PREVIOUS STUDIES

The following reports and plans are applicable to portions of the Lake Wingra Watershed Management Plan planning area and were reviewed as part of this study.

Wingra Watershed: A Model for Green Infrastructure Design and Implementation, Edgewood College Student Report, Fall 2013.

Monroe Street and Wingra Park: Design for Healthy Neighborhoods and Lakes, UW-Madison Student Report, May 2013

UW-Madison Curtis Prairie Stormwater Plan, WI DOA/DSF and UW-Madison, Strand Associates, Inc.[®], November 2012.

Vilas Park & Lake Wingra Shoreline Vision, Edgewood College Student Report, July 2012

Adopting Green Infrastructure Strategies for The Lake Wingra Watershed, Edgewood College Student Project, 2011.

Groundwater Status Report Prepared for Friends of Lake Wingra, Edgewood College Student Project, August 2011.

UW-Madison Arboretum-Curtis and Coyote Ponds Stormwater Management Plan, WI DOA/DSF and UW-Madison, Strand Associates, Inc.[®], March 2011.

Lake Wingra; a Vision for the Future, Friends of Lake Wingra, 2009.

Road Salt Management and Chloride Dynamics of An Urban Lake, UW-Madison Student Project, 2009.

UW-Madison Stormwater Quality Management Plan, WI DOA/DSF Project No. 06A1B, Strand Associates, Inc.[®], September 2008.

Arbor Hills Greenway Stormwater Infiltration Design, UW-Madison Student Project, 2008.

Lake Wingra Dam Investigation and Analysis, City of Madison, Strand Associates, Inc.[®], November 2006.

Monroe Street Commercial District Plan, Dudgeon-Monroe and Vilas Neighborhood Associations and the Monroe Street Merchants Association in collaboration with Planning and Design Institute, Inc. and Business Districts, Inc., November 2006

UW-Madison Arboretum Stormwater Management Plan, WI UW-Madison, September 2006.

UW-Madison Arboretum Facility Stormwater Management Plan, UW-Madison, July 2006.

Hydrologic Modeling for the Lake Wingra Watershed: Ho Nee Um Pond and Wingra Park Subwatersheds, UW-Madison Student Project, 2004.

Lake Wingra Watershed Management Plan–Storm Water, Friends of Lake Wingra, August 2003

Monthly and Annual Water Budgets of Lake Wingra, Madison, Wisconsin, 1972-1977, United States Geological Survey, Water Resources Division, October 1979.

Road Salt Report, Public Health Madison and Dane County, Annual Publication.

1.05 FRIENDS OF LAKE WINGRA

The Friends of Lake Wingra was formed in 1998 with an interest in improving the health of Lake Wingra through coordinated watershed management and by engaging the watershed community in stewardship of the lake and its watershed.

The Friends of Lake Wingra mission, vision, and goals reflect the belief that sustaining the balance of a healthy lake ecosystem requires the participation and collaboration of many citizens, agencies and organizations. FOLW's approach to watershed protection therefore involves partnerships with numerous stakeholders who live, work, and play in the Lake Wingra watershed.

The Friends of Lake Wingra's goals are in the following areas.

- Citizen Stewardship—Grow present and future generations of watershed stewards.
- Integrated Watershed Management—Protect and improve the 'lake as a system' through innovative and coordinated management practices.
- Long-term monitoring and research—Ensure that the information needed to address the mission is available on an ongoing basis.
- Organizational Capacity and Resources—Build the internal capacity to achieve the mission.

Friends of Lake Wingra is currently engaged in a variety of projects aimed at improving the health of Lake Wingra. Our projects include both outreach to the watershed community and on-the-ground restoration and stewardship efforts.

The Friends of Lake Wingra could not work without the help of our friends and partners: dedicated volunteers, members, and organizations who contribute essential time and labor to the preservation and protection of Lake Wingra and the Wingra Watershed

To learn more about the Friends of Lake Wingra or to get involved in one of the Friends of Lake Wingra projects, please visit the FOLW website: <http://www.lakewingra.org>

1.06 DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations are presented as an aid to the reader.

A. Definitions

Average Sediment Depth—The average depth of deposited sediment measured over the entire stormwater pond area.

Average Current Normal Pool Depth—The average depth of water measured over the entire stormwater pond area. This is the difference between the water surface and the top of sediment.

Average Current Total Pond Depth—The average depth of the stormwater pond if all deposited sediment were removed. This is the difference between the water surface and the existing bottom of the pond.

Control Structure–The manmade structure that controls the water released from a stormwater facility to the outfall.

Curve Number–The Soil Conservation Service has devised a method of computing runoff from an area based on a system of curve numbers. The curve number for an area of land is obtained by examining the land use and soil type of the land area.

Flume–The structure or channel upstream of the stormwater facility used to convey stormwater to the facility.

Forebay–The area of the pond near the inlet where heavy sediments are encouraged to settle out of the stormwater that enters a facility.

Outfall–The piping, channel, or other equipment downstream of the control structure used to transfer water out of the control structure to the surrounding environment.

Recurrence Interval–The probability that a given rainfall event will occur in a given year. For example, a 100-year rainfall event has a 1 percent chance of occurring in a given year ($1/100 = 0.01 = 1$ percent); a 5-year rainfall event has a 20 percent chance of occurring in a given year ($1/5 = 0.20 = 20$ percent).

Salt Route, No-Salt Route–The portion of a transportation system where the maintaining entity applies road salt for purposes of deicing. No-salt routes (i.e., Sand Routes) are the portion of a transportation system where the maintaining entity does not apply road salt, typically applying sand as an alternative.

Subbasin–The parts of a drainage basin that, when combined, create the entire drainage basin for a facility.

Time of Concentration (T_c)–“...the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed,” SCS, 1986.

Time Distribution of Rainfall–The amount of rainfall that has fallen during a storm event versus the amount of time that has elapsed during a storm event.

Weir–A wall or vertical plate spanning the control structure. When the water level of the pond reaches the top of the weir, water flows over the weir and out of the pond.

B. Abbreviations

BMP	best management practices
BOD	biochemical oxygen demand
CCC	Criteria for Continuous Concentration
CCL	Drinking Water Contaminant Candidate List
City	City of Madison
CTC	Chronic Toxicity Criterion
ft ³	cubic feet
ft ³ /year	cubic feet per year

FOLW	Friends of Lake Wingra
GIS	geographical information system
GPS	global positioning system
HSG	Hydrologic Soils Group
HSG	Hydrologic Soils Group
Mgd	million gallons per day
MG&E	Madison Gas & Electric
MMSD	Madison Metropolitan Sewerage District
MS4	municipal separate storm sewer system
NOI	Notice of Intent
NOI	net present worth
NRCS	Natural Resources Conservation Service
P8	Program for Predicting Polluting Particle Passage Thru Pits, Puddles, and Ponds
SDWA	Safe Drinking Water Act
Strand	Strand Associates, Inc.®
T _c	time of concentration
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WDNR	Wisconsin Department of Natural Resources
WGNHS	Wisconsin Geological and Natural History Survey
WisDOT	Wisconsin Department of Transportation

**SECTION 2
CHLORIDES**

2.01 OBJECTIVE

The 2009 *Lake Wingra: A Vision for the Future*, prepared by FOLW, cites addressing Lake Wingra chloride concentrations as a critical element of Goal 1, clean, clear water. The report goes on to establish a target surface chloride concentration of 40 milligrams/liter (mg/L). This 40 mg/L target was about one-half of the Lake Wingra surface chloride concentrations sampled in 2008.

In an effort to achieve this goal, this portion of the management plan:

1. Describes the current chloride concentration trend in Lake Wingra and the contributing factors.
2. Identifies primary road salt contributors, and estimates the magnitude of each contribution.
3. Performs a conceptual mass balance of lake chloride concentrations, and uses this mass balance to estimate what chloride load reductions are necessary to achieve 40 mg/L surface chloride concentration.
4. Reviews management changes that have the potential to achieve the chloride reduction goals.
5. Recommends management changes to pursue.

This study looks only at road salt application as it applies to chloride concentrations; it does not address issues regarding traveling safety affected by salt use.

2.02 BACKGROUND

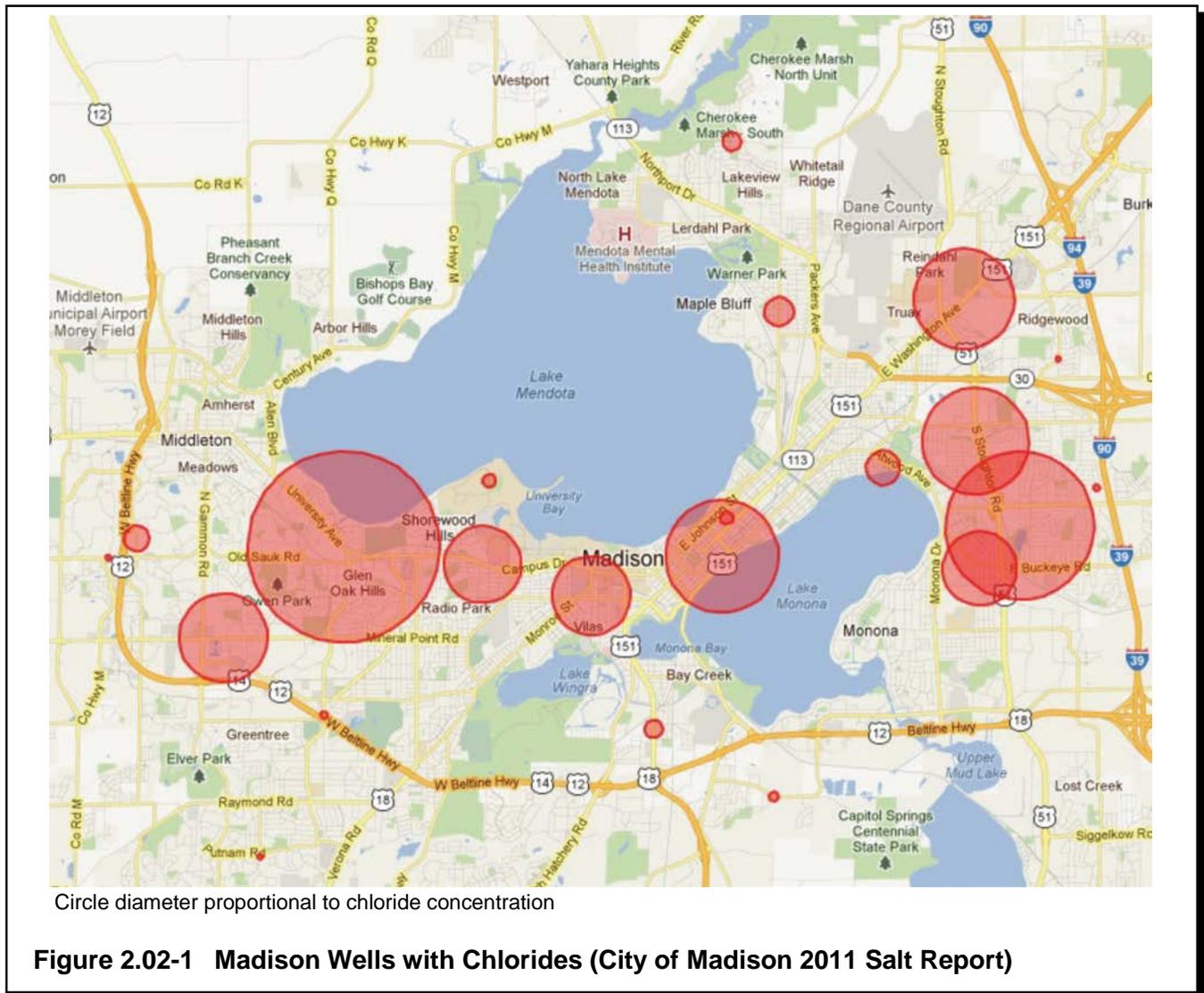
A. Effects of Chloride

Chloride is soluble and very mobile. There is no natural process by which chlorides are removed from the environment. Chloride in surface waters can be toxic to fish, macroinvertebrates, insects, and amphibians. High chloride concentrations also affect food sources for these aquatic species. Salinity stress on sensitive aquatic communities can impact species diversity. Salt use also impacts vegetation. High concentrations of chloride interfere with a plant's absorption of moisture from soil, which can cause browning or burning of leaves. High sodium concentrations, often associated with high chloride concentrations, may affect plant growth by altering soil structure, permeability, and aeration.

Because of the adverse effect on surface waters, the United States Environmental Protection Agency (USEPA) has set the Criteria for Continuous Concentration (CCC) for chloride at 230 mg/L, while the Wisconsin Department of Natural Resources (WDNR) has set the Chronic Toxicity Criterion (CTC) at 395 mg/L. Both the USEPA and WDNR define the duration of chronic exposure as four days, with frequencies limited to once every three years. The Canadian Government has estimated that prolonged

exposure to chloride concentrations as low as 120 mg/L can have toxic effects on 5 percent of the species.

Chlorides also have the potential to affect groundwater. Chlorides are increasing in some city wells that are located next to arterial roadways. Wells with shorter steel casings have higher chloride concentrations, with some as high as 50 mg/L. Figure 2.02-1 illustrates Madison wells affected by chlorides, taken from the 2001 Salt Report.



The WDNR secondary standard for drinking water is 250 mg/L chloride. The USEPA does not have any drinking water standards for chlorides, but sodium is included on the Drinking Water Contaminant Candidate List (CCL). The CCL is a list of contaminants that are not subject to any proposed drinking regulation but that are known to occur in public water systems and may require regulations under the Safe Drinking Water Act (SDWA). The USEPA has recommended Secondary Drinking Water Standards through the SDWA, and the chlorides secondary standard is 250 mg/L.

B. Chloride Use

Since the late 1950s, the City has used salt in its winter pavement deicing program. Since that time, there has been a continuing awareness and concern regarding the detrimental effects of road salt to Madison area lakes. In 1973, the City’s common council called for a reduction in salt usage in the Lake Wingra watershed, which was extended city-wide four years later. The Madison Department of Public Health has issued an annual report documenting the city’s use of salt.

The 2012 Salt Report states the average chloride concentration for Lake Wingra in 2012 was 115 mg/L, with a sustained concentration of over 125 mg/L being observed between August 2 and September 24, 2012. A prolonged drought and reduced lake discharge likely contributed to this late and prolonged chloride concentration. Figure 2.02-2 is Figure 3 from the Madison 2012 Salt Report and shows the chloride concentrations in Lake Wingra compared to the other Yahara Lakes. Figure 2.02-3 shows Figure 2 of that same report that compares city salt usage with chloride concentrations in Lake Wingra.

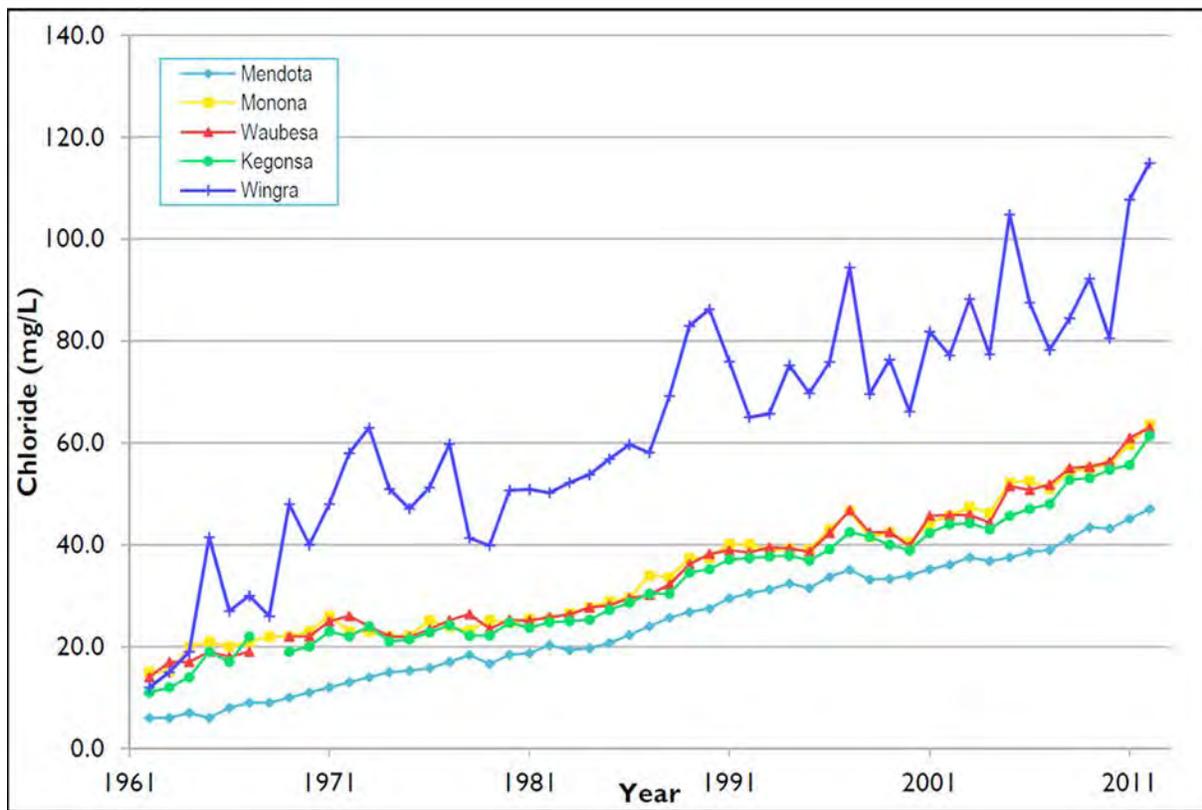


Figure 2.02-2 Yahara Lakes Chloride Levels (City of Madison 2012 Salt Report)

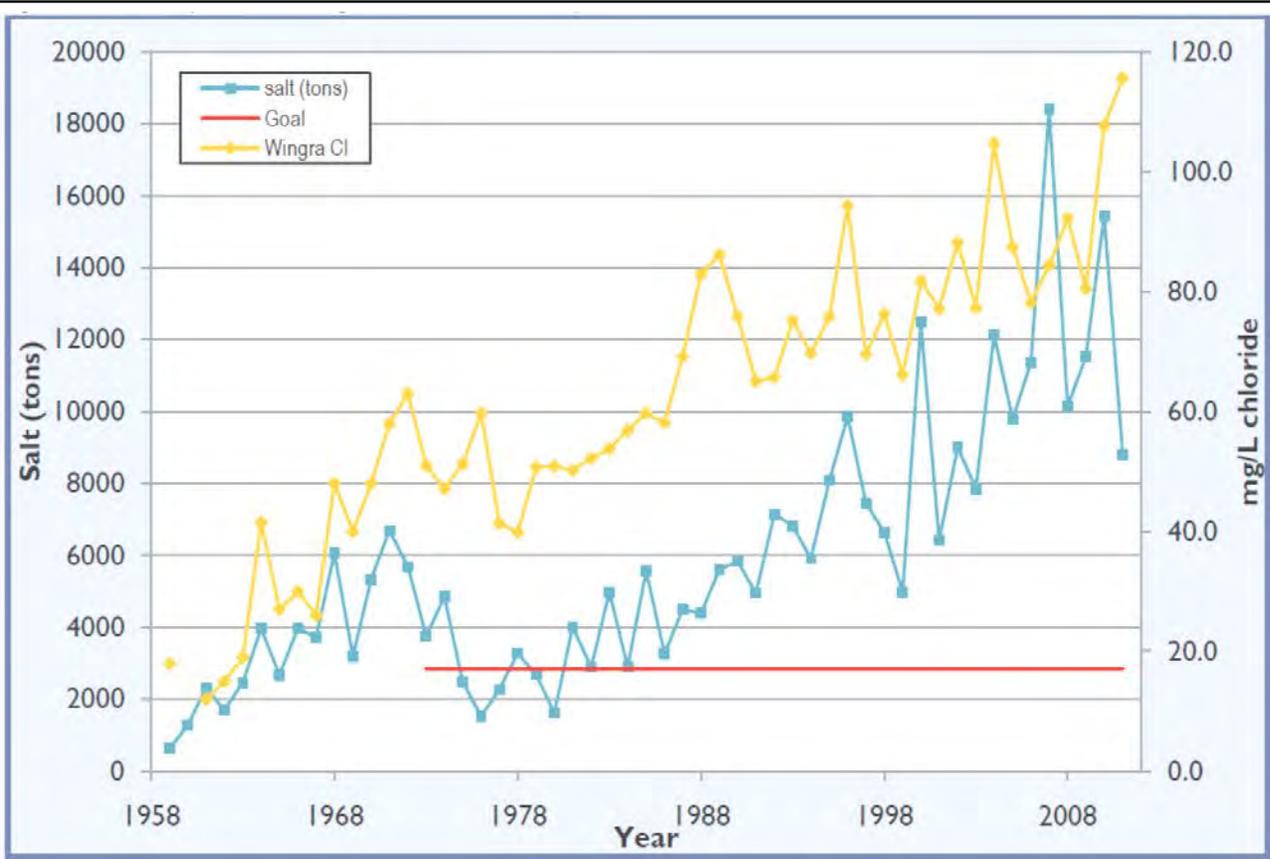


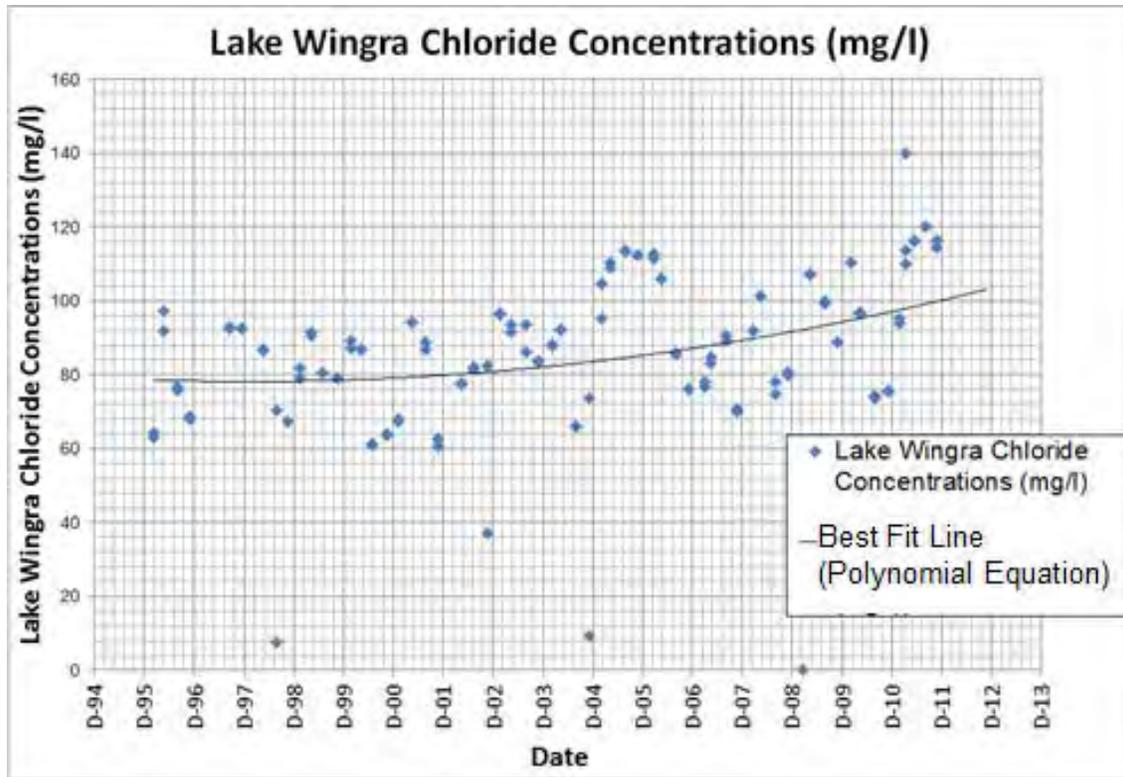
Figure 2.02-3 Madison Salt Use Compared with Lake Wingra Chloride Levels (City of Madison 2012 Salt Report)

Figure 2.02-4 provides more recent data on Lake Wingra chloride concentrations obtained from research on the *Chemical Limnology of North Temperate Lakes*.¹ This research shows Lake Wingra chloride concentrations averaging about 80 mg/L from 1994 to 2004, with the trend increasing to above 100 mg/L between 2004 and 2012. Chloride levels within Lake Wingra have appeared to reach an equilibrium with winter maintenance practices being relatively constant within the watershed area and a flushing rate of approximately one year. With this equilibrium and absent management changes, chloride levels are influenced by the number of salting events per year.

Chloride concentrations vary within a water column, with surface chloride concentrations being lower than chloride concentrations deeper in the water column because water density increases with increasing ion concentrations. Figure 2.02-5 provided by Roger Bannerman, WDNR and United States Geological Survey (USGS), shows the chloride concentrations at different depths in Lake Wingra in late winter of 2008. This graph indicates the average chloride concentration is much higher than the surface chloride concentrations that have been monitored. This graph also shows the chloride loadings per water depth. Even though higher concentrations occur at greater

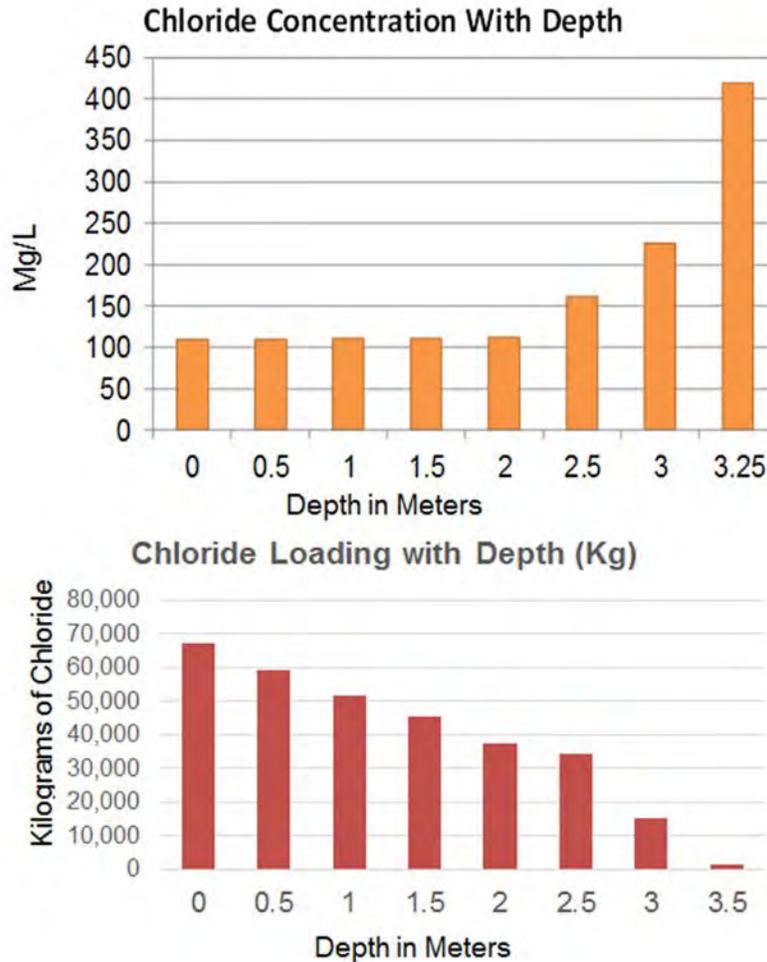
¹<http://lter.limnology.wisc.edu/datafile/chemical-limnology-north-temperate-lakes-lter-primary-study-lakes-major-ions>

water depths, because Lake Wingra is relatively shallow, the surface levels still account for most of the lake's chloride.



<http://lter.limnology.wisc.edu/datafile/chemical-limnology-north-temperate-lakes-lter-primary-study-lakes-major-ions>
accessed on May 21, 2013 Note: D-94 = December 1994, etc.

Figure 2.02-4 Lake Wingra Chloride Levels



Source: Roger Bannerman, May 2013; David Liebl, November 2014. Modified to provide similar scales.

Figure 2.02-5 Chloride Concentrations and Loadings in Water Column in Lake Wingra

C. Factors Affecting Chloride Concentrations

Several factors affect chloride concentrations in Lake Wingra.

1. Sources and Extent of Salt
 - a. All pavements maintained with salt within the tributary area of the lake (watershed area).
 - b. The salt application rate for pavements within the watershed boundary.
 - c. The number of salt events (winter storm events) and the number of applications per event where salt is applied to pavements.
 - d. Chlorides that enter Lake Wingra from groundwater flow.
 - e. The impervious area that is connected to the lake by storm drains.

2. Water Balance of Lake Wingra
 - a. The amount of precipitation within the watershed that falls into the lake.
 - b. The amount of groundwater flowing into the lake.
 - c. The amount of water leaving the lake through evaporation and evapotranspiration.
 - d. The amount of water leaving the lake via Wingra Creek.

3. Watershed Retention of Chlorides—Many studies have found that watersheds retain chlorides, so they are not discharged into the waterways. Novotny et al performed a chloride mass balance for the Twin Cities (Minneapolis-Saint Paul, Minnesota) seven-county metropolitan area. The analysis was used to estimate how much of the road salt applied annually was exported from the watershed by the Mississippi River and how much was retained in the soils, groundwater, and surface waters. The study found that there was a 77 percent chloride retention rate, meaning only 23 percent of the chloride that was applied reached the waterbody outflow.² Other studies cited in the article describe chloride retention rates of 55 percent in Toronto, Canada; 50 to 65 percent in Helsinki, Finland; 28 to 45 percent in Chicago, Illinois; 59 percent in Rochester, New York; and 35 percent in Boston, Massachusetts.³

The presence and introduction of wetlands as well as detention/infiltration basins may aid the retention of chlorides within a watershed. In a separate study,⁴ Novotny, the author of the Twin Cities study, states, “*The presence of a high salinity layer at the bottom of the lake causes the convective penetration of saltwater into the pore system of the lake sediments.*” This phenomena contributes to chloride retention within a water body and may lengthen the time necessary for lake restoration.

4. Chloride Equilibrium—The same Twin City study found a mean annual equilibrium chloride concentration is reached when all the chloride added to a lake during the winter season is flushed out during the summer and fall season. Smaller lakes with high flushing rates tend to reach chloride equilibrium sooner than larger lakes with low flushing rates. Lake Wingra’s flushing rate ranges from 0.75 to 1.5 years dependent on rainfall in a given year, yet chloride mixing is continuous and leaves a chloride presence even after a full flush. The recovery of many urban lakes to normal chloride levels could take from 10 to 30 years.⁵

²Eric Novotny et al., *Chloride Ion Transport and Mass Balance in a Metropolitan Area Using Road Salt*, Water Resources Research, Vol. 45, Issue 12, December 2009.

³Howard and Hayes 1993, Ruth 2003, Wulkowicz and Saleem 1974, Bubeck et al., 1971, and Juling and Hollocher 1972, respectively.

⁴Novotny’s *Increase Of Urban Lake Salinity by Road Deicing Salt* (2008).

⁵ Eric Novotny et al., *Chloride Ion Transport and Mass Balance in a Metropolitan Area Using Road Salt*, Water Resources Research, Vol. 45, Issue 12, December 2009. In this same article, the authors also mention chloride residence times in lakes ranging from 3 to 14 years.

2.03 CHLORIDE CONTRIBUTORS

The primary contributor of chlorides to Lake Wingra is pavement. While salt is also discharged from water softeners, this discharge is routed to the sanitary sewer system. Madison Metropolitan Sewerage District (MMSD) has been experiencing increasing chloride concentrations in its wastewater. MMSD taking measures to evaluate and reduce these chloride concentrations including monitoring of salt concentrations in the sanitary sewer. Through infiltration of groundwater and inflow of stormwater into the sanitary sewer system, pavement salt application is affecting chloride concentrations in the wastewater. The water softener discharge from the sanitary sewer system is likely a negligible contributor of chlorides to Lake Wingra. Similarly road salt infiltration into the sanitary system, while affecting wastewater chloride levels, is likely a very small portion of the road salt applied throughout the watershed.⁶

A. Watershed Area

The official watershed boundary for the management plan is shown in Figure 2.03-1. It includes areas that drain into Wingra Creek as well as the Gardner Marsh. While the study boundary includes these eastern areas, these areas do not drain into Lake Wingra and, therefore, do not affect lake chloride concentrations. The two different blue-shaded areas within Figure 2.03-1 illustrate the tributary area directly draining into the lake and the tributary area that affects the chloride concentrations in the lake. The red-shaded area represents the area draining into Wingra Creek and Gardner Marsh and does not affect lake chloride concentrations. There are numerous pavements and jurisdictions within this watershed boundary with pavements that receive road salt during the winter. Table 2.03-1 lists these pavements and who maintains them. The impervious areas shown in this table include only those likely to receive salt and do not include roofs. Figure 2.03-2 provides a larger display of the Wingra Watershed area with Salt Routes.

⁶ The study performed a cursory review of the difference in MMSD effluent chloride levels between the four quarters in 2013 (in tons). This difference in chloride levels from the baseline was multiplied by the wastewater traveling through the Plaenart Drive pump station that is attributable to the Lake Wingra Watershed (28 percent) divided by the total effluent from MMSD. This cursory analysis indicates that the Lake Wingra Watershed contributed up to 150 tons of salt to MMSD effluent chloride levels. This could suggest that from 3 to 4 percent of the salt applied within the watershed could reach MMSD pipes.

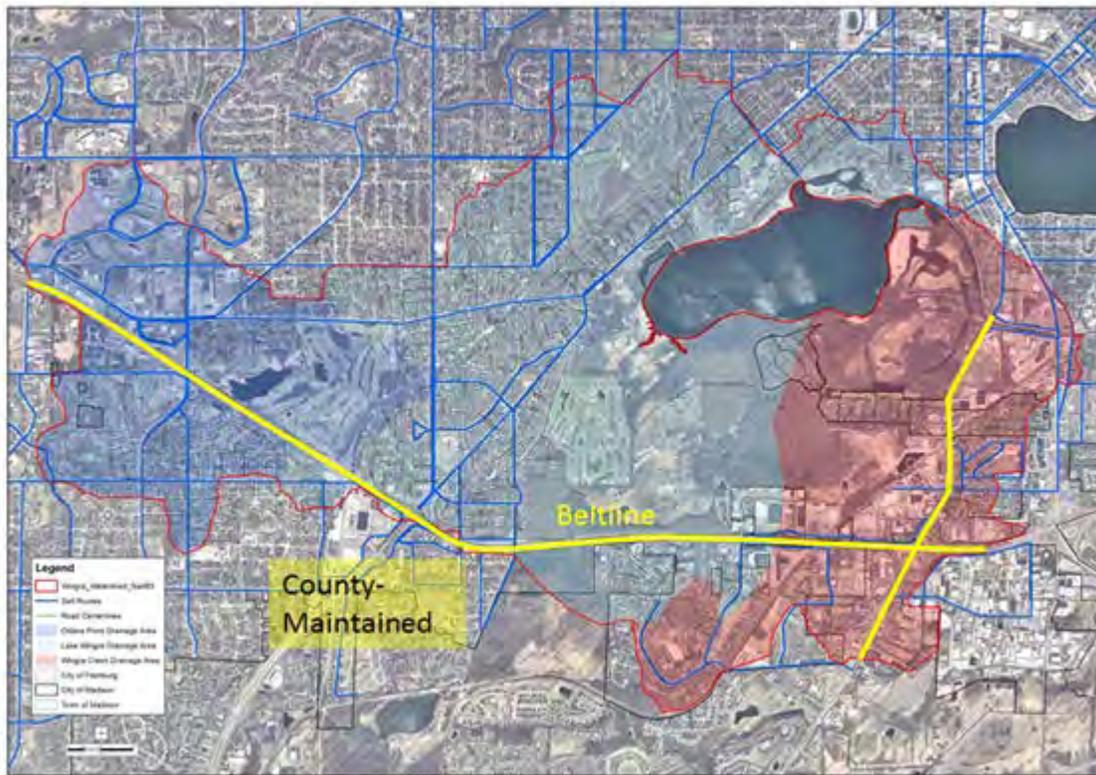
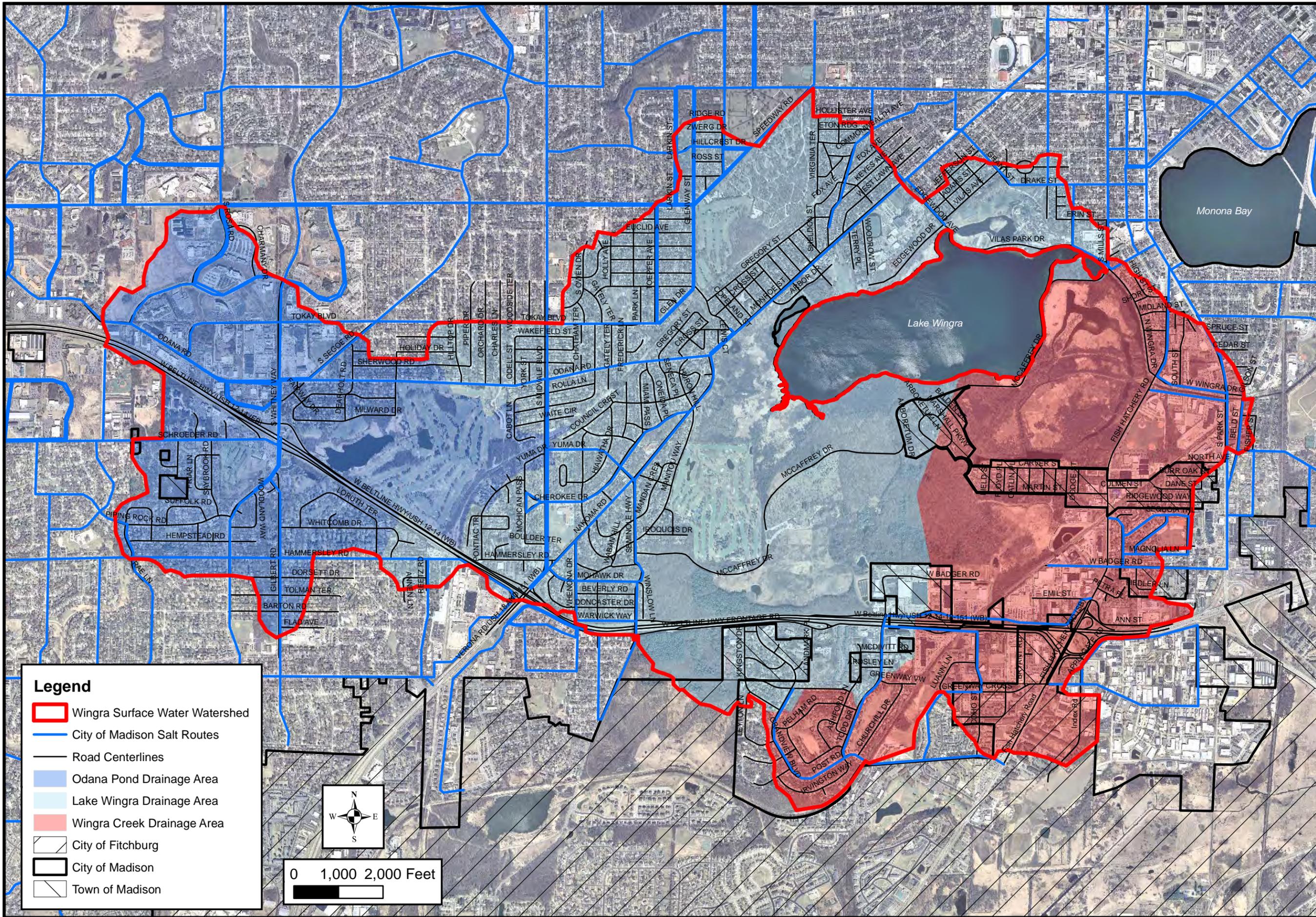


Figure 2.03-1 Lake Wingra Tributary Area with Salt Routes (Blue and Yellow)

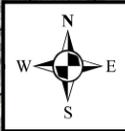
Pavement	Maintainer	Tributary to Lake
Madison Salt Routes—No Curbs	City of Madison	0.44 lane miles—0.6 acres
Madison Salt Routes—Curb One Side	City of Madison	0.24 lane miles—0.4 acres
Madison Salt Routes—Curbs Both Sides	City of Madison	61.07 lane miles—88.8 acres
Madison No-Salt Routes—No Curbs	City of Madison	8.89 lane miles—12.93 acres
Madison No-Salt Routes—Curb One Side	City of Madison	0.08 lane miles—0.1 acres
Madison No-Salt Routes—Curbs Both Sides	City of Madison	69.49 lane miles—101.1 acres
WisDOT—No Curbs	Dane County	7.19 lane miles—10.5 acres
WisDOT—Curb One Side	Dane County	12.46 lane miles—18.1 acres
WisDOT—Curb Both Sides	Dane County	10.05 lane miles—15.3 acres
Streets within Arboretum—No Curbs	University of Wisconsin	3.14 lane miles—4.6 acres
Town of Madison Salt Route—Curb One Side	Town of Madison	0.12 lane miles—0.17 acres
Town of Madison Salt Route—Curbs Both Sides	Town of Madison	0.46 lane miles—0.7 acres
Town of Madison No-Salt Routes—No Curb	Town of Madison	1.51 lane miles—2.2 acres
Town of Madison No-Salt Routes—Curbs Both Sides	Town of Madison	2.20 lane miles—3.2 acres
Single-Family Residential	Individual owners	4,620 parcels totaling 67 acres of pavements
Commercial/Business/Institutional/Multifamily Residential	Commercial applicators	216 acres of pavements
Sidewalks within right-of-way	Individual owners/ commercial applicators	49 acres of pavements
Bike Paths	City of Madison	14 acres of pavements
Alleys	City of Madison	1 acre of pavements

Table 2.03-1 Pavements Tributary to Lake Wingra

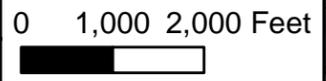


Legend

- Wingra Surface Water Watershed
- City of Madison Salt Routes
- Road Centerlines
- Odana Pond Drainage Area
- Lake Wingra Drainage Area
- Wingra Creek Drainage Area
- City of Fitchburg
- City of Madison
- Town of Madison



0 1,000 2,000 Feet



SALT ROUTES

LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 2.03-2
1020.065

B. Application Rate

Salt application rates vary widely. For private pavements, the WDNR indicates 5 pounds of salt is sufficient to clear 1000 square feet of pavement. Yet May 2013 discussions with area winter maintenance providers indicate most applicators use much more. Similarly, Cornell University provides recommendations for road application that range from 50 pounds to 450 pounds per lane mile, depending on the temperature.⁷ The study team used a variety of methods to obtain application rates from those maintaining pavements during the winter months. Many applicators stated their application rate. The study also calculated application rates for the City by taking the amount of salt used and dividing it by the pavement maintained and the number of salt events. For Dane County, the average application rate was determined by obtaining the amount of salt distributed on a section of the Beltline in the 2011 winter season through global positioning system (GPS) technology and dividing the tonnage by the number of events and lane miles treated.

The stated application rate and the calculated salt applied per event varied considerably, with the calculated application rate per event being many times more than the stated application rate. This is probably attributable to multiple applications occurring per storm event. The calculated application rate was used in the chloride mass balance for this management plan. Table 2.03-2 lists general application rates for those maintaining pavements within the Wingra Watershed boundary per pass and per event. The residential and commercial application rates were obtained through interviews with property owners and commercial applicators. These rates could conceivably vary by 50 percent (or more).⁸

Pavement Maintainer	Stated Application Rate per Application	Rate Used in Analysis per Event+
City of Madison, Salt Routes	150 lbs per lane mile	1,072 lbs per lane mile
City of Madison, Nonsalt Routes	29 lbs per lane mile	27.6 lbs per lane mile
Dane County (highways)	Variable lbs per lane mile	1,072 lbs per lane mile
Town of Madison	300 lbs per lane mile	2,144 lbs per lane mile*
University of Madison Arboretum	29 lbs per lane mile	29 lbs per lane mile*
Single-Family Residential owners	3 to 5 lbs per 1,000 ft ²	5 lbs per 1,000 ft ² (2.5 lbs net)#
Commercial applicators	20 to 35 lbs per 1,000 ft ²	20 lbs per 1,000 ft ² (13 lbs net)#

*Based on City of Madison Ratios
 +Average from 2006-2013
 #Rate was applied to 50 percent of residential properties and 65 percent of commercial properties.
 (For example, 20 lbs commercial application rate = a 13 lbs net application rate - 65 percent of 20 lbs)

Table 2.03-2 Salt Application Rates

⁷<http://www.clrp.cornell.edu/techassistance/calibration%20chart.pdf> accessed on May 12, 2013.

⁸ Note: Two contacts with Dane County and WisDOT provided differing application rates per event. One contact indicated an application rate substantially below the City of Madison’s application rate. The second contact provided an application rate substantially above the City of Madison’s application rate. For the purposes of this study, Dane County’s application rate is assumed to be identical to the City of Madison’s application rate.

C. Frequency of Application

The number of storms per year varies as does snow and ice clearance and the use of salt varies. The variance leads to the amount of salt each municipality purchases and the amount that is applied. Figure 2.03-3 shows the number of “salt events” from 1985 to 2012. Discussions with City personnel also indicate that each “salt event” includes one to seven applications, with the average number of applications per salt event being between three and four. The figure shows that from 1985 to 2013, the number has generally increased. Again, the number of salt events influences chloride levels in Lake Wingra.

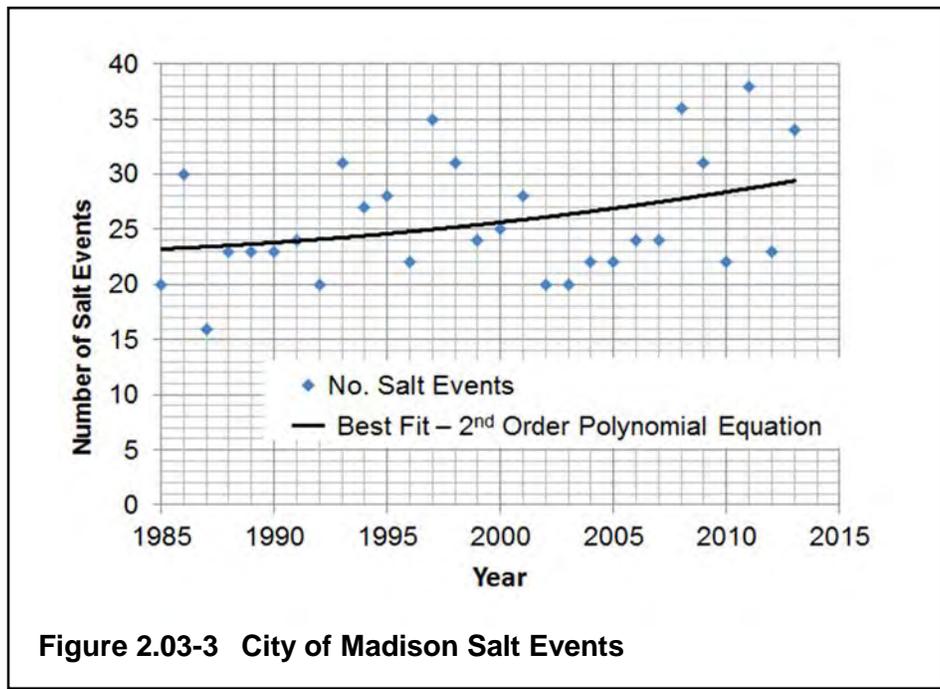


Figure 2.03-3 City of Madison Salt Events

D. Relative Contribution

The study team identified main contributors of chlorides to Lake Wingra using calculated⁹ rates per event. The results can be seen in Table 2.03-3.

As part of the development of a predictive tool, the study team performed a chloride mass balance to predict past, current, and future chloride levels within Lake Wingra. In developing the predictive tool, it became evident that not all chlorides applied to city pavements within the watershed made it to the main waters of Lake Wingra. Figure 2.03-4 illustrates the discrepancy for the 2010 water year where the amount of salt applied to pavements tributary to Lake Wingra exceeded the amount of salt leaving the lake by a factor of four. If all the chlorides applied to pavements actually made it to the waters of Lake Wingra, chloride levels would approach 500 mg/L within two years. Instead, the watershed appears to retain the chlorides. Retention rates of 75 percent for roadways

⁹Instead of stated application rates which are lower.

with curb and gutter, and 88 percent for roadways without curb and gutter, were found to provide predictive results that were relatively similar to measured chloride levels in Lake Wingra. Roadways without curb and gutter were given a higher retention rate because chlorides in ditches have greater opportunity to infiltrate into the soil. These retention rates used in the prediction tool are similar to the 77 percent retention value found in the Novotny study.¹⁰

There are numerous possible contributors to the chloride retention. Factors contributing to the retention factor discussed in two different Novotny studies, as well as others, include the following:

1. Salt particles become airborne behind vehicles during strong winds. One study concluded that between 20 and 63 percent of the road salt was transported by air and deposited on the ground within 130 feet of the road.¹¹ These chlorides could then be infiltrated into the groundwater flow.
2. Wetlands and streetside ditches provide the opportunity for chlorides to infiltrate into the groundwater flow. Residence times in aquifers can be high ranging from decades to hundreds of years in the surficial aquifers and thousands of years in deeper ones.¹² This poses an additional concern. Surface waters have a relatively brief recovery period while subsurface aquifers, once contaminated, could take centuries to recover.
3. Chlorides can attach themselves to natural organic matter forming chlorinated organic matter when transported through soils.¹³ This chlorinated organic material could avoid detection.
4. There are higher chloride concentrations in the saline water layer at the lake bottom as well as the pore water in the lake sediments. Another study by Novotny et al looked at sediment cores at the bottom of two Minnesota lakes and found chloride concentrations higher than the overall chloride concentration in the lake.¹⁴

¹⁰A check was performed using average chloride concentrations from pipes feeding Lake Wingra and multiplying the concentrations by monthly flow volumes. This rough check yielded a retention rate of between 0.65 to 0.72, which is in the same range as the 0.75 retention rate being used in this analysis. This check also does not account for chlorides being stored in wetlands, ditches, and ponds.

¹¹Blomqvist and Johansson, "Airborne spreading and deposition of de-icing salt - a case study", *the Science of the Total Environment*, Vol. I 235, 1999, pp. 161-168.

¹²Novotny et al., "Chloride ion transport and mass balance in a metropolitan area using road salt", *Water Resources Research*, Vol. I 45. - Citing work performed by Bester et al., 2006, 2006 "Numerical investigation of road salt impact on an urban wellfield", *Ground Water*, 44, 2009, pp. 165-175.

¹³Bastviken et al., "Chloride retention in forest soil by microbial uptake and by natural chlorination of organic matter", *Geochim. Cosmochim. Acta*, 71, 2007 pp. 3182-3192.

¹⁴Novotny et al., "Increase of urban lake salinity by road deicing salt" *Science of the Total Environment* vol 406, 2008, pp. 131-144.

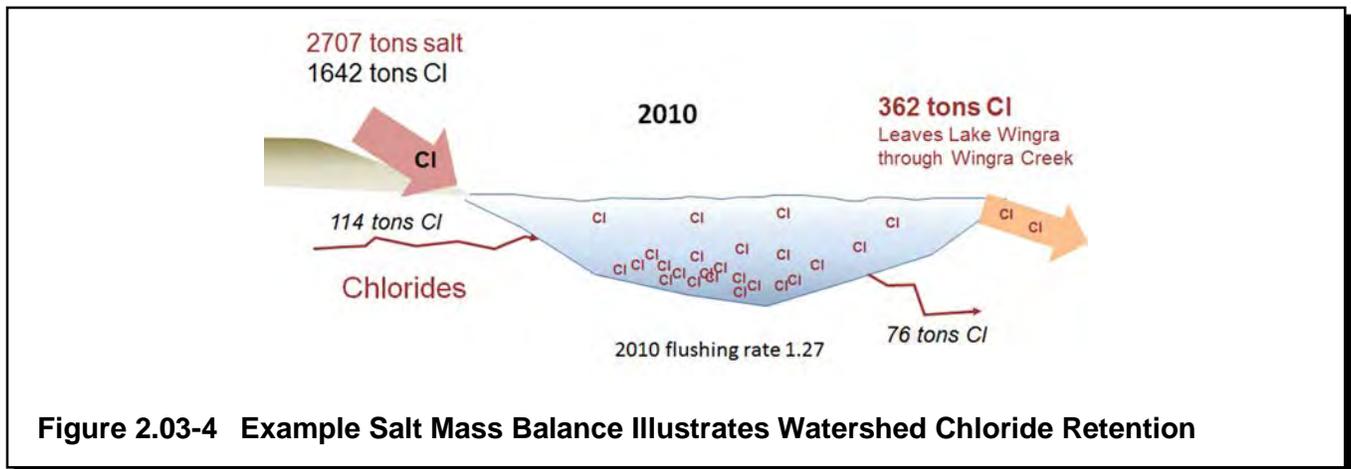


Figure 2.03-4 Example Salt Mass Balance Illustrates Watershed Chloride Retention

To apply the 75 and 87 percent retention rates used for the Wingra predictive tool, the study used the complement of the retention rate (an index) factor to reduce the amount of chloride that actually reaches the lake. The index factor is meant to acknowledge that the watershed, soil, groundwater, wetlands, and basins all capture and retain chlorides before they are transported to the lake. Even with potential variations in application rates and the corresponding index factors, the analysis is revealing.

Figure 2.03-5 illustrates the estimated average chloride contribution for all entities from 2006 to 2012. Table 2.03-3 shows contributions, by applicator, for the two most recent analysis years. Pavements treated by private commercial applicators, even with indexing, are large contributors to chloride concentrations in Lake Wingra. Other high contributors include the city of Madison followed by Dane County. This illustrates the importance of engaging all stakeholders to reduce chloride concentrations in Lake Wingra.

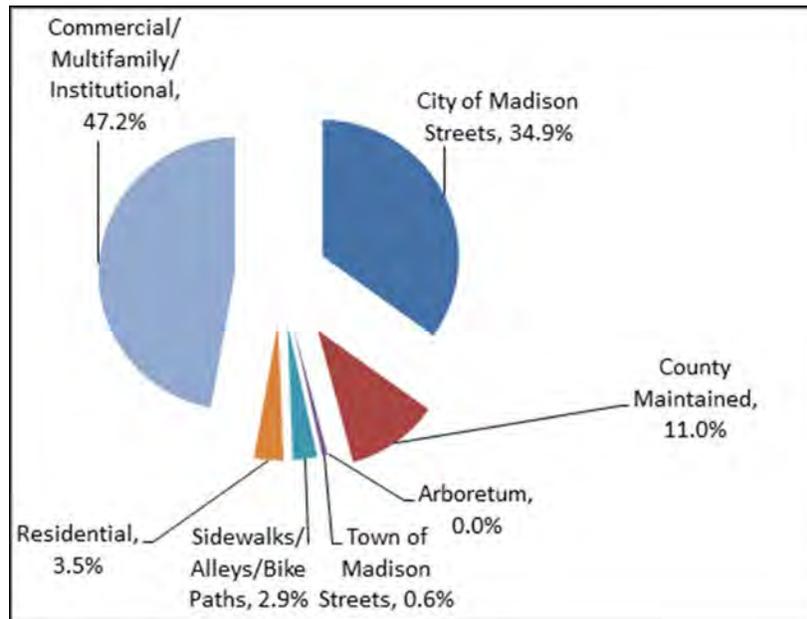


Figure 2.03-5 Approximate Chloride Contributions 2006-2012

Municipality	Lane Miles To Lake	Paved Acres to Lake	Retention Rate/Index Factor	2011-2012 Winter Season		2012-2013 Winter Season	
				Tons Contributed	Percentage Contribution	Tons Contributed	Percentage Contribution
Madison-Salt Routes–Not Curbed	0.68	1.0	0.87/0.13	1	0.2%	2	0.2%
Madison Salt Routes–Curbed	61.07	88.8	0.75/0.25	151	29.7%	284	33.8%
Madison-Nonsalt Routes–Not Curbed	8.97	13.0	0.87/0.13	0	0.0%	1	0.1%
Madison Nonsalt Routes–Curbed	69.49	101.1	0.87/0.13	4	0.7%	12	1.5%
County Maintained–Not Curbed (WisDOT)	19.65	28.6	0.87/0.13	24	4.8%	46	5.4%
County Maintained–Curbed (WisDOT)	10.05	15.3	0.75/0.25	25	4.9%	47	5.6%
University of Wisconsin–Not Curbed	3.13	4.6	0.87/0.13	0	0.0%	0	0.0%
Town Madison Salt Routes–Not Curbed	0.12	0.2	0.87/0.13	0	0.1%	1	0.1%
Town Madison Salt Routes–Curbed	0.46	0.7	0.75/0.25	2	0.4%	4	0.5%
Town Madison Nonsalt Routes–Not Curbed	1.51	2.2	0.87/0.13	0	0.0%	0	0.0%
Town Madison Nonsalt Routes–Curbed	2.2	3.2	0.75/0.25	0	0.0%	0	0.0%
Single-Family Residential		67	0.77/0.23	19	3.8%	29	3.4%
Commercial/Business/Institutional/Multifamily Residential		216	0.77/0.23	264	52.1%	390	46.5%
ROW Sidewalk		49	0.77/0.23	15	3.0%	23	2.7%
Bike Paths		14	0.77/0.23	1	0.2%	1	0.2%
Alleys		1	0.77/0.23	0	0.0%	0	0.0%
Total				507	100%	839	100.0%
Salt Events				23		34	

Table 2.03-3 Salt Contributors

2.04 CHLORIDE MASS BALANCE PREDICTIVE TOOL

This study developed a predictive tool for estimating chloride concentrations in Lake Wingra. The tool was developed using data from the 2006 to 2012 winters. The tool uses a mass balance of water and chlorides to predict chloride concentrations in Lake Wingra. The tool can be used to estimate how varying different parameters, such as commercial application rates, could affect chloride concentrations in Lake Wingra. The prediction tool uses four-time steps per month to simulate the continuous flow of water and chlorides in and out of the lake. While the weekly (approximately) time steps do not fully simulate the continuous flows into and out of the lake, it is as short a period as the data allows. The tool uses the following parameters.

Water Balance

1. Inputs
 - a. Rainfall on Lake (cubic feet): The amount of precipitation by month during nonwinter months that falls on the lake. Data was obtained from the Wisconsin State Climatologist Office.
 - b. Runoff and Snowmelt To Lake (cubic feet): The amount of rainfall that drains to the lake from the watershed area. Data obtained from the City's P8 model¹⁵ modified to include Wisconsin Department of Transportation (WisDOT) right-of-way, as well as Town of Madison, Town of Middleton, and City of Fitchburg areas. The yearly runoff was then factored by monthly rainfall/precipitation data to distribute the P8 runoff/snowmelt to each month.
 - c. Groundwater to Lake (cubic feet): This value was obtained from Mike Parsen of the Wisconsin Geological and Natural History Survey (WGNHS) using a new groundwater flow model, MODFLOW.
2. Outputs
 - a. Evaporation from Lake Surface per month was obtained from Monthly and Annual Water Budgets of Lake Wingra, Madison, Wisconsin, 1972-1977, USGS. Average rates from 1972 to 1977 were used.
 - b. Evapotranspiration from Lake Wingra Wetlands was obtained from Monthly and Annual Water Budgets of Lake Wingra, Madison, Wisconsin, 1972-1977, USGS. Average rates from 1972 to 1977 were used.

¹⁵P8 is a model for predicting the generation and transport of stormwater runoff pollutants in urban watersheds

- c. Groundwater from the Lake (cubic feet). This value was also obtained from Mike Parsen of the WGNHS using a new groundwater flow model, MODFLOW.
 - d. Outflow from groundwater and flow over dam. Outflow from the lake is the difference between the total inputs and the evaporation, evapotranspiration, and groundwater outputs.
3. Chlorides
- a. Chloride from Groundwater (springs) in tons: This value was obtained by using estimated groundwater to lake volumes at a concentration of 100 mg/L.
 - b. Salt Applied Total (tons): Data obtained from the City of Madison, Dane County, and interviews with local private applicators.
 - c. Base Chloride Surface Concentration (mg/L): This value represents the measured surface chloride concentrations from North Temperate Lakes Long Term Ecological Research Network as well as values obtained from the Dane County Public Health Department.
 - d. Base Average Chloride Concentration (mg/L): This value represents the true average chloride concentration in the lake. It accounts for the increasing chloride concentration that occurs with depth. The tool currently estimates that the lake chloride concentration is about 1.1 times the surface concentration based on the chloride profile of Lake Wingra prepared by Roger Bannerman and the bathymetric volume of Lake Wingra prepared by Chin Wu of the University of Wisconsin, 2013.

An inverse exponential function was used to prevent the tool from fully flushing chlorides from Lake Wingra during high rain events.¹⁶ This was needed for high precipitation months such as August 2007 and June 2008, where 34 percent and 25 percent of the yearly rainfall occurred, respectively. Without this inverse exponential function, the tool would have predicted greater chloride flushing than had actually occurred and would not appropriately reflect the continuous mixing that occurs throughout the month. Even with the inverse exponential function, the prediction tool shows greater amounts of chlorides leaving the lake in 2007 and 2008 than what actually occurred. In large rainfall periods, it is likely that full lake mixing does not occur and warm runoff travels across the surface of the lake to the outfall without fully collecting chlorides from the deeper portions of the lake. Future refinements of the tool could consider the following modifications:

¹⁶

$$\text{Base Chloride in Lake (tons)} \times \text{\% Lake Flushed in Time Period} \times \frac{\left[1 + \text{\% Lake Flushed in Time Period} \right]}{\left[1 + \text{\% Lake Flushed in Time Period} \right]^C}$$

1. Factoring the salt flushing concentrations based on runoff volume, with higher volumes flushing lower concentrations of salt.
2. Estimating chloride infiltration into the sanitary sewer.
3. Understanding and incorporating the sequestration of chlorides in wetlands, ponds, and lake bottom sediment.

Figure 2.04-1 illustrates actual measured surface chloride concentration readings with those predicted from the tool. While not fully mimicking the actual measured chlorides, the tool can be useful for estimating how altering different management practices could influence chloride concentrations within Lake Wingra.

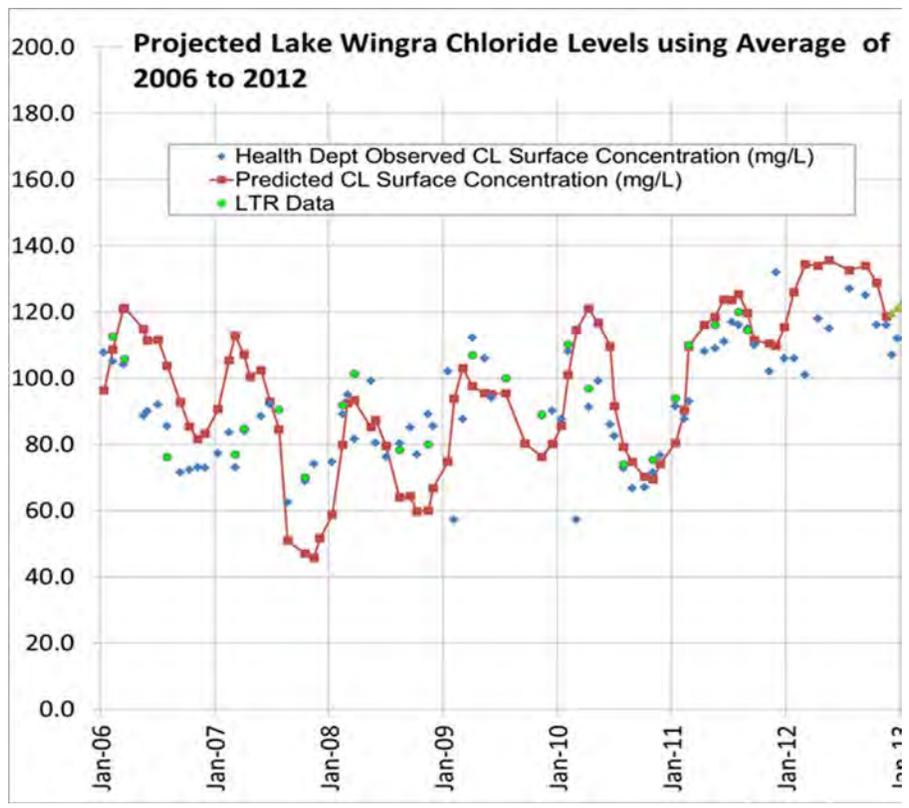


Figure 2.04-1 Chloride Predictive Model Results

2.05 MANAGEMENT ALTERNATIVES

A. Strategies

The relative salt contributions by entities shown in Table 2.03-3 are estimates, yet they provide guidance on where the greatest benefits may lie with winter pavement management changes. Private applicators that manage commercial and multifamily residential parking lots appear to have a large influence on chloride concentrations in Lake Wingra.

There are two feasible mechanisms to reduce chloride application in Lake Wingra.

1. Substitute road salt for other types of deicers such as calcium chloride, agricultural byproducts such as beet juice, or other organic juices. Several municipalities have had success using a non-salt-based deicer. This strategy, however, does add an organic load [biochemical oxygen demand (BOD)] to water bodies and may include undesirable nutrients like phosphorus.
2. Reduce the use of road salt through winter pavement management techniques including:
 - a. Anti-icing—The application of anti-icing products to the roadway before a winter storm. It forms a bond-breaker between the pavement and the snow/ice, decreasing the amount of deicing needed.
 - b. Reducing the number of salt routes.
 - c. Reducing the salt application rates.
 - d. Removing snow more completely, reducing the deicing need.

B. Deicers

Sodium chloride is the predominant deicer being used by the City as well as adjacent maintainers. Many different deicers have been and continue to be investigated. The following bullets summarize some of the more common deicers and list their benefits and drawbacks as obtained from Minnesota Pollution Control Agency's Winter Parking Lot and Sidewalk Maintenance Manual, revised 2010, and University of Wisconsin Deicing Chemical Summary, 2013.

1. Sodium Chloride—As mentioned, sodium chloride is the most common deicer and the least expensive. The lowest practical melting temperature is 15°F. It increases salinity of waters and soils, yet of the chemical deicers, it has a relatively low toxicity. Sodium chloride damages vegetation and is corrosive to steel.
2. Inhibited Magnesium Chloride—Inhibited magnesium chloride (as a liquid) has an effective deicing temperature down to -10°F. It increases salinity of waters and soils and has a relatively low toxicity. It is less harmful to vegetation than sodium chloride. It is corrosive to steel and is about twice as expensive as sodium chloride.

3. Calcium Chloride—Calcium chloride has an effective deicing temperature down to -20°F . It increases the salinity of waters and soils and has a relatively low toxicity. Calcium chloride can be corrosive to steel, but it is less corrosive than sodium chloride. It costs about three times more than sodium chloride.
4. Potassium Acetate—Potassium acetate has an effective deicing temperature down to -15°F . It does not increase the salinity of soils, but it can lead to oxygen depletion in the soil. It can deplete oxygen in water bodies. It causes minimal damage to vegetation and is noncorrosive. It costs eight times more than sodium chloride and is sometimes used on airport pavements.
5. Calcium Magnesium Acetate—Calcium magnesium acetate has an effective deicing temperature down to 20°F . It also does not increase the salinity of soils but can lead to oxygen depletion. It causes minimal damage to vegetation and is noncorrosive. It can cost twenty times more than sodium chloride and is sometimes used on airport pavements.
6. Agricultural Byproducts—The addition of agricultural byproducts to deicers has been in practice for years. Agricultural byproducts are generally noncorrosive and biodegradable and may improve the melting properties of other deicers. Agricultural byproducts added to salt brine has been shown to reduce corrosion in laboratory conditions. There are wide ranging claims by manufacturers and suppliers that the addition of agricultural byproducts can decrease the effective deicing temperature when mixed with salt. This is difficult to substantiate since typically these products are sold as a blend, which has a mixture of deicers with lower freeze points. Some highway maintenance agencies report that mixing agricultural byproducts can increase the residual retention time of the anti-icing liquids on the pavement in advance of a storm.

Some municipalities are experimenting with the use of beet juice as an anti-icer or as a mixing agent. Beet juice is less corrosive than salt and less damaging to vegetation but it carries an oxygen demand and can deplete oxygen in water bodies. Some have complained about soiling of vehicles.

The specific application of deicing chemicals and management of snow removal are complex. Each deicing substance carries benefits and drawbacks. There appears to be no substance having a clear advantage without substantial disadvantages. Because reviewing snow management techniques, procedures, and deicing chemicals is an ongoing effort by the City and Dane County, this study concerns itself primarily with the current snow management practices and chemicals. Different deicing substances and procedures could and should be explored further by pavement-maintaining entities in their effort to reduce overall chloride use. Table 2.05-1 shows the salt application rates per maintaining body along with recommended rates provided by the Minnesota Pollution Control Agency Salt Use Training Program. The table illustrates where there may be more room for management changes in salt reduction.

	Stated Rate lbs per 1000 sf per <u>Application</u>	Calculated Average Rate lbs per 1,000 sf per <u>Event**</u>	Recommended Rate per <u>Application+</u>
Madison Salt Routes	2.4	16.9	
Madison Nonsalt Routes	0.1	0.43	
County Maintained (assumed same as Madison) (Fish Hatchery, Beltline Road, and Verona Road)	3.9	16.9	
Single-Family Residential*#	5.0#	5.0	1.5 to 3.0
Commercial/Business/Institutional/Multifamily Residential*#	20.0#	20.0*	1.5 to 3.0
ROW Sidewalk*	5.0	5.0*	1.5 to 3.0
Bike Paths (City)*	1.0	1.0	1.5 to 3.0

*Assumed one application per event.
+According to Minnesota Pollution Control Agency Snow Removal Training, Dry Salt, varies with temperature.
#Applied to 65 percent of commercial pavements and 50 percent of residential pavements. Many commercial pavements, such as parking stalls, alleys, and storage areas may not be deiced. Also, not all commercial properties deice with every storm event. Residential deicing also is not a uniform practice and is not applied to all pavements within a residence.
**For roadways, calculated values were determined by taking total yearly salt tonnage and dividing it by the number of salt events and treated lane miles.

Table 2.05-1 Salt Application Rates

C. Scenarios

The study used the predictive tool to understand how chloride levels might vary based on different types of weather years and different types of management measures. In doing this the predictive tool:

- Uses a consistent weather year for each projected future year. Since the water balance and chloride input is uniform year after year, the lake reaches equilibrium relatively quickly.
- Does not account for latent chlorides being stored in soils, groundwater, wetlands, ponds, and the chloride layer at the bottom of the lake. While the tool may predict chloride reductions relatively quickly, these sources of latent chloride will likely slow the decrease in surface water chloride concentration levels. As mentioned in the Novotny article, even if all chlorides were fully prevented from entering Lake Wingra, it would likely take ten years or more for the lake to be restored.

The following paragraphs describe different scenarios that were modeled.

1. No Change–Average of 2006-2012 Weather Years

This analysis uses the average weather, salt usage, and salt events between 2006 and 2012. Figure 2.05-1 illustrates the chloride levels using the water balance from this average year. Chloride levels are projected to reach a yearly rhythm that varies from about 75 mg/L to 110 mg/L.

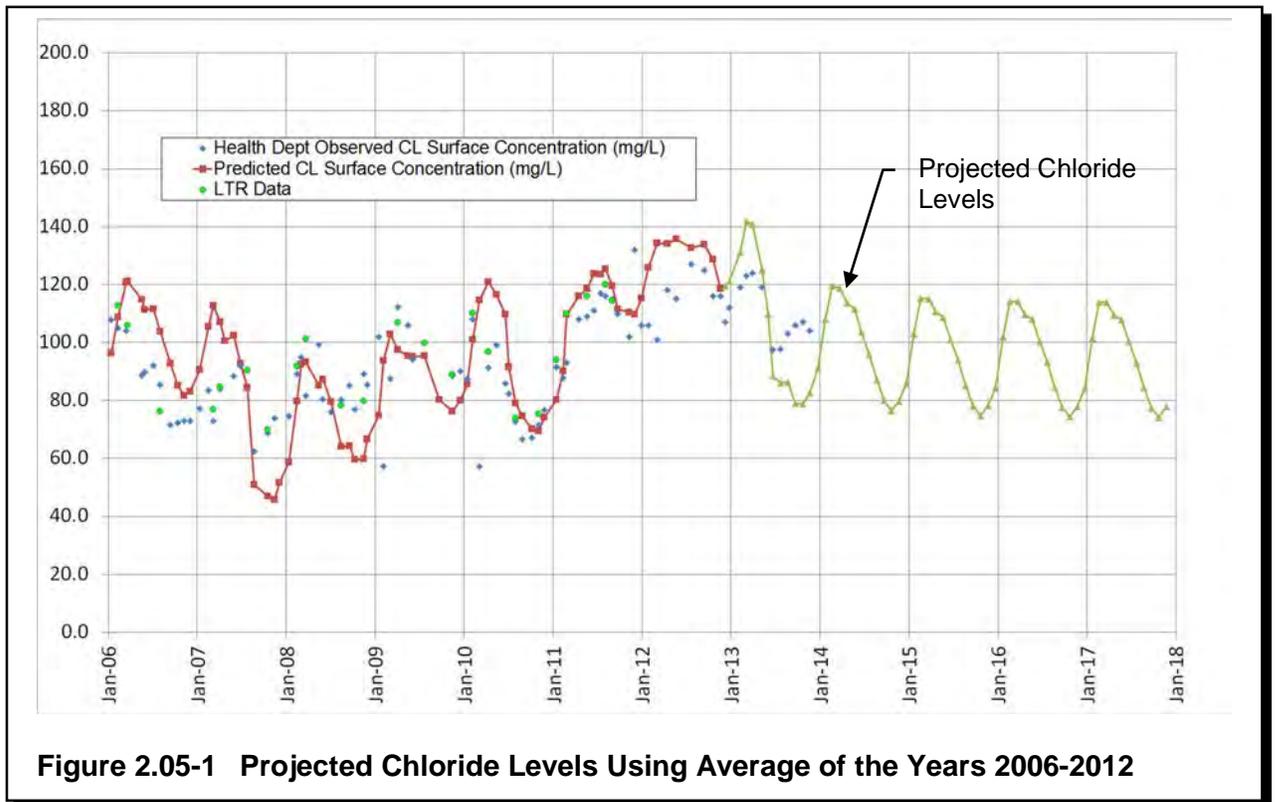


Figure 2.05-1 Projected Chloride Levels Using Average of the Years 2006-2012

2. No Change—Average Weather Year (2011)

The Wisconsin Initiative on Climate Change Impacts released a report in 2011 titled *Changing Climate: Impacts and Adaptation*. That report summarizes an analysis by the University of Wisconsin-Madison climate scientists using 14 “downscale” global circulation models. The report predicts the following climate change trends for Wisconsin:

- a. Wisconsin’s warming trend will continue, with the statewide average annual temperature increasing 6°F to 7°F.
- b. Wisconsin is likely to continue the trend toward more precipitation, with probable increases in winter, spring, and fall.
- c. The amount of winter precipitation that falls as rain is predicted to increase.
- d. More freezing rain is likely to occur.

Based on these predictions, some speculate that the winter of 2011 provides a better base year for winters likely to occur in the future. Using the 2011 precipitation, salt use and salt event data indicates that chloride levels would rise to a cycle between 140 and 180 mg/L within three years (Figure 2.05-2).

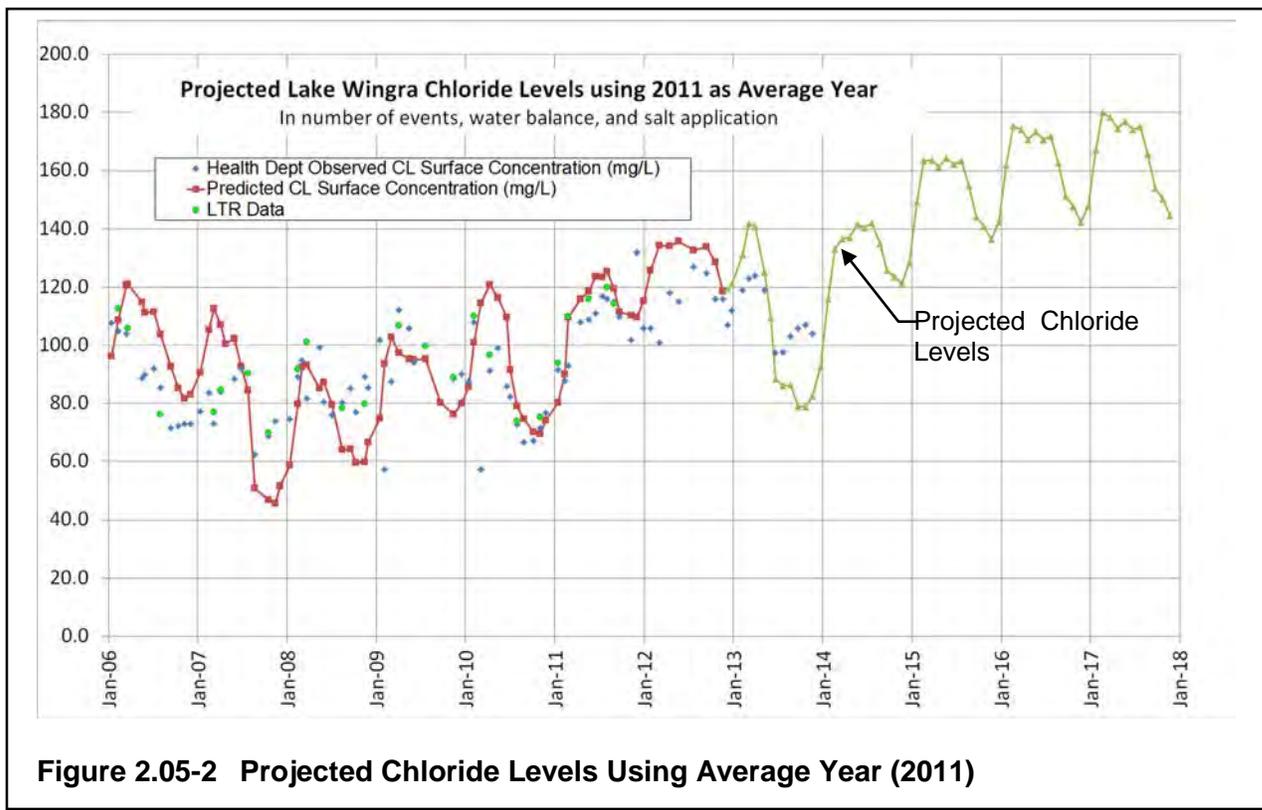
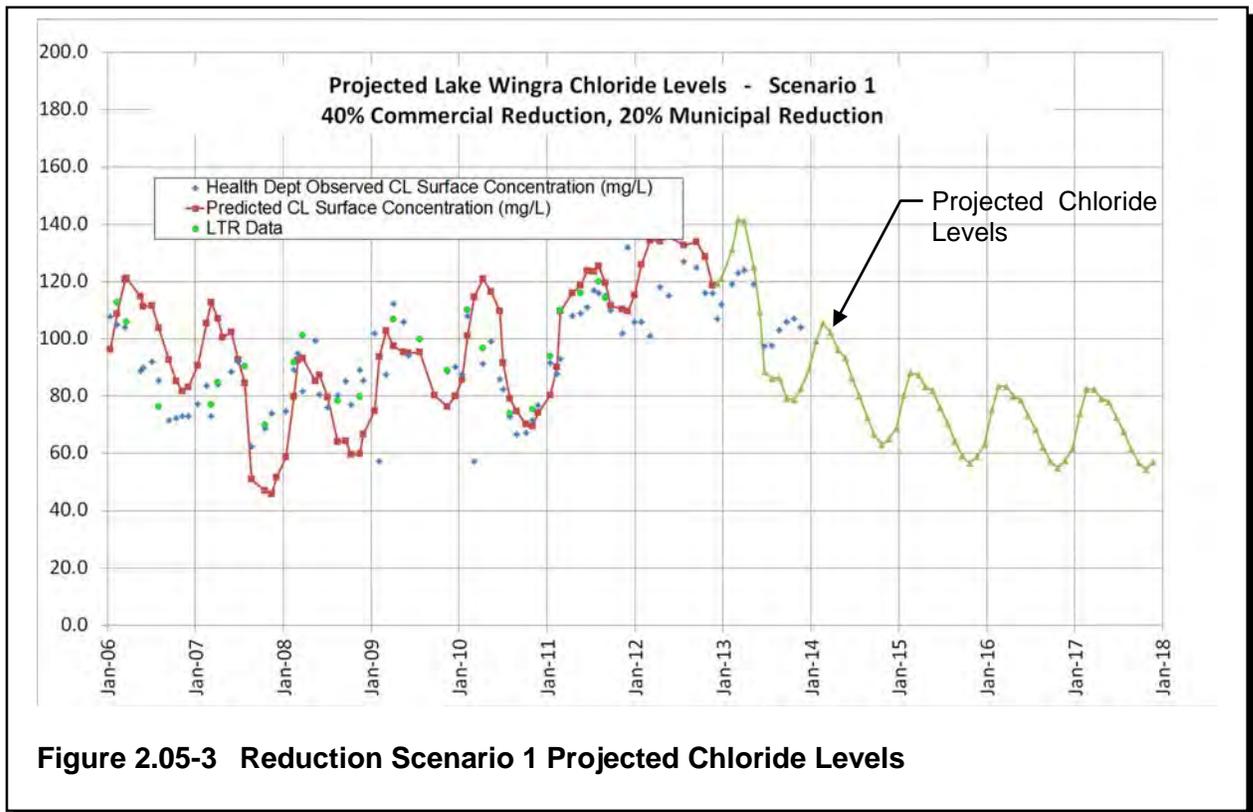


Figure 2.05-2 Projected Chloride Levels Using Average Year (2011)

3. Reduction Scenario 1—Reduce Commercial/Residential Application Rates by 40 Percent and Municipal Application Rates by 20 Percent

Reduction Scenario 1 (Figure 2.05-3) is an aggressive chloride reduction that would seek to reduce the salt applied by residential and commercial applicators by 40 percent and municipal applicators by 20 percent. The average weather and application rates from 2006 to 2012 were used in the analysis. The analysis indicates that if these reductions were made, chloride levels in Lake Wingra would range from 55 to 85 mg/L. This would represent a substantial improvement from current chloride levels, yet it falls short of the target level of 40 mg/L stated in the *2009 Lake Wingra: A Vision for the Future*.



4. Reduction Scenario 2—Reduce Commercial/Residential Application Rates by 60 Percent and Municipal Application Rates by 30 Percent

Reduction Scenario 2 (Figure 2.05-4) is a more aggressive chloride reduction that would seek to reduce the salt applied by residential and commercial applicators by 60 percent and municipal applicators by 30 percent. The average weather and application rates from 2006 to 2012 again were used in the analysis. The analysis indicates that if these reductions were made, chloride levels in Lake Wingra would range from 45 mg/L to 70 mg/L. This represents an even greater improvement from current chloride levels. While reaching the 40 mg/L for a portion of the year, this reduction falls short of the intent of the target level of 40 mg/L stated in the *2009 Lake Wingra: A Vision for the Future*.

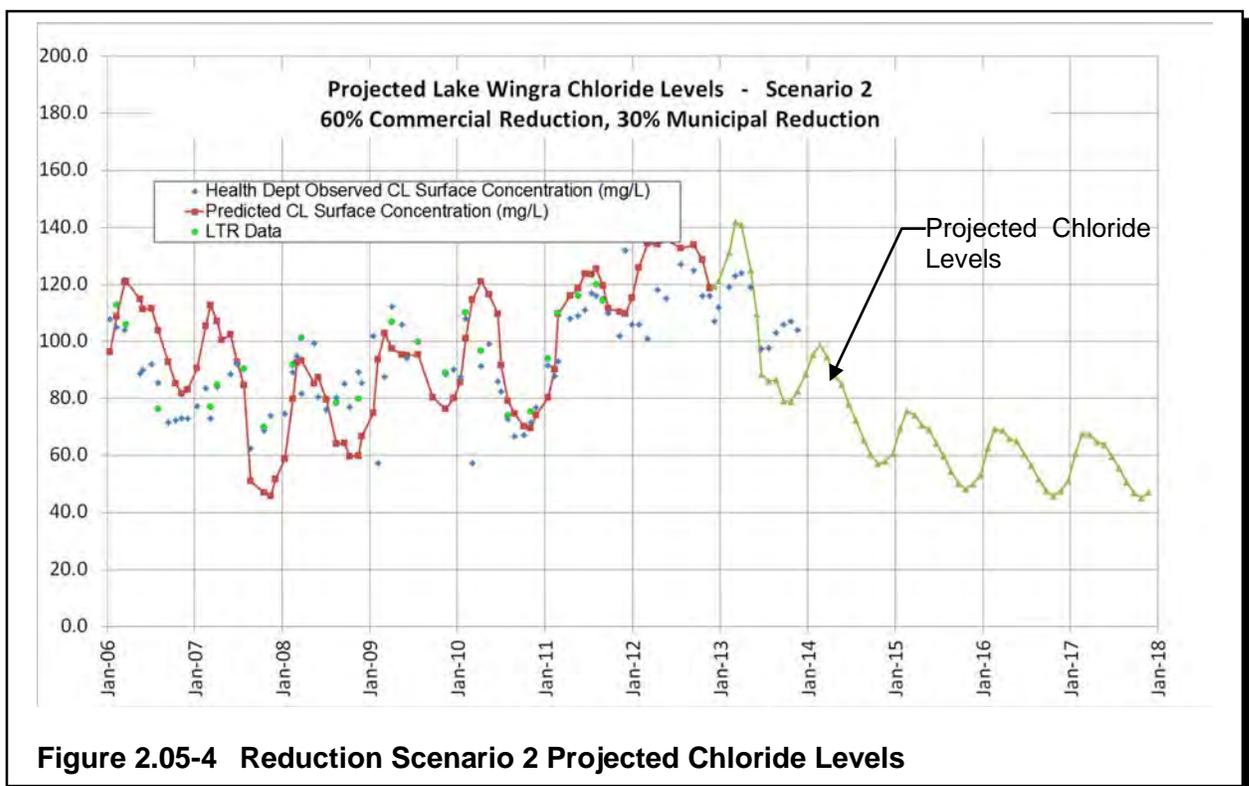
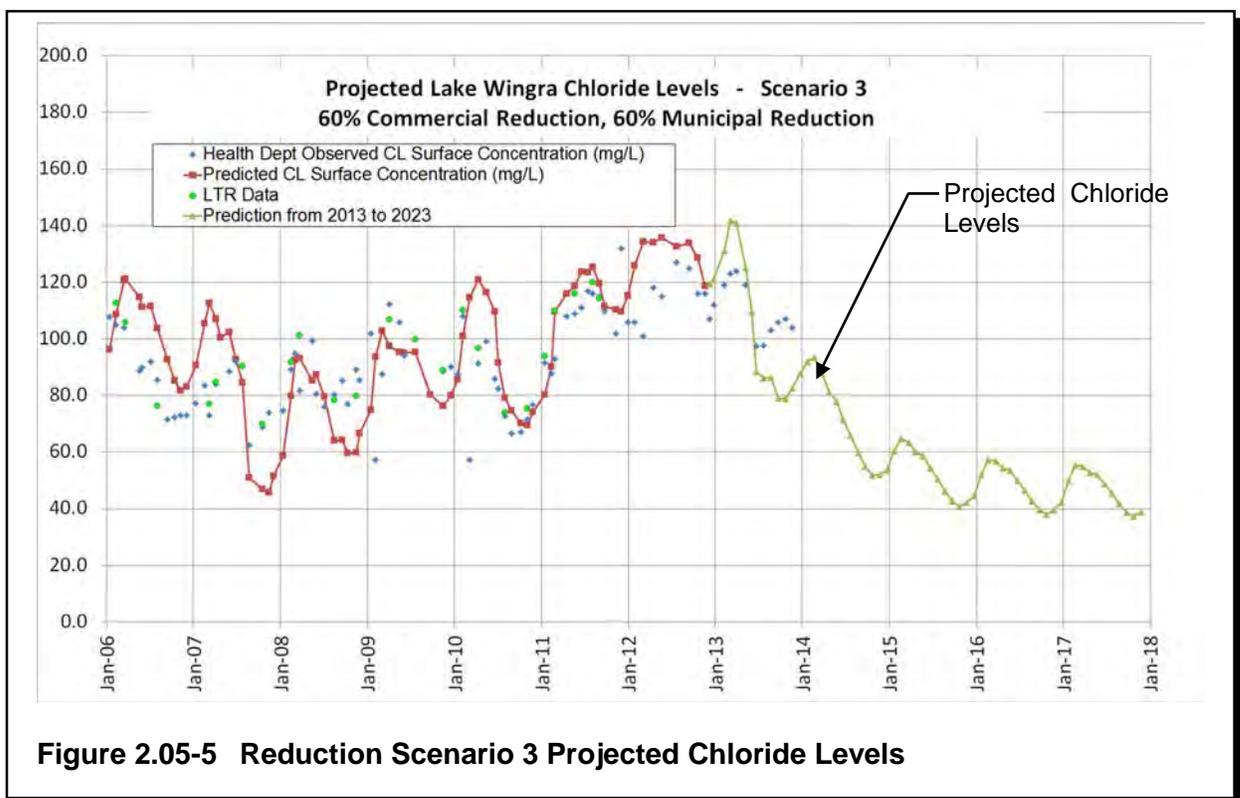


Figure 2.05-4 Reduction Scenario 2 Projected Chloride Levels

5. Reduction Scenario 3—Reduce Commercial/Residential and Municipal Application Rates by 60 Percent

Reduction Scenario 3 (Figure 2.05-5) is the most aggressive chloride reduction that would seek to reduce the salt applied by residential, commercial, and municipal applicators by 60 percent. The average weather and application rates from 2006 to 2012 again were used in the analysis. The analysis indicates that if these very aggressive reductions were made, chloride levels in Lake Wingra would range from 35 to 55 mg/L. This aggressive reduction seems to approach the target goal of 40 mg/L stated in the *2009 Lake Wingra: A Vision for the Future*. Interestingly, these chloride levels in Lake Wingra are similar to those measured in the 1970s.



D. Target Reductions Scenario

Table 2.05-2 shows the reductions that would be necessary to achieve the desired chloride reductions associated with the three reduction scenarios. The table also shows the resulting surface chloride concentration of Lake Wingra forecasted by the predictive tool. It should be noted the predictive tool uses the average weather, salt, and salt events from 2006 to 2012. This eliminates yearly variation and leads to a consistent chloride cycle within three to four years. Because of the latent chlorides that are stored in wetlands, ponds, and the chloride layer at the lake bottom, actual restoration time would likely be longer than ten years.

Municipality	Lane Miles To Lake or Acres	Base 2006-2012 Ave	Base 2011	Reduction Scenario 1 40% Com/ Res 20% Muni	Reduction Scenario 2 60% Com/Res 30% Muni	Reduction Scenario 3 60% Com/Res 60% Muni
		Salt Use Reduction	Salt Use Reduction	Salt Use Reduction	Salt Use Reduction	Salt Use Reduction
Madison Salt Routes	61.8	0%	0%	20%	30%	60%
Madison Nonsalt Routes	78.5	0%	0%	20%	30%	60%
County Maintained (Fish Hatchery Road, Beltline, and Verona Road)	29.7	0%	0%	20%	30%	60%
University of Wisconsin	3.1	0%	0%	20%	30%	60%
Town Madison	4.3	0%	0%	20%	30%	60%
Single-Family Residential	67 ac	0%	0%	40%	60%	60%
Commercial/ Business/ Institutional/Multifamily	216 ac	0%	0%	40%	60%	60%
Sidewalk in Right-of-Way	49 ac	0%	0%	20%	30%	60%
Bike Paths	14 ac	0%	0%	20%	30%	60%
Alleys	1 ac	0%	0%	20%	30%	60%
Surface Chloride Concentration Achieved		75 mg/L to 110 mg/L	140 mg/L to 180 mg/L	55 mg/L to 85 mg/L	45 mg/L to 70 mg/L	30 mg/L to 50 mg/L

*The retention rate represents the chlorides that are not delivered to the water body. Single-family residential refers to the amount of impervious residential nonroof surfaces in the watershed area. Sidewalk in right-of-way refers to sidewalks that are not on private property, but on public right-of-way. (Note: Most sidewalks adjacent to roadways are on public right-of-way.)

Table 2.05-2 Salt Reduction Strategy Predictions

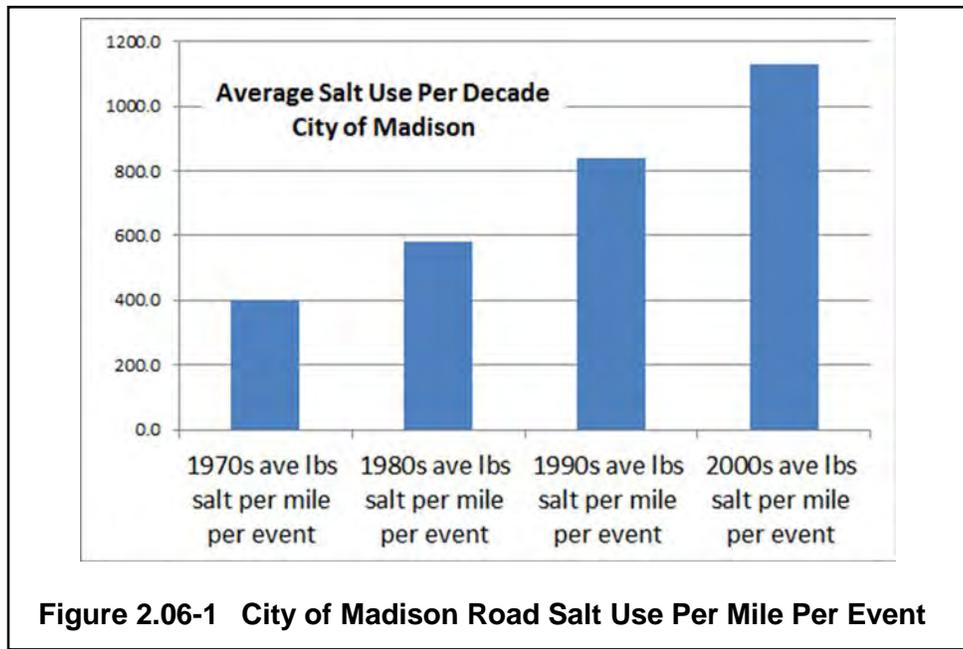
Because of the relatively rapid flushing rate of Lake Wingra, immediate management changes would produce lower chloride concentrations within ten years. However, it is likely that it would take several years to educate pavement managers and owners, change policies, change pedestrian and driver expectations, and implement meaningful management changes. Because salt water is denser than fresh water, higher concentrations of chlorides are in the deeper portions of the lake. This influences the ability of the lake to fully flush chlorides.¹⁷

¹⁷ Novotny and Stephan, "Road Salt Impact on Lake Stratification and Water Quality", *Journal of Hydraulic Engineering*, 2012. Novotny found the formation of a saline layer that varied in thickness based on water temperature and chloride input. Depending on the lake, the saline layer sometimes did and did not dissipate later in the year. The saline layer could affect chloride mixing within the lake and the release of lake chlorides into Wingra Creek.

2.06 FEASIBILITY OF CHLORIDE REDUCTIONS

A. Municipal Reductions

Some area governmental bodies are making efforts to reduce chloride use in winter pavement maintenance. This has led to recent equipment purchases and equipment upgrades in the past five years. Despite these upgrades and management changes, the average chloride use per event per road mile has increased from the 1970s to now. In the decade of the 2000s, the City of Madison applied 2.8 times more salt per mile per event than it did in the 1970s. Resident expectations of clear roads during most winter conditions are likely driving these application rates upward. Safety considerations also factor into resident expectations upon elected officials and, ultimately, city snow management operations. A 60 percent salt application reduction would require application rates that were used in the 1970s.



Barriers to these reduced application rates include customer, or resident, expectations. Significant education regarding the negative effects to water bodies, groundwater, and well water would probably be needed to facilitate such large reductions. These aggressive measures would also require changing winter pedestrian and driver expectations.

B. Commercial Applicator Reductions

This analysis surveyed several commercial applicators to obtain average application rates per event. The responses ranged from 20 pounds to 35 pounds per 1,000 square feet. Based on this information, the analysis used 20 pounds per 1,000 square feet and applied that rate to 65 percent of the commercial pavements. The 65 percent is meant to acknowledge that not all commercial pavements are salted. For example, often the isle of a parking lot may be salted, where the occupied stalls would not be. Commercial alleys and outside storage areas also may not be salted. The study used a 5 pounds per 1,000 ft² application rate for residential pavements but only assumed that 50 percent of the property owners performed winter maintenance using salt.

The Minnesota Department of Natural Resources recommended application rate is 3 pounds per 1,000 ft², while the WDNR recommended application rate is 5 pounds per 1,000 ft². The application rate used in this analysis is four to six times these recommended application rates. If two thirds of commercial applicators would reduce their application rate by half to 10 pounds per 1,000 ft², it would result in a net 33 percent reduction for commercial applicators. If the same two-thirds reduced their application rate to WDNR's recommended 5 pounds per 1,000 ft², it would result in a net 50 percent reduction for commercial applicators. To achieve the 60 percent reduction required by Reduction Scenario 3, about 80 percent of commercial applicators would need to reduce their application rate to the WDNR's recommended 5 pounds per 1,000 ft².

The threat of litigation to property owners and commercial applicators is a serious barrier to reducing commercial application rates. Interviews with commercial applicators indicate most have been sued. The threat of litigation leads to the liberal application of salt. Another barrier to reduced salt application is the structure of the winter maintenance contracts. Most contracts pay for salt by weight, providing an incentive for commercial applicators to use salt liberally. Changing commercial application rates will probably need to involve not only the applicator but also property owners and building tenants.

2.07 SOCIAL MARKETING OPPORTUNITIES

There are many measures that could be implemented to achieve these chloride reduction goals. Some of the measures may lend themselves to social marketing measures and/or social paradigm changes. The following bullets list some possibilities.

- Focusing on commercial applicators and property owners to encourage them to use less salt in their winter maintenance activities. A variety of measures could be used to do this including education, certification and/or incentives.
- Focusing on city residents/drivers to help them accept low salt roadways for several arterials within the watershed.

2.08 POSSIBLE MANAGEMENT CHANGES TO ACHIEVE TARGET CHLORIDE LEVELS

Many states have developed salt reduction projects and have excellent training materials. This study reviewed the New Hampshire Road Salt Reduction Initiative¹⁸ and Minnesota's Road Salt Education Program.¹⁹ Both are good training materials that will not be replicated in this report.

The City and Dane County have instituted salt reduction recommendations from the 2007 Lakes and Watershed report on reducing road salt. This includes implementing GPS Automatic Vehicle Locating technology, providing training programs for applicators, calibrating truck application rates, and adding prewetting capacity to equipment.

Table 2.08-1 describes potential additional management measures that could be implemented to achieve the necessary salt application reductions to achieve the targeted chloride concentration in Lake Wingra. The table also rates their implementation feasibility and potential effectiveness in reducing Lake Wingra chlorides. Implementation feasibility is a qualitative assessment based on interviews with City Department managers, commercial applicators, and property owners. It is also based on the possible ease of implementation based on current City funds and resources. Potential effectiveness also is a qualitative assessment based on anticipated participation levels and the actual salt contribution the targeted audience. For example, "Establish Maximum Salt Guidelines" was given a "+" rating in potential effectiveness because it was anticipated that fewer than 25 percent of commercial applicators would participate and they are just guidelines. Yet "Establish Maximum Salt Application Rates by Ordinance" was given a "++" rating because a law is more likely to garner participation.

A third column is provided for implementation priority and is left blank. Catalyst teams (see Section 5) can determine the priority of the potential measures. The management changes could be implemented in any order, yet if the target chloride concentrations are to be achieved, it is likely that multiple or most measures will need to be implemented. Any combination that provides significant reductions in commercial and municipal application rates will help lower chloride inputs to Lake Wingra (i.e.: rising chloride levels may occur despite implementation of the measures).

Reduction Scenario 1 provides an attainable short-term goal and substantially improves chloride levels. Scenario 1 requires a 40 percent salt reduction by commercial applicators and a 20 percent reduction by municipal applicators. A varying combination of these two reductions could also be implemented to achieve chloride levels between 55 and 80 mg/L.

To come close to achieving the 40 mg/L target, Reduction Scenario 3 is required and should serve as the ultimate goal. Achieving this goal would require 60 percent reduction by all applicators, which in turn would require a change in community expectations.

¹⁸<http://www.des.state.nh.us/organization/divisions/water/wmb/was/salt-reduction-initiative/> May 2013.

¹⁹<http://www.pca.state.mn.us/index.php/about-mpca/mpca-events-and-training/road-salt-education-program.html> May 2013.

Table 2.08-1 Possible Management Change

Management Measure	Feasibility	Potential Effectiveness	Implementation Priority
<p>Implement a Certification Program for Commercial Applicators Other states have had success with this measure and applicators have been able to use their certification in marketing efforts. The certification program provides measurable reductions quicker when property owners also attend training events.</p>	+++	+	*
<p>Provide Sample Contracts for Winter Pavement Maintenance on Web Site and with Certification This measure would help reduce the number of winter pavement maintenance contracts that use salt as a payment measure.</p>	+++	+	*
<p>Require Certification for Government Snow Removal Contractors This measure encourages certification and provides an economic advantage to commercial applicators who obtain certification.</p>	+++	+	*
<p>Establish Maximum Salt Guidelines This measure provides some coverage for litigation for commercial applicators.</p>	++	+	*
<p>Establish Maximum Salt Application Rates by Ordinance Discussions with other states indicate that commercial applicators encourage maximum guidelines, but prosalt interests make it politically difficult to implement on a state-wide concentration. It may be more feasible to implement on a county basis.</p>	++	++	*
<p>Expand the Practice of Anti-icing Anti-icing helps provide extra time for winter pavement maintenance and helps reduce overall road salt application.</p>	+++	++	*
<p>Reduce the Number of Applications per Snow Event The application rate per event is several times the recommended application rate per pass. Altering management techniques might allow municipalities to make fewer salt passes, reducing the overall salt usage per event.</p>	++	++	*
<p>Reduce the Salt Route Mileage The City and/or Town of Madison could transition current salt routes to sand routes. Signage could be used to alert drivers of the low salt routes. City streets that are currently salt routes within the Wingra watershed include Monroe St, Nakoma Rd., Midvale Blvd., Odana Rd., Mohawk Dr., Seminole Hwy., Tokay Blvd., Speedway, and Commonwealth. If sand routes are expanded, the sand could later be retrieved during the spring sweeping operations.</p>	++	+++	*
<p>Investigate Alternate Deicers Several municipalities are using different deicers, such as beet juice, as part of their snow removal strategy. No deicing substance is without its disadvantages, but using alternate deicers could help reduce the overall amount of chlorides reaching the lake.</p>	++	++	*
<p>*Note that Implementation priority will be determined in the future by the Chloride Catalyst Team. Multiple or most measures will need to be implemented to attain chloride reduction goals.</p>			

**SECTION 3
INFILTRATION**

3.01 OBJECTIVE

The 2009 *Lake Wingra: A Vision for the Future*, prepared by the FOLW, identifies increasing infiltration in the Lake Wingra watershed as a critical element of Goal 2, restored spring flow. The report goes on to establish a target increase of 25 percent in spring flow. For purposes of this plan, the objective in working toward this target is described in terms of the following short-term and long-term goals.

1. Short-Term Goal: Recover 10 percent of the lost infiltration resulting from development.
2. Long-Term Goal: Recover 25 percent of the lost infiltration resulting from development.

Working toward these goals will, in kind, work toward meeting the two other targets identified under Goal 2: “Lost springs flowing year-round” and “Year-round flows from Lake Wingra into Wingra Creek.”

In an effort to achieve this goal, this portion of the management plan:

1. Describes the Lake Wingra surface water watershed and groundwater watershed including current estimated annual average runoff and groundwater flow to the lake.
2. Describes the estimated current infiltration rates in the watershed.
3. Identifies existing, proposed, and potential recharge locations.
4. Performs an alternatives analysis that identifies ways to achieve the short-term goal of increasing infiltration in the watershed to recover 10 percent of the lost infiltration resulting from development.
5. Seeks to achieve the infiltration and TP reduction short-term goals through projects that jointly provide an infiltration and TP reduction benefit.
6. Reviews management changes that have the potential to achieve the short-term infiltration goals.
7. Recommends management changes to pursue.
8. Provides discussion on potential strategies for meeting the long-term goal.

3.02 BACKGROUND

A. Importance of Infiltration

Infiltration of rainfall/runoff into the ground has a threefold benefit to Lake Wingra. First, this water becomes a source for groundwater recharge and spring flow. Second, this water can contribute clean water (if direct surface infiltration) or pretreated water (if directed to a rain garden, bioretention, or other facility) for groundwater recharge and spring flow. Infiltrated water does not have the opportunity to pick up and convey additional pollutants to Lake Wingra as it would if conveyed through a storm sewer. Third, infiltration can reduce runoff peak flows and volumes. Figure 3.02-1 shows a graphic of different factors that affect spring flow.

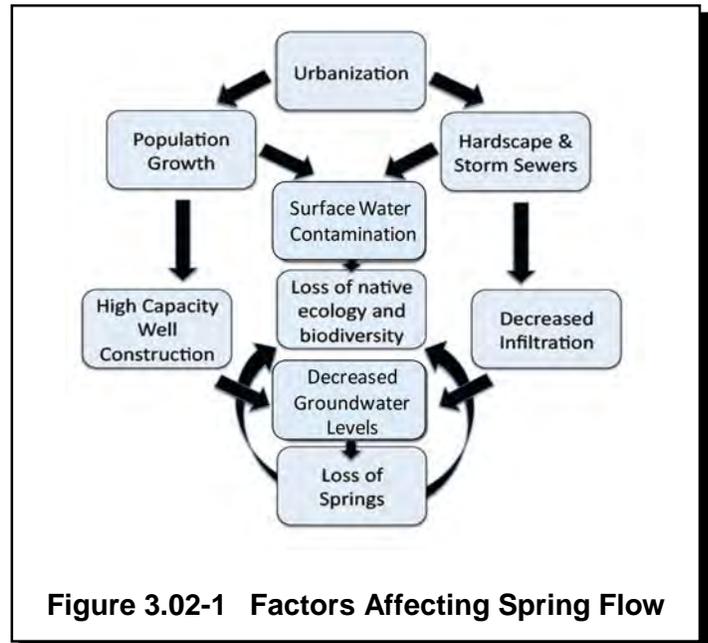


Figure 3.02-1 Factors Affecting Spring Flow

Groundwater recharge and spring flow are valuable to Lake Wingra because they sustain existing spring flow, improve lake water quality, provide unique habitat for plants and animals, reduce the temperature of the lake waters, and contribute base flow to Wingra Creek.

Increasing infiltration in the watershed provides the opportunity to enhance these benefits and restore spring flow.

B. Factors Affecting Infiltration

Several factors affect infiltration in the Lake Wingra watershed:

1. Amount of pervious/impervious area.
2. Soil types and condition (e.g., compaction level and sodium level)
3. Infiltration rate of pervious surfaces.
4. Amount of surface runoff.
5. dedicated postconstruction infiltration Best Management Practices (BMPs) in the surface water watershed and groundwater watershed.

C Effects of Development

Lake Wingra’s original hydrologic cycle has been altered because of human development. Development in the form of construction of impervious surfaces has essentially sealed off significant amounts of formerly pervious surfaces that formerly allowed rainfall/runoff to infiltrate into the ground and recharge the groundwater table, which is now conveyed via storm sewer to Lake Wingra. Connection of internally drained areas (e.g., Odana wetlands) to the lake and filling of wetlands are also significant human impacts. Partially attributable to this is the loss of 24 springs (located mainly along the north shore of Lake Wingra) that formerly flowed into Lake Wingra according to Wayland Noland’s 1951 report titled *Hydrography, Fish and Turtle Population of Lake Wingra*.

Additionally, groundwater wells constructed to serve society’s needs for drinking water and irrigation have caused groundwater drawdown, primarily in the deep Mount Simon sandstone aquifer. Figure 3.02-2 illustrates a drawdown effect. The effects of development on and a description of the three aquifers in the study area (a shallow sand and gravel aquifer, an upper bedrock aquifer, and a lower bedrock aquifer) are further described.

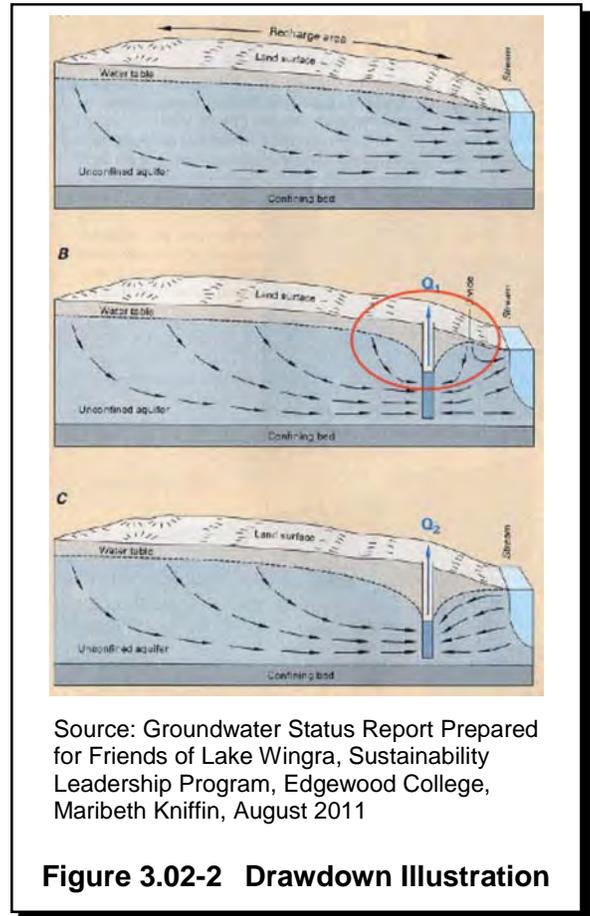


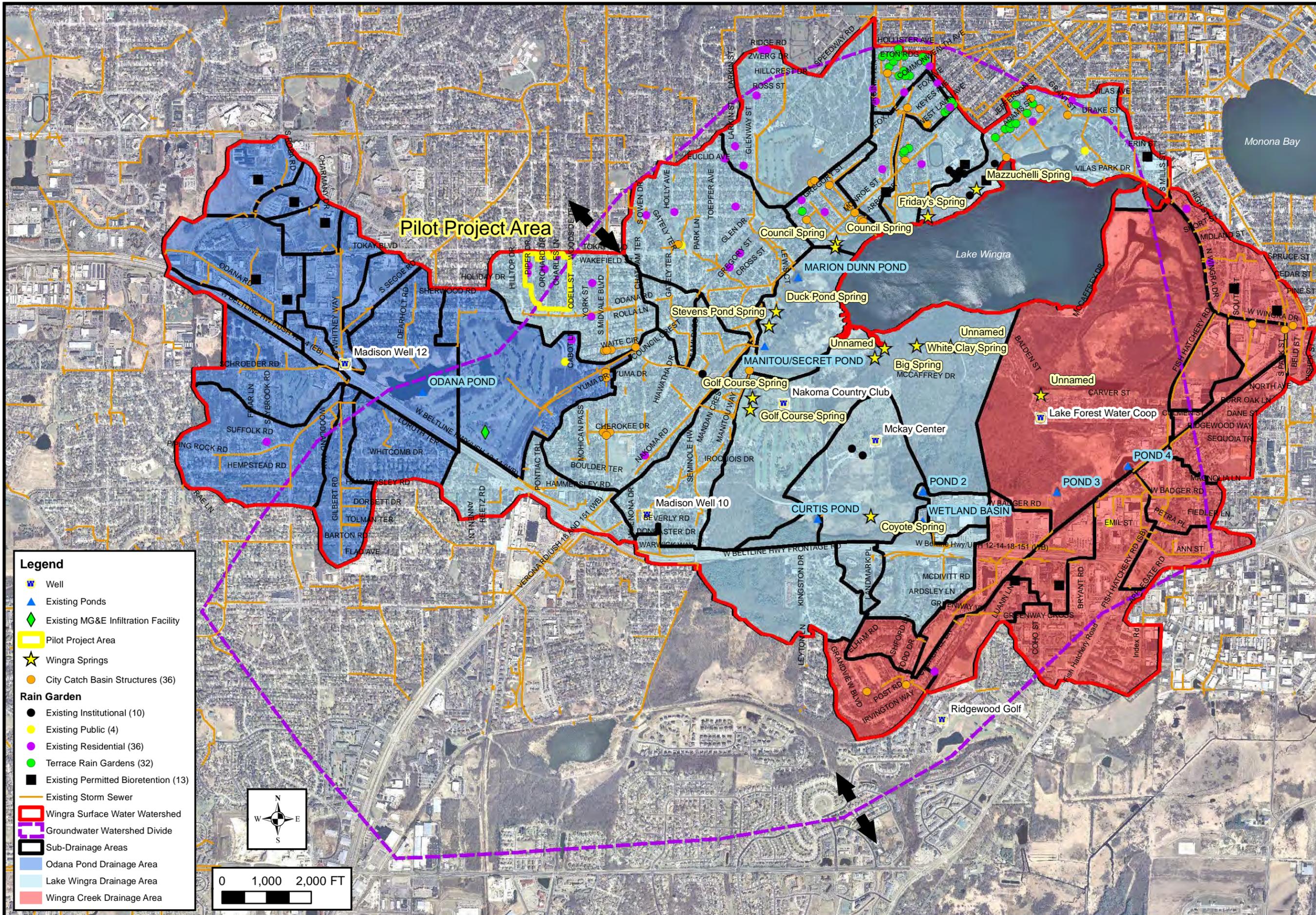
Figure 3.02-2 Drawdown Illustration

D. Existing Lake Wingra Springs

Groundwater flows manifest themselves at Lake Wingra as either surface springs or as seepage through the lake bottom. While over 24 springs have ceased flowing as noted previously, Table 3.02-1 lists 14 known active springs surrounding Lake Wingra. Figures 3.02-3 and 3.02-4 show the locations of the springs in relation to the surface water watershed and groundwater watershed based on a geographical information system (GIS) shapefile received from the UW-Madison Arboretum staff.

Spring Name	Number of Springs	Flow Rate (gpm) if available
Coyote Spring	1	Not Available
Unnamed 1	1	Not Available
Unnamed 2	1	Not Available
White Clay	1	Not Available
Unnamed 3	1	Not Available
Big	1	445 gpm
Golf Course Spring	2	90 gpm (1 spring only)
Duck Pond Spring	1	362 gpm
Stevens Pond	1	Not Available
Council Spring	2	Not Available
Friday’s Spring	1	Not Available
Mazzuchelli Spring	1	Not Available

Table 3.02-1 Existing Lake Wingra Springs

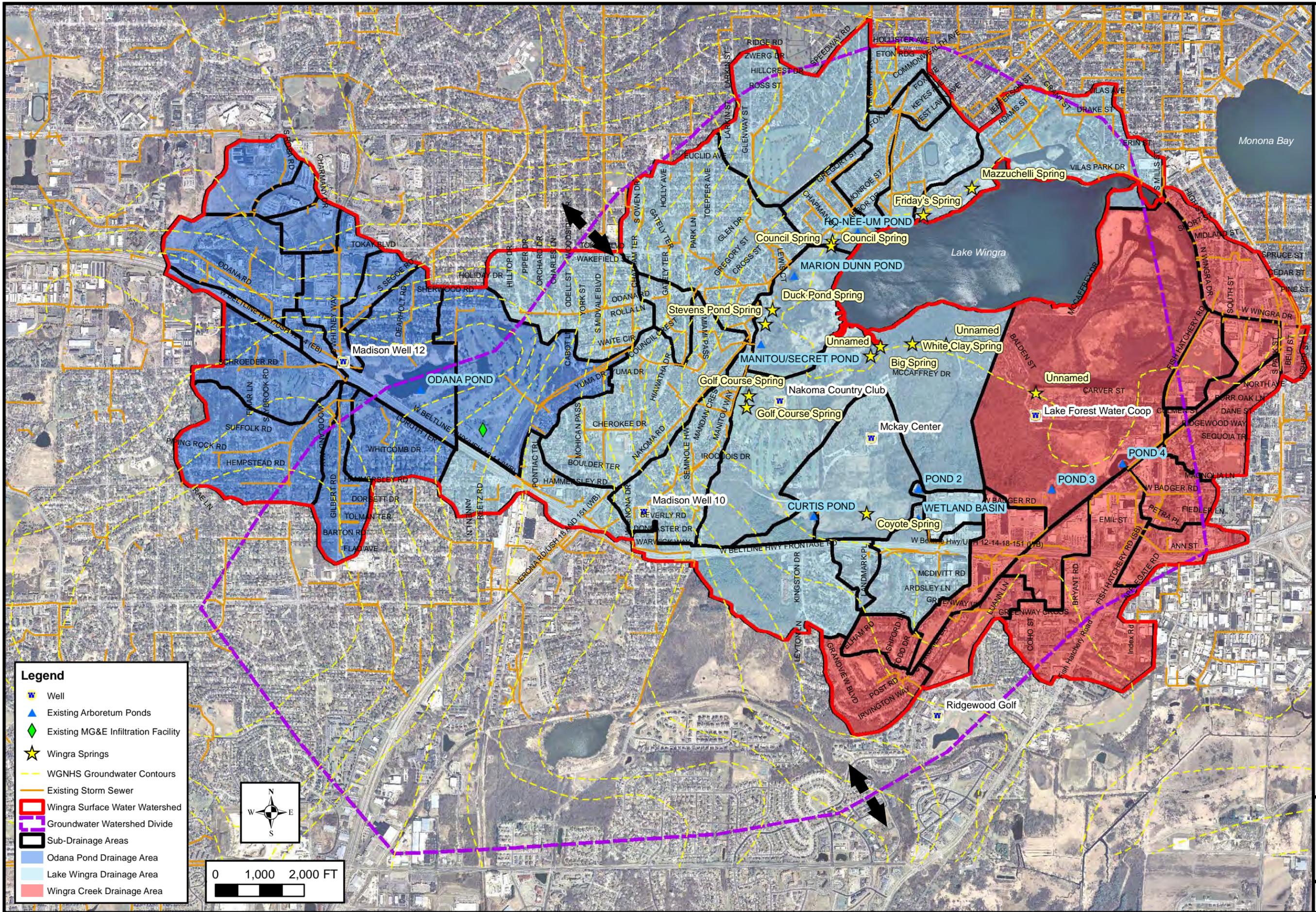


LAKE WINGRA SURFACE WATER WATERSHED

LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.02-3
 1020.065



Legend

- Well
- Existing Arboretum Ponds
- Existing MG&E Infiltration Facility
- Wingra Springs
- WGNHS Groundwater Contours
- Existing Storm Sewer
- Wingra Surface Water Watershed
- Groundwater Watershed Divide
- Sub-Drainage Areas
- Odana Pond Drainage Area
- Lake Wingra Drainage Area
- Wingra Creek Drainage Area

0 1,000 2,000 FT

LAKE WINGRA GROUND WATER WATERSHED

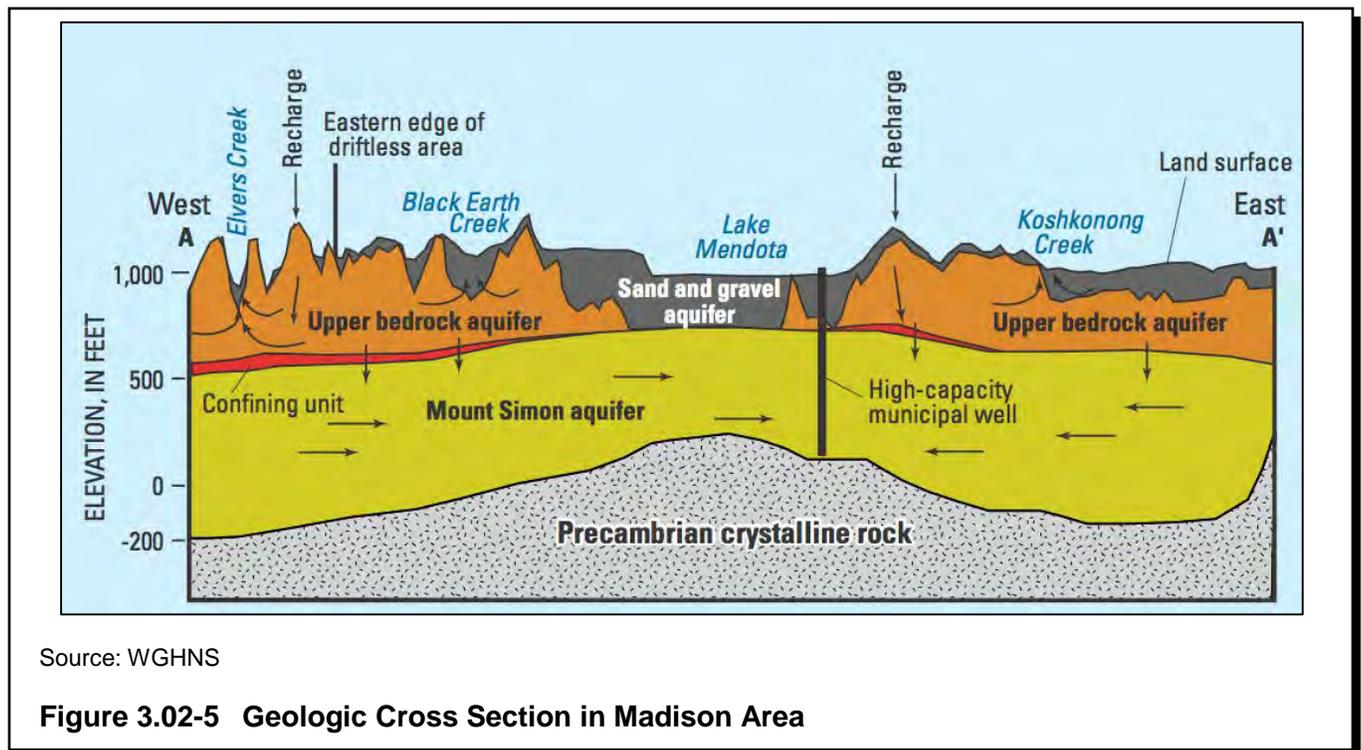
LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.02-4
 1020.065

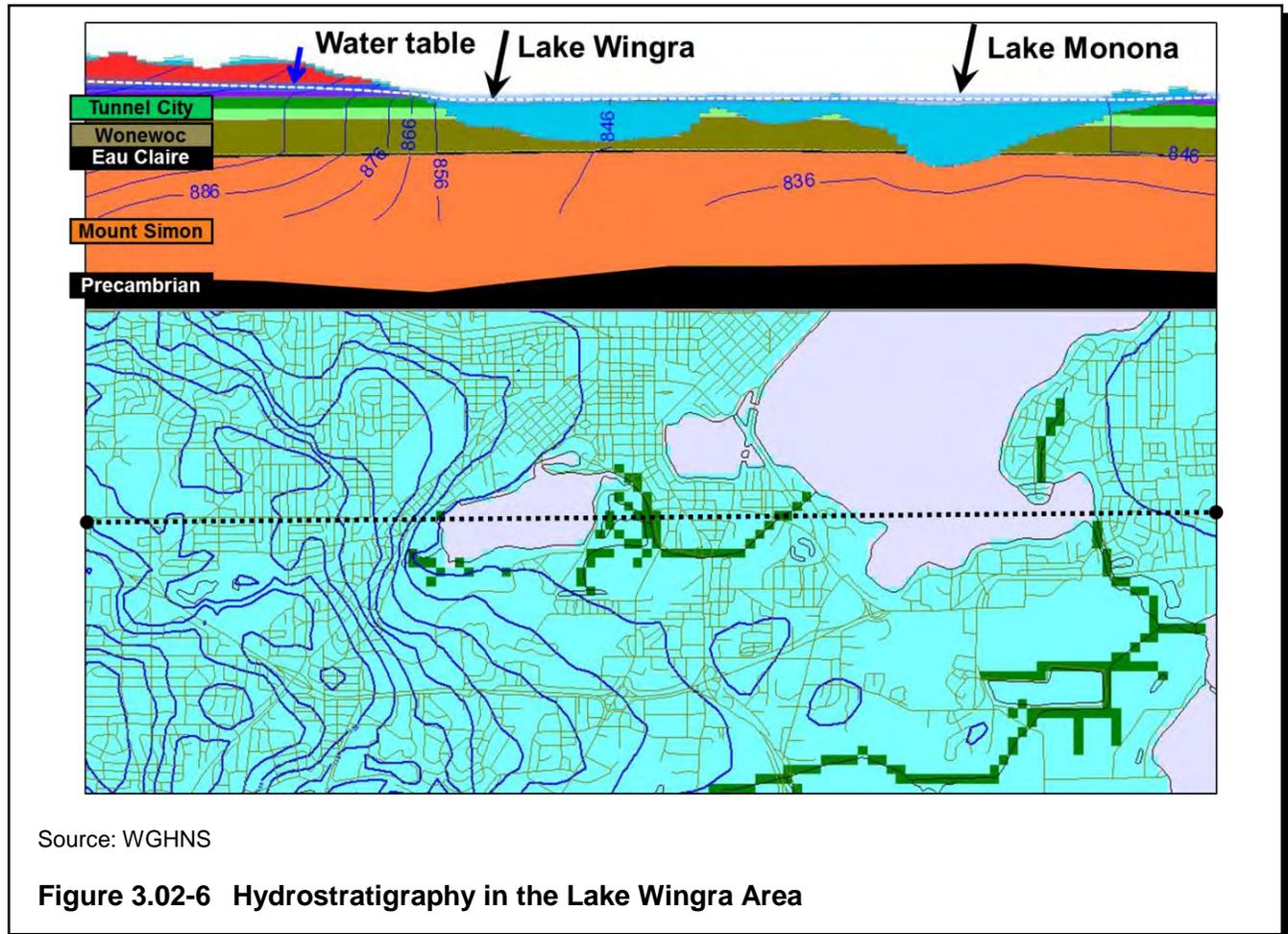
E. Dane County Regional Groundwater Model

At the time calculations were completed for this report, the WGNHS was in the midst of completing an update to the Dane County Regional Groundwater Model. Mike Parsen from WGNHS gave a presentation at the June 28, 2013, Issue Team Meeting describing the improvements to the model and relevant geology and groundwater issues to the Lake Wingra watershed. This model will be released soon to the public and will be useful for many projects and studies. The new model is more refined than the previous model and could be used to identify the potential source areas or recharge areas of specific springs.



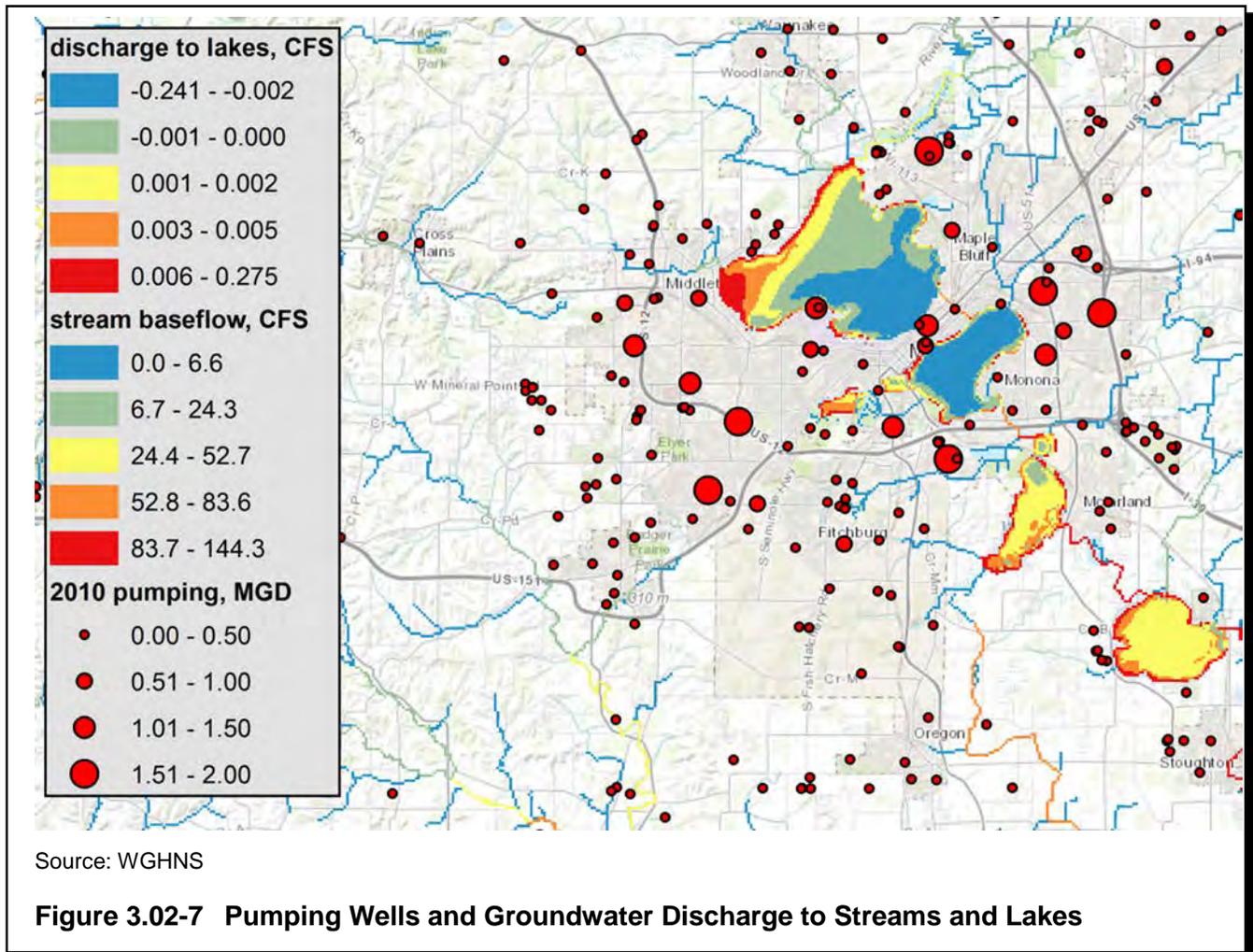
Of particular importance to the Wingra Watershed Management Plan is an understanding of the link between surface water and groundwater. In the Wingra Watershed, there are three aquifers: a shallow sand and gravel aquifer, an upper bedrock aquifer, and a lower bedrock aquifer. Glacial deposits and recent stream sediments form the shallow sand and gravel aquifer (Lathrop et al., 2006). Dolomite and sandstone form the upper bedrock aquifer, and the deep Mount Simon aquifer is made of well-sorted sandstones (Swanson et al., 2006). Most of the high capacity water wells in the Madison area pump groundwater from the deep Mount Simon sandstone aquifer. Figure 3.02-5 depicts a geologic cross section in the Madison area from west to east. The upper bedrock aquifer is the source for the springs in the Lake Wingra watershed. The upper bedrock aquifer includes the Tunnel City formation, shown in Figure 3.02-6, which is generally believed to be the formation that is most connected to/contributes the most water to the majority of the Lake Wingra watershed springs. Thus, surface water infiltration is directly linked to the shallow sand and gravel aquifer and the upper bedrock aquifer while then connecting to the lower bedrock aquifer at locations of weak or partially absent confining unit, the Eau Claire aquitard.

The Eau Claire aquitard (shown in red on Figure 3.02-5) is a leaky confining unit that separates parts of the upper and lower aquifers throughout Dane County (Hunt et al., 2001). The exact thickness and presence of this aquifer is unknown ranging from over 60 feet thick in northwestern Dane County to absent in northeast Dane County (Bradbury et al., 2010). In the Yahara lakes area, the aquitard appears patchy and partially absent (Bradbury et al., 2010).



The presence or absence of this aquitard has implications for surface water and deep aquifer (Mount Simon Sandstone) groundwater connection. In much of the Madison area where the aquitard is absent, groundwater in the Mount Simon aquifer is hydrologically connected to surface water and can either recharge or draw from the lakes, rivers, and wetlands (Hunt et al., 2001). Without intervention, ground and surface water are in state of approximate equilibrium (Fetter, 2001). Historically, Madison lakes, rivers and wetlands were groundwater sinks supported by the abundant quantity of groundwater from the Mount Simon aquifer and upward flow/discharge of groundwater from this aquifer to the lakes and streams (Lathrop et al., 2006). Today, because of the heavy pumping of groundwater from the Mount Simon aquifer, lakes lose water to the groundwater system, which may allow contaminated lake water to enter groundwater.

Figure 3.02-7 is a graphic from the updated Dane County Regional Groundwater Model. The graphic shows the numerous high capacity wells pumping groundwater primarily from the deep Mount Simon aquifer in the Madison area. The graphic also shows the model simulated areas of groundwater discharge to the Madison area lakes and streams. Model simulations indicate that Lake Monona and the southern half of Lake Mendota no longer receive groundwater. While Lake Wingra is still shown as a groundwater sink, groundwater withdrawals from area wells have also reduced the rate of groundwater discharge to Lake Wingra.



Another way the surface water and the deep Mount Simon aquifer are hydrologically connected is by cross-connecting wells. According to the WGNHS, the updated Dane County Regional Groundwater Model includes 589 wells. Of those, 31 are unused and are cross-connected while another 100 are in use but also cross-connected. As illustrated in Figure 3.02-8, a cross-connected well allows surface water and groundwater from above the aquitard to migrate down to the deep Mount Simon aquifer. The Dane County Regional Model quantifies the ambient flow through these wells in Dane County from the shallow aquifers to the deep Mount Simon aquifer at between 3 to 5 million gallons per day (mgd).

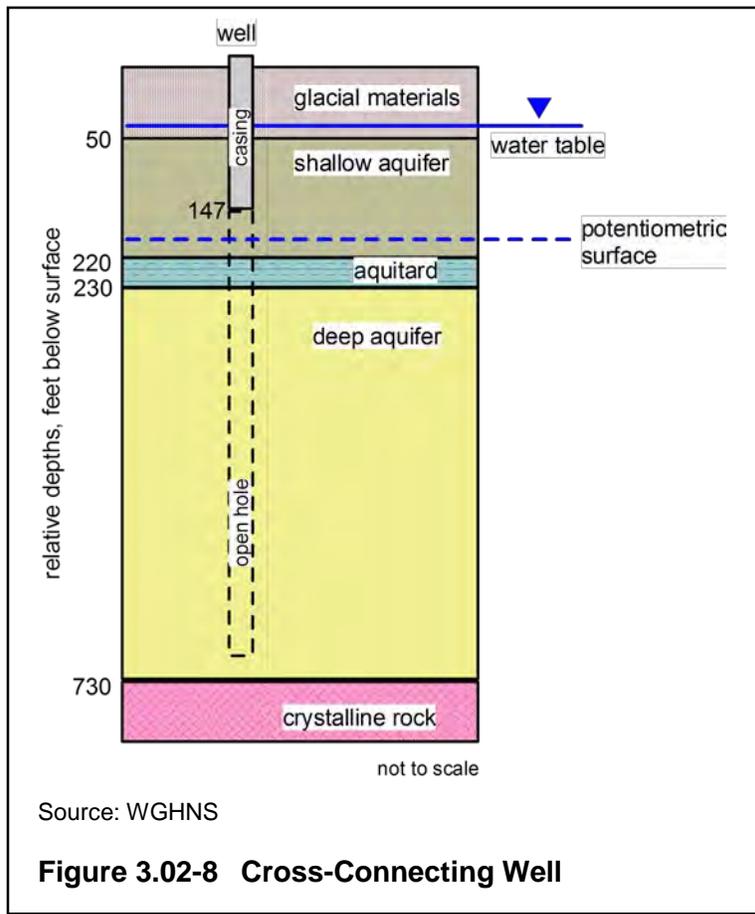
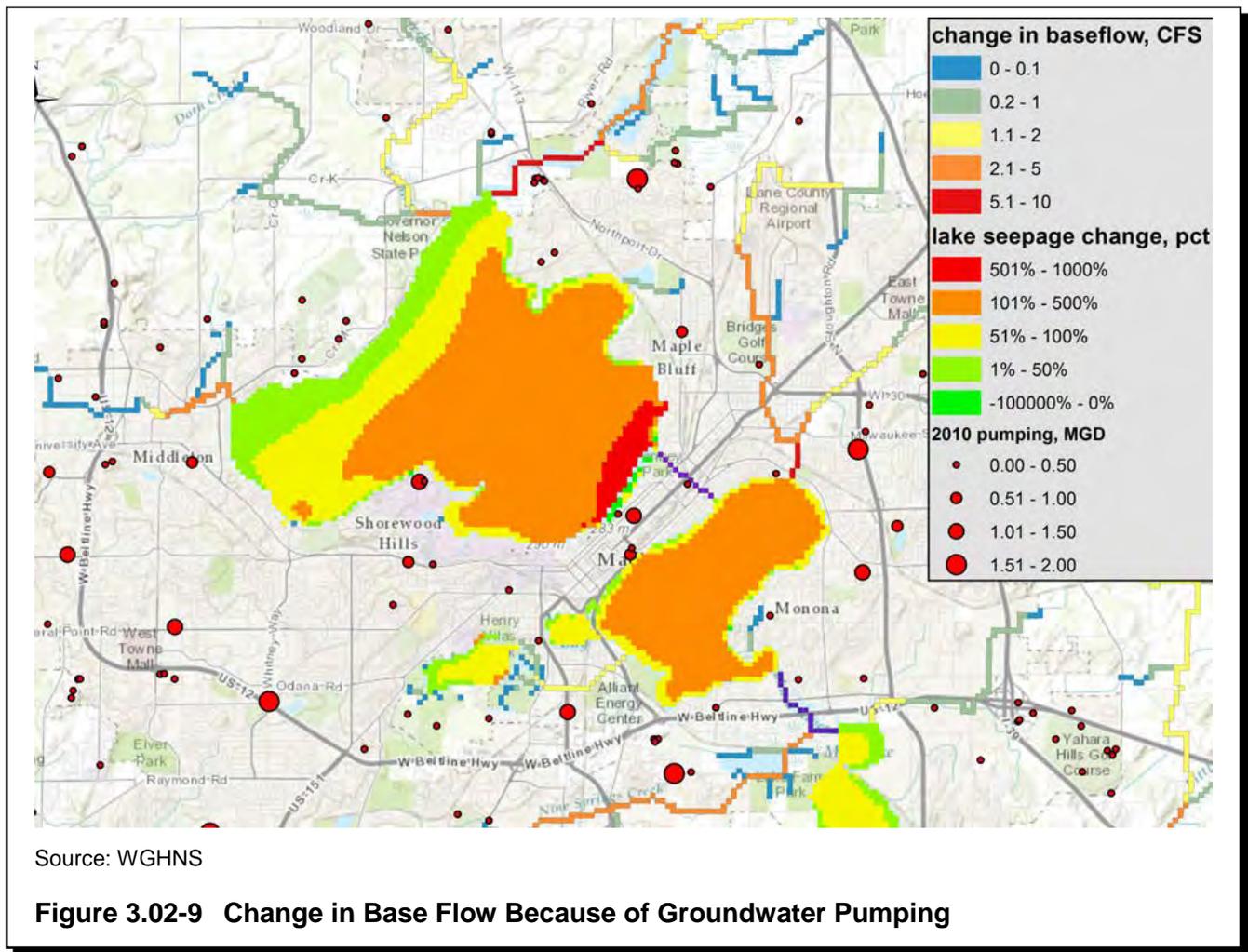


Figure 3.02-9 shows the simulated changed base flow conditions resulting from groundwater pumping around the Madison lakes. The percent change of lake seepage to Lake Wingra is estimated to range from approximately 1 to 100 percent.

Because surface water is directly connected to the shallow aquifers, reduced pumping of groundwater from those aquifers would likely have a direct, positive effect on base flow (spring flow and groundwater discharge to surface waters). Unfortunately, most groundwater withdrawal in the area is from wells installed in the deep Mount Simon aquifer. There is also some level of connection between surface water, the shallow aquifers, and ultimately the deep aquifer in the Madison area as discussed in the previous paragraphs. These connections are where the shale aquitard is absent and at cross-connecting wells. Reducing the groundwater pumping from the deep sandstone aquifer would also have a positive effect on spring flow and groundwater discharge to surface waters. Reducing the withdrawal rate from the deep aquifer could be accomplished through water conservation. However, water demands from future development may offset these gains unless an alternative potable water source for the municipalities in the area is identified.



3.03 CONTRIBUTING WATERSHED CHARACTERISTICS

The primary contributors to infiltration in the watershed are annual precipitation and pervious surfaces that convey a portion of the precipitation to the groundwater. Likewise, impervious surfaces prevent precipitation from being infiltrated into the ground. A combination of naturally occurring pervious surfaces (e.g., UW-Madison Arboretum), pervious surfaces within the urban environment (yards, golf courses), and dedicated infiltration-type facilities [Madison Gas & Electric (MG&E) Infiltration Facilities, rain gardens, bioretention basins] all contribute to the infiltrative capacity of the watershed.

A. Watershed

1. Surface Water Watershed

The official watershed boundary for the management plan is shown in Figure 3.02-3. It includes areas that drain to Wingra Creek as well as to the Gardner Marsh. While the study boundary includes these eastern areas, these areas do not drain into Lake Wingra and, therefore, do not affect lake chloride or phosphorus concentrations. Likewise, the groundwater watershed generally conforms to the surface water watershed on the eastern side of the lake meaning that groundwater is being fed from the lake rather than feeding the lake. Figure 3.03-1 depicts the estimated groundwater flow in and out of Lake Wingra as established by Pennequi and Anderson in 1983. In that regard, the two different blue-shaded areas within Figure 3.02-3 illustrate the tributary area directly draining into the lake the tributary area that affects recharge of groundwater flowing to Lake Wingra. Taking this into account, the Lake Wingra surface water watershed (both blue areas on Figure 3.02-3) encompasses 3,636 acres; 1,105 of these acres first drain through the Odana Hills Golf Course pond before draining to Lake Wingra.

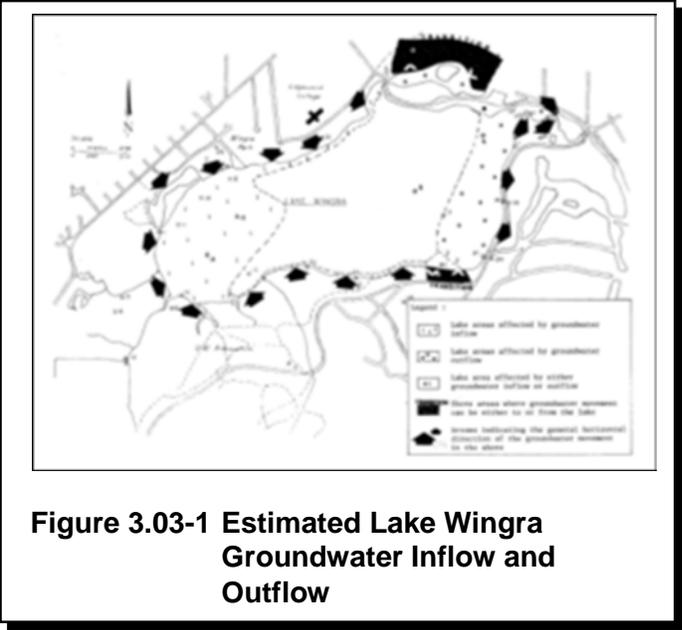


Figure 3.03-1 Estimated Lake Wingra Groundwater Inflow and Outflow

The watershed generally drains from west to east via a system of storm sewers, open channels, and ditches as shown on Figure 3.02-3. Surrounding Lake Wingra are six ponds including Pond 2/Wetland Basin, Coyote Pond (a natural seepage depression also fed by upstream storm sewers), Curtis Pond, Secret Pond, Marion-Dunn Pond, and Ho-Nee-Um Pond. Each pond provides some level of stormwater quality treatment of runoff before discharge into Lake Wingra but generally does not provide appreciable infiltration of stormwater runoff. Two ponds, Pond 4 and Pond 3, drain downstream of the lake to Wingra Creek.

2. Groundwater Watershed

Lake Wingra’s groundwater watershed encompasses an area of approximately 6,177 acres and does not coincide with the surface water watershed boundary as shown in Figure 3.02-4. The groundwater watershed was generated based on groundwater contours obtained from the WGNHS.

B. Pervious/Impervious Area Analysis

A map showing pervious and impervious areas within the watershed is shown in Figure 3.03-2 including their underlying land use.

Estimates based on GIS analysis and City databases indicate that of the 3,636 acres within the watershed, 2,550 acres (70 percent) are pervious and 1,086 acres (30 percent) are impervious. Of these pervious areas, 1,790 acres (70 percent) are nonresidential land use including multifamily residential and 760 (30 percent) are residential (single-family and duplex) land use.

C. Soils in the Watershed

The amount of stormwater runoff produced by a storm event is impacted by the types of soil underlying the watershed. Soils having a high percentage of sand and gravel will absorb a higher percentage of stormwater runoff than will soils having high clay content. This means that sandy soil generally produces less runoff than clay soil.

The Natural Resources Conservation Service (NRCS) classifies soil types in categories known as Hydrologic Soils Groups (HSG). Group A soils consist of sandy soils having high infiltration rates and low runoff potential. Group B soils have moderately fine to moderately coarse textures and moderate runoff potential. Group C soils are typically sandy clay loam soils having moderately fine to fine textures and a low infiltration capacity. Examples of Group D soils are clays, soils with a permanent high water table, and shallow soils over nearly impervious material. Group D soils have a very low infiltration capacity and have high runoff potential.

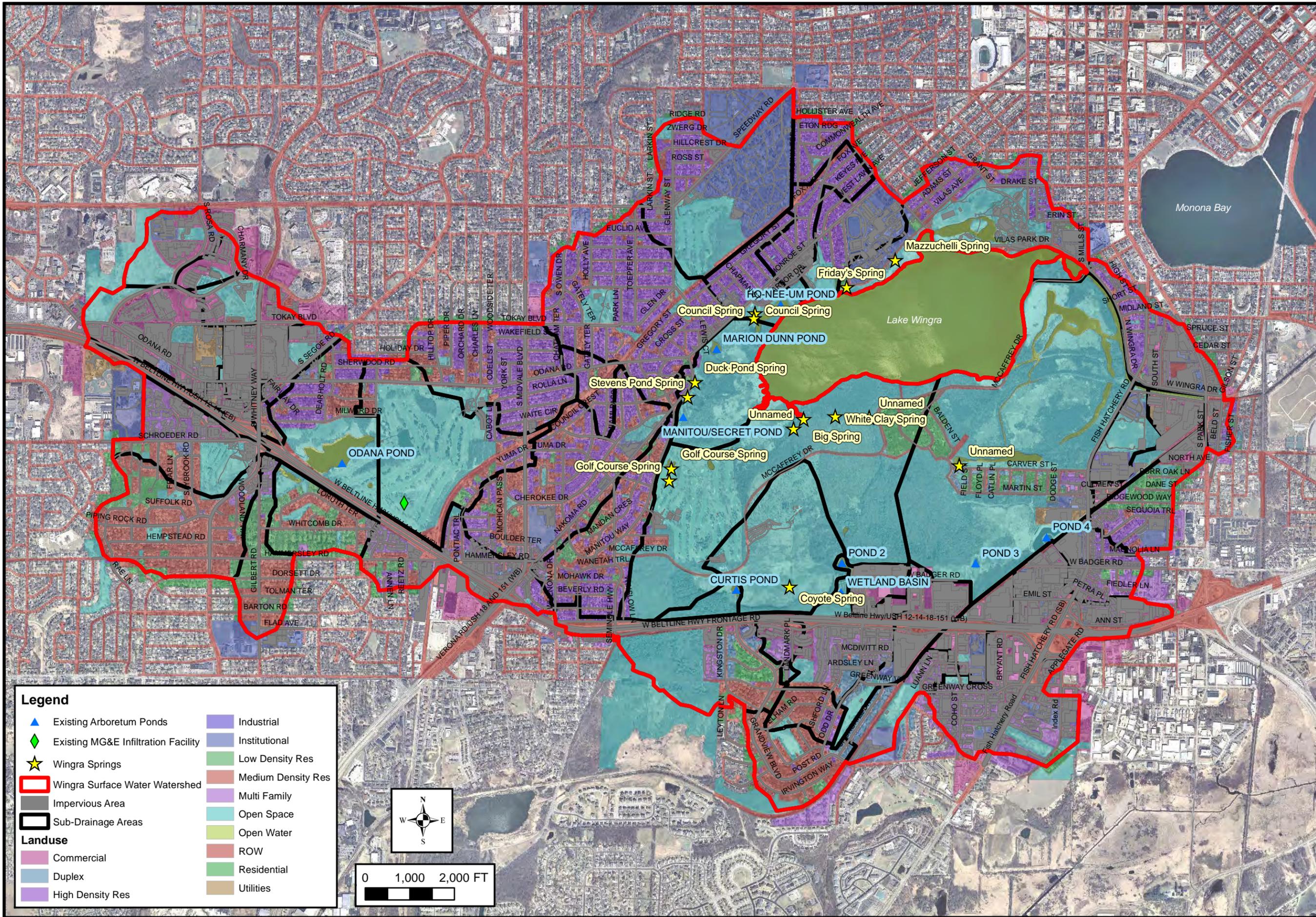
Hydrologic soil groups and soil types (based on the highest percentage of clay, silt, and sand in a particular soil type) in the watershed (directly draining to the lake) are identified in Tables 3.03-1, 3.03-2, and 3.03-3 and illustrated in Figures 3.03-3 and 3.03-4. According to the Dane County, Wisconsin, Soils Survey (published by the United States Department of Agriculture Soil Conservation Service in cooperation with the University of Wisconsin; Wisconsin Geological and Natural History Survey, Soils Department; and Wisconsin Agricultural Experiment Station), local soils are primarily silt loam. These soils are classified by the NRCS as mainly HSG Group B soils. Infiltration rates for the Group B soils range from 0.15 to 0.30 inches per hour.

HSG	Percent of Watershed
A	0.1
A/D	5.6
B	82.8
B/D	9.3
C	1.0
D	1.2
Total	100.0

Table 3.03-1 Hydrologic Soil Groups

Predominant Soil Composition	Percent of Watershed
Silty	85.4
Sandy	8.1
Clayey	5.3
Water	1.2
Total	100.0

Table 3.03-2 Predominant Soil Composition



Legend

Existing Arboretum Ponds	Industrial
Existing MG&E Infiltration Facility	Institutional
Wingra Springs	Low Density Res
Wingra Surface Water Watershed	Medium Density Res
Impervious Area	Multi Family
Sub-Drainage Areas	Open Space
Landuse	Open Water
Commercial	ROW
Duplex	Residential
High Density Res	Utilities

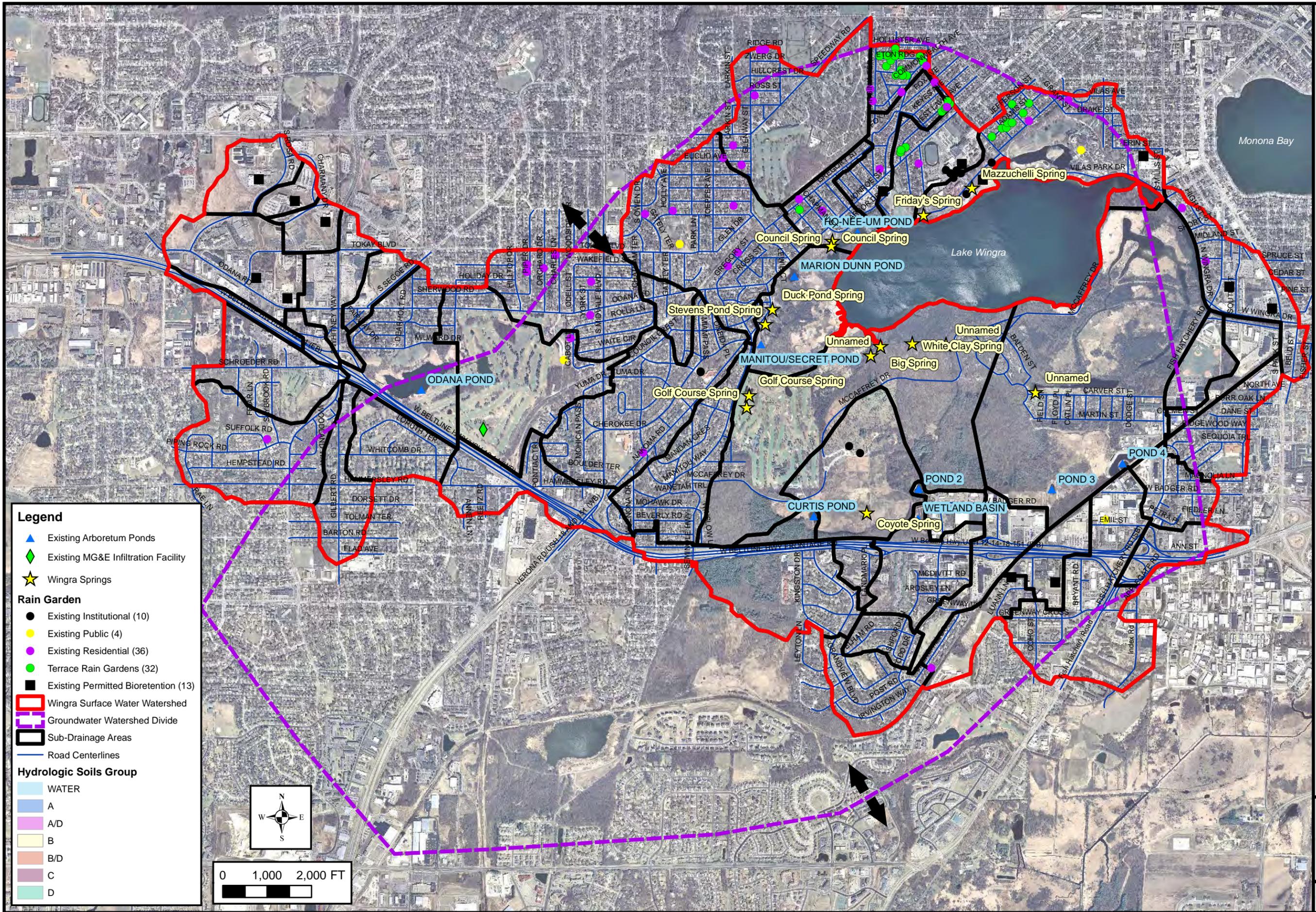
0 1,000 2,000 FT

PERVIOUS/IMPERVIOUS AREA MAP

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 3.03-2
1020.065



Legend

- ▲ Existing Arboretum Ponds
- ◆ Existing MG&E Infiltration Facility
- ★ Wingra Springs

Rain Garden

- Existing Institutional (10)
- Existing Public (4)
- Existing Residential (36)
- Terrace Rain Gardens (32)
- Existing Permitted Bioretention (13)

Wingra Surface Water Watershed (Red outline)

Groundwater Watershed Divide (Purple dashed line)

Sub-Drainage Areas (Black outline)

Road Centerlines (Blue line)

Hydrologic Soils Group

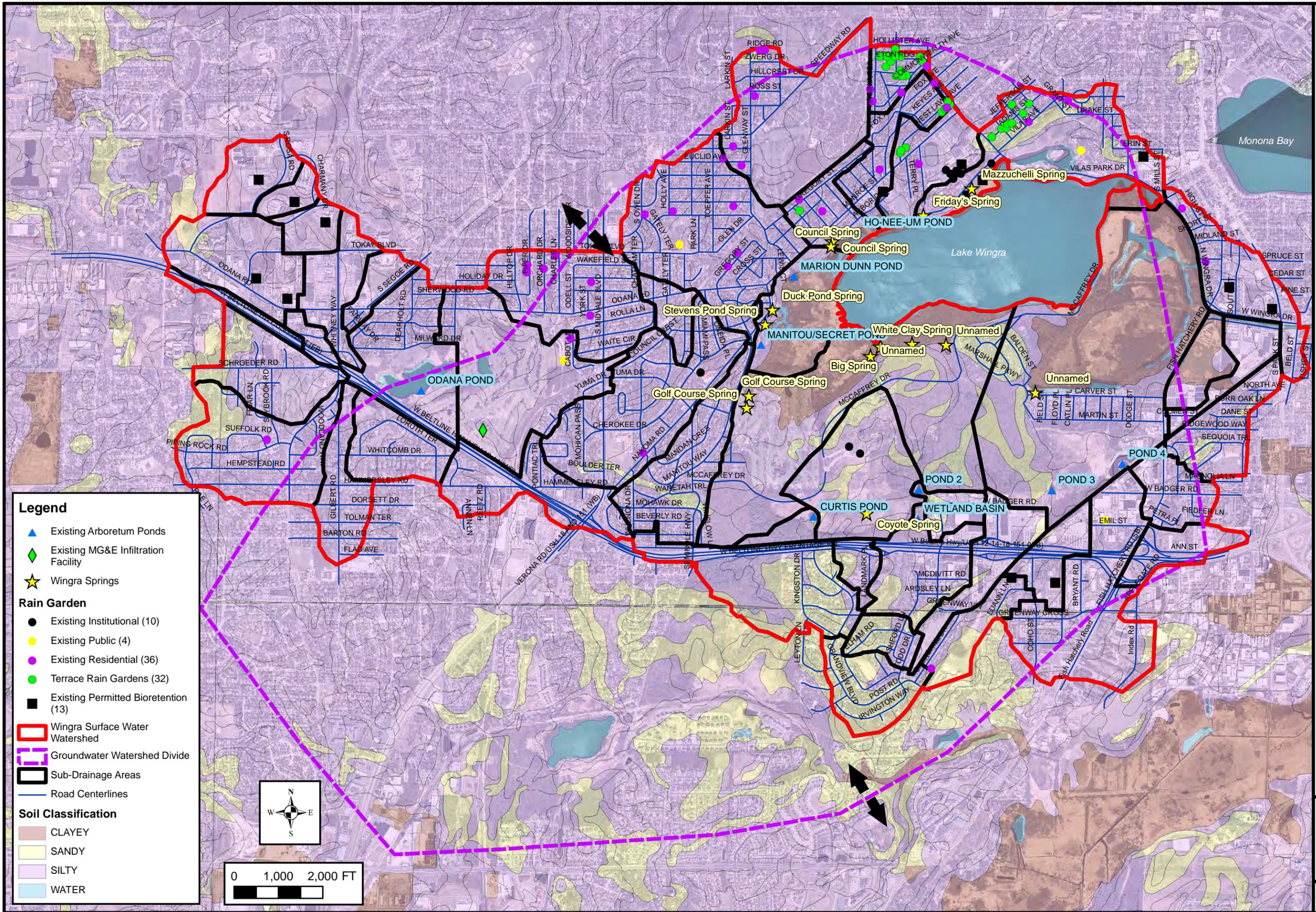
- WATER (Light blue)
- A (Medium blue)
- A/D (Purple)
- B (Yellow)
- B/D (Orange)
- C (Light green)
- D (Dark green)

0 1,000 2,000 FT

LAKE WINGRA WATERSHED SOILS
 HYDROLOGIC SOIL GROUP
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.03-3
1020.065



Legend

- ▲ Existing Arboretum Ponds
- ◆ Existing MG&E Infiltration Facility
- ★ Wingra Springs

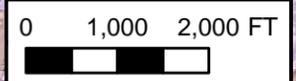
Rain Garden

- Existing Institutional (10)
- Existing Public (4)
- Existing Residential (36)
- Terrace Rain Gardens (32)
- Existing Permitted Bioretention (13)

- ▭ Wingra Surface Water Watershed
- ▭ Groundwater Watershed Divide
- ▭ Sub-Drainage Areas
- ▭ Road Centerlines

Soil Classification

- CLAYEY
- SANDY
- SILTY
- WATER



LAKE WINGRA WATERSHED SOILS
 SOIL CLASSIFICATION

LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.03-4
1020.065

Table 3.03-3 Wingra Watershed (Directly Draining to Lake) Soils

Symbol	Soil	HSG	Percent of Watershed
BbA	Batavia Silt Loam, Gravelly Substratum, 0 to 2 Percent Slopes	B	0.26%
BbB	Batavia Silt Loam, Gravelly Substratum, 2 to 6 Percent Slopes	B	0.45%
BoB	Boyer Sandy Loam, 2 to 6 Percent Slopes	B	0.93%
BoC2	Boyer Sandy Loam, 6 to 12 Percent Slopes, Eroded	B	1.76%
BoD2	Boyer Sandy Loam, 12 to 20 Percent Slopes, Eroded	B	0.15%
DnB	Dodge Silt Loam, 2 to 6 Percent Slopes	B	28.24%
DnC2	Dodge Silt Loam, 6 to 12 Percent Slopes, Eroded	B	3.69%
DsB	Dresden Silt Loam, 2 to 6 Percent Slopes	B	2.30%
GsB	Grays Silt Loam, 2 to 6 Percent Slopes	B	5.08%
GsC2	Grays Silt Loam, 6 to 12 Percent Slopes, Eroded	B	0.43%
Ho	Houghton Muck	A/D	5.32%
KdC2	Kidder Loam, 6 to 12 Percent Slopes, Eroded	B	0.29%
KdD2	Kidder Loam, 12 to 20 Percent Slopes, Eroded	B	1.84%
KeB	Kegonsa Silt Loam, 2 to 6 Percent Slopes	B	1.02%
KrD2	Kidder Soils, 10 to 20 Percent Slopes, Eroded	B	0.28%
Mc	Marshan Silt Loam	B/D	0.03%
MdC2	McHenry Silt Loam, 6 to 12 Percent Slopes, Eroded	B	14.68%
MdD2	McHenry Silt Loam, 12 to 20 Percent Slopes, Eroded	B	0.53%
MhC2	Military Loam, 6 to 12 Percent Slopes, Eroded	B	1.15%
MhD2	Military Loam, 12 to 20 Percent Slopes, Eroded	B	0.66%
Os	Orion Silt Loam, Wet	B/D	0.68%
Pa	Palms Muck	A/D	0.28%
RaA	Radford Silt Loam, 0 To 3 Percent Slopes	B	0.04%
RpE	Rodman Sandy Loam, 12 to 35 Percent Slopes	A	0.02%
SaA	Sable Silty Clay Loam, 0 to 3 Percent Slopes	B/D	3.31%
ScA	St. Charles Silt Loam, 0 to 2 Percent Slopes	B	0.38%
ScB	St. Charles Silt Loam, 2 to 6 Percent Slopes	B	9.11%
ScC2	St. Charles Silt Loam, 6 to 12 Percent Slopes, Eroded	B	3.06%
SfA	Salter Silt Loam, 0 to 2 Percent Slopes	B	0.13%
SfB2	Salter Silt Loam, 2 to 6 Percent Slopes, Eroded	B	0.45%
ShA	Salter Sandy Loam, Wet Variant, 0 to 3 Percent Slopes	C	0.96%
SpC	Spinks And Plainfield Loamy Sands, 6 to 12 Percent Slopes	A	0.05%
TrB	Troxel Silt Loam, 1 to 3 Percent Slopes	B	0.50%
VrB	Virgil Silt Loam, 1 to 4 Percent Slopes	B	1.70%
VwA	Virgil Silt Loam, Gravelly Substratum, 0 to 3 Percent Slopes	B	3.82%
W	Water Greater Than 40 Acres	D	1.15%
Wa	Wacousta Silty Clay Loam	B/D	5.27%
		Total	100%

¹HSG = Hydrologic soils group

D. Infiltration Rate Analysis

According to preliminary results of the Dane County Regional Groundwater Model presented by Mike Parsen of WGNHS on June 28, 2013, the calibrated recharge rate for lands within the Wingra Watershed based on soil-water balance modeling is generally in the range of 6.1 to 8 inches per year as shown in Figure 3.03-5. This means that of the average annual 34.2 inches of rainfall, approximately 6.1 inches to 8 inches per year would infiltrate into the ground from pervious areas and contribute to groundwater flows. (i.e., 6.1 inches/year = 0.00069 in/hr) However, this infiltration performance is different from the estimated infiltration rate of soils. The estimated infiltration rate for soils in the watershed (directly draining to lake) is included in Tables 3.03-4, 3.03-5, and 3.03-6 and Figures 3.03-6, 3.03-7, and 3.03-8. Table 3.03-4 is based on designated WDNR Infiltration Rates for various soil types. Tables 3.03-5 and 3.03-6 are based on saturated hydraulic conductivity rates published by NRCS for different soils types at the ground surface and at a 3-foot depth, respectively. For purposes of infiltration modeling for this plan, proposed infiltration BMPs are analyzed using a range of infiltration rates (0.3, 0.5, and 1.0 in/hr) to provide a range of possible performance since site-specific data was not available.

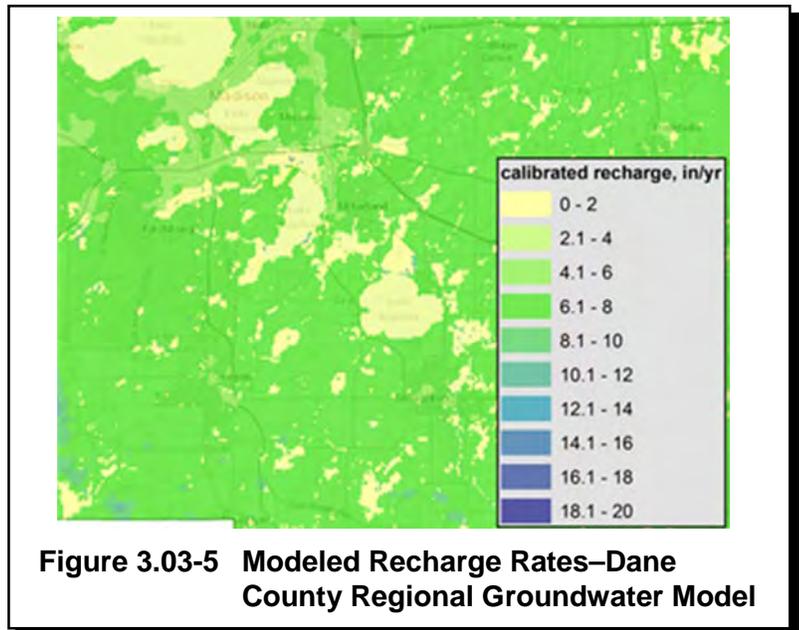


Figure 3.03-5 Modeled Recharge Rates–Dane County Regional Groundwater Model

WDNR Infiltration Rate (in/hr)	Total Acres	Percent
0.00	41	1%
0.04	306	8%
0.07	190	5%
0.13	2,802	77%
0.24	153	4%
0.50	136	4%
1.63	5	0%
Total	3,634	100%

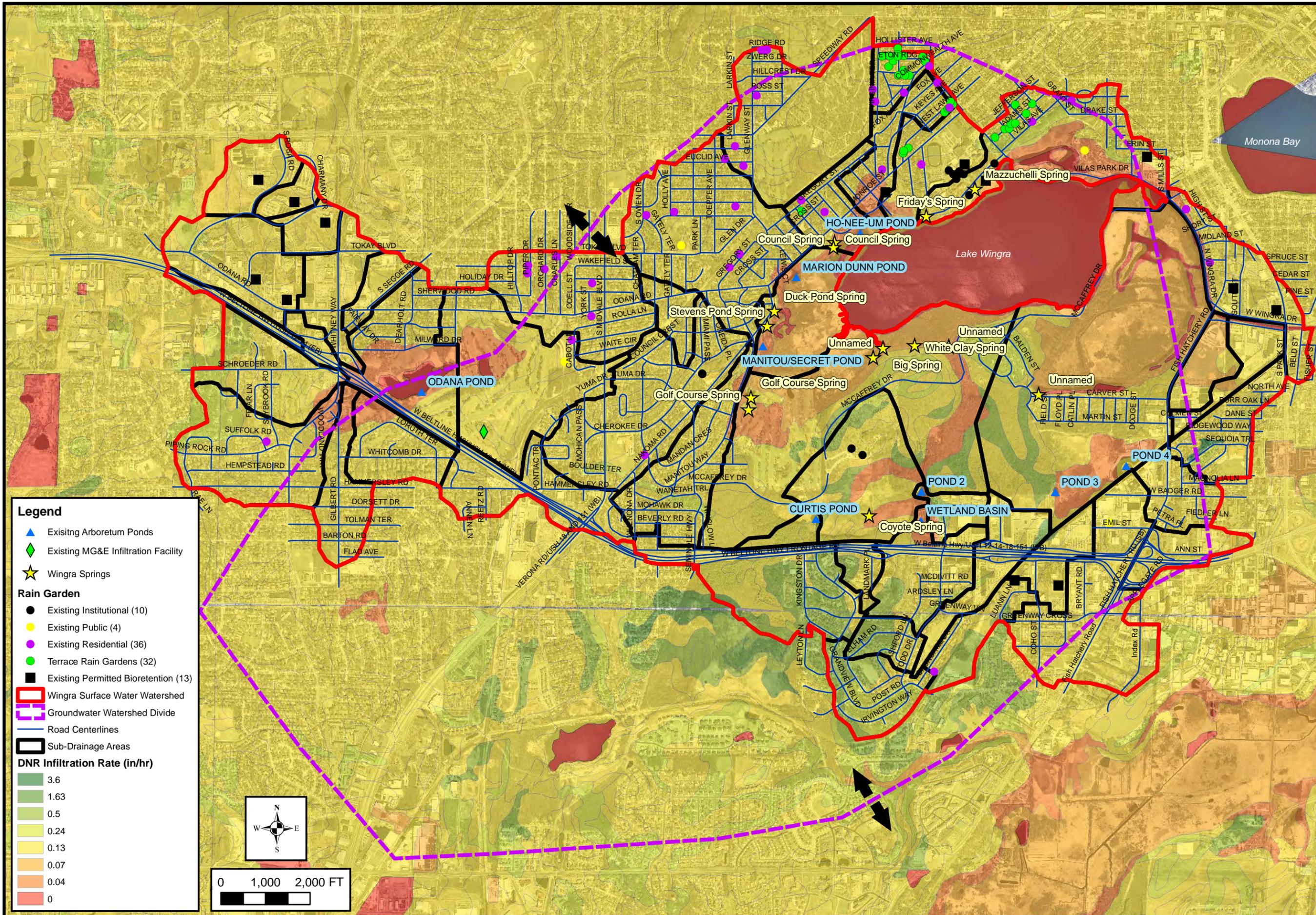
Table 3.03-4 Lake Wingra Watershed WDNR Infiltration Rate

Infiltration Rate (in/hr)	Total Acres	Percent
0.00	41	1%
1.28	3,251	89%
3.12	200	5%
3.97	136	4%
13.04	5	0%
Total	3,634	100%

Table 3.03-5 Lake Wingra Watershed Surface Ksat Rate

Infiltration Rate (in/hr)	Total Acres	Percent
0.00	41	1%
1.28	2,444	67%
1.34	34	1%
1.91	16	0%
1.92	9	0%
3.12	223	6%
3.97	740	20%
13.04	89	2%
19.98	37	1%
Total	3,634	100%

Table 3.03-6 Lake Wingra Watershed 3-Foot Depth Ksat Rate



Legend

- ▲ Existing Arboretum Ponds
- ◆ Existing MG&E Infiltration Facility
- ★ Wingra Springs

Rain Garden

- Existing Institutional (10)
- Existing Public (4)
- Existing Residential (36)
- Terrace Rain Gardens (32)
- Existing Permitted Bioretention (13)

- ▭ Wingra Surface Water Watershed
- ▭ Groundwater Watershed Divide
- ▭ Road Centerlines
- ▭ Sub-Drainage Areas

DNR Infiltration Rate (in/hr)

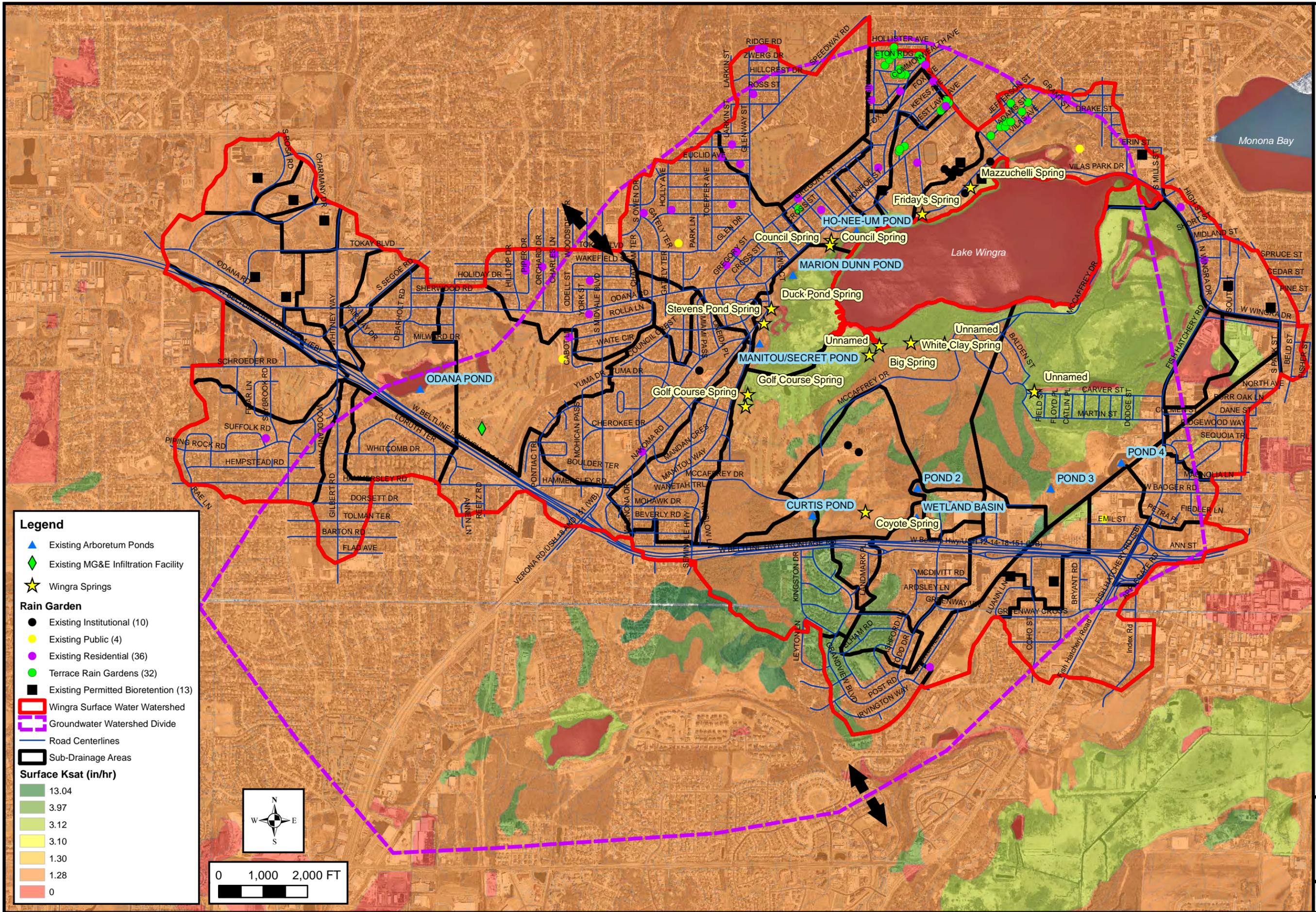
- 3.6
- 1.63
- 0.5
- 0.24
- 0.13
- 0.07
- 0.04
- 0

0 1,000 2,000 FT

LAKE WINGRA WATERSHED SOILS
 WDNR INFILTRATION RATE
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



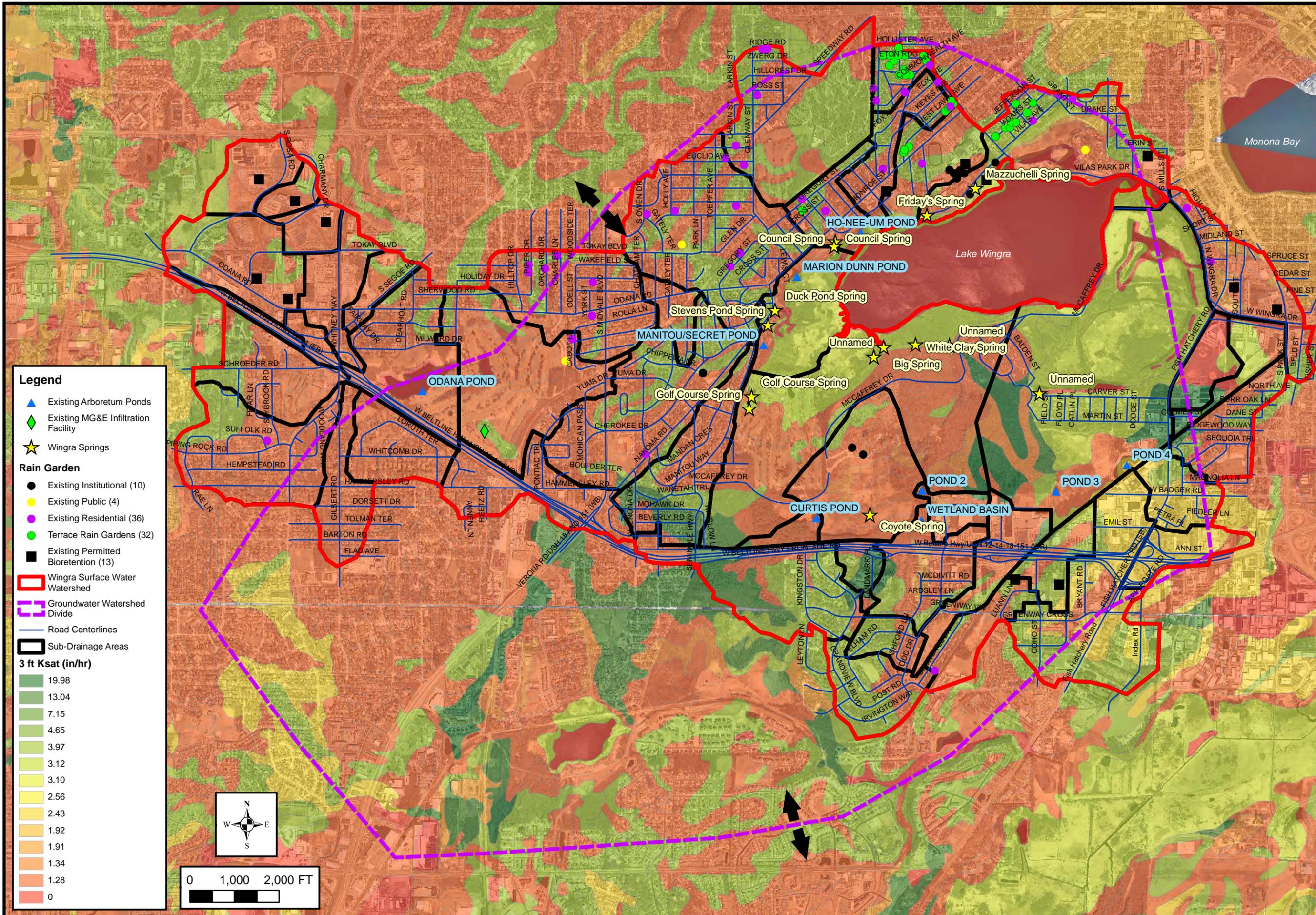
FIGURE 3.03-6
1020.065



LAKE WINGRA WATERSHED SOILS
 SURFICIAL SATURATED HYDRAULIC CONDUCTIVITY
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.03-7
 1020.065



LAKE WINGRA WATERSHED SOILS
 3-FOOT DEPTH SATURATED HYDRAULIC CONDUCTIVITY
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.03-8
 1020.065

E. Surface Runoff Amount

The City provided Strand a Program for Predicting Polluting Particle Passage Thru Pits, Puddles, and Ponds (P8) model that was used to estimate the average annual runoff from the watershed. Utilizing the Mdsn6095.pcp and Mdsn6095.tmp precipitation and temperature files, respectively, the P8 models were run from October 1, 1980, to September 30, 1981, to simulate the average annual runoff from the watershed. The P8 model predicts that the average annual runoff is 82,842,408 ft³. For purposes of comparison, the USGS/WDNR WinSLAMM model was obtained that indicates the average annual runoff is approximately 84,501,324 ft³ (after adjusting to match the watershed areas between the two models), which compares well with the P8 results.

F. Groundwater Flow to Lake Wingra

Based on groundwater modeling completed by the WGNHS and documented in an August 30, 2013, letter from WGNHS to Strand, the estimate of annual average groundwater flow to Lake Wingra is 31,636,725 ft³ as shown in Table 3.03-7. This estimate does not include the infiltration from the MG&E Infiltration Facility at the Odana Hills Golf Course. Previously, a rate of 37,892,637 ft³ was used as published in Table 1 of the article *Responses to Urbanization: Groundwater, Stream Flow, and Lake Level Responses to Urbanization in the Yahara Lakes Basin* published in the Winter 2005 Lakeline Magazine by Ken Bradury et. al. It was confirmed with Mike Parsen of the WGNHS that this estimate also does not include the infiltration from the MG&E Infiltration Facility at the Odana Hills Golf Course. This article indicates that current groundwater flow to the lake represents a 64 percent reduction from historic flow rates.

Item	Volume (cubic feet)
Groundwater Flow to Lake (Springs)	22,674,530
Groundwater Flow to Lake (Seepage)	16,335,575
Total	39,010,105
Groundwater Outflow From Lake (Seepage)	7,373,380
Net Groundwater Inflow to Lake	31,636,725

Table 3.03.7 WGNHS Groundwater Estimates

G. Infiltration Goal

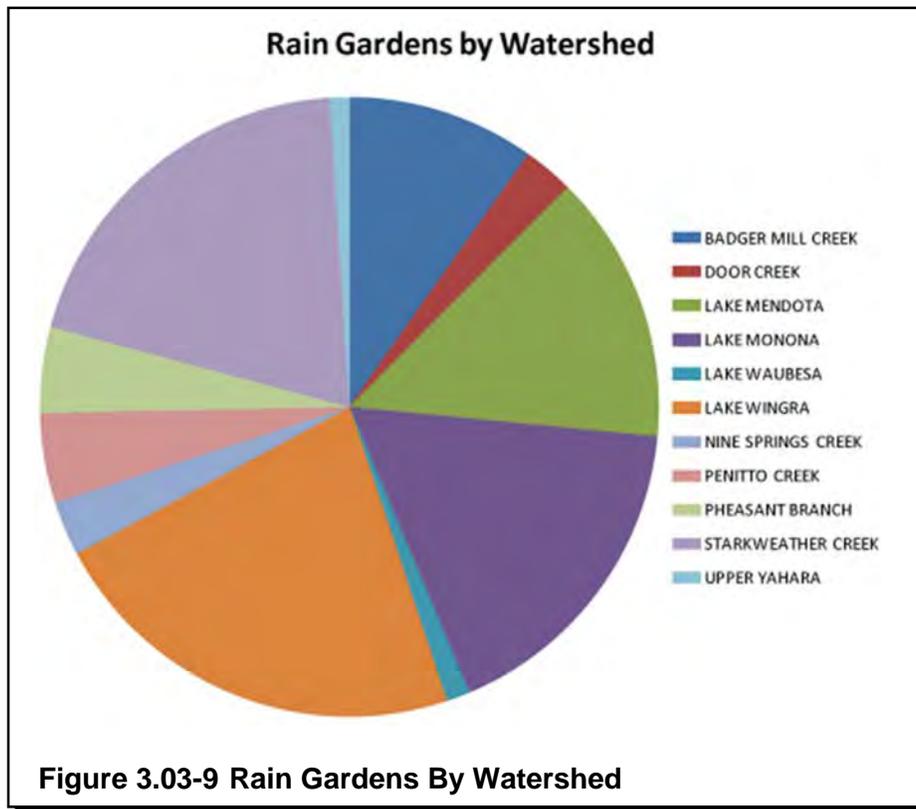
As shown in Table 3.03-8, the City’s P8 model estimates annual percolation/infiltration volume under existing and predevelopment conditions. This analysis shows that approximately 26 percent of the predevelopment infiltration volume has been lost resulting from development in the watershed. A realistic short-term goal is shown in Table 3.03-8 as well as a long-term goal to serve as a vision for further improvement.

Condition	Volume (cubic feet)
Predevelopment Conditions	377,634,700
Existing Conditions	<u>278,400,672</u>
Reduction (Lost Infiltration)	99,234,028
Percent Reduction	26.3%
Short-Term Goal: 10 Percent of Lost Infiltration	9,923,403
Long-Term Goal: 25 Percent of Lost Infiltration	24,808,507

Table 3.03-8 Watershed Percolation/Infiltration Rate

H. Existing Infiltration Facilities In Watershed

The Wingra Watershed is currently home to one of the highest densities of infiltration facilities in the City (see Figure 3.03-9). These facilities include private rain gardens, street terrace rain gardens, permitted private bioretention basins, and the MG&E Infiltration Facility at the Odana Hills Golf Course and a public infiltration facility. A description of each follows. The total estimated existing annual average infiltration volume resulting from these facilities is in the range of 3.75 million ft³ as shown in Table 3.03-9. This leaves an infiltration gap in the range of 6.17 million ft³ that needs to be made up by proposed additional infiltration facilities to meet the short-term goal.



Facility	Infiltration Performance (ft ³) at Varying Infiltration Rates		
	0.3 in/hr	0.5 in/hr	1.0 in/hr
Structural Improvements			
36 Existing Residential Rain Gardens	37,636	39,204	40,772
4 Existing Public Rain Gardens (City of Madison)	14,462	15,682	16,901
10 Existing Institutional Rain Gardens (Arboretum, Edgewood College, Henry David Thoreau School)	36,155	39,204	42,253
32 Existing Terrace Rain Gardens	9,757	9,757	11,151
13 Existing Permitted Bioretention Basins	47,001	50,965	54,929
Odana Hills Golf Course: MG&E Infiltration Facility	3,600,000	3,600,000	3,600,000
Total	3,745,011	3,754,812	3,766,007
<i>Short-Term Goal: 10 Percent of Lost Infiltration</i>	9,923,403	9,923,403	9,923,403
Infiltration Gap	6,178,392	6,168,591	6,157,396

Table 3.03-9 Infiltration Performance of Existing Infiltration Facilities in Watershed

1. Rain Gardens–The City administers the 1,000 Rain Gardens project that encourages and tracks rain gardens in the City. To date, the City has registered 523 rain gardens, of which 36 are in the Lake Wingra Watershed as shown on each of the figures in this section. Figure 3.03-10 shows an example of a rain garden serving a residential roof area.



Source: Roger Bannerman

Figure 3.03-10 Wingra Watershed Rain Garden Example



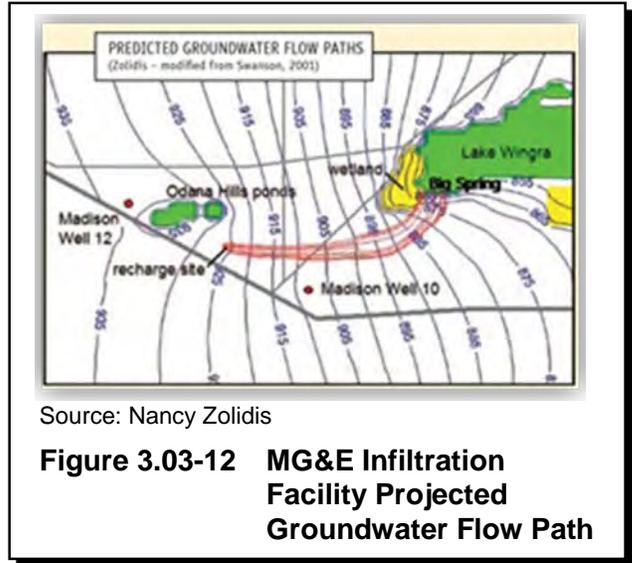
Figure 3.03-11 Adams Street Terrace Rain Garden Project

2. Terrace Rain Gardens–Originally initiated as the Adams Street Terrace Rain Garden (see Figure 3.03-11) project in 2005, the City’s program has been formalized as the Terrace Rain Garden Program. The City offers cost-sharing to homeowners who are interested in participating in this volunteer program along City street terraces. It is

our understanding the City has installed 32 terrace rain gardens (according to City GIS identified as Public) in the Lake Wingra Watershed.

- 3. Permitted Private Bioretention Basins–To date, the City has a record of thirteen bioretention facilities in the watershed at locations shown on each of the GIS figures in this section.

- 4. MG&E Infiltration Facility at Odana Hills Golf Course–The MG&E Infiltration Facility is located in the Odana Hills Golf Course. This facility is predicted to increase flows to Big Spring as shown in Figure 3.03-12. This facility performed at the levels shown in Table 3.03-10 between 2005 and 2012. While the average annual infiltration volume from 2006 to 2012 is 5,862,867 cubic feet per year (ft³/year), concerns with chloride contamination surfaced in 2011. This concern prompted a seasonal modified operation of the facility that calls for a reduced volume of infiltration moving forward.



Source: Nancy Zolidis

Figure 3.03-12 MG&E Infiltration Facility Projected Groundwater Flow Path

According to conversations with David Benforado of MG&E on July 25, 2013, MG&E is comfortable using the 2011 performance of approximately 3.6 million ft³ as the annual average surface water infiltration per year. For purposes of the Wingra Watershed Plan, the 3.6 million ft³ of annual average surface water infiltration is used. It should be noted that MG&E, as part of their cogeneration permit, was supposed to infiltrate 80,000,000 gallons (10.7 million ft³) per year. It appears that MG&E is obligated to meeting that permit requirement, perhaps through contribution towards another facility in the Wingra watershed.

Year	Infiltration (million gallons)	Infiltration (ft ³)	Rainfall (inches)		Well (million gallons)	Well (ft ³)
2005	0	0	24.7		14	1,871,534
2006	18	2,406,258	36.6		7	935,767
2007	55	7,352,455	44.3		30	4,010,430
2008	71	9,491,351	44.0		0	0
2009	60	8,020,860	38.2		0	0
2010	58	7,753,498	37.9		0	0
2011	27	3,609,387	30.3		16	2,138,896
<u>2012</u>	<u>18</u>	<u>2,406,258</u>	<u>26.2</u>		<u>154</u>	<u>20,586,874</u>
Total	307	41,040,067			221	29,543,501
Average	43.86	5,862,867	35.3	Average	29.57	3,953,138

Table 3.03-10 WWCF Water Mitigation

5. Westmorland Park Infiltration Facility–The City constructed a bioretention basin in Westmorland Park. This basin is modeled as a pond in the City’s P8 model, and therefore, no infiltration performance is listed. This facility is proposed to be expanded as one of the alternative components and will be modeled for infiltration performance.

I. Proposed Infiltration Facilities In Watershed

The following is a listing of additional infiltration facilities that have the potential to incrementally increase infiltration in the watershed. All facilities will also provide a certain level of phosphorus reduction. Table 3.03-11 lists twelve potential infiltration facilities and their corresponding infiltration performance as modeled in P8. As can be seen, all facilities would need to be constructed in order to generally meet the short-term infiltration goal. As shown on Figure 3.02-4, the Lake Wingra groundwater watershed extends only approximately two-thirds of the way to the western boundary of the surface water watershed. For this reason, additional source-area-type BMPs (downspout disconnection program, rain barrel program, private residential rain gardens, commercial rain gardens, porous pavement, and terrace rain gardens) should be targeted for the eastern two-thirds of the surface water watershed and within the Lake Wingra groundwater watershed.

At the public meeting for this project, it was suggested that interpretive signage be included on all structural practices to engage the public.

Facility	Infiltration Performance (ft3) at Varying Infiltration Rates				% of Total	OPCC	Total 20-Year Present Worth	20-Year NPW Cost/cf
	0.3 in/hr	0.5 in/hr	1.0 in/hr					
Structural Improvements								
Westmorland Park Bioretention Basin	374,616	431,244	557,568	6.9%	\$ 249,300	\$ 367,640	\$ 0.04	
Downspout Disconnection Program (35% Watershed Participation)	950,893	950,893	950,893	15.2%	\$ 466,900	\$ 877,124	\$ 0.05	
Rain Barrel Program (25% Watershed Participation)	339,605	339,605	339,605	5.4%	\$ 151,600	\$ 377,697	\$ 0.06	
1,000 Private Residential Rain Gardens (Serving Roofs Only)	1,045,440	1,089,000	1,132,560	17.4%	\$ 1,047,600	\$ 1,654,205	\$ 0.08	
Devolis Park (Axel Avenue) Bioretention	239,580	248,292	261,360	4.0%	\$ 331,200	\$ 479,671	\$ 0.10	
Arbor Hills Greenway Infiltration (@1.63 in/hr)	535,788	535,788	535,788	8.6%	\$ 883,500	\$ 1,279,398	\$ 0.12	
Glenway Wet Pond & Infiltration	779,724	779,724	779,724	12.5%	\$ 1,819,400	\$ 1,952,764	\$ 0.13	
Grandview Boulevard Bioswale	326,700	335,412	344,124	5.4%	\$ 612,100	\$ 893,405	\$ 0.13	
60 Private Commercial Rain Gardens (Serving Roofs Only)	128,066	130,680	135,907	2.1%	\$ 290,200	\$ 417,396	\$ 0.16	
4 Acres Porous Pavement (Serving 12 acres)	888,624	888,624	888,624	14.2%	\$ 2,471,413	\$ 3,143,409	\$ 0.16	
Monroe Street Green Street	196,020	226,512	291,852	3.6%	\$ 532,100	\$ 835,587	\$ 0.18	
1,000 Terrace Rain Gardens	304,920	304,920	457,380	4.9%	\$ 1,370,500	\$ 2,184,378	\$ 0.36	
TOTAL	6,109,976	6,260,694	6,675,385	100%	\$ 10,225,813	\$ 14,462,675	\$0.11 (avg)	
Infiltration Gap to Meet Short-Term Goal	6,178,392	6,168,591	6,157,396					
Difference	-68,416	92,103	517,989					

Notes: OPCC = Planning level opinion of probable construction cost.
NPW=Net present worth
All costs are 1st Quarter 2014 dollars.

Table 3.03-11 Infiltration Performance and Cost-Effectiveness of Proposed Infiltration Facilities

1. City of Madison 1,000 Rain Garden Program—Continuation of this program will be instrumental in providing source area infiltration BMPs in the watershed for single-family residential and duplex land uses. This program could be expanded to the non-single-family residential and duplex sector (e.g., commercial, business, institutional, and multifamily residential). These programs are expected to serve mainly rooftops. Table 3.03-12 provides information on the opportunities for expansion of this program.

Land Use	Parcels in the Watershed	Rooftop Area (acres)
Residential (Single-Family and Duplex)	4,620	183
Nonresidential (Commercial, Business, Institutional, Multifamily Residential, and Institutional)	460	178

Table 3.03-12 Rain Garden Opportunities

For purposes of this plan, performance of residential and commercial rain gardens was evaluated with the assumptions shown in Table 3.03-13.

Measure	Assumptions
Private residential rain garden	<ul style="list-style-type: none"> ▪ 6:1 watershed to rain garden area ratio ▪ Avg. residential roof area = 2,800 SF ▪ 1/4 of roof drains to rain garden ▪ 0.6 lbs of TP per acre of roof ▪ 0.5 in/hr infiltration rate ▪ Infiltration: 93% of annual runoff infiltrated ▪ Phosphorus: 93% reduction ▪ Participation: 22% (1,000) of residential parcels in watershed (4,620)
Commercial rain garden	<ul style="list-style-type: none"> ▪ 6:1 watershed to rain garden area ratio ▪ Avg. commercial roof area = 5,600 SFf ▪ 1/4 of roof drains to rain garden ▪ 0.6 lbs of TP per acre of roof ▪ 0.5 in/hr infiltration rate ▪ Infiltration: 93% of annual runoff infiltrated ▪ Phosphorus: 93% reduction ▪ Participation: 13% (60) of non-residential parcels in watershed (460) ▪ Cost: Constructed as a bioretention basin with engineered soil and underdrain

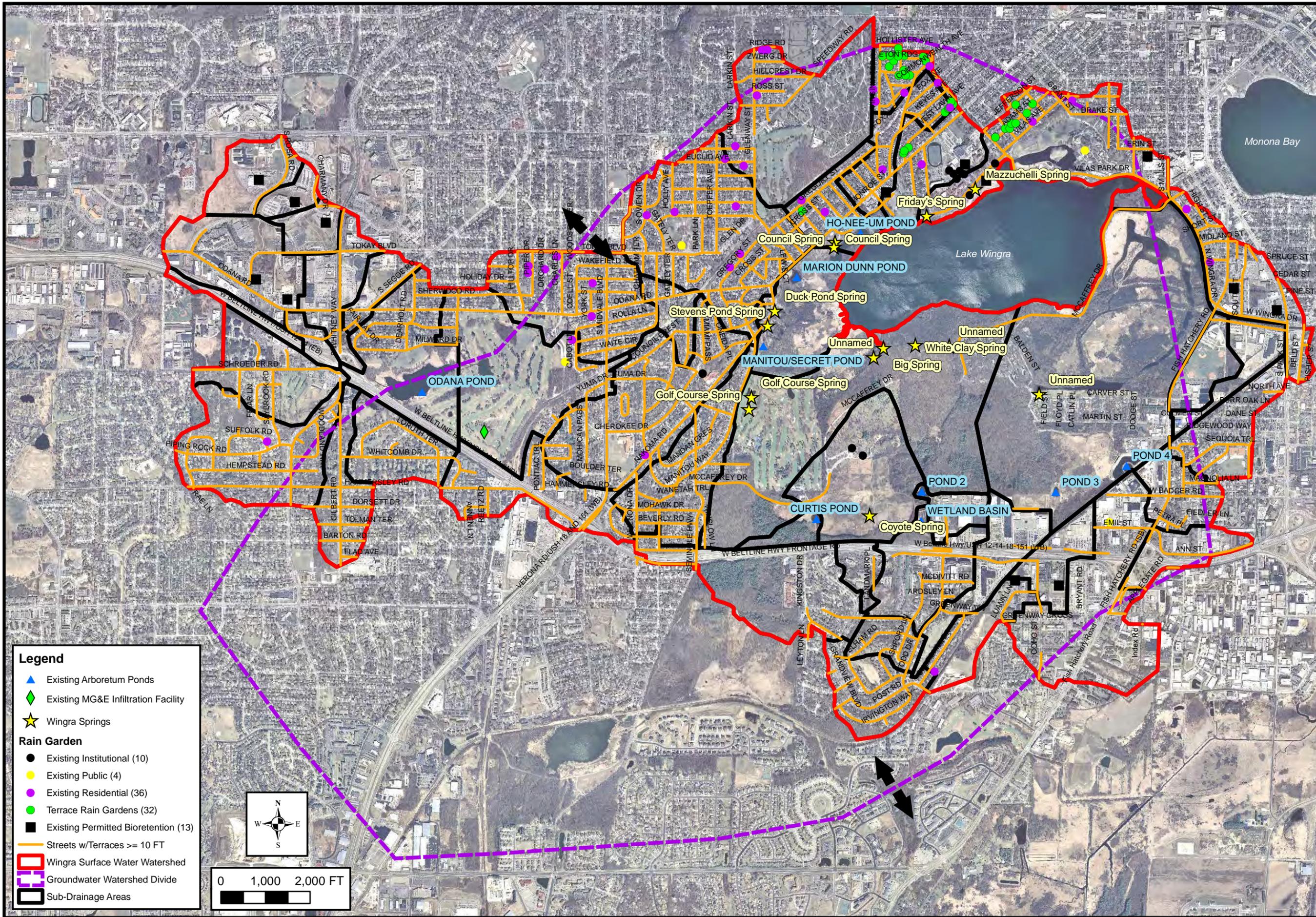
Table 3.03-13 Rain Garden Assumptions

It is recommended that the Infiltration and Phosphorus Catalyst Teams further investigate the assumptions used for the analysis shown in Table 3.03-13 and adjust the relative contribution of these measures toward meeting the short-term infiltration and phosphorus goals.

2. City of Madison Terrace Rain Garden Program—Continuation of this program will be instrumental in providing source area infiltration BMPs in the watershed that serve single-family residential and duplex land uses and portions of their associated public right-of-way. Figure 3.03-13 shows the location of streets in the watershed with terraces greater than or equal to 10 feet generally considered a minimum for implementation of terrace rain gardens. Figure 3.03-14 shows the location of streets in the watershed with terraces greater than or equal to 10 feet and a pavement rating less than 7, which allows for targeting implementation of terrace rain gardens because a rating less than 7 means the pavement is in a state of decline such that the road will likely be reconstructed or resurfaced sooner than higher rated streets.

This program is incentivized by the City as the City pays for 75 percent of the construction cost (minus the cost of plants) and the homeowner pays for 25 percent of the construction cost (plus the cost of the plants). Costs are assessed to homeowners on their property tax bill.

At the public information meetings, there was significant discussion regarding improvements to the City’s existing program including enhancements of the City’s promotion of terrace rain gardens to residents and additional opportunities because of terrace ash tree removals (potentially more opportunities for full terrace rain garden or more simply for depression of the terrace alongside tree removal). Additional discussion is included in Appendix F.

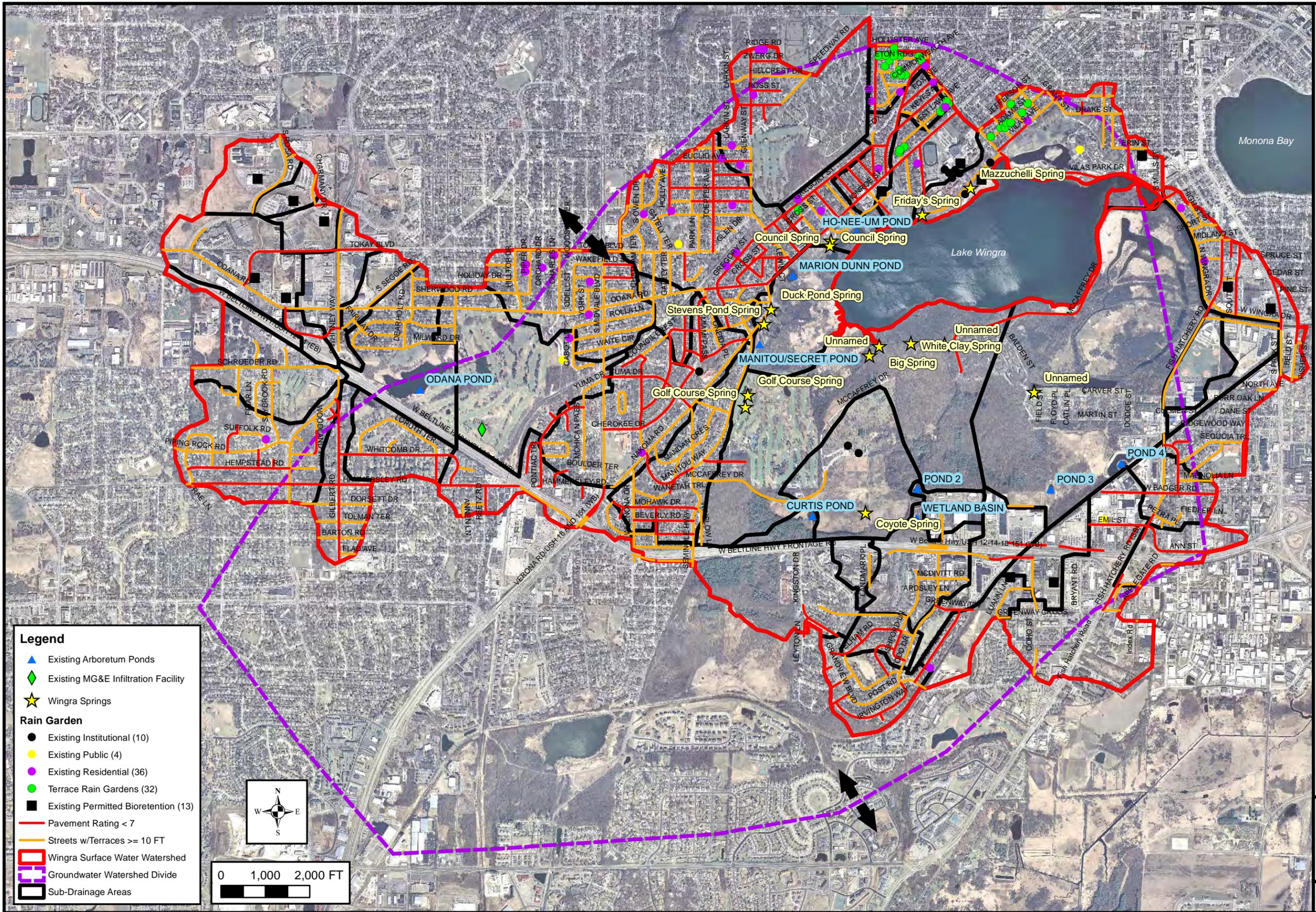


LAKE WINGRA WATERSHED
STREETS WITH TERRACES GREATER THAN OR EQUAL TO 10 FEET WIDE

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 3.03-13
1020.065



STREETS WITH TERRACES GREATER THAN OR EQUAL TO 10 FEET AND PAVEMENT RATING LESS THAN 7

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 3.03-14
1020.065

For purposes of this plan, performance of terrace rain gardens was evaluated with the assumptions shown in Table 3.03-14.

Measure	Assumptions
Terrace rain garden	<ul style="list-style-type: none"> ▪ 12:1 watershed to terrace rain garden bottom area ratio ▪ Rain garden top footprint = 10 feet x 15 feet ▪ Rain garden bottom footprint = 2 feet x 10 feet ▪ 0.5 in/hr infiltration rate ▪ Infiltration: 78% of annual runoff infiltrated ▪ Phosphorus: 100% reduction ▪ Participation: 1,000 terrace rain gardens (4,620 residential parcels in watershed) ▪ Cost: Designed and constructed as part of City street reconstruction projects

Table 3.03-14 Terrace Rain Garden Assumptions

3. Porous Pavement—As redevelopment occurs, use of porous pavement (see Figure 3.03-15) in nonresidential land uses is effective in converting impervious surfaces to pervious surfaces. Whether using porous concrete, porous asphalt, or porous pavers, each technique requires a storage layer beneath the pavement and an underdrain pipe in addition to the surficial porous pavement. The WDNR has developed a Permeable Pavement Conservation Practice Standard 1008 that provides a guide for planning and design of these facilities. There appear to be opportunities for porous pavement installation at the southern end of the Odana Hills Golf Course Parking lot (approximately one-half acre) as well as generally at parks and locations of overflow parking. The City should consider a porous pavement program/strategy that incentivizes incorporation of porous pavement in redevelopment projects.



For purposes of this plan, performance of porous pavement was evaluated with the assumptions shown in Table 3.03-15.

Measure	Assumptions
Porous pavement	<ul style="list-style-type: none"> ▪ 3:1 watershed to porous pavement ratio (e.g., runoff) ▪ 4 acres of porous pavement serving 12-acre watershed ▪ 0.5 in/hr infiltration rate ▪ Constructed in eight 0.5-acre porous pavement projects ▪ Infiltration: 100% of annual runoff infiltrated ▪ Phosphorus: 100% reduction ▪ Cost: Incremental cost to install porous concrete pavement rather than traditional asphalt

Table 3.03-15 Porous Pavement Assumptions

4. Westmorland Park Bioretention–The existing depressional area where this existing facility is located presents an opportunity to expand the facility. Because of the large upstream watershed (86 acres), a diversion of flows from larger storm events around the basin may be advisable. Figure 3.03-16 shows a picture of the proposed bioretention area and Figure 3.03-17 shows the watershed draining to this area.



Figure 3.03-16 Proposed Westmorland Park Bioretention Area

5. Arbor Hills Greenway Infiltration Facility–The City has planned for the construction of an infiltration facility in the Arbor Hills Greenway as shown in Figure 3.03-18. This project was originally analyzed in 2008 as a student report titled *Arbor Hills Greenway Stormwater Infiltration Design*.
6. Devolis Park (Axel Avenue) Bioretention Facility–This proposed project is within the Lake Wingra groundwater watershed but not in the surface water watershed. Therefore, the increased infiltration will affect Lake Wingra and the improved surface water quality will affect Wingra Creek downstream of the lake. Figure 3.03-19 shows a picture of the proposed bioretention area and Figure 3.03-20 shows the watershed draining to this area.



Figure 3.03-19 Proposed Devolis Park Bioretention Area

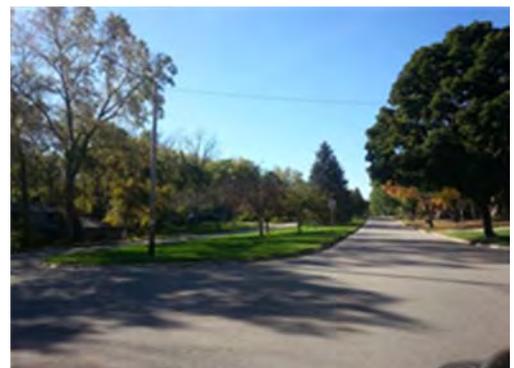


Figure 3.03-21 Proposed Grandview Boulevard Bioswale Area

7. Grandview Boulevard Bioswales–A unique opportunity presents itself along Grandview Boulevard where a boulevard approaching 40 feet in width could be depressed to create a series of bioretention swales. Figure 3.03-21 shows a picture of the proposed bioswale area, and Figure 3.03-22 shows the watershed draining to this area. *This project is located in the Town of Madison.*



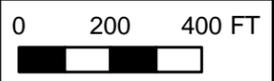
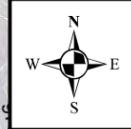
3 Infiltration Basins Serving
145-Acre Watershed

INF. BASIN 3
INF. BASIN 2
INF. BASIN 1

33 acres

73 acres

53 acres



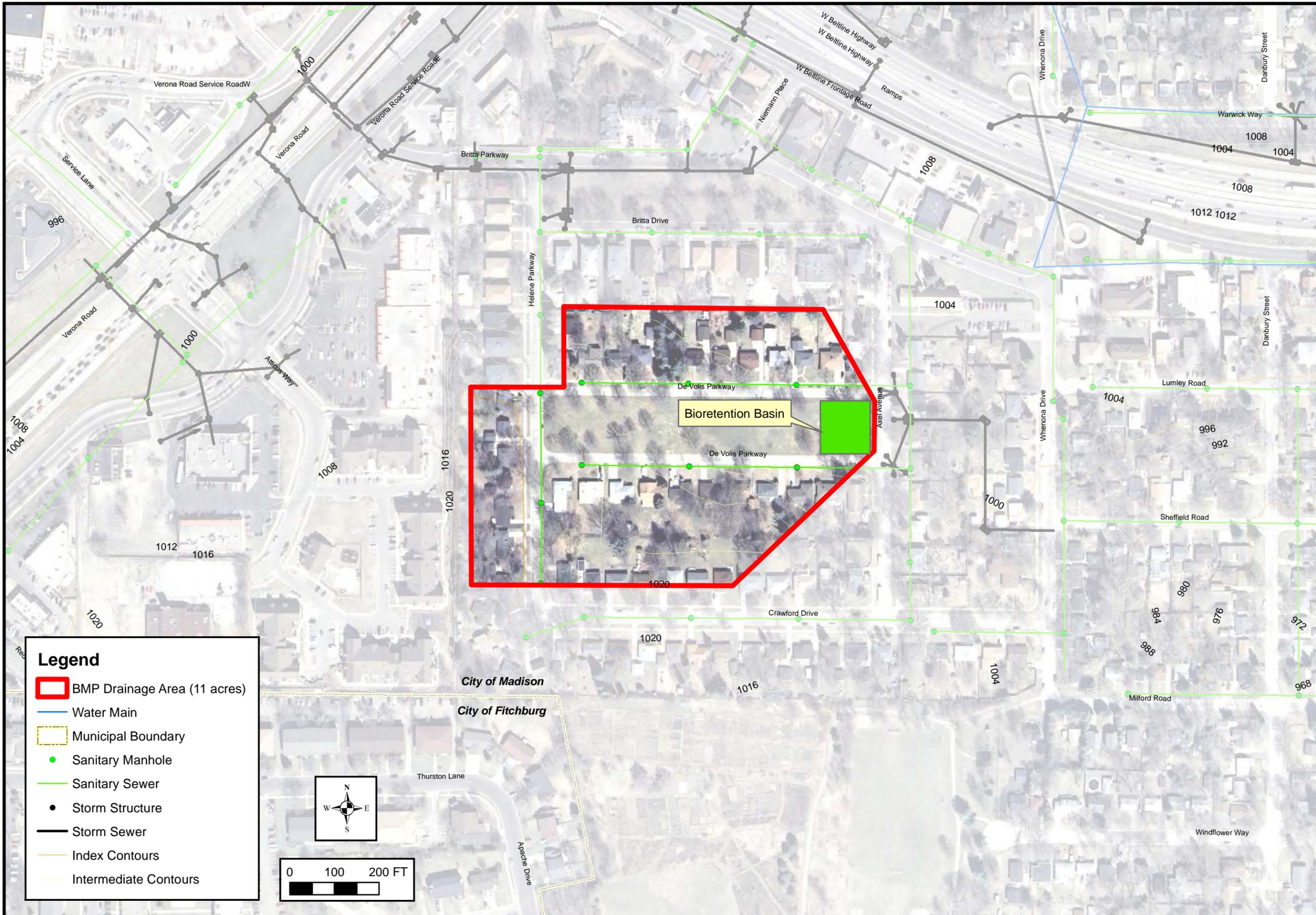
Legend

- BMP Drainage Areas
- Sanitary Manhole
- Water Main
- Sanitary Sewer
- Municipal Boundary
- Storm Structure
- Storm Sewer
- Index Contours
- Intermediate Contours

ARBOR HILLS
INFILTRATION BASIN
LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



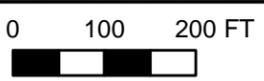
FIGURE 3.03-18
1020.065



Legend

- BMP Drainage Area (11 acres)
- Water Main
- Municipal Boundary
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Index Contours
- Intermediate Contours





DEVOLIS PARK
 BIORETENTION BASIN
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN

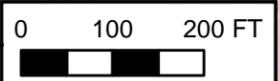


FIGURE 3.03-20
1020.065



Legend

- BMP Drainage Area (19 acres)
- Water Main
- Municipal Boundary
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Index Contours
- Intermediate Contours

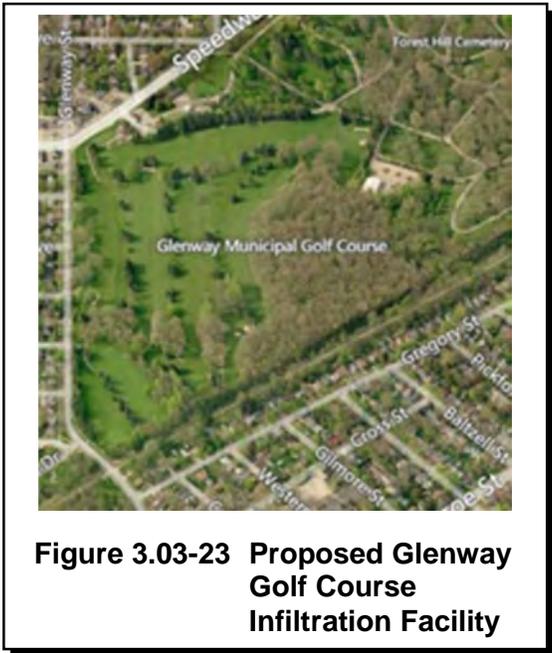


**GRANDVIEW BOULEVARD
 BIORETENTION SWALES**
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



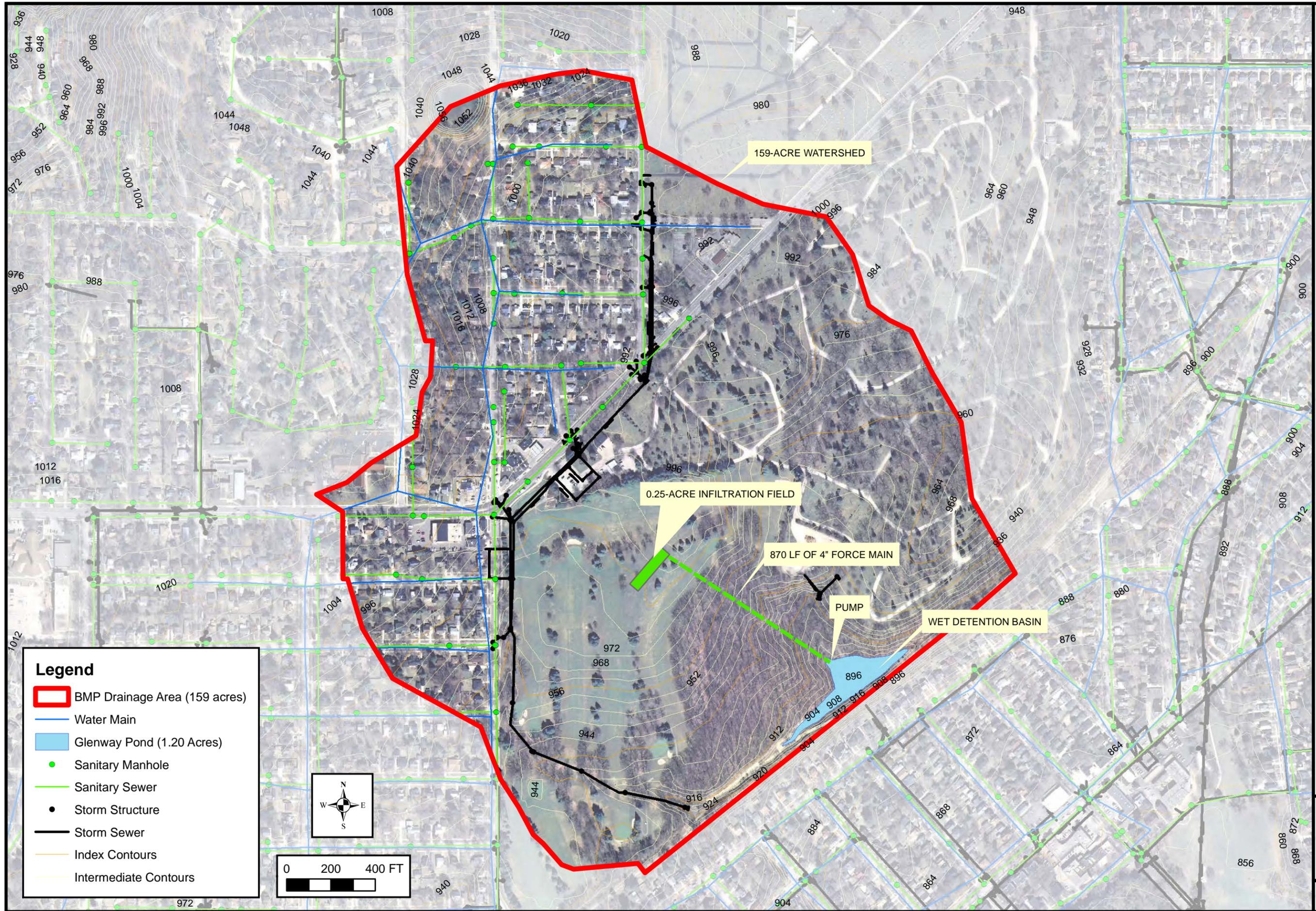
FIGURE 3.03-22
1020.065

- 8. Glenway Golf Course Infiltration Facility– Similar to the MG&E Infiltration Facility in the Odana Golf Course, this proposed project would include a wet detention basin that would pretreat stormwater prior to pumping up to an infiltration area on the golf course. Sizing of this facility is similar to the sizing of the MG&E Infiltration Facility. It is our understanding there are existing groundwater seepage into basement issues downstream of this proposed facility that would need to be addressed. Figure 3.03-23 shows an aerial view of the proposed facility, and Figure 3.03-24 shows the watershed draining to this area.



- 9. Monroe Street Reconstruction with Green Features–The City is planning to reconstruct Monroe Street in 2017 with design beginning in 2014. This project presents opportunities for incorporation of green features such as bioretention planters and bioretention bumpouts for traffic calming/pedestrian refuge to provide both infiltration and stormwater quality improvement. Our analysis assumes that the reconstruction project will seek to achieve a 53 percent total suspended solids (TSS) reduction along the corridor and corresponding 29 percent TP reduction. Figure 3.03-25 and 3.03-26 show three examples of bioretention features integrated into street redevelopment projects that Strand has been involved with. Figure 3.03-27 shows the watershed draining to the Monroe Street corridor. At the public information meetings for this project, it was suggested that redevelopment and street reconstruction projects be required to provide infiltration even though current ordinances do not require infiltration for these project types.

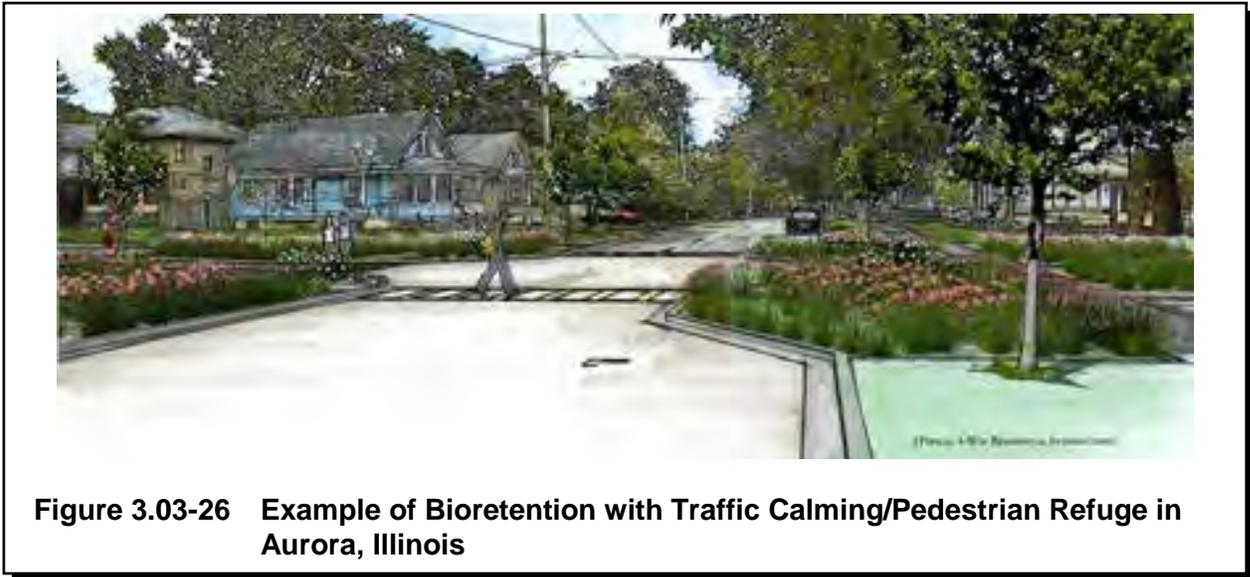




GLENWAY GOLF COURSE
 WET DETENTION BASIN AND INFILTRATION
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 3.03-24
1020.065

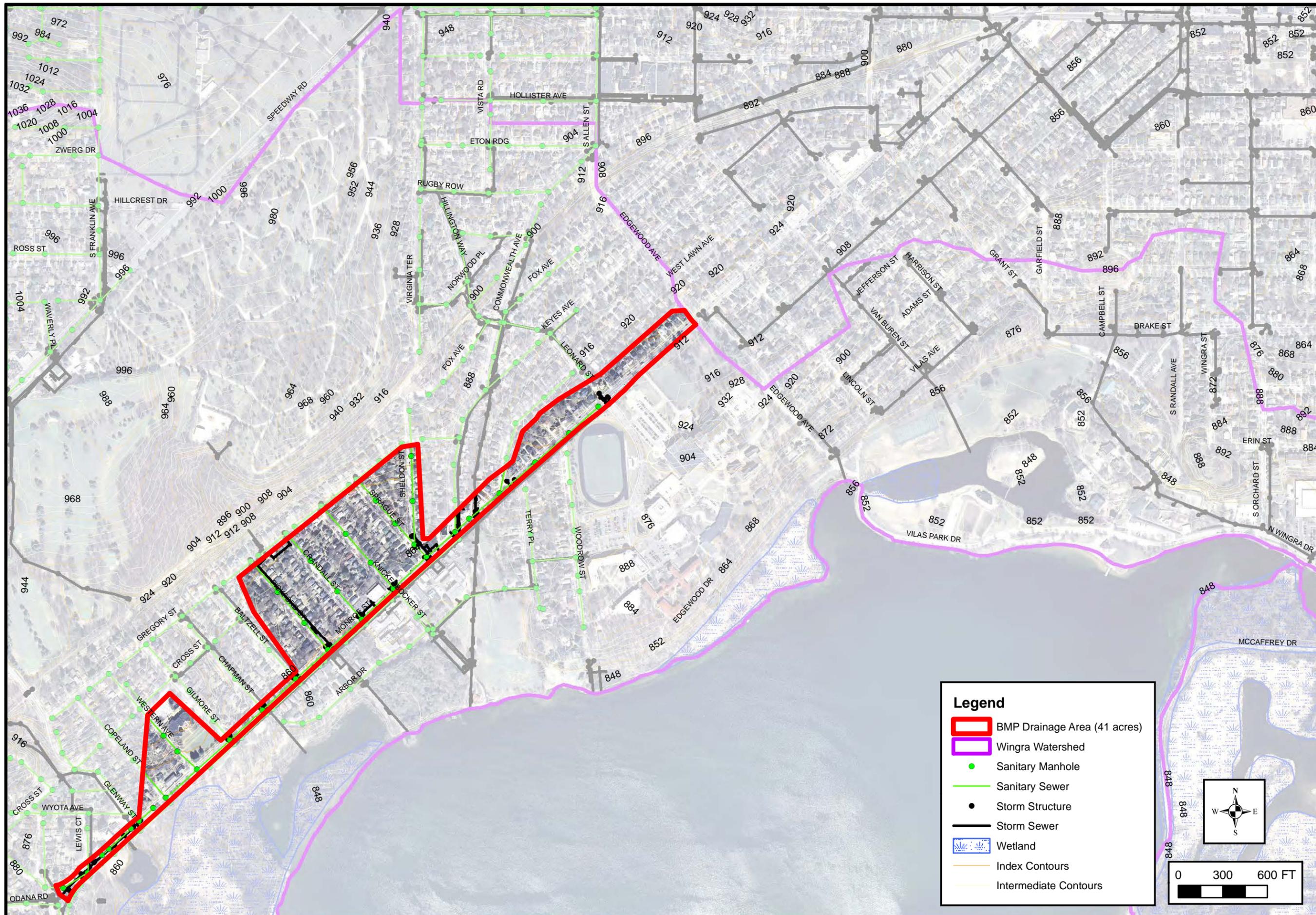


10. Rain Barrels and Downspout Disconnection

There have been various initiatives seeking to increase infiltration through installation of rain barrels and downspout disconnection (redirecting a downspout from draining over impervious area to over pervious area). Sustain Dane was instrumental in selling and installing rain barrels from 2005 to 2011, when they sold the business now known as RainReserve. The City of Madison now promotes and provides guidance (including a link to purchasing the Rain Reserve system) on rain barrel installation on its Stormwater Management webpage. Figure 3.03-28 shows an example of a rain barrel. The Madison Area Municipal Storm Water Partnership (MAMSWAP) also maintains a myfairlakes.com webpage that has a rain barrel page and a page regarding downspout disconnection. Downspout disconnection refers to the redirection of a downspout from an impervious area to a pervious area, thus disconnecting from the impervious area that would convey flows quickly downstream.



For purposes of this plan, performance of rain barrels and downspout disconnection was evaluated with the assumptions shown in Table 3.03-16.



MONROE STREET
STREET CONSTRUCTION WITH GREEN FEATURES

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN

Legend

- BMP Drainage Area (41 acres)
- Wingra Watershed
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Wetland
- Index Contours
- Intermediate Contours

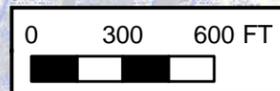


FIGURE 3.03-27
1020.065

Measure	Assumptions
Rain barrels	<ul style="list-style-type: none"> ▪ Avg. residential roof area = 2,800 SF ▪ 1/4 of roof drains to disconnected downspout(s) ▪ 50% of annual runoff stored by rain barrel ▪ 50% of rain barrels are maintained ▪ Infiltration: Runoff stored assumed to infiltrate ▪ Phosphorus: 25% of TP in stored runoff runs off after next rain event ▪ Participation: 25% of the 4,620 residential parcels in the watershed
Downspout disconnection	<ul style="list-style-type: none"> ▪ Avg. residential roof area = 2,800 SF ▪ 1/4 of roof drains to disconnected downspout(s) ▪ 100% of annual runoff from 1/4 of roof area drained to lawn area ▪ Infiltration: 50% of annual runoff infiltrates and 50% continues on as runoff ▪ Phosphorus: 50% of annual runoff infiltrates and 50% continues on as runoff with associated TP load ▪ Participation: 35% of the 4,620 residential parcels in the watershed

Table 3.03-16 Rain Barrel and Downspout Disconnection Assumptions

It is recommended that the Infiltration and Phosphorus Catalyst Teams further investigate the assumptions used for the analysis shown in Table 3.03-16 and adjust the relative contribution of these measures toward meeting the short-term infiltration and phosphorus goals.

3.04 ALTERNATIVES ANALYSIS

A. Alternatives Analysis Overview

This section discusses alternatives analyzed to meet the short-term infiltration goal of recovering 10 percent of the infiltration lost to development. All the projects identified would need to be completed to achieve the goal, depending on the infiltration rate of in situ soils. Table 3.03-11 shows the cost-effectiveness of each project in terms of a 20-year net present worth cost per cubic foot of infiltrated stormwater. As can be seen, there is a wide range of cost-effectiveness. This information allows for prioritizing project implementation. It is envisioned that the most cost-effective projects would be completed first.

Costs presented were estimated using historical bid costs, where available, and supplemented by other reference sources. All estimated project costs include allowances for engineering and contingencies and soils investigation where necessary. Land acquisition or easement costs, if needed, have not been included. The goal of this section is to provide the City personnel with the information required to initiate the budgeting and planning phase for facilities improvements. All costs are presented in 1st quarter 2014 dollars. Future construction costs should be adjusted for inflation when final project schedules are determined. Opinions of probable construction cost will be updated during the design phase; Appendix B contains detailed cost spreadsheets.

The costs for excavation assume there will be off-site disposal of the excavated material. If an on-site source of disposal is identified, this cost would be reduced. As appropriate, costs for soil investigation and wetland delineation are included. This information will provide important design information and determine regulatory constraints.

B. Long-Term Goal Discussion

The long-term infiltration goal is to recover 25 percent of the infiltration lost to development. This is an ambitious goal that will serve to guide future efforts to increase infiltration in the watershed. Achievement of the goal may take major shifts in development patterns (e.g., conversion of curb and gutter streets to drainage via grass-lined swales), major implementation of source area infiltration BMPs (1000s of rain gardens in the watershed) and/or identification and implementation of additional larger infiltration projects in the watershed. Regardless of the goal, increasing infiltration in the watershed may increase the potential for basement groundwater flooding in the watershed. It is recommended that each infiltration project that is implemented be assessed for basement groundwater flooding potential and mitigating measures be taken as necessary.

3.05 SOCIAL MARKETING OPPORTUNITIES

Table 3.05-1 lists the different infiltration facilities necessary to meet the short-term infiltration goal. Most of these are project-based whereby City budgeting will be instrumental in providing a revenue source for the projects. Two of the projects include continuation and expansion of existing programs that involve residential and nonresidential property owners. These projects rely on property owners to participate in the program and lend themselves well to social marketing strategies. The City’s Stormwater Utility Rate Adjustment Policy currently provides incentives for construction of stormwater BMPs by way of a reduction in stormwater utility charge. It is recommended that this policy be periodically reviewed for effectiveness.

Facility	Responsible Party	Social Marketing Opportunity	Pilot Project Opportunity
Westmorland Park Bioretention Basin	City of Madison	No, City project	No
Downspout Disconnection Program (35% Watershed Participation)	City of Madison/FOLW/ Residential property owners	Yes	Yes
Rain Barrel Program (25% Watershed Participation)	City of Madison/FOLW/ Residential property owners	Yes	Yes
1,000 Private Residential Rain Gardens (Serving Roofs Only)	City of Madison/FOLW/ Residential property owners	Yes	Yes-Ongoing program
Devolis Park (Axel Avenue) Bioretention	City of Madison	No, City project	No
Arbor Hills Greenway Infiltration (@1.63 in/hr)	City of Madison	No, City project	No
Glenway Golf Course Wet Pond and Infiltration	City of Madison	No, City project	No
Grandview Boulevard Bioswales	City of Madison/Town of Madison	No, City/Town project	No
60 Private Commercial Rain Gardens (Serving Roofs Only)	City of Madison/FOLW/ Nonresidential property owners	Yes	Yes
4 Acres Porous Pavement (Serving 12 acres)	City of Madison/FOLW/ Nonresidential property owners	Yes	Yes
Monroe Street Green Street	City of Madison	No, City project	No
1,000 Terrace Rain Gardens	City of Madison/FOLW/ Residential property owners	Yes	Ongoing program including incentives

Table 3.05-1 Infiltration Project-Based Social Marketing Opportunities

3.06 PROPOSED MANAGEMENT CHANGES TO ACHIEVE SHORT-TERM INFILTRATION GOAL

Table 3.06-1 describes p potential management measures that could be implemented to achieve the short-term infiltration goal in the Lake Wingra watershed. The table also rates their implementation feasibility, potential effectiveness, and implementation priority. These ratings are a qualitative assessment to an understanding of potential prioritization. As can be seen, each of these measures rank “+++” for each category. Table 3.03-11 shows the necessary projects to meet the short-term infiltration goal. Each of the measures identified in Table 3.06-1 will be necessary to implement the corresponding facilities shown in Table 3.03-11.

Management Measure	Implementation Feasibility	Potential Effectiveness	Implementation Priority
Implement Dedicated Funding For City Projects Interaction with City of Madison Public Works, Engineering, Parks Departments to promote Lake Wingra Watershed projects. Goal to prioritize projects for inclusion in Capital Improvement Plans. Interact with Town of Madison for the Grandview Boulevard project.	+++	+++	+++
Expansion of City’s 1,000 Rain Gardens Initiative Provide additional strategies to increase participation in the program.	+++	+++	+++
Expansion of City’s Terrace Rain Garden Program Provide additional strategies to increase participation in the program.	+++	+++	+++
Creation of a City Porous Pavement Initiative Create this initiative for nonresidential property owners to promote redevelopment of properties with porous pavement. The initiative would be a blend of integration into City development process as well as a voluntary program for discretionary replacement of traditional with porous pavement.	+++	+++	+++

Table 3.06-1 Proposed Management Measures

**SECTION 4
PHOSPHORUS**

4.01 OBJECTIVE

The 2009 *Lake Wingra: A Vision for the Future*, prepared by the FOLW, identifies addressing excessive pollutants that cause frequent algae blooms (namely TP and sediment/TSS) in the Lake Wingra watershed as a critical element of Goal 2, clean, clear water. For purposes of this plan, the objective in working toward this goal is described in terms of the following short-term and long-term goals.

1. Short-Term Goal: 50 percent reduction in TP compared to no pollutant reduction controls.
2. Long-Term Goal: 80 percent reduction in TP compared to no pollutant reduction controls. This goal is consistent with the Rock River Total Maximum Daily Load (TMDL) and the City's requirement for redevelopment sites. The Rock River TMDL (Reach 64) requires a 61 percent and 73 percent TSS and TP load reduction, respectively.

In an effort to achieve these goals, this portion of the management plan:

1. Describes the Lake Wingra surface water watershed including current estimated phosphorus and TSS loads to Lake Wingra.
2. Identifies primary TP and TSS contributors.
3. Performs an alternatives analysis that identifies ways to achieve the short-term goal of 50 percent reduction in TP in the watershed compared to baseline conditions without pollutant reduction controls.
4. Seeks to achieve the infiltration and TP reduction short-term goals through projects that jointly provide an infiltration and TP reduction benefit.
5. Reviews management changes that have the potential to achieve the short-term pollutant reduction goal.
6. Recommends management changes to pursue.
7. Provides discussion on potential strategies for meeting the long-term goal.

4.02 BACKGROUND

A. Sources of Sediment and Phosphorus

The Wingra Watershed is predominantly a fully built-out urban environment from which sediment and phosphorus originate. Urban stormwater runoff carries with it sediments that wash off impervious areas (parking lots, roadways, driveways, and sidewalks), pervious areas (lawns, golf courses, landscaped areas), streambank erosion, and construction sites. Phosphorus in that runoff exists in both a particulate and dissolved state. Sources of phosphorus include organic matter (i.e., leaves, pollen,

buds, grass clippings, and yard waste), legacy lawn fertilizer, starter fertilizer for new lawns, soil, windblown soil, pet waste, waterfowl waste, streambank erosion, and construction sites. Figure 4.02-1 shows an example of phosphorus and sediment discharging just upstream of Lake Wingra at Manitou Pond.



Source: David Liebl

Figure 4.02-1 Phosphorus and Sediment-Laden Stormwater Entering Manitou Pond



Source: David Liebl

Figure 4.02-2 Sediment Islands on West End of Lake Wingra

B. Effects of Sediment and Phosphorus on Lake Wingra

1. **Sediment**—Signs of sediment in Lake Wingra include ever increasing lake bottom sediments, buildup of sediment at storm sewer outfalls, and a number of sediment islands on the west end of Lake Wingra created by slow moving water settling out sediment as shown in Figure 4.02-2. These sediments can cover spawning habitat and carry with them pollutants such as phosphorus and pesticides that are harmful to aquatic plants and animals.
2. **Phosphorus**—Nutrients such as phosphorus are essential, naturally occurring elements for plant growth but increased levels of these nutrients can jeopardize water quality. High phosphorus levels in water bodies can lead to excessive algae and aquatic plant growth that can harm aquatic life and impair recreational use. It can cause toxic algae blooms, reduce water clarity, and deplete oxygen levels. Low water oxygen levels can stress or kill fish and other aquatic animals.

Signs of phosphorus in Lake Wingra include algae blooms as shown in Figure 4.02-3 and excessive aquatic plant growth that are both unsightly and unhealthy, leading to reduced recreational use of the lake. Coupled with bacteria in stormwater runoff, phosphorus has also contributed to Vilas Park Beach closures as shown in Figure 4.02-4.



Source: Mike Kakuska

Figure 4.02-3 Algae Bloom on Lake Wingra



Figure 4.02-4 Vilas Park Beach Closure

C. Previous Efforts to Control Phosphorus in the Wingra Watershed

The negative effects of sediment and phosphorus have not gone unheeded. Over the years, various initiatives have moved forward to control urban pollutants both upstream of the lake and within the lake as follows. The effect of many of the structural controls is reflected in the City's P8 stormwater quality model discussed in Section 4.03.

1. Upstream Phosphorus Initiatives

- a. *Fertilizer Phosphorus Bans*—On January 1, 2005, Dane County Ordinance Chapter 80 became effective. This ordinance prohibits the use of phosphorus-containing lawn fertilizer for residential, commercial, and golf course applications, unless a soil test shows that phosphorus is necessary or when starting a new lawn. It also prohibits the retail display of phosphorus-containing lawn fertilizers. On April 1, 2010, Chapter 94.643 of the Wisconsin Administrative Code became effective which bans the use and sale of phosphorus and phosphate-containing fertilizer in Wisconsin. Both of these initiatives are positive for the state and Lake Wingra, though legacy phosphorus on lawns and golf course will continue to contribute phosphorus until phosphorus levels naturally decrease.
- b. *UW-Madison Arboretum Stormwater Best Management Practices (BMPs)*—Stormwater detention ponds constructed in the 1980s within the UW-Madison Arboretum that protected the lake from urban pollutants had degraded or filled up with sediment by the early 2000s. The UW-Madison embarked on an ambitious plan to rehabilitate and/or upgrade these facilities over the last decade. Funding for completion of these projects was garnered through an intermunicipal agreement between UW-Madison, City of Madison, Town of Madison, and City of Fitchburg. Figure 4.02-5 shows a picture of rehabilitated Secret Pond and Channel in the fall of 2013, and Table 4.02-1 provides a listing of the BMPs in the UW-Madison Arboretum.

- c. *Wisconsin Department of Transportation (Verona Road/Beltline Reconstruction)*–In 2013, the Wisconsin Department of Transportation constructed a wet detention pond along the Southwest Commuter Bike Path near the southeast corner of the Odana Hills Golf Course. For purposes of this plan, 105.85-acre watershed W102-C-0324-H-MAD-C was split into two watersheds (8.33-acre W102-C-0324A-H-MAD-C not draining through the pond and 97.52-acre W102-C-0324B-H-MAD-C draining through the pond).



Figure 4.02-5 Secret Pond and Channel Rehabilitation

Facility	Year Constructed	Comments
Marion-Dunn Pond	2003	Pond dredging and forebay construction.
Secret Pond Channel Energy Dissipater	2003	Field stone energy dissipater at storm outfall to Secret Pond Channel.
Pond 2 and Wetland Basin	2009	In-line stormwater treatment device on Waste Management property constructed by Waste Management, Pond 2 dredging, and wetland creation.
Pond 4	2009	Pond dredging, expansion and rehabilitation with sediment forebay. Drains downstream of Lake Wingra.
Secret Pond	2011	Secret Pond dredging and conversion to wetland stilling basin, Secret Pond Channel restoration and meandering, and Manitou Pond wet pond construction.
Pond 3	2012	City of Madison-funded project providing pretreatment of flows to Pond 3, dredging and expansion of Pond 3, and storm sewer. Drains downstream of Lake Wingra.
Sand and Trash Collector Upstream of Curtis Pond	2014	WisDOT-funded project providing pretreatment for Curtis Pond.
Curtis Pond	Pending	Pond dredging and replacement of damaged concrete flume with storm sewer.

Table 4.02-1 UW-Arboretum and WisDOT Stormwater BMPs

- d. *Stormwater and Erosion Control Regulatory Requirements*—Both the City of Madison (Chapter 37) and Dane County (Chapter 14) have ordinances to control runoff from construction sites and postconstruction sites. Current City ordinances for new development projects require an 80 percent TSS reduction compared to no runoff management controls. Likewise, current City ordinances for redevelopment projects within the Rock River TMDL require an 80 percent TSS reduction compared to existing conditions of the site before redevelopment.
- e. *Marion-Dunn Pond Alum Pilot Project*—In 2013, the City of Madison initiated a pilot project at the Marion-Dunn Pond to look at the feasibility of dosing stormwater flows with alum upstream of detention ponds. Alum may make the pond more efficient at removing phosphorus by precipitating out dissolved phosphorus that normally would pass through the pond.

2. In-Lake Phosphorus Initiatives

- a. *Carp Harvesting*—In March of 2008, project partners, Friends of Lake Wingra, Wisconsin WDNR, UW-Extension, Dane County, City of Madison Parks, Dane County Fishing Expo, and the Madison Muskie Club collaborated on a carp harvesting project (see Figure 4.02-6). This initiative entailed harvesting carp using remote control submarines below the ice surface. Lake Wingra water quality in the past five years has been noticeably improved resulting from a reduction in carp-induced sediment resuspension and improved aquatic vegetation coverage.



Source: David Liebl

Figure 4.02-6 Winter 2008 Lake Wingra Carp Harvesting



Figure 4.02-7 Weed Cutter

- b. *Weed Cutting by Dane County*—Dane County has a program for weed harvesting in Lake Wingra (see Figure 4.02-7). It has been reported that increased water clarity resulting from carp harvesting has allowed macrophyte (aquatic plant) growth to increase. Increased weed cutting will likely be required as water quality continues to improve. Removal of the cut weeds also removes an in-lake phosphorus source.

- c. UW-Madison Lake Wingra Response Model (March 2015 Draft Report)—The UW-Madison and the City partnered to create a lake response model that estimates the various controlling factors for water quality in Lake Wingra including phosphorus loads from surface runoff and sediment resuspension from wind/waves and carp. This model assists in targeting the right contributing factor for lake water quality. Preliminary results of this effort suggest that carp are the main contributor to sediment in the lake water column during summer months while wind resuspension has the least impact (owing to dense vegetation and low wind speeds in the summer, though spring and late fall could increase significantly with sparse vegetation and higher winds, especially along the north lake shoreline). Preliminary results also suggest that TP loadings in the lake are governed by both storm runoff and carp, while orthophosphorus (i.e., dissolved phosphorus) loading in the lake is governed by storm runoff. Sediment resuspension did not result in significant increases in orthophosphorus.

D. Factors Affecting Sediment and Phosphorus Loads

Several factors affect sediment and phosphorus loads in the Lake Wingra watershed:

1. Amount of pervious/impervious area.
2. Soil types.
3. Infiltration rate of pervious surfaces.
4. Amount of surface runoff.
5. Amount of pet waste and waterfowl waste.
6. Management of grass clippings and leaves.
7. Construction site erosion control effectiveness.
8. Streambank or stormwater conveyance channel erosion rates.
9. Dedicated postconstruction BMPs in the surface water watershed.

4.03 CONTRIBUTING WATERSHED CHARACTERISTICS

The primary contributor of stormwater pollutants (TSS and TP) to Lake Wingra is development in the watershed. Various development types contribute different quantities of runoff and associated pollutants depending on their characteristics. These varying pollutant loads are estimated using the City's P8 model. The P8 model aggregates all urban pollutant sources as loads from a particular watershed without differentiating the specific source that includes varying proportions of the following: lawns, streets, sidewalks, roofs, leaves, streambank erosion, construction sites, and pet waste. Within this study, we provide information on the City's P8 model output and how management of some of the specific sources can provide reduced stormwater pollutant loads in the Lake Wingra watershed. Appendix C includes a schematic of the watershed model.

A. Watershed

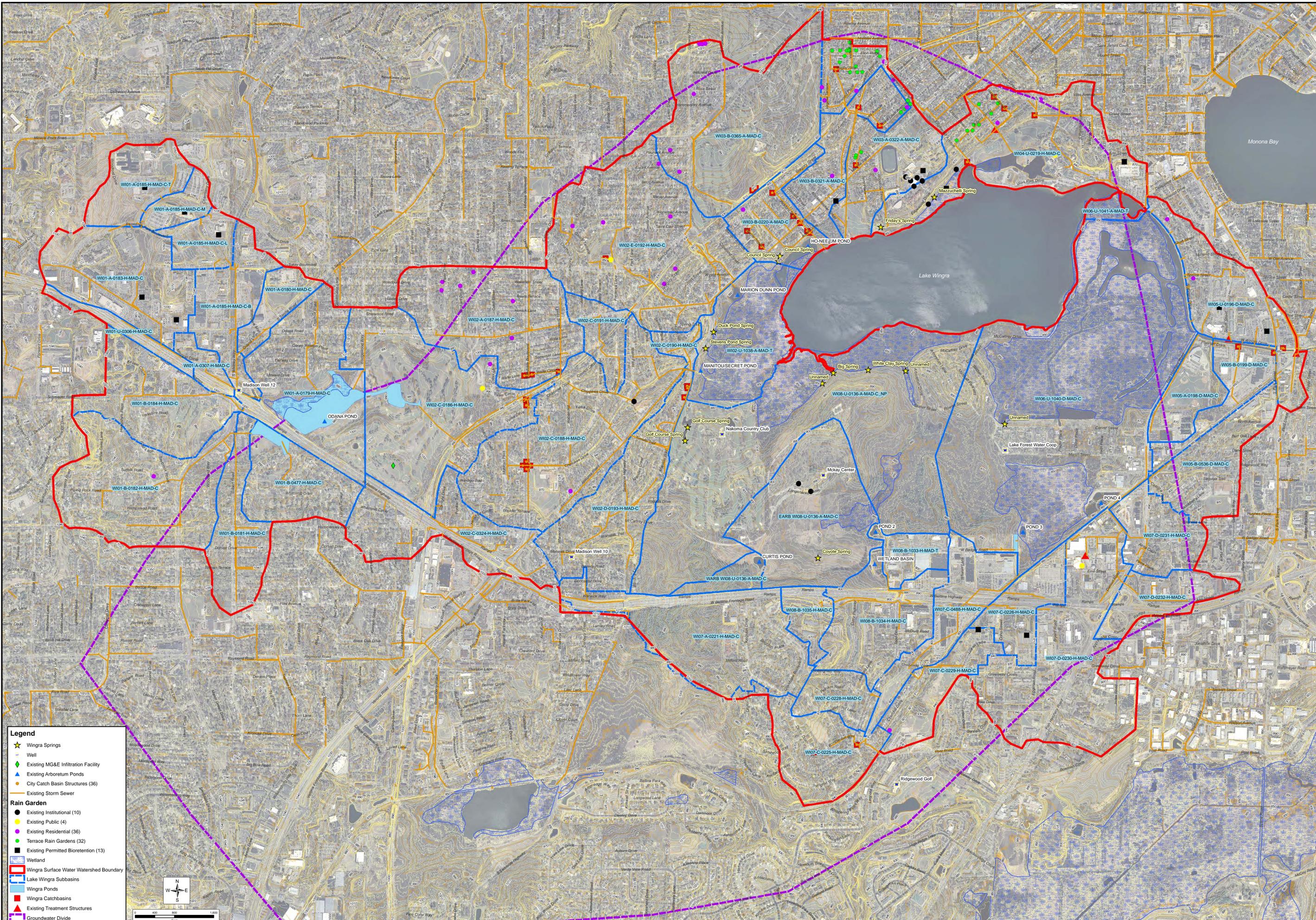
1. Surface Water Watershed—The official watershed boundary for the management plan is shown in Figure 3.02-3. It includes areas that drain to Wingra Creek as well as to the Gardner Marsh. While the study boundary includes these eastern areas, these areas do not drain into Lake Wingra and, therefore, do not affect TP and TSS loads to the lake. In that regard, the two blue-shaded areas within Figure 3.02-3 illustrate the tributary area directly draining into the lake, the tributary area that affects TP and TSS loads to the lake. Taking this into account, the Lake Wingra surface water watershed (both blue areas on Figure 3.02-3) encompasses a total of 3,636 acres with 1,105 of these acres first draining through the Odana Hills Golf Course pond before draining to Lake Wingra.

The watershed generally drains from west to east via a system of storm sewers, open channels, and ditches as shown on Figure 4.03-1. Six stormwater detention ponds surround Lake Wingra including Pond 2/Wetland Basin, Coyote Pond (a natural seepage depression also fed by upstream storm sewers), Curtis Pond, Secret Pond, Marion-Dunn Pond, and Ho-Nee-Um Pond. Each pond provides some level of stormwater quality treatment of runoff before discharge into Lake Wingra but generally does not provide appreciable infiltration of stormwater runoff. Two ponds, Pond 4 and Pond 3, drain downstream of the lake to Wingra Creek.

B. Baseline Pollutant Loads

The City-provided P8 model (September 18, 2013 revision) was used to determine the locations within the watershed that contribute the highest pollutant loading rates for both TP and TSS. Table 4.03-1 and Figures 4.03-2 and 4.03-3 illustrate the highest pollutant loading rates for TP and TSS, respectively, under baseline (no BMP controls) conditions.

These figures show that the highest baseline pollutant loads generally originate from commercial, business, institutional, and multifamily residential areas in the watershed. They also show that open areas such as the UW-Madison Arboretum have the lowest pollutant loads in the watershed and thus the least amount of need for stormwater treatment. More telling, then, are the pollutant loading rates with existing stormwater quality BMPs in place as is discussed in the next section.



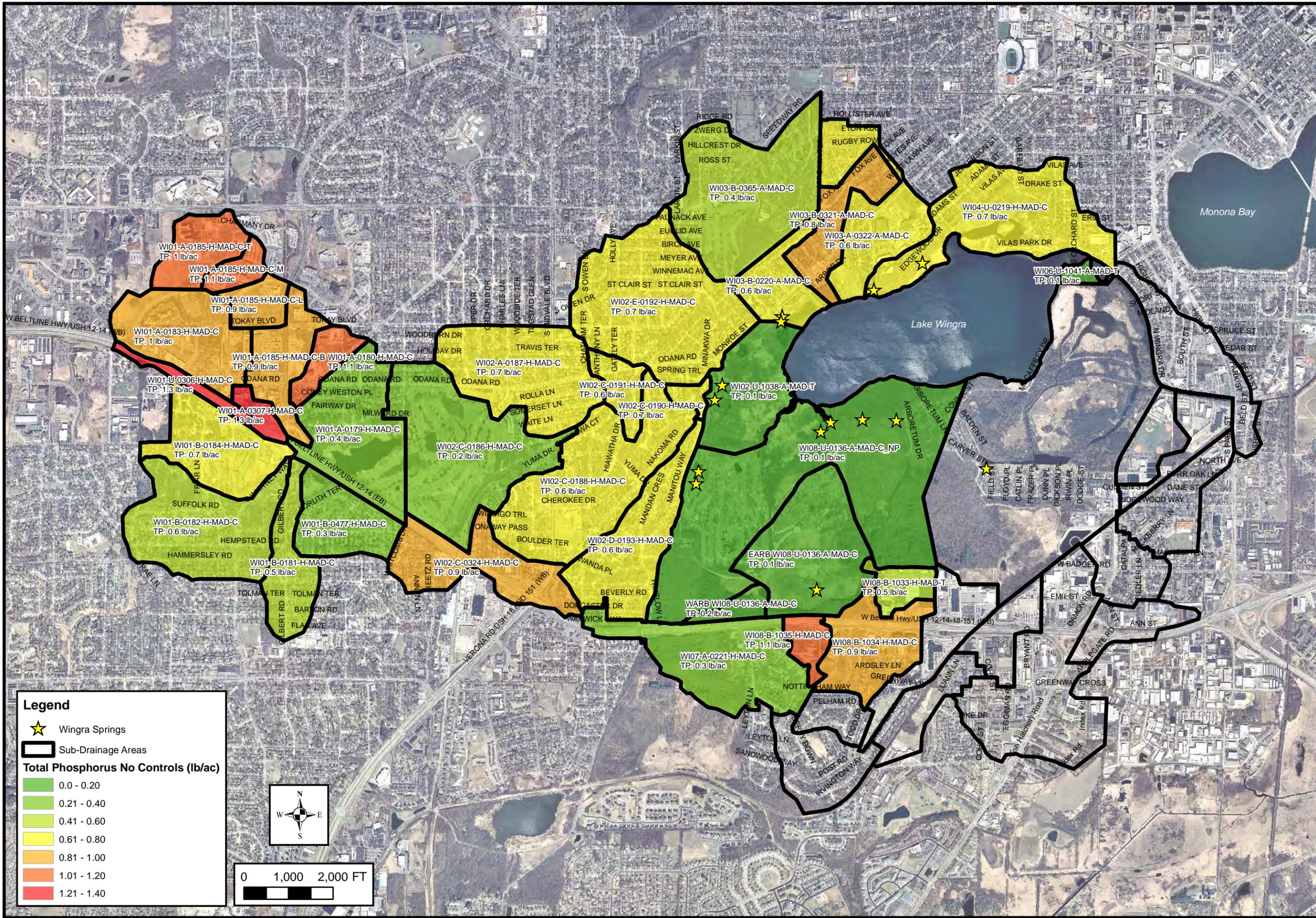
Legend

- ★ Wingra Springs
- Well
- ◆ Existing MG&E Infiltration Facility
- ▲ Existing Arboretum Ponds
- City Catch Basin Structures (36)
- Existing Storm Sewer

Rain Garden

- Existing Institutional (10)
- Existing Public (4)
- Existing Residential (36)
- Terrace Rain Gardens (32)
- Existing Permitted Bioretention (13)

- Wetland
- Wingra Surface Water Watershed Boundary
- Lake Wingra Subbasins
- Wingra Ponds
- Wingra Catchbasins
- Wingra Treatment Structures
- Groundwater Divide

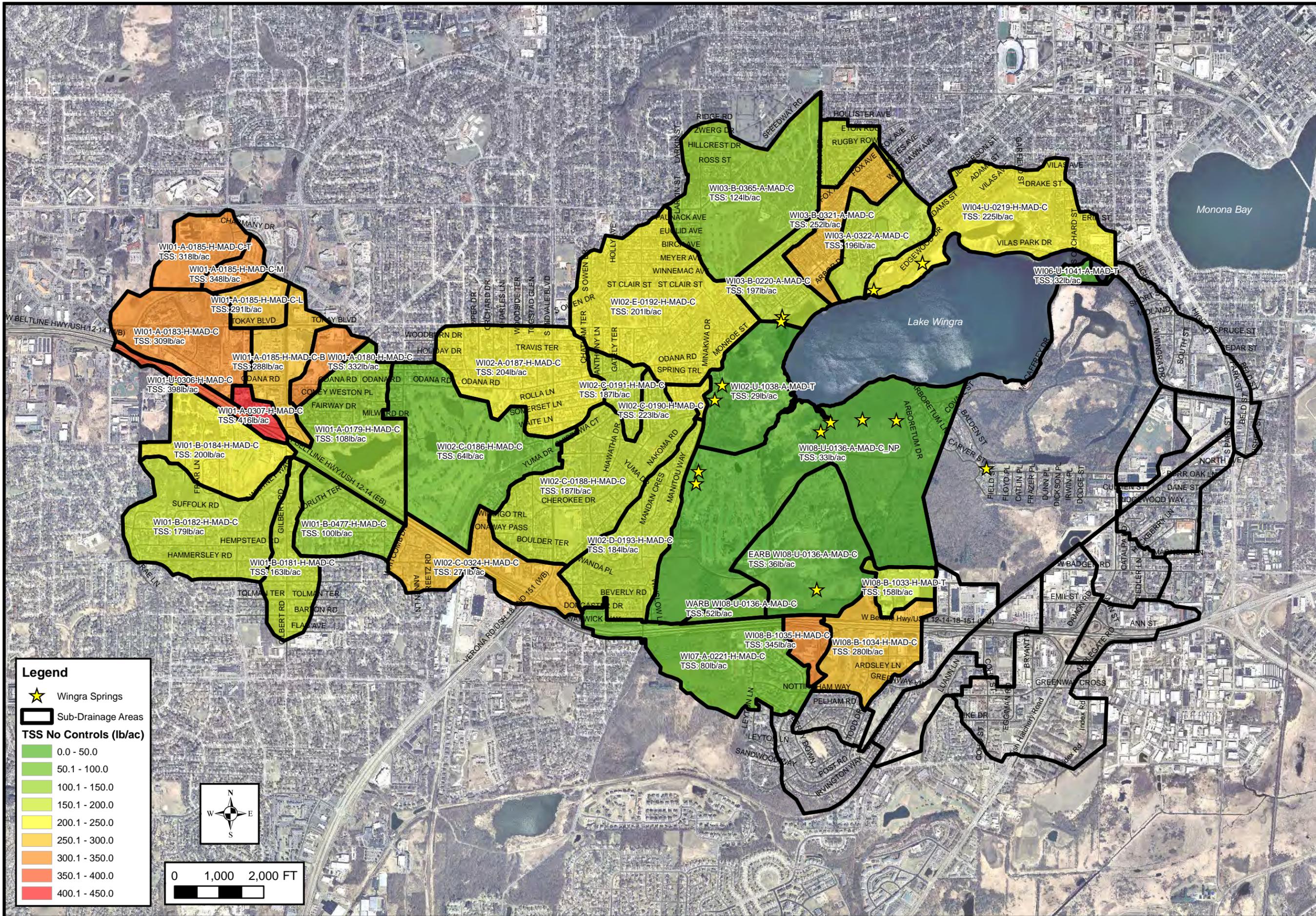


LAKE WINGRA TOTAL PHOSPHORUS UNIT LOADS
P8 MODELING - BASELINE WITH NO CONTROLS

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 4.03-2
1020.065



LAKE WINGRA TOTAL SUSPENDED SOLIDS UNIT LOADS
P8 MODELING - BASELINE WITH NO CONTROLS

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN

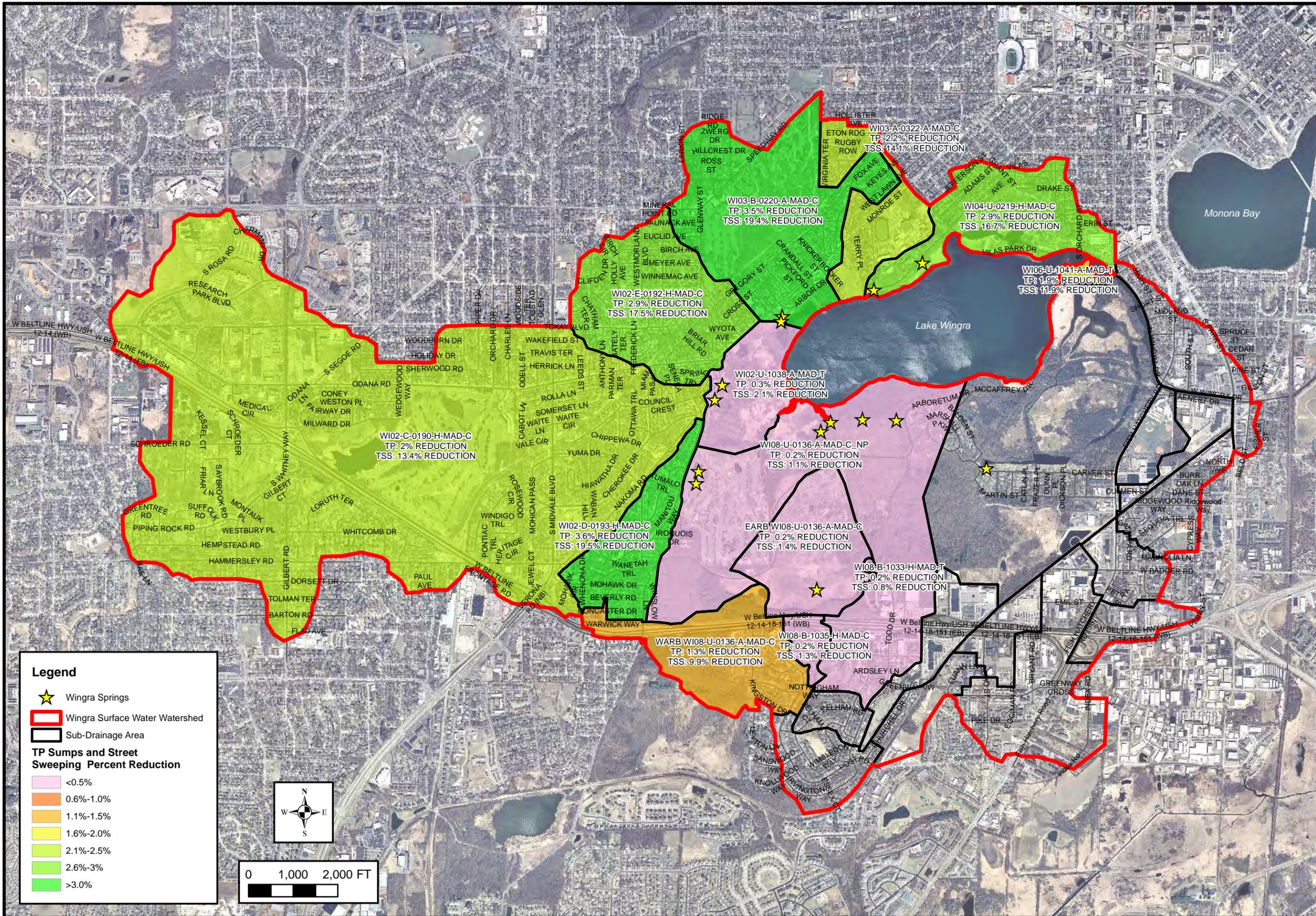


FIGURE 4.03-3
1020.065

C. Existing Pollutant Loads and Phosphorus Reduction Goal

Tables 4.03-2 and 4.03-3 show the watershed-wide performance under existing conditions (with BMP controls that have been implemented to date) for TP and TSS, respectively. The table includes performance for two scenarios: (1) sumps and street sweeping and (2) sumps, street sweeping, and ponds/bioretenion basins (i.e., all BMPs). Figure 4.03-4 shows the watershed-wide performance for scenario 1 for TP and TSS. Figure 4.03-5 shows the watershed-wide performance for scenario 2 for TP and TSS. This allows for the contribution from ponds/bioretenion basins to be evaluated. As can be seen, the watershed-wide TP and TSS reduction is 38.3 percent and 63.3 percent, respectively, compared to no pollutant controls. Table 4.03-4 provides the TSS and TP reduction performance of existing BMPs modeled in P8.

Figure 4.03-5 also shows drainage basins that are underserved in terms of stormwater quality treatment, namely basins W102-D-0193-H-MAD-C, W103-B-0220-A-MAD-C, W103-A-0322-A-MAD-C, and W104-U-0219-H-MAD-C. It should be noted that the basins (W102-U-1038-A-MAD-T, W108-U-0136-A-MAD-C_NP, EARB W108-U-0136-A-MAD-C) in the UW-Madison Arboretum show little treatment; however, because of their location in the UW-Madison Arboretum, they have little pollutant load. Targeting the underserved basins for proposed stormwater controls will allow additional stormwater quality treatment to be pursued for areas in need. Figure 4.03-6 shows the same condition as Figure 4.03-5 but also shows potential projects to gain additional stormwater quality treatment for underserved basins. Potential projects to gain additional stormwater quality treatment for underserved basins are described in Section 4.03 C. and shown in Figure 4.03-6. Identification and analysis of structural improvements has targeted these areas to the extent possible. Additional non-structural-type BMPs (wetland harvesting, modified leaf collection methods, waterfowl management, enhanced construction site erosion control enforcement, modified street sweeping methods/schedule, and pet waste enforcement) should be targeted for the following basins since they currently have not been analyzed to be served by a structural BMP: W103-B-0321-A-MAD-C and W104-U-0219-H-MAD-C. In general, modified leaf collection methods and modified street sweeping methods/schedule that address dissolved phosphorus should target all basins.

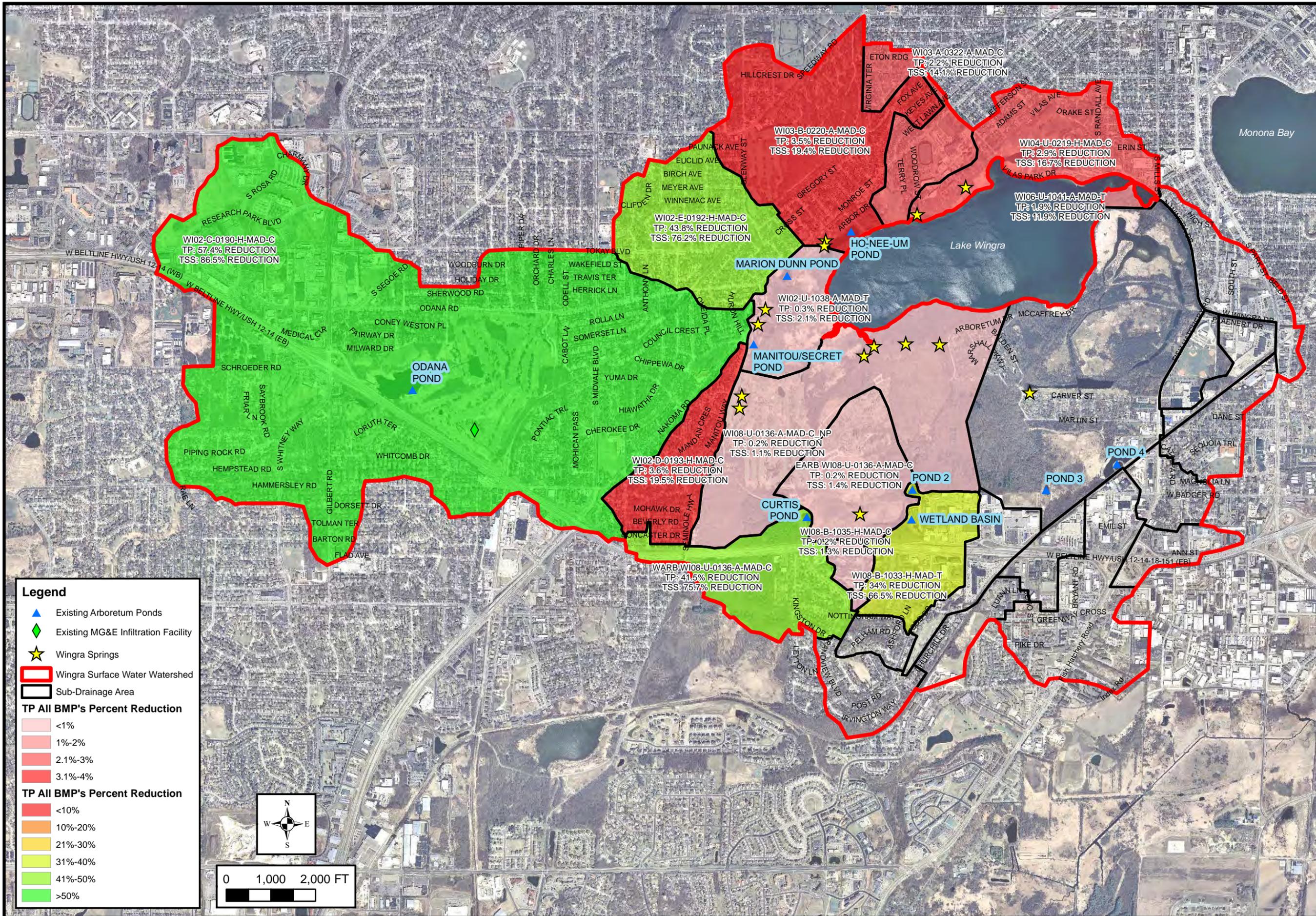


LAKE WINGRA TOTAL PHOSPHORUS AND SUSPENDED SOLIDS PERCENT REDUCTIONS
P8 MODELING (WITH EXISTING SUMPS AND STREET SWEEPING ONLY)

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 4.03-4
1020.065

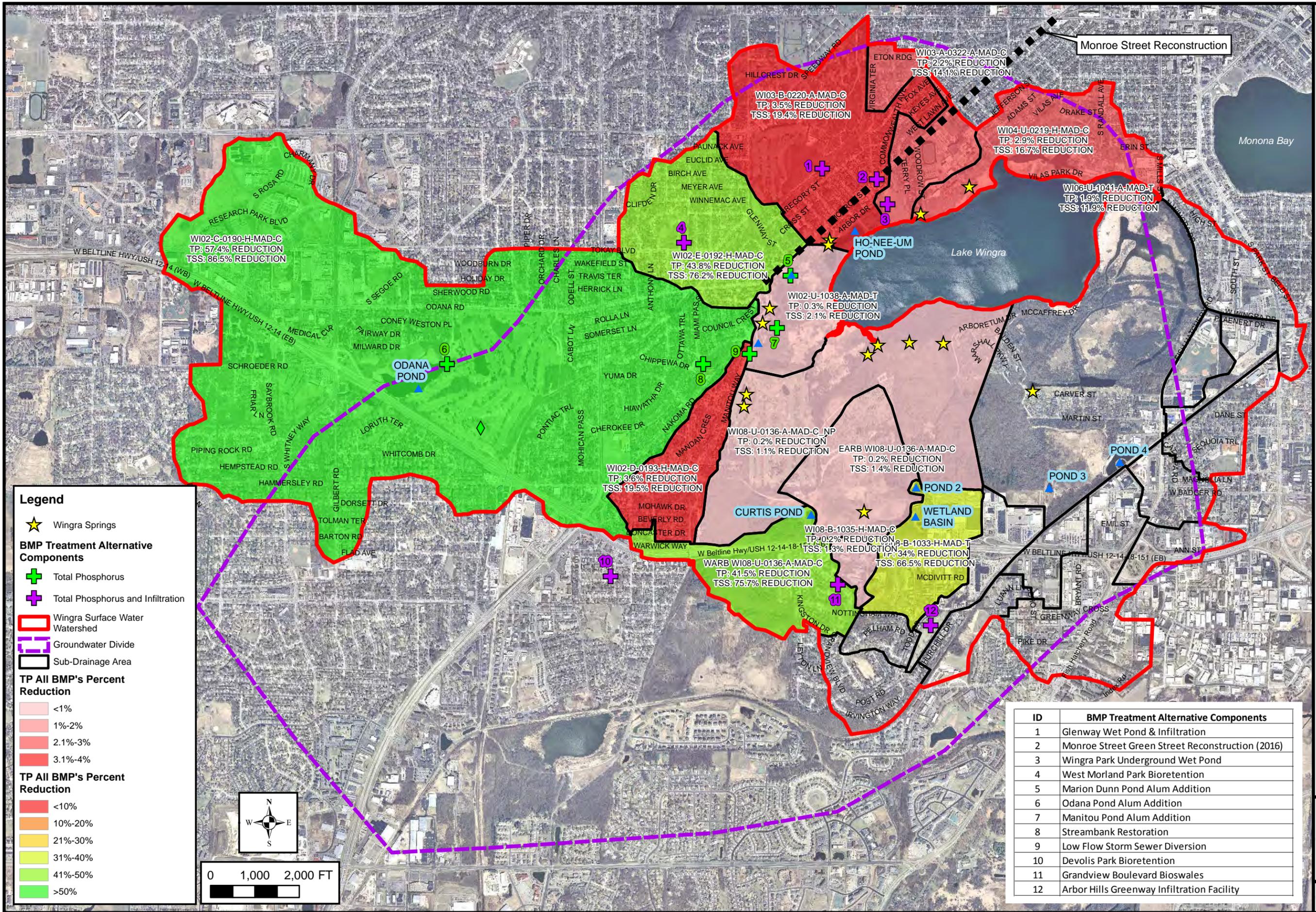


LAKE WINGRA TOTAL PHOSPHORUS AND SUSPENDED SOLIDS PERCENT REDUCTIONS
P8 MODELING (WITH ALL EXISTING BMPs)

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN

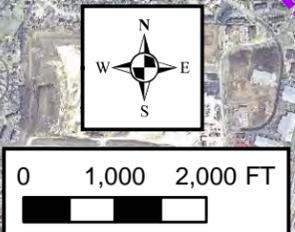


FIGURE 4.03-5
1020.065



Legend

- ★ Wingra Springs
- BMP Treatment Alternative Components**
- ⊕ Total Phosphorus
- ⊕ Total Phosphorus and Infiltration
- Red outline: Wingra Surface Water Watershed
- Dashed purple line: Groundwater Divide
- Black outline: Sub-Drainage Area
- TP All BMP's Percent Reduction**
- <1% (Lightest pink)
- 1%-2% (Light pink)
- 2.1%-3% (Pink)
- 3.1%-4% (Light red)
- TP All BMP's Percent Reduction**
- <10% (Lightest orange)
- 10%-20% (Light orange)
- 21%-30% (Orange)
- 31%-40% (Light yellow)
- 41%-50% (Yellow)
- >50% (Brightest yellow)



ID	BMP Treatment Alternative Components
1	Glenway Wet Pond & Infiltration
2	Monroe Street Green Street Reconstruction (2016)
3	Wingra Park Underground Wet Pond
4	West Morland Park Bioretention
5	Marion Dunn Pond Alum Addition
6	Odana Pond Alum Addition
7	Manitou Pond Alum Addition
8	Streambank Restoration
9	Low Flow Storm Sewer Diversion
10	Devolis Park Bioretention
11	Grandview Boulevard Bioswales
12	Arbor Hills Greenway Infiltration Facility

LAKE WINGRA TOTAL PHOSPHORUS AND SUSPENDED SOLIDS PERCENT REDUCTIONS
P8 MODELING (WITH ALL EXISTING BMPs) - SHOWING PROPOSED PROJECTS

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 4.03-6
1020.065

Table 4.03-1 TP and TSS Baseline (No Controls) Loading Rates

Basin	Acres	Baseline TP Load	Baseline TP Load/Acre	Baseline TSS Load	Baseline TSS Load/Acre
WI02-U-1038-A-MAD-T (P8 File)					
WI02-U-1038-A-MAD-T	100.8	11.7	0.1	2,942	29.2
WI02-D-0193-H-MAD-C	120.7	72.9	0.6	22,181	183.8
WI02-E-0192-H-MAD-C	230.9	152.3	0.7	46,334	200.7
WI01-A-0185-H-MAD-C-T	55.6	57.1	1.0	17,662	317.6
WI01-A-0185-H-MAD-C-M	22.2	25.0	1.1	7,741	348.1
WI01-A-0185-H-MAD-C-L	31.3	29.5	0.9	9,122	291.1
WI01-A-0185-H-MAD-C-B	68.5	63.5	0.9	19,726	287.8
WI01-A-0180-H-MAD-C	29.7	31.7	1.1	9,844	331.6
WI01-A-0183-H-MAD-C	116.0	115.2	1.0	35,826	308.9
WI01-U-0306-H-MAD-C	18.1	22.8	1.3	7,176	397.6
WI01-A-0307-H-MAD-C	16.9	22.3	1.3	7,010	416.0
WI01-B-0181-H-MAD-C	67.2	36.0	0.5	10,925	162.7
WI01-B-0182-H-MAD-C	156.2	92.2	0.6	27,987	179.1
WI01-B-0477-H-MAD-C	74.7	25.4	0.3	7,473	100.1
WI01-B-0184-H-MAD-C	100.4	65.9	0.7	20,111	200.3
WI01-A-0179-H-MAD-C	141.8	52.1	0.4	15,374	108.4
WI02-C-0186-H-MAD-C	206.6	47.0	0.2	13,295	64.4
WI02-C-0324-H-MAD-C	105.9	92.7	0.9	28,711	271.2
WI02-A-0187-H-MAD-C	153.1	101.9	0.7	31,234	204.0
WI02-C-0188-H-MAD-C	203.5	125.2	0.6	38,122	187.3
WI02-C-0191-H-MAD-C	32.4	19.9	0.6	6,051	186.7
WI02-C-0190-H-MAD-C	11.6	8.5	0.7	2,592	222.9
WI08-U-0136-A-MAD-C (P8 File)					
WI07-A-0221-H-MAD-C	153.3	42.3	0.3	12,266	80.0
WARB WI08-U-0136-A-MAD-C	18.1	3.4	0.2	931	51.5
WI08-B-1034-H-MAD-C	93.8	84.7	0.9	26,287	280.2
WI08-B-1033-H-MAD-T	28.6	15.7	0.5	4,509	157.9
WI08-B-1035-H-MAD-C	24.7	27.5	1.1	8,517	344.8
EARB WI08-U-0136-A-MAD-C	151.0	20.6	0.1	5,393	35.7
WI08-U-0136-A-MAD-C_NP	412.8	53.2	0.1	13,777	33.4
WI03-B-0220-A-MAD-C (P8 File)					
WI03-B-0220-A-MAD-C	57.4	37.2	0.6	11,332	197.4
WI03-B-0321-A-MAD-C	64.5	52.9	0.8	16,283	252.4
WI03-B-0365-A-MAD-C	202.8	84.6	0.4	25,152	124.0
Individual P8 Files					
WI03-A-0322-A-MAD-C	112.5	71.9	0.6	22,011	195.7
WI04-U-0219-H-MAD-C	179.1	132.9	0.7	40,298	225.0
WI06-U-1041-A-MAD-T	8.7	1.1	0.1	279	31.9
Total	3571.1	1,898.6		574,474	

Table 4.03-2 TP Reduction from Existing Controls

Major Watershed	Location in Watershed	From Street Sweeping and Sumps		With All BMPs	
		Incoming TP Load (lbs)	Outgoing TP Load (lbs)	Outgoing TP Load (lbs)	Load Reduction (%)
WI02-C-0190-H-MAD-C	Western Basins including Areas Draining Through UW Research Park BMPs, Odana Ponds Incl/Infiltration Facility, Manitou Pond, Secret Pond, and WisDOT Pond	1034	1013	440	2.0%
W102-E-0192-H-MAD-C	Marion Dunn Pond and Westmorland Rain Garden Area	152	148	86	2.9%
W102-D-0193-H-MAD-C	Seminole Highway/Manitou Way Area	73	70	70	3.6%
WI03-B-0220-A-MAD-C	Ho-Nee-Um Pond Area	175	169	169	3.5%
WI03-A-0322-A-MAD-C	Edgewood College Area	72	70	70	2.2%
WI04-U-0219-H-MAD-C	Vilas Park Area	133	129	129	2.9%
WI06-U-1041-A-MAD-T	South Side of Wingra Dam	1	1	1	1.9%
WARB W108-U-1036-A-MAD-C	Curtis Pond Area	46	45	27	1.3%
W108-B-1035-H-MAD-C	Coyote Pond	27	27	27	0.2%
W108-B-1033-H-MAD-C	Pond 2 and Wetland Basin	100	100	66	0.2%
EARB W108-U-0136-A-MAD-C	Central Arboretum	21	21	21	0.2%
W108-U-0136-A-MAD-C_NP	Northern Arboretum and Nakoma Golf Course	53	53	53	0.2%
W102-U-1038-A-MAD-T	Downstream of Manitou and Secret Pond	12	12	12	0.3%
Total		1,899	1,858	1,171	2.2%

Table 4.03-3 TSS Reduction from Existing Controls

Major Watershed	Location in Watershed	From Street Sweeping and Sumps		With All BMPs	
		Incoming TSS Load (lbs)	Outgoing TSS Load (lbs)	Outgoing TSS Load (lbs)	Load Reduction (%)
WI02-C-0190-H-MAD-C	Western Basins including Areas Draining Through UW Research Park BMPs, Odana Ponds Incl/Infiltration Facility, Manitou Pond, Secret Pond, and WisDOT Pond	315,982	273,683	42,763	13.4%
W102-E-0192-H-MAD-C	Marion Dunn Pond and Westmorland Rain Garden Area	46,334	38,217	11,011	17.5%
W102-D-0193-H-MAD-C	Seminole Highway/Manitou Way Area	22,181	17,848	17,848	19.5%
WI03-B-0220-A-MAD-C	Ho-Nee-Um Pond Area	52,768	42,549	42,549	19.4%
WI03-A-0322-A-MAD-C	Edgewood College Area	22,011	18,903	18,903	14.1%
WI04-U-0219-H-MAD-C	Vilas Park Area	40,298	33,577	33,577	16.7%
WI06-U-1041-A-MAD-T	South Side of Wingra Dam	279	246	246	11.9%
WARB W108-U-1036-A-MAD-C	Curtis Pond Area	13,197	11,888	3,205	9.9%
W108-B-1035-H-MAD-C	Coyote Pond	8,517	8,405	8,405	1.3%
W108-B-1033-H-MAD-C	Pond 2 and Wetland Basin	30,796	30,547	10,322	0.8%
EARB W108-U-0136-A-MAD-C	Central Arboretum	5,393	5,320	5,320	1.4%
W108-U-0136-A-MAD-C_NP	Northern Arboretum and Nakoma Golf Course	13,777	13,625	13,625	1.1%
W102-U-1038-A-MAD-T	Downstream of Manitou and Secret Pond	2,942	2,880	2,880	2.1%
Total		574,474	497,689	210,655	13.4%

Table 4.03-4 Existing BMPs Performance

BMP	TSS				TP			
	Incoming TSS Load (lbs)	Outgoing TSS Load (lbs)	TSS Load Reduction (lbs)	TSS Load Reduction (%)	Incoming TP Load (lbs)	Outgoing TP Load (lbs)	TP Load Reduction (lbs)	TP Load Reduction (%)
Marion-Dunn Pond	35,502	11,011	24,491	69.0%	146	86	60	41.3%
C UW Research Park West Ponds	17,433	4,821	12,611	72.3%	57	34	23	40.8%
SE UW Research Park West Ponds	12,379	5,239	7,140	57.7%	59	43	15	26.1%
S UW Research Park West Ponds	14,316	8,677	5,639	39.4%	73	64	9	11.9%
SW UW Research Park West Ponds	35,523	16,138	19,385	54.6%	115	91	24	20.7%
South Odana Hills Pond	39,834	10,829	29,005	72.8%	150	85	65	43.2%
North Odana Hills West Pond	111,527	10,073	101,455	91.0%	497	223	274	55.1%
North Odana Hills Infiltration	9,808	7,618	2,190	22.3%	223	195	28	12.7%
North Odana Hills East Pond	20,604	8,531	12,072	58.6%	239	212	27	11.4%
WisDOT Pond	26,064	9,644	16,421	63.0%	85	58	28	32.3%
Manitou Pond	84,363	50,564	33,799	40.1%	524	462	62	11.9%
Secret Pond	50,564	42,763	7,801	15.4%	462	440	22	4.7%
Curtis Pond	11,888	3,205	8,683	73.0%	45	27	18	40.8%
Wetland Basin	26,038	12,365	13,673	52.5%	85	65	20	23.1%
Pond 2	16,874	10,322	6,552	38.8%	81	66	14	17.8%
Total (Wetland Basin and Pond 2)	38,952	10,322	28,630	73.5%	100	66	34	33.9%

C. Existing Stormwater BMPs Not Accounted For in City P8 Model

As described in Section 3.03 D of this report, there are 36 existing residential rain gardens, 4 existing public rain gardens (City of Madison), 10 existing institutional rain gardens (Arboretum, Edgewood College, Henry David Thoreau School), 32 existing street terrace rain gardens, and 13 existing permitted private rain gardens/bioretenion basins that are not accounted for in the City P8 model. Table 4.03-5 provides a TP reduction credit for these existing BMPs, which lessens the additional reduction needed to meet the *Short-Term Goal*.

Facility	TP Reduction Performance (lb) at Varying Infiltration Rates		
	0.3 in/hr	0.5 in/hr	1.0 in/hr
Structural Improvements			
36 Existing Residential Rain Gardens	0	0	0
4 Existing Public Rain Gardens (City of Madison)	0.4	0.4	0.4
10 Existing Institutional Rain Gardens (Arboretum, Edgewood College, Henry David Thoreau School)	1.0	1.0	1.1
32 Existing Terrace Rain Gardens	0.3	0.3	0.3
13 Existing Permitted Bioretention Basins	1.3	1.3	1.4
Total	3.0	3.0	3.1

Table 4.03-5 TP Reduction Performance of Existing Infiltration Facilities in Watershed

D. Phosphorus Reduction Goal

Table 4.03-6 shows the additional TP reduction necessary in the watershed to meet both the short-term and long-term TP reduction goals. Figure 4.03-7 shows a bar chart comparing the short-term and long-term TP reduction goals to the no controls and existing controls conditions.

Condition	TP Load (lbs)
No Control TP Load	1,899
Existing Controls TP Load (Modeled in P8)	1,171
TP Load Reduction Due to Existing Controls (Modeled in P8)	728
TP Load Reduction Due to Existing Controls (Not Modeled in P8)	3
Total TP Load Reduction Due to Existing Controls	731
Total TP % Reduction Due to Existing Controls	38.5%
<i>Short-Term Goal: 50 Percent Reduction Compared to No Controls (1,899 * 0.5)</i>	950
Additional Reduction Necessary to Meet Short-Term Goal (950-731)	218
<i>Long-Term Goal: 80 Percent Reduction Compared to No Controls (1,899*0.2)</i>	1,519
Additional Reduction Necessary to Meet Long-Term Goal (1,519-731-218)	570

Table 4.03-6 Existing TP Reduction and TP Reduction Goals

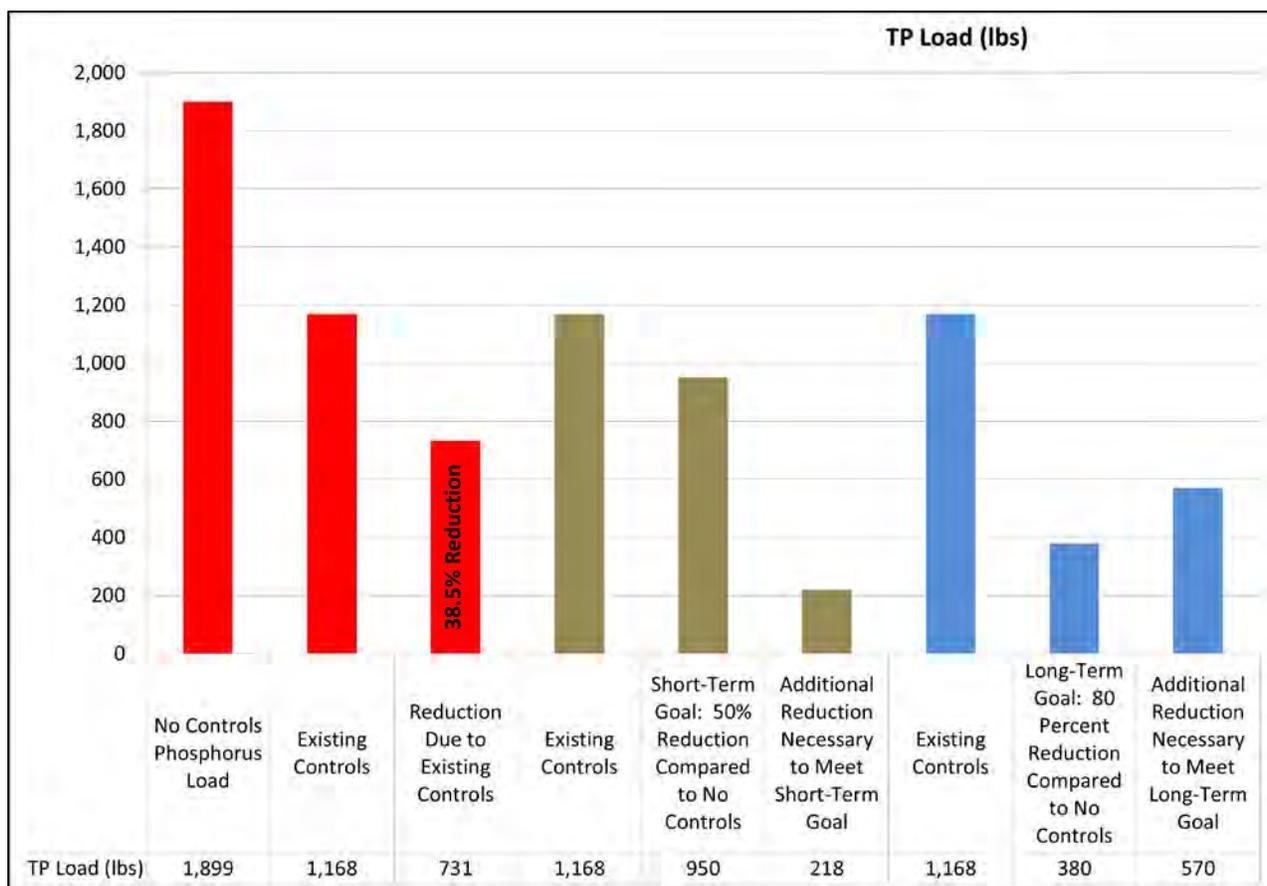


Figure 4.03-7 Comparison of Existing TP Reduction and TP Reduction Goals

E. Proposed TP Reduction Facilities in Watershed

As described in Section 3.03 D of this report, all infiltration facilities proposed would need to be completed to meet the infiltration short-term goal. These facilities also would provide TP reduction as shown in Table 4.03-7 and would reduce the TSS gap for consideration of additional BMPs in the watershed. Table 4.03-7 retains the infiltration cost-effectiveness order from Section 4. Approximately 97 additional pounds of TP needs to be removed from the watershed to meet the short-term goal.

Facility	TP Reduction Performance (lb) at Varying Infiltration Rates			% of Total	Total 20-Year Present Worth	20-Year NPW Cost/lb (@ 0.5 in/hr)
	0.3 in/hr	0.5 in/hr	1.0 in/hr			
Westmorland Park Bioretention Basin	14.7	15.5	17	11.5%	\$ 367,640	\$ 1,186
Downspout Disconnection Program (35% Watershed Participation)	7.8	7.8	7.8	5.8%	\$ 877,124	\$ 5,623
Rain Barrel Program (25% Watershed Participation)	2.1	2.1	2.1	1.6%	\$ 377,697	\$ 8,993
1,000 Terrace Rain Gardens	8.0	8.0	8.0	5.9%	\$ 2,184,378	\$ 13,652
1,000 Private Residential Rain Gardens (Serving Roofs Only)	8.6	8.9	8.9	6.6%	\$ 1,654,205	\$ 9,293
Devolis Park (Axel Avenue) Bioretention (<i>Not in Lake Wingra Surface Water Watershed</i>)	5.8	5.9	6.0	4.4%	\$ 479,671	\$ 4,065
Arbor Hills Greenway Infiltration (<i>Not in Lake Wingra Surface Water Watershed</i>) @ 1.63 in/hr	7.6	7.6	7.6	5.6%	\$ 1,279,398	\$ 8,417
Glenway Wet Pond & Infiltration	43.2	43.2	43.2	32.0%	\$ 1,952,764	\$ 2,260
Grandview Boulevard Bioswale	7.1	7.2	7.3	5.3%	\$ 893,405	\$ 6,204
60 Private Commercial Rain Gardens (Serving Roofs Only)	1.0	1.1	1.0	0.8%	\$ 417,396	\$ 18,973
Monroe Street Green Street	7.8	8.2	9.1	6.1%	\$ 835,587	\$ 5,095
4 Acres Porous Pavement (Serving 12 acres)	19.6	19.6	19.6	14.5%	\$ 3,143,409	\$ 8,019
TOTAL	133.3	135.1	137.8	100%	\$14,462,675	\$5,352 (avg)
TOTAL TO LAKE	119.9	121.6	124.2		\$12,703,606	\$5,223 (avg)
TP Reduction Gap to Meet Short-Term Goal	219.0	218.0	218.0			
Difference	99.1	96.4	93.8			

Table 4.03-7 Phosphorus Reduction Performance and Cost-Effectiveness of Proposed Infiltration Facilities

4.04 ALTERNATIVES ANALYSIS

A. Alternatives Analysis Overview

This section discusses alternatives analyzed to meet the short-term TP reduction goal of a 50 percent reduction in TP compared to no pollutant reduction controls. All projects identified would need to be completed to achieve the goal, depending on the infiltration rate of in situ soils. Table 3.03-10 showed the cost-effectiveness of each project in terms of a cost (planning level opinion of probable construction cost) per cubic feet of infiltrated stormwater. There is a wide range of cost-effectiveness. This information allows for prioritizing project implementation. It is envisioned the most cost-effective projects would be completed first.

Costs presented were estimated using historical bid costs, where available, and supplemented by other reference sources. All estimated project costs include allowances for engineering (15 percent) and construction contingencies (15 percent) and soils investigation where necessary. Land acquisition or easement costs, if needed, have not been included. The goal of this section is to provide the City of Madison personnel with the information required to initiate the budgeting and planning phase for facilities improvements. All costs are presented in 1st quarter 2014 dollars. Future construction costs should be adjusted for inflation when final project schedules are determined. Opinions of probable construction cost will be updated during the design phase; Appendix B contains detailed cost spreadsheets.

The costs for excavation assume there will be off-site disposal of the excavated material. If an on-site source of disposal is identified, this cost will be reduced. As appropriate, costs for soil investigation and wetland delineation are included. This information will provide important design information and determine regulatory constraints.

A total 20-year net present worth (NPW) for each project has been calculated that includes provisions for long-term maintenance of the various alternative components.

B. Alternative Components

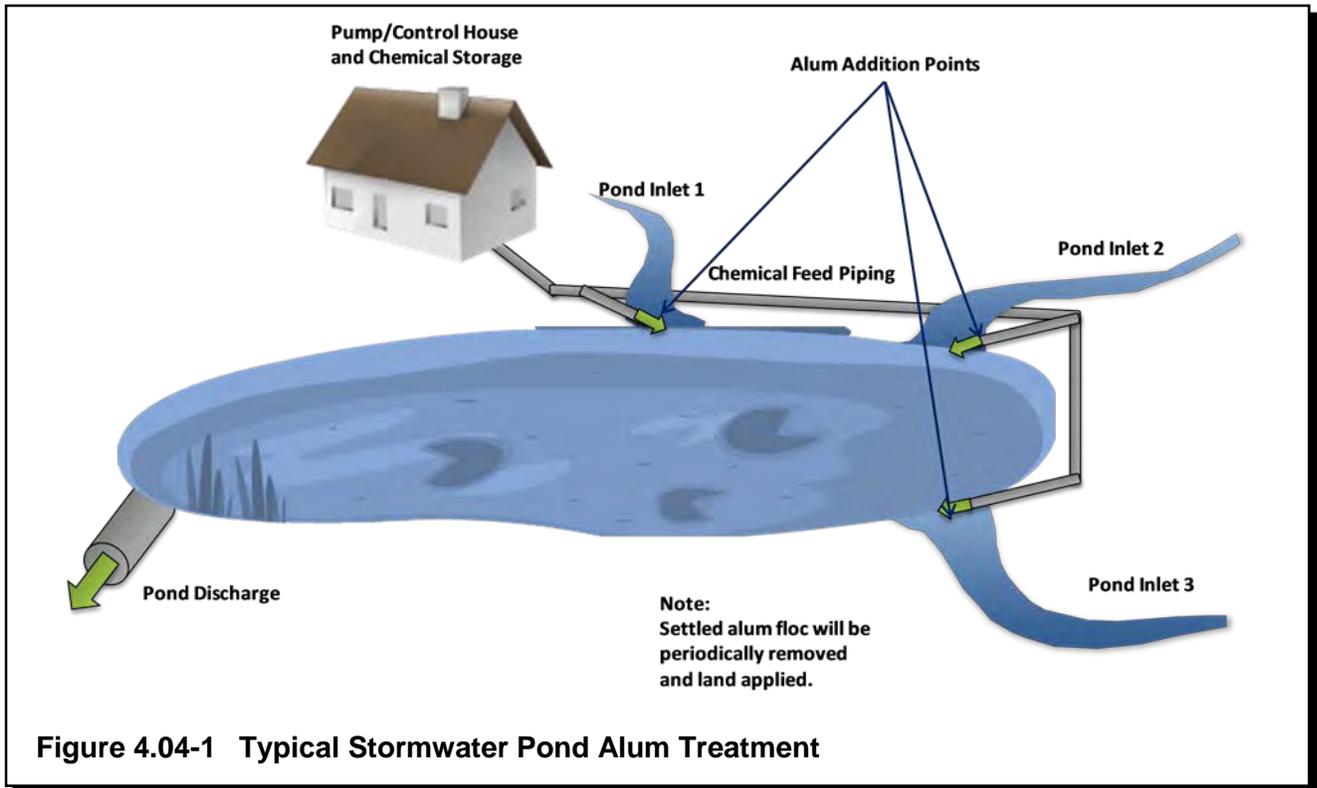
Table 4.04-1 lists structural and nonstructural practices that could be implemented to remove the additional 90 to 98 pounds of TP to meet the short-term goal. These alternative components are packaged together in the next section as five alternatives to collectively meet both the short-term infiltration and phosphorus reduction goals.

At the public meetings for this project, it was suggested that interpretive signage be included on all structural practices to engage the public.

Facility	Annual TP Reduction Performance (lb)	Opinion of Probable Construction Cost	Total 20-Year Present Worth Cost	20-Year NPW Cost/lb	Double Counting Potential
Structural Improvements					
Alum Addition At Manitou Pond	139.4	\$ 287,300	\$ 817,200	\$ 293	No
Alum Addition At Marion Dunn Pond	64.7	\$ 279,500	\$ 720,900	\$ 557	No
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672	No
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006	Yes
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)	13.3	\$ 369,000	\$ 369,100	\$ 1,391	Yes
Wingra Park Wet Pond (60% TSS Reduction)	20.6	\$ 1,771,100	\$ 1,827,400	\$ 4,435	No
Subtotal	262.3				
Nonstructural Improvements		Annual Cost			
Wetland Harvesting (4.6 acres)	41.4	\$ 43,000	\$ 97,600	\$ 119	No
Modified Leaf Collection Methods (\$47,000 Year 1 Capital Cost + \$10,000 Annual Operation Cost, thereafter)	84.6	\$ 57,000	\$ 229,100	\$ 135	Yes
Waterfowl Management (50 Geese Per Year)	8.5	\$ 2,500	\$ 42,400	\$ 249	
Construction Site (12.3 Acres) Erosion Control Enforcement (Enhanced)	138.7	\$ 55,000	\$ 931,900	\$ 335	Yes
Modified Street Sweeping Methods/Schedule	39.0	\$ 47,500	\$ 804,900	\$ 1,032	Yes
Pet Waste Enforcement	27.3	\$ 45,000	\$ 726,400	\$ 1,396	Yes
Subtotal	339.5				
TOTAL	601.8				

Table 4.04-1 Alternative Components Performance and Cost-Effectiveness for TP Reduction

1. Alum Addition—Alum, $Al_2(SO_4)_3$, is a coagulant often used for coagulation, flocculation, and settling in drinking water and wastewater treatment processes. Alum is commonly used for phosphorus removal in wastewater treatment. Alum treatment of stormwater to remove phosphorus, bacteria, and both dissolved and suspended solids has been employed in more than 60 locations in Florida. It has also been used in Europe to treat tributary streams for water quality improvement of drinking water reservoirs. The WDNR recognizes alum addition as a method for treating lakes to inactivate phosphorus in bottom sediments and it has been used sporadically for this purpose since the 1970s. The City’s Marion Dunn Pond alum pilot project is one of the first uses of alum for removal of TSS and phosphorus from stormwater or lake inflows in Wisconsin. There are a few projects in Wisconsin using alum to treat a whole lake, and there has been some use throughout the Midwest. The low usage rate may be because alum treatment of stormwater is generally more costly than other methods for removing TSS to the 20 percent removal levels required for Wisconsin municipal separate storm sewer systems (MS4s). Now that Wisconsin TMDLs and clean lakes initiatives will require much greater removal rates for phosphorus and TSS, alum (or other chemicals such as ferric, lime, or rare earth metals) may be worth further consideration. A schematic of the alum treatment process is shown in Figure 4.04-1.



Since alum and similar chemicals have not been used extensively for stormwater treatment in Wisconsin, detailed planning and additional pilot testing are recommended at a few sites before more widespread implementation. Three potential urban stormwater projects in the Lake Wingra watershed have been identified: Marion Dunn Pond, Manitou Pond, and Odana Pond. Background information and budgetary costs for the projects are presented in Table 4.04-2.

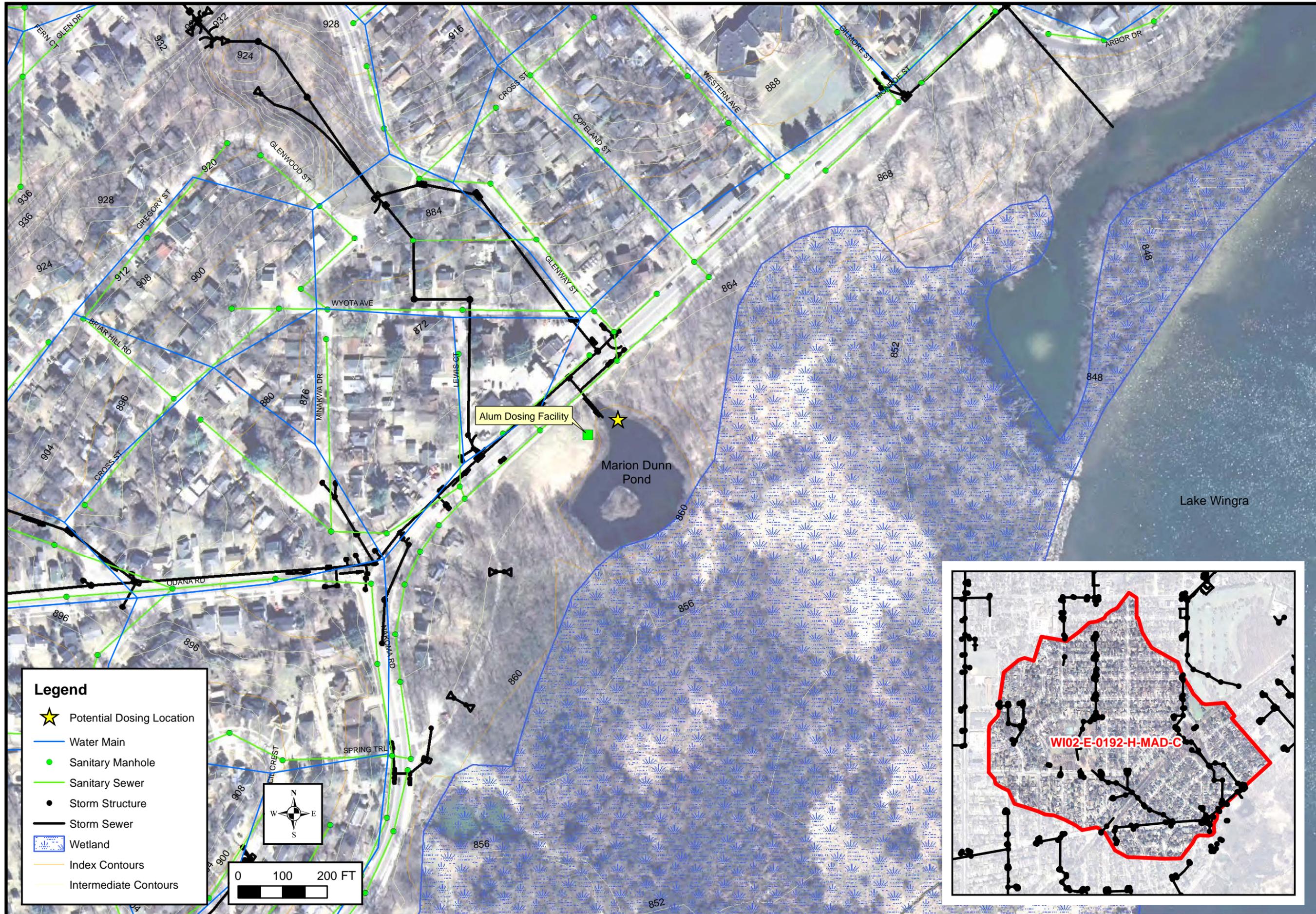
Project Location	Average Flow (ft ³ /sec)	Average Influent Phosphorus Concentration (mg/L) ¹	Additional Annual Phosphorus Removal (lb/year)	Total 20-Year Present Worth Cost	Total 20-Year NPW Cost/Pound
Marion Dunn Pond	4.3	0.32	65	\$720,900	\$557
Manitou Pond	13.1	0.20	139	\$817,000	\$293
Odana Pond	15.6	0.32	146	\$1,317,000	\$451

¹From WinSLAMM modeling.

Table 4.04-2 Background Information and Budgetary Costs for Proposed Stormwater Pond Alum Treatment Projects

- a. Marion-Dunn Pond is located on the east side of Lake Wingra near the intersection of Monroe Street and Glenway Street. The pond has one inlet and two outlets. Figure 4.04-2 shows the vicinity of Marion-Dunn Pond and the proposed dosing facility and dosing location. To compare the Marion-Dunn Pond project to the other proposed treatment projects, the costs presented in Table 4.04-2 assume a new structure would be constructed and new equipment would be installed. The costs would likely be significantly reduced if the existing pilot project is converted to a permanent, full-scale project.
- b. Manitou Pond is located on the north side of the Nakoma Golf Club near the intersection of Manitou Way and Nakoma Road. The pond has two inlets and one outlet. An alum dosing facility would be constructed and alum would be pumped to each inlet (if deemed necessary). Figure 4.04-3 shows the vicinity of Manitou Pond and the proposed dosing facility and dosing location.
- c. Odana Pond is located on the west side of the Odana Hills Municipal Golf Course near the intersection of Whitney Way and the Beltline Highway. The pond has four inlets and one outlet. For this project, one alum dosing facility would be constructed and alum would be pumped to each of the four inlets (if deemed necessary). Figure 4.04-4 shows the vicinity of Odana Pond and the proposed dosing facility and dosing locations. It should be noted that there are two Odana Ponds, the upstream Main Odana Pond and the downstream Secondary Odana Pond. The upstream Main Odana Pond is considered a water of the state and is the pond from which water is drawn to feed the Odana Golf Course Infiltration Facility. As a water of the state, it is anticipated that there would be significant regulatory hurdles associated with an alum treatment facility at the upstream Main Odana Pond. Likewise, chemical dosing of water that will feed the Odana Golf Course Infiltration Facility is also a concern. For purposes of this plan, the upstream Main Odana Pond has been removed from further consideration as an alum treatment facility. However, chemical dosing of the downstream Secondary Odana Pond may still present opportunities for chemical treatment of stormwater based on the understanding that it is not a water of the state and that water is not drawn from it for the Odana Golf Course Infiltration Facility.

It is anticipated that each pond would be dosed so that the majority of the settling would occur in the forebay. The sediment would remain in the pond and be periodically removed by dredging. The costs presented in Table 4.04-2 assume sediment would be hauled and spread on agricultural land to an area of low soil test phosphorus or outside the watershed.

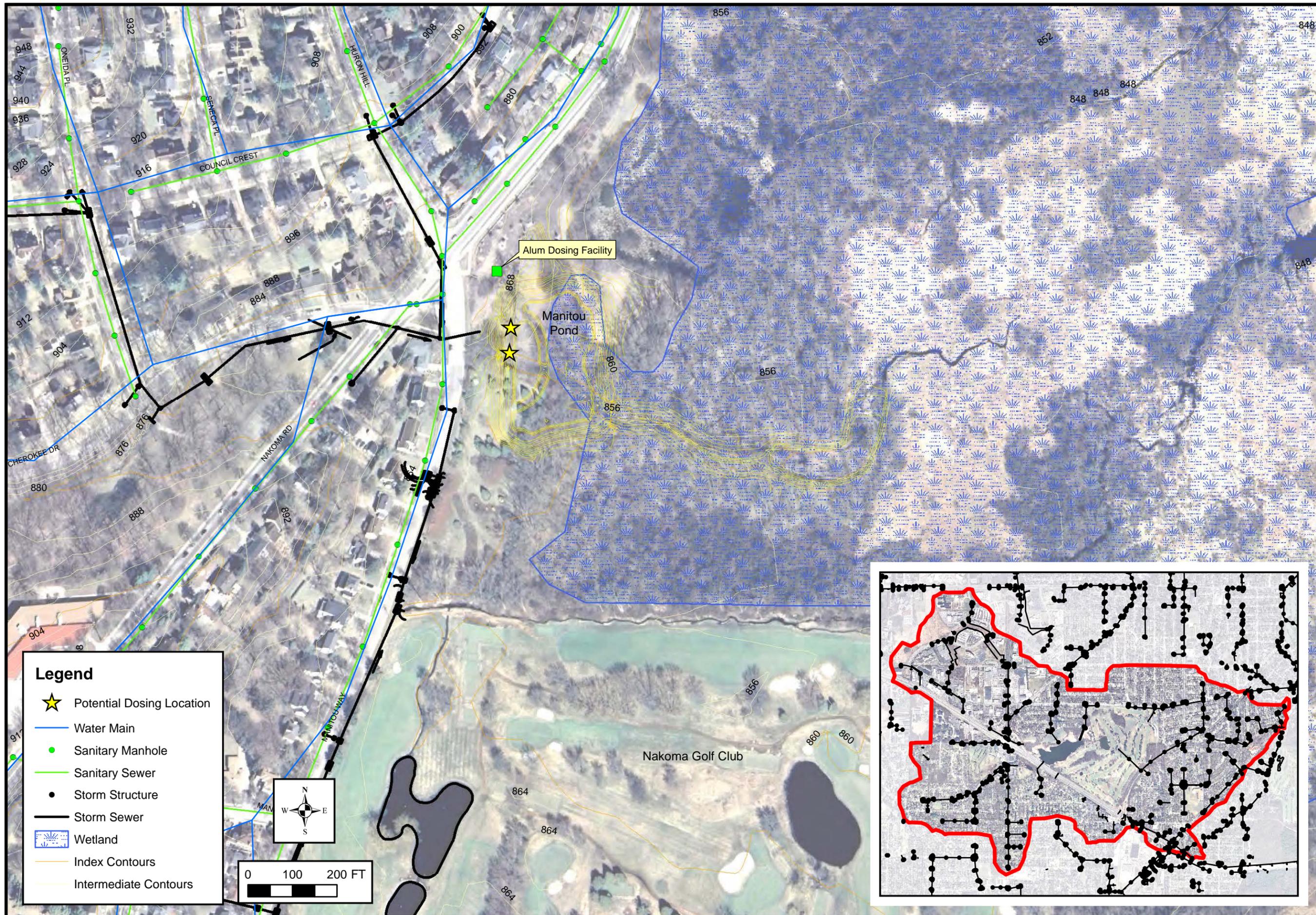


MARION-DUNN POND ALUM TREATMENT

LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 4.04-2
 1020.065



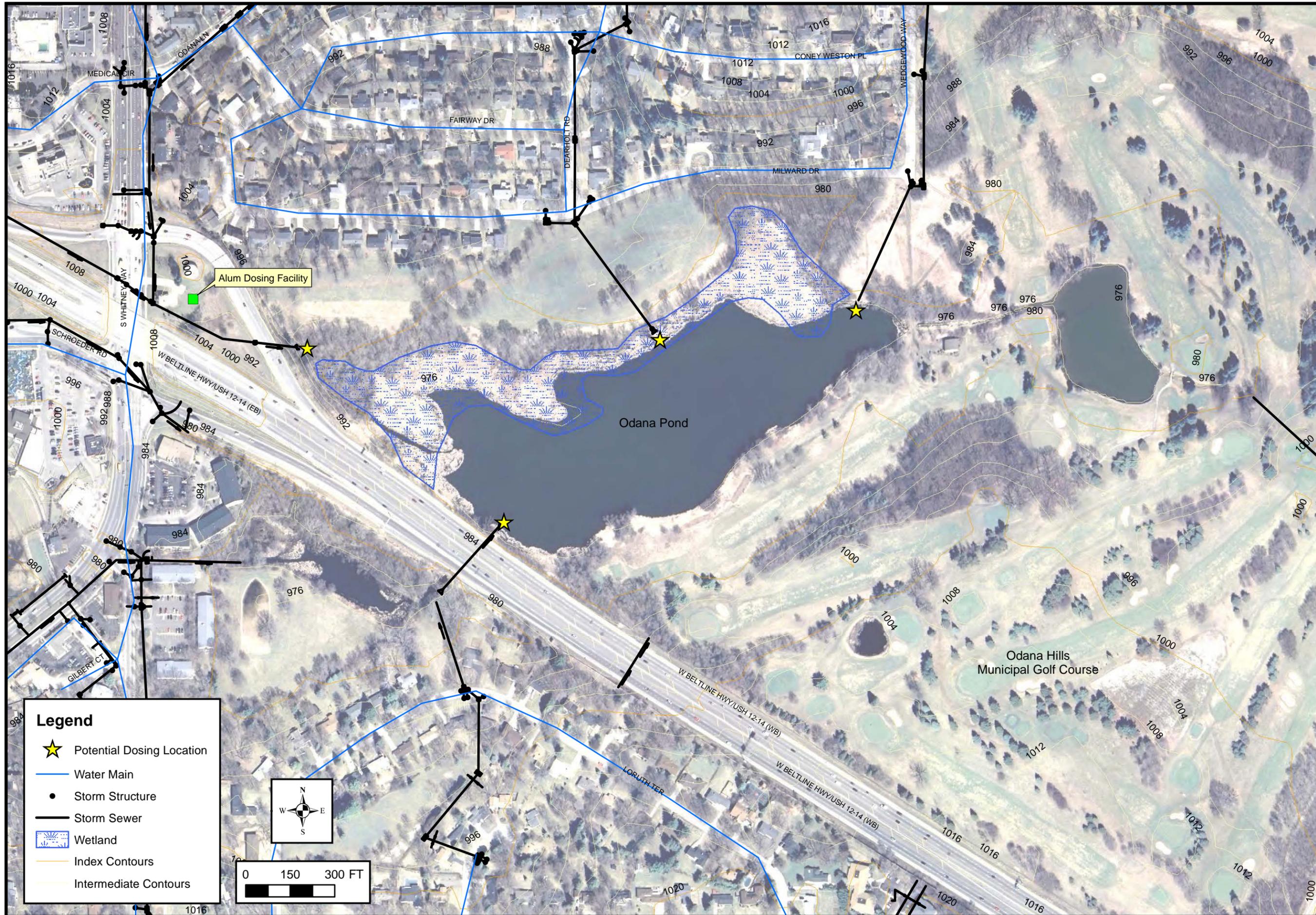
Legend

- ★ Potential Dosing Location
- Water Main
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Wetland
- Index Contours
- Intermediate Contours

MANITOU POND ALUM TREATMENT
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 4.04-3
1020.065



ODANA POND ALUM TREATMENT

LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN

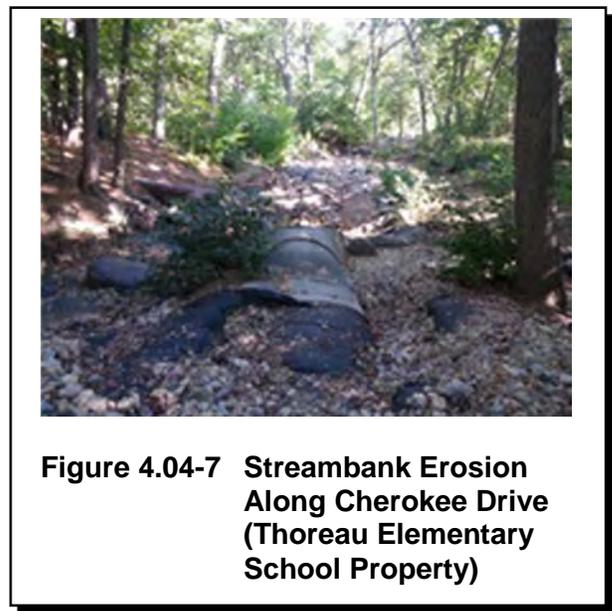
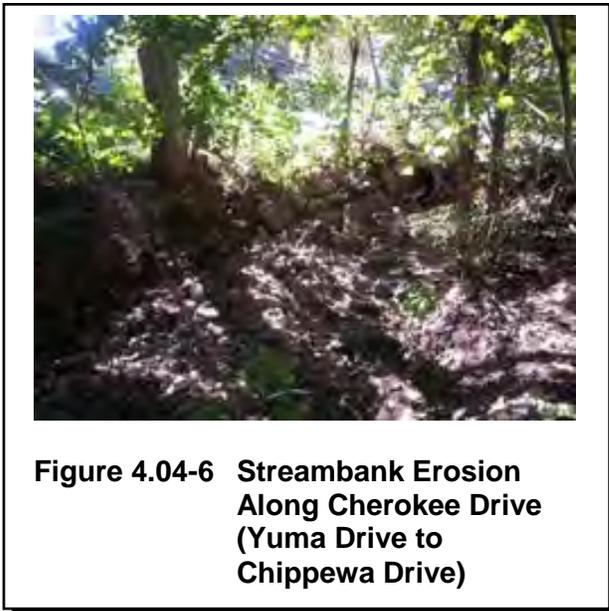


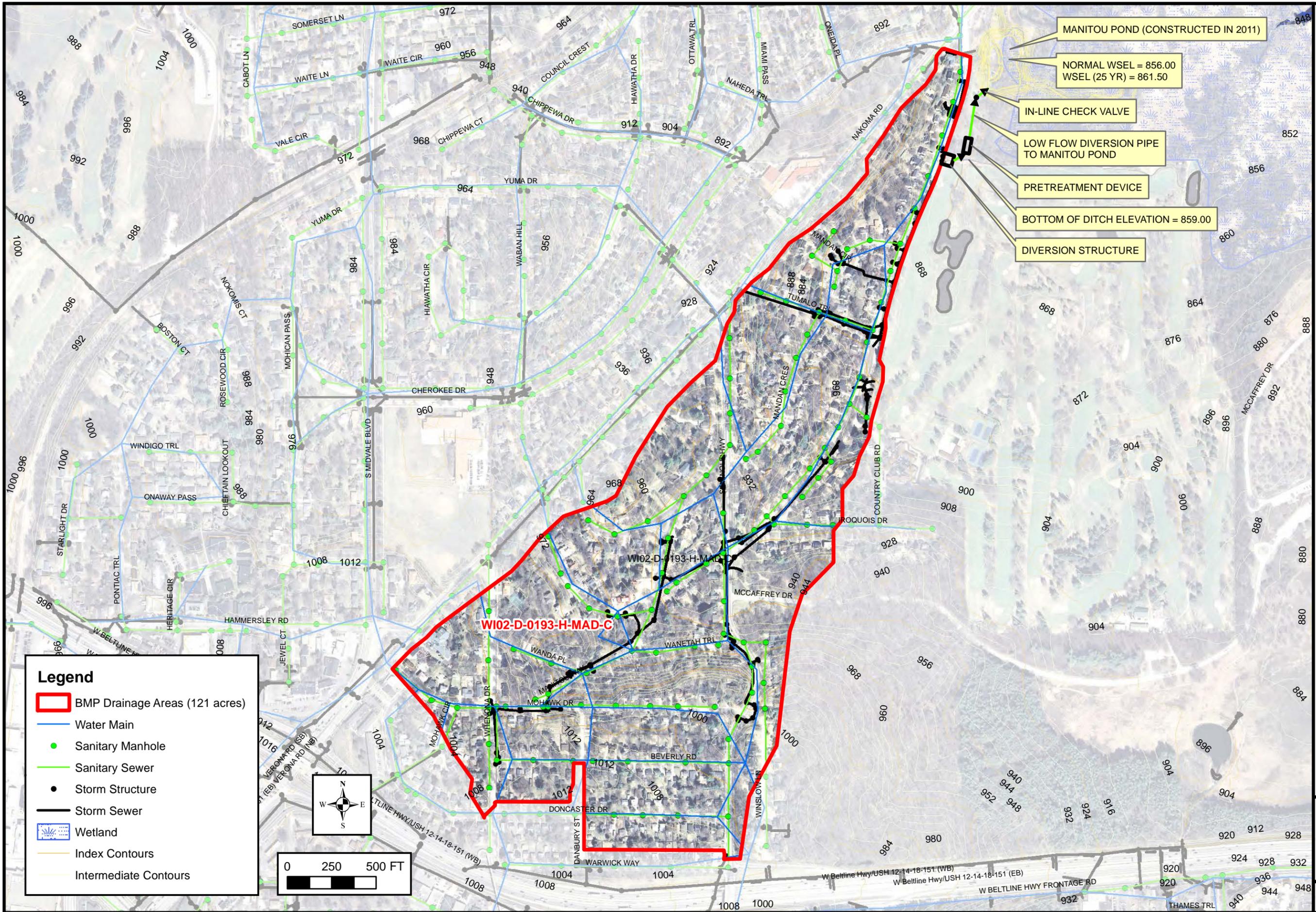
FIGURE 4.04-4
 1020.065

2. Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond—Currently an underserved basin, Basin W102-D-0193-H-MAD-C achieves a 3.6 percent TP and 19.5 percent TSS reduction resulting from street sweeping and sumps. Providing additional treatment to this drainage basin by way of diversion of low flows from this basin to Manitou Pond appears to be a cost-effective way to provide additional stormwater quality treatment to this drainage basin. Figure 4.04-4a shows Manitou Pond that was constructed in 2011 and Figure 4.04-5 shows the drainage basin and improvements necessary to provide the diversion. A stormwater pretreatment device (that removes sand, floatables, and oil and grease) is proposed to reduce dredging maintenance needs in the pond.



3. Streambank Restoration—Field reconnaissance was completed in the fall of 2013 to determine areas of significant erosion of streambanks. Two locations were identified along Cherokee Drive in the general vicinity of Thoreau Elementary School where open channels convey stormwater. Restoration of these channel segments will reduce the TP and TSS loads to Manitou Pond and ultimately to Lake Wingra. Figures 4.04-6 and 4.04-7 show pictures of the areas experiencing streambank erosion. Figure 4.04-8 shows the watershed draining to these streambanks and the area proposed for restoration.

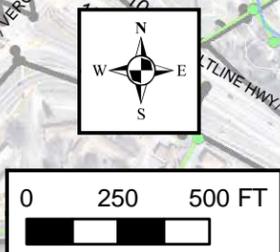




- MANITOU POND (CONSTRUCTED IN 2011)
- NORMAL WSEL = 856.00
WSEL (25 YR) = 861.50
- IN-LINE CHECK VALVE
- LOW FLOW DIVERSION PIPE TO MANITOU POND
- PRETREATMENT DEVICE
- BOTTOM OF DITCH ELEVATION = 859.00
- DIVERSION STRUCTURE

Legend

- BMP Drainage Areas (121 acres)
- Water Main
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- ▨ Wetland
- Index Contours
- Intermediate Contours

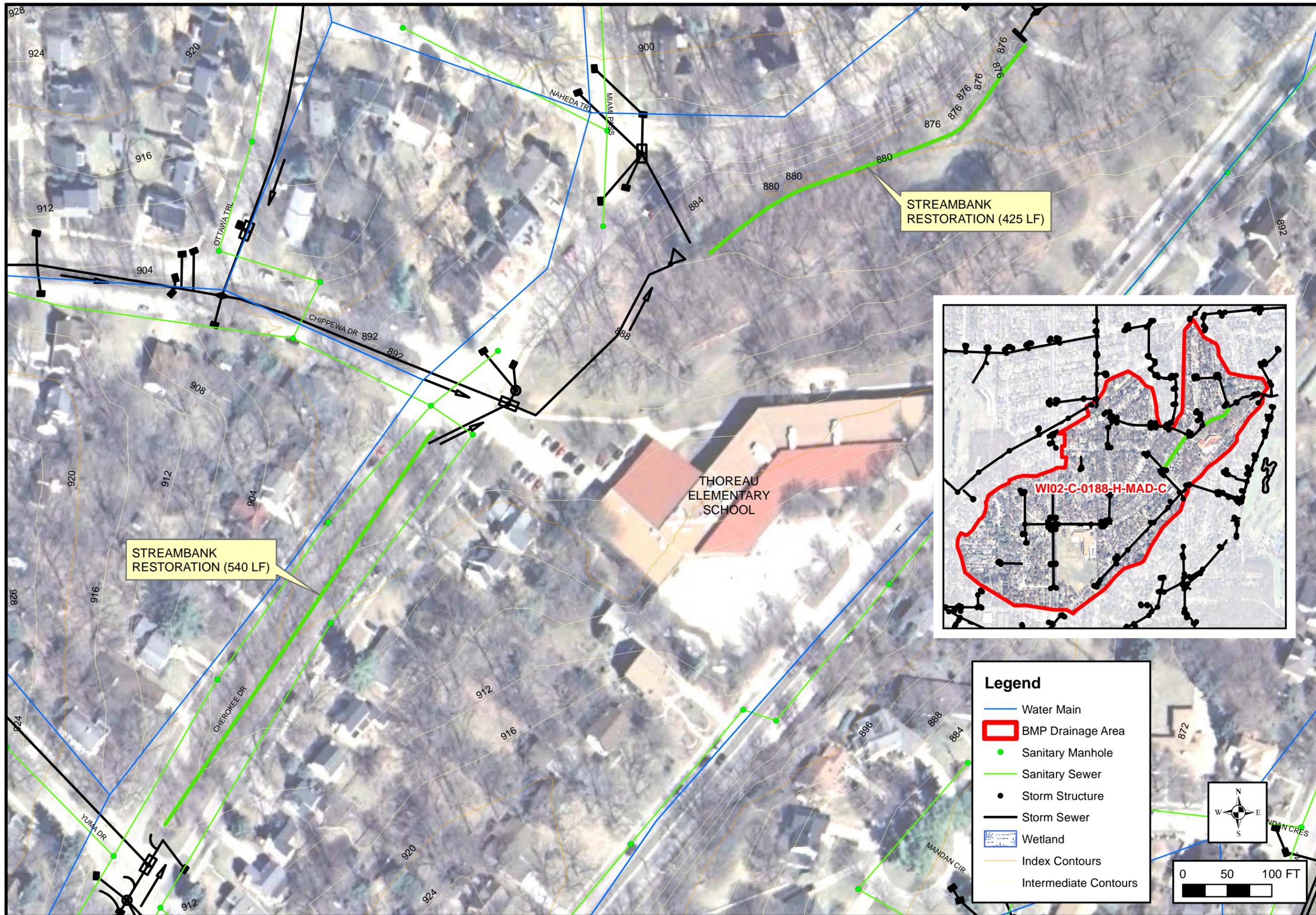


MANITOU POND DIVERSION

LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 4.04-5
1020.065



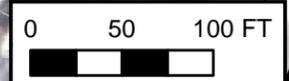
STREAMBANK RESTORATION (540 LF)

STREAMBANK RESTORATION (425 LF)

THOREAU ELEMENTARY SCHOOL

Legend

- Water Main
- BMP Drainage Area
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Wetland
- Index Contours
- Intermediate Contours



STREAMBANK RESTORATION

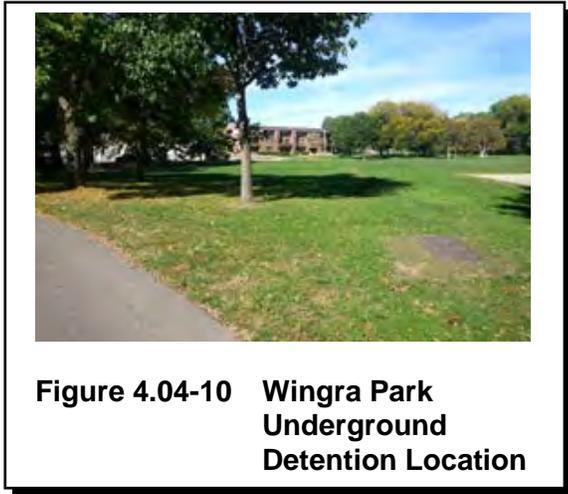
LAKE WINGRA WATERSHED MANAGEMENT PLAN
CITY OF MADISON
DANE COUNTY, WISCONSIN



FIGURE 4.04-8
1020.065

At the public meetings for this project, it was suggested that the City consider incorporation of the Regenerative Stormwater Conveyance (RSC) concept into the Cherokee Drive project area. This is a relatively new stormwater management concept consisting of a step pool conveyance system incorporating specifically designed media (i.e., wood chips and sand) focused on nutrient removal. The City recently incorporated this concept into a streambank restoration project in Owen Park. While not specifically identified in this report, it was also discussed that Glenwood Park is in need of streambank restoration but that consensus is needed on a streambank restoration technique.

4. Wingra Park Wet Pond—As shown on Figure 4.03-5, Basin W103-A-0322-A-MAD-C is currently an underserved basin achieving a 2.2 percent TP and 14.1 percent TSS reduction. An underground wet detention basin achieving a 60 percent TSS reduction and a 44 percent TP reduction is proposed as shown in Figure 4.04-9. Figure 4.04-10 shows a picture of the approximate location of the underground wet detention basin. This basin could be an aboveground basin if dedication of this land for stormwater treatment would be considered acceptable.



5. Modified Leaf Collection Methods—There have been a number of studies on the impact of urban pollen, seed, and leaf management on water quality, including one completed in the Madison area. Generally, these studies have shown that when trees shed pollen, seeds, and leaves onto impervious surfaces and rainfall then occurs, phosphorus leaches from the plant materials and is carried with the stormwater. Certain rainfall events can also transport the leaves directly to waterbodies. Table 4.04-3 shows the assumptions made for purposes of this report regarding modified leaf collection methods.

Condition	TP (lbs)
Phosphorus Content in Leaves Collected Annually	564 lbs
Assumed Portion of Phosphorus Collected Leached Out Before Collection (30 percent)	169 lbs
Additional Phosphorus Collected Because of Modified Leaf Collection Methods (50 percent of Currently Leached Before Collection)	85 lbs
Estimated Current Annual Leaf Collection Cost in Wingra Watershed	\$70,148
Estimated Increased Annual Cost For Modified Leaf Collection Methods (50 percent Increase)	\$57,000
Total 20-Year Present Worth	\$229,065
Cost Per Pound Phosphorus Removed	\$135

Table 4.04-3 Wingra Watershed Leaf Collection



Legend

- BMP Drainage Areas (112 acres)
- Water Main
- Sanitary Manhole
- Sanitary Sewer
- Storm Structure
- Storm Sewer
- Wetland
- Index Contours
- Intermediate Contours



0 200 400 FT



WINGRA PARK POND
 LAKE WINGRA WATERSHED MANAGEMENT PLAN
 CITY OF MADISON
 DANE COUNTY, WISCONSIN



FIGURE 4.04-9
1020.065

In Madison, citizens are asked to keep their leaves in piles on their lawn near the street (or on the “terrace”); see Figure 4.04-11. This delivers the leached phosphorus to the soils where it tends to remain and may benefit the lawn. Leaves are picked up every two to three weeks so the residents need to manage the piles and try to keep them from blowing into the street. Fitchburg requires residents to bag their leaves, which helps prevent blowing and nutrient leaching and, in Fitchburg’s case, also helps with collection. The City of Champaign, Illinois, also requires city-wide bagging of leaves in 32-gallon paper “yard waste” bags



Figure 4.04-11 Typical Fall Leaf Collection View

collected by a contractor hired by the City. This was prompted by budget and staffing cuts and was less expensive than traditional leaf collection methods. More details can be found at the following Web site: <http://ci.champaign.il.us/departments/public-works/residents/yard-waste-collection/>

Models that are currently used for stormwater management planning in the watershed (SLAMM and P8) do not provide credit for phosphorous removal through leaf management. This is an area that requires further study and quantification so that municipalities can obtain appropriate credit for the TSS and TP reductions, for example to assist with compliance with the Rock River TMDL waste load allocations. The quantity of phosphorus diverted should be refined as additional information becomes available from ongoing studies. For purposes of this study, we made some assumptions about phosphorus content of leaves, delivery factors, and cost of additional collection per pound of phosphorous diverted from the lakes; this should be refined following additional studies.

The City is participating with the WDNR and USGS in a pilot study of leaf collection techniques in three residential neighborhoods. Each neighborhood has its leaves managed differently. The first is a minimal level of service to show what would happen if the city and the residents did next to nothing beyond picking up the leaves occasionally. The second is the current level of service employing regular street sweeping, leaves stored on the terrace, and street sweepers following the collection activities as closely as possible. The third is the maximum level of service to reduce leaf-related runoff where residents would be asked to collect leaves from their lawns and the gutters and bag them in compostable bags that would be hauled away by the city. The results of this pilot study should be used to support adding this method of phosphorus diversion into stormwater management planning models.

At the public meetings for this project, there was discussion relative to methods that could be considered for improved leaf collection including having a leaf mulcher/bagger available for rental at the Sequoya Library (perhaps owned by the Friends of Lake Wingra) and identification of volunteer groups that would be available for leaf bagging

assistance (i.e., high school students). Additionally, there was discussion relative to investigation into a manufactured product that is more environmentally friendly than bags for leaf bagging and promotion of covering leaf piles with tarps to keep leaves in place.

6. Modified Street Sweeping Methods/Schedule—According to WDNR-supplied data, many MS4s in the Yahara River watershed sweep streets (16 communities) and many, mostly towns, do not sweep (six communities) or have not recorded the data (one community). This data is valuable in calculating an amount of phosphorus currently being diverted from the watershed and that is already accounted for in the baseline loadings for each lake. By assuming that a 20 percent increase in the amount of street sweeping completed is feasible, an additional amount of phosphorus reduction can be calculated. Assuming that street sweepings contain approximately 0.03 percent phosphorus, calculations show that a modest amount of additional phosphorus can be diverted from the lakes. Table 4.04-4 shows the assumptions made for purposes of this report regarding modified street sweepings collection methods.

Condition	TP (lbs)
Phosphorus Content in Street Sweepings Collected Annually	194 lbs
Additional Phosphorus Collected Because of Modified Street Sweepings Collection Methods (20 Percent)	39 lbs
Estimated Current Annual Street Sweeping Cost in Wingra Watershed	\$95,008
Estimated Increased Annual Cost For Modified Street Sweeping Methods (50 Percent Increase)	\$47,504
Total 20-Year Present Worth	\$804,900
Cost Per Pound Phosphorus Removed	\$1,032

Table 4.04-4 Wingra Watershed Street Sweepings Collection

Street sweepings generally consist of street dirt accumulation and sand applied as part of municipal deicing operations. Studies have been completed documenting the effectiveness or lack of effectiveness of street sweeping at providing significant stormwater quality benefit. Calculations herein show that increasing street sweeping by 20 percent has a small potential for phosphorus reduction with a low cost-effectiveness when compared to other BMPs. Current street sweeping efforts (Figure 4.04-12), by keeping our communities clean and providing a modest stormwater quality benefit, should continue.



Figure 4.04-12 Street Sweeper

At the public meetings for this project, it was suggested that winter parking regulations should be in effect year-round to support street sweeping efforts, especially in areas with no downstream wet detention basins.

7. **Pet Waste Enforcement**—Although our citizens already do a very good job of collecting pet waste in the watershed, even further reduction could be seen through increased regulation/enforcement or improved access to pet waste disposal locations in popular dog walking areas. A stricter ordinance combined with better education (Figure 4.04-13), a convenient way to dispose of the waste, and enforcement could reduce phosphorus loadings significantly. This may particularly be true during runoff events when the ground is frozen, since studies have found that many pet owners do not remove pet wastes from their yards in the winter. For purposes of this study, it is assumed that only 10 percent of pet owners do not pick up pet waste, and that through ordinance and stricter enforcement, this could be reduced. It is assumed that one limited-term employee at a total municipal cost of \$45,000 a year would be required to administer this program. The staff costs are lower because the necessary qualifications for this position are lower than other positions. Enforcement of this action item may be challenging unless, or even if, ordinances are carefully written. A social marketing campaign whereby public behaviors are changed may provide better cost-effectiveness.



At the public meetings for this project, it was discussed that consideration should be given to the environmental effects of bagging waste (i.e.: bag and pet waste, not just pet waste). This may include logistics related to flushing pet waste down the toilet.

8. **Wetland Harvesting**—Wetlands clean stormwater, provide green space in an urban environment, and provide wildlife habitat. The accumulation of phosphorus in the wetland soils occurs as the wetland cleanses stormwater. Some of this phosphorus is taken up by wetland plants, which provides an opportunity to lower the level of phosphorus in the soil by “mining down” soil phosphorus levels through harvesting the plants. For purposes of this study, we have assumed that equipment, similar to that shown in Figure 4.04-14, would need to be purchased (and replaced after 10 years) and that urban wetlands designated for phosphorus collection and mining in either existing wetlands or new areas would be harvested once every year for a period of 20 years for each unit of application. Harvested wetland plants may be used for a beneficial use such as a biomass aggregator (e.g.: Virent, Inc.) or other end-user. Compared to other urban BMPs, harvesting wetland plants may be a relatively cost-effective means of reducing phosphorus to the lakes.

At public meetings for this project, it was discussed that the following items should be considered with wetland harvesting:

- a. Sensitivity to timing in relation to wildlife impacts.
- b. Align harvesting with invasive species control.
- c. Align program with harvestable buffer program regarding end-use of materials.
- d. Potential to feed a biodigester.



From a delivery factor standpoint, phosphorus sequestered in wetlands is not considered significantly mobile other than potentially after more extreme storm events. Therefore, a delivery factor of 0.03 was used for this action item.

For purposes of this plan, performance of cattail harvesting was evaluated with the assumptions shown in Table 4.04-4a.

Measure	Assumptions
Wetland harvesting	<ul style="list-style-type: none"> ▪ Wetlands surrounding Lake Wingra = 23 acres ▪ Harvest 20% of these wetlands to mine down TP in soils ▪ Dry biomass/acre yield = 18.2 tons/acre ▪ Plant P content = 0.824% of dry biomass weight ▪ P removed = 1,380 lbs ▪ Delivery Factor= 0.03 ▪ P removed from being mobile = 41.4 lbs

Table 4.04-4a Wetland Harvesting Assumptions

9. Waterfowl Management–The City has been actively monitoring, studying, and managing giant Canada geese populations in select locations within the City (Figure 4.04-15). This has included oiling of eggs and active management of geese, for example actively managing 200 geese in the summer of 2011. Continuation of this program to manage 50 geese in the Wingra Watershed was considered. Calculations were completed for active management of 50 geese with research showing that goose droppings contain approximately 0.175 lb/phosphorus/year/goose.



Figure 4.04-15 Geese Along the Shore of Lake Wingra

10. Construction Site Erosion Control Enforcement–This action item involves increased staff support (one limited-term employee). The associated cost to the City was assumed to be \$45,000. The impact of this activity on phosphorus diversion is difficult to quantify; however, a cost per pound of phosphorus diverted was developed based primarily on assumptions from the Yahara CLEAN MOU staff.

There will be a point of diminishing returns on erosion control inspection and enforcement that the City may eventually reach and that could reduce the annual pounds diverted from the lakes in the future. Either initially or when that point of diminishing returns is reached, it may be appropriate to scale back City staff time and require self-reporting instead. A self-reporting example provided by the City staff is the WDNR Green Tier program in which contractors self-report and provide weekly photo documentation of the site. The City currently requires this for sites with more than 20,000 feet of disturbance, as well.

An example of a construction site erosion control BMP is shown in Figure 4.04-16.



Figure 4.04-16 Example Construction Site Erosion Control BMP

For purposes of this plan, performance of porous pavement was evaluated with the assumptions shown in Table 4.04-4b.

Measure	Assumptions
Enhanced erosion control enforcement	<ul style="list-style-type: none"> ▪ Yearly active construction site area open to disturbance = 12.33 acres (according to City of Madison records) ▪ Portion of active construction site area non-compliant = 2.5 ares ▪ Uncontrolled construction site sediment release = 30 T sediment/acre/year (per UW-Extension publication). ▪ Dane County Erosion Control Ordinance requires no greater than 7.5 T sediment/acre/year release. ▪ 100% compliance = 22.5 T sediment/acre/year (30-7.5) controlled ▪ 50% better compliance is achievable on non-compliant acreage (22.5 x 0.5 = 1.25 T sediment/acre/year) ▪ 2.5 acres x 11.25 T sediment/acre/year x 5 lbs TP / T sediment = 139 lbs TP.

Table 4.04-4b Enhanced Erosion Control Enforcement Assumptions

C. Alternatives

A total of seven alternatives are described below. Alternatives 1 through 5 assume that all Infiltration BMPs described in Table 4.03-6 will be implemented in addition to the mix of phosphorus BMPs in the respective alternative. Alternative 6 (as a modification of Alternative 1) assumes 75 percent of the Infiltration of BMPs are implemented and that the remaining infiltration BMPs are implemented in a to-be-determined fashion at an increased cost (30 percent cost adder). Alternative 7 (as a modification of Alternative 1) assumes 50 percent of the infiltration of BMPs are implemented and that the remaining infiltration BMPs are implemented in a to-be-determined fashion at an increased cost (30 percent cost adder).

1. Alternative 1–Table 4.04-5 shows the components of Alternative 1.

Facility	TP Reduction Performance (lb)	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
All Infiltration BMPs (See Table 4.03-6)	121.6	\$ 10,225,800	\$ 14,462,700	\$ 5,352
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672
Modified Leaf Collection Methods (\$47,000 Year 1 Capital Cost + \$10,000 Annual Operation Cost, thereafter)	84.6	\$ 57,000	\$ 229,100	\$ 135
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006
Total	230.4	\$ 10,811,900	\$ 15,267,900	\$ 3,310
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	12.4			

Table 4.04-5 Alternative 1 Cost and Performance

2. Alternative 2–Table 4.04-6 shows the components of Alternative 2.

Facility	TP Reduction Performance (lb) at 0.5 in/hr	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
All Infiltration BMPs (See Table 4.03-6)	121.6	\$ 10,225,800	\$ 14,462,700	\$ 5,352
Alum Addition At Manitou Pond	139.4	\$ 287,300	\$ 817,200	\$ 293
Total	261.0	\$ 10,513,100	\$ 15,279,900	\$ 2,930
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	43.0			

Table 4.04-6 Alternative 2 Cost and Performance

3. Alternative 3–Table 4.04-7 shows the components of Alternative 3.

Facility	TP Reduction Performance (lb) at 0.5 in/hr	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
All Infiltration BMPs (See Table 4.03-6)	121.6	\$ 10,225,800	\$ 14,462,700	\$ 5,352
Alum Addition At Marion Dunn Pond	64.7	\$ 279,500	\$ 720,900	\$ 557
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)	13.3	\$ 369,000	\$ 369,100	\$ 1,391
Total	223.8	\$ 11,403,400	\$ 16,128,800	\$ 3,600
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	5.8			

Table 4.04-7 Alternative 3 Cost and Performance

4. Alternative 4–Table 4.04-8 shows the components of Alternative 4.

Facility	TP Reduction Performance (lb) at 0.5 in/hr	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
All Infiltration BMPs (See Table 4.03-6)	121.6	\$ 10,225,800	\$ 14,462,700	\$ 5,352
Construction Site (12.3 Acres) Erosion Control Enforcement (Enhanced)	138.7	\$ 55,000	\$ 931,900	\$ 335
Total	260.3	\$ 10,280,800	\$ 15,394,600	\$ 2,960
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	42.3			

Table 4.04-8 Alternative 4 Cost and Performance

5. Alternative 5–Table 4.04-9 shows the components of Alternative 5.

Facility	TP Reduction Performance (lb) at 0.5 in/hr	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
All Infiltration BMPs (See Table 4.03-6)	121.6	\$ 10,225,800	\$ 14,462,700	\$ 5,352
Wingra Park Wet Pond (60% TSS Reduction)	20.6	\$ 1,771,100	\$ 1,827,400	\$ 4,435
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)	13.3	\$ 369,000	\$ 369,100	\$ 1,391
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672
Wetland Harvesting (4.6 acres)	41.4	\$ 43,000	\$ 97,600	\$ 119
Total	221.1	\$ 12,938,000	\$ 17,332,900	\$ 3,920
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	3.1			

Table 4.04-9 Alternative 5 Cost and Performance

6. Alternative 6–Table 4.04-10 shows the components of Alternative 6.

Facility	TP Reduction Performance (lb)	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
75% of All Infiltration BMPs (See Table 4.03-6)	91.2	\$ 7,669,400	\$ 10,847,000	\$ 5,352
25% of All Infiltration BMPs (at 30% Greater Cost)	30.4	\$ 3,323,300	\$ 4,700,400	\$ 6,958
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672
Modified Leaf Collection Methods (\$47,000 Year 1 Capital Cost + \$10,000 Annual Operation Cost, thereafter)	84.6	\$ 57,000	\$ 229,100	\$ 135
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006
Total	230.4	\$ 11,578,800	\$ 16,352,600	\$ 3,550
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	12.4			

Table 4.04-10 Alternative 6 Cost and Performance

7. Alternative 7–Table 4.04-11 shows the components of Alternative 7.

Facility	TP Reduction Performance (lb)	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
50% of All Infiltration BMPs (See Table 4.03-6)	60.8	\$ 5,112,900	\$ 7,231,300	\$ 5,352
50% of All Infiltration BMPs (at 30% Greater Cost)	60.8	\$ 6,646,800	\$ 9,400,800	\$ 6,958
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	10.3	\$ 232,900	\$ 276,800	\$ 672
Modified Leaf Collection Methods (\$47,000 Year 1 Capital Cost + \$10,000 Annual Operation Cost, thereafter)	84.6	\$ 57,000	\$ 229,100	\$ 135
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200	\$ 299,300	\$ 1,006
Total	230.4	\$ 12,345,800	\$ 17,437,300	\$ 3,780
TP Reduction Gap to Meet Short-Term Goal	218			(average)
Difference	12.4			

Table 4.04-11 Alternative 7 Cost and Performance

D. Alternatives Analysis

Table 4.04-12 provides a side-by-side comparison of Alternatives 1, 2, 3, 4, 5, 6, and 7. Additional alternatives may be considered by mixing and matching alternatives presented in Table 4.04-1. Of the seven alternatives considered, Alternative 2 and 4 have the lowest OPCC and 20-Year NPW costs. Alternative 2 relies upon the infiltration projects and alum addition at Manitou Pond. Alternative 4 relies upon the infiltration projects and enhanced erosion control enforcement. The next most cost-effective project is Alternative 1 that relies on the infiltration projects, two structural phosphorous projects (diversion to Manitou Pond and streambank restoration), and one nonstructural phosphorus project (modified leaf collection). Alternative 3 relies on the infiltration projects and four structural projects (alum addition at Marion-Dunn Pond, diversion to Manitou Pond, and two streambank restoration projects). Alternative 5 is the least cost-effective of the five alternatives while relying on the infiltration BMPs, four structural phosphorus projects (Wingra Park Wet Pond, two streambank restoration projects, and diversion to Manitou Pond), and one nonstructural phosphorus project (wetland harvesting). From a cost and performance standpoint, Alternatives 1, 2, and 4 can be considered very similar. As described above, Alternatives 6 and 7 (as modifications of Alternative 1) contemplate partial implementation of the Infiltration BMPs and replacement of the remaining infiltration BMPs with less cost-effective BMPs.

Facility	TP Reduction Performance (lb) at 0.5 in/hr	OPCC	20-Year NPW Cost	20-Year NPW Cost/lb
Alternative 1	230	\$ 10,811,900	\$ 15,267,900	\$ 3,310
Alternative 2	261	\$ 10,513,100	\$ 15,279,900	\$ 2,930
Alternative 3	224	\$ 11,403,400	\$ 16,128,800	\$ 3,600
Alternative 4	260	\$ 10,280,800	\$ 15,394,600	\$ 2,960
Alternative 5	221	\$ 12,938,000	\$ 17,332,900	\$ 3,920
Alternative 6	230	\$ 11,578,800	\$ 16,352,600	\$ 3,550
Alternative 7	230	\$ 12,345,800	\$ 17,437,300	\$ 3,780

Table 4.04-12 Alternatives Comparison

E. Long-Term Goal Discussion

The long-term TP reduction goal is an 80 percent reduction in TP compared to no pollutant reduction controls. This is an ambitious goal that will serve to guide future efforts to further reduce TP loads in the watershed. Table 4.04-1 shows there are strategies and projects available that could contribute to achieving the long-term goal but not fully meet the goal, though some of the strategies have the potential to double-count the phosphorus reduction. Achievement of the goal may take major shifts in development patterns (e.g., conversion of curb and gutter streets to drainage via grass-lined swales), major implementation of source area phosphorus control BMPs (1000s of terrace rain gardens in the watershed) and/or identification and implementation of additional larger phosphorus control projects in the watershed. Once the short-term goal is met by providing 218 (121.6 from infiltration/phosphorus BMPs and 96.4 from phosphorus BMPs) pounds of TP removal, an additional 570 pounds of TP removal would be needed to meet the long-term goal as further described in Table 4.03-6.

4.05 SOCIAL MARKETING OPPORTUNITIES

In addition to Table 3.05-1, Table 4.05-1 lists the different alternative components to meet the short-term phosphorus reduction goal. These alternative components are a mix of projects and strategies. The projects and some of the strategies rely on City budgeting to provide a dedicated revenue source. Strategies such as modified leaf collection methods and pet waste enforcement rely on property owners to participate and lend themselves to social marketing strategies. The City’s Stormwater Utility Rate Adjustment Policy currently provides incentives for construction of stormwater BMPs by way of a reduction in the stormwater utility charge. It is recommended that this policy be periodically reviewed for effectiveness.

Facility	Responsible Party	Social Marketing Opportunity	Pilot Project Opportunity
Structural Improvements			
Alum Addition At Manitou Pond	City of Madison	City Project	No
Alum Addition At Marion Dunn Pond	City of Madison	City Project	Current Project
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond	City of Madison	City Project	No
Streambank Restoration at Henry David Thoreau School	City of Madison	City Project	No
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)	City of Madison	City Project	No
Wingra Park Wet Pond (60% TSS Reduction)	City of Madison	City Project	No
Nonstructural Improvements			
Wetland Harvesting (4.6 acres)	UW-Madison Arboretum	No	No
Modified Leaf Collection Methods	City of Madison/Residential Property Owners	Yes	Yes
Waterfowl Management (50 Geese Per Year)	City of Madison	Maybe	No
Construction Site (12.3 Acres) Erosion Control Enforcement (Enhanced)	City of Madison	Maybe	Maybe
Modified Street Sweeping Methods/Schedule	City of Madison	No	No
Pet Waste Enforcement	City of Madison	Yes	Yes

Table 4.05-1 Phosphorus Project-Based Social Marketing Opportunities

4.06 PROPOSED MANAGEMENT CHANGES TO ACHIEVE SHORT-TERM TP REDUCTION GOAL

Similar to management measures described in Section 3.06 for meeting the short-term infiltration goal, Table 4.06-1 describes potential management measures that could be implemented to achieve the short-term phosphorus reduction goal in the Lake Wingra watershed. The table also rates their implementation feasibility, potential effectiveness, and implementation priority. These ratings are a qualitative assessment to help provide an understanding of potential prioritization. Table 4.04-10 describes the seven alternatives considered for meeting the short-term phosphorus reduction goal. Management changes from Table 4.06-1 necessary to implement the pursued alternative components should be given the highest priorities.

Management Measure	Implementation Feasibility	Potential Effectiveness	Implementation Priority
Implement Dedicated Funding For City Projects Interaction with City of Madison Public Works, Engineering, Parks Departments to promote Lake Wingra Watershed projects. Goal to prioritize projects for inclusion in Capital Improvement Plans. Interact with Town of Madison for the Grandview Boulevard project.	+++	+++	+++
Modified City Leaf Collection Methods Provide additional strategies to increase participation in the program.	+++	+++	+++
Modified Street Sweeping Methods/Schedule Provide additional strategies to increase participation in the program.	++	++	++
Miscellaneous City TP Reduction Strategies Initiatives such as waterfowl management, construction site erosion control, and pet waste enforcement could be enhanced.	++	++	+ (+++for construction site erosion control)

Table 4.06-1 Proposed Management Change

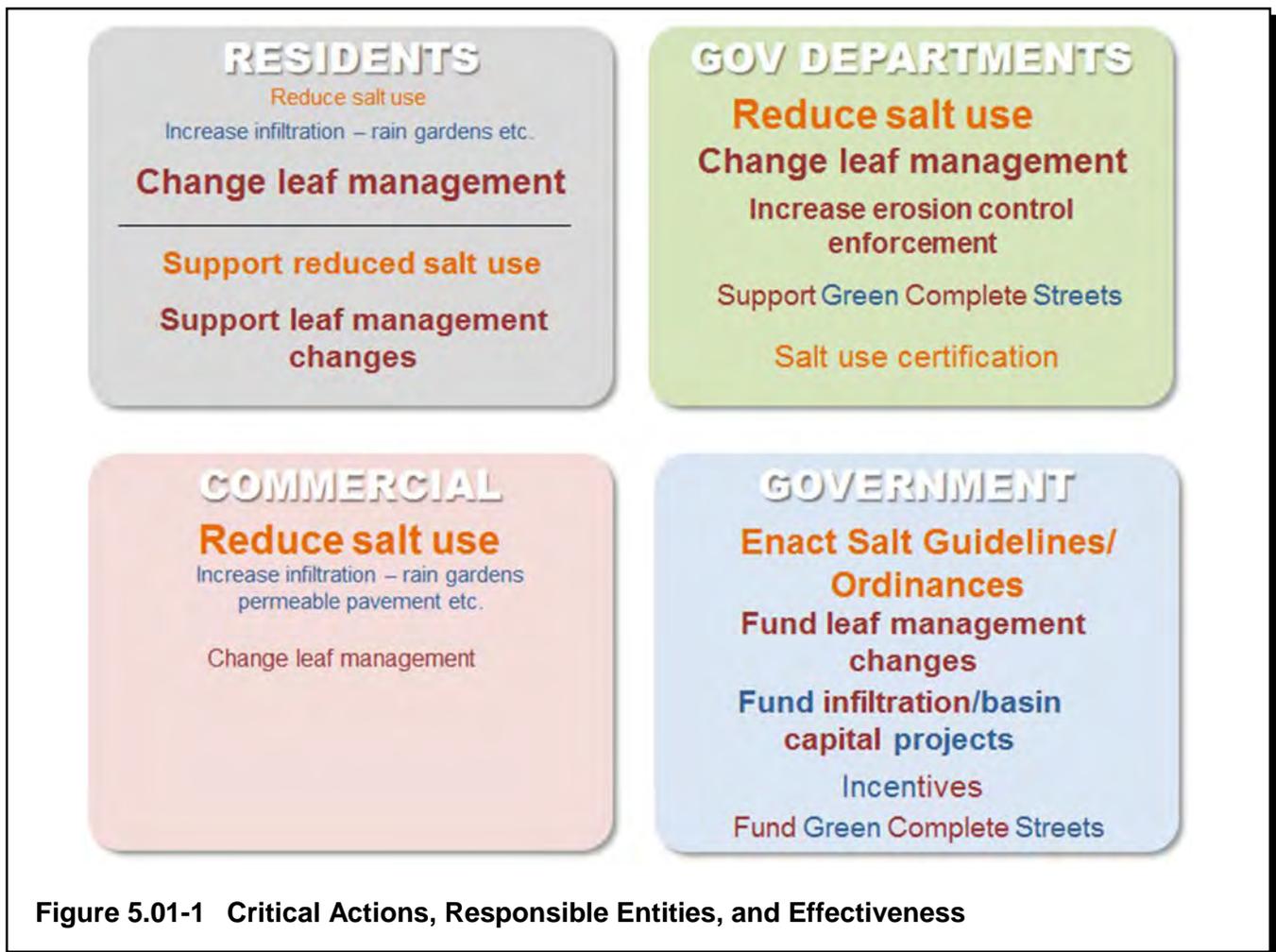
SECTION 5
ENGAGEMENT AND IMPLEMENTATION

5.01 INTRODUCTION

A. Introduction and Goals

The Lake Wingra Watershed Management Plan identifies the critical actions seeking to achieve the goals outlined in the 2009 document *Lake Wingra: A Vision for the Future*. These goals include: (1) clean, clear water, (2) restored spring flow, (3) abundant native plants and animals, and (4) stewardship and enjoyment.

The previous sections of this report identify critical actions that work toward achieving these goals. The critical actions have varying effectiveness and different responsible entities. The word cloud shown in Figure 5.01-1 illustrates the entities that influence Lake Wingra water quality, the measures they can influence, and the general effectiveness of the measure (by text size).¹



¹ The text size is meant to be illustrative and general for discussion purposes only.

Looking at chlorides, one can understand the complexity of the interaction. A resident can take strident measures to reduce salt use in the winter, yet residential properties only contribute about 1 percent of the chlorides reaching Lake Wingra. The concerned resident has limited influence over the two largest contributors, commercial applicators and city/county snow plowing crews. Conversely, commercial applicators and local government plowing crews could use less salt if residents and patrons would accept different winter pavement conditions. This interrelationship highlights how change is needed by all entities on all issues.

A positive dynamic is the numerous advocacy groups and government committees that support similar measures, yet with different objectives. For instance, MMSD currently is promoting reduced winter maintenance salt use within its service area. While benefiting the lakes, MMSD’s primary objective in reducing salt use is to prevent chlorides from infiltrating into the sanitary sewer. Similarly, Madison Water Utility’s support for reduced salt use is to limit the chloride levels in wells. A single supported measure, reducing salt use, can have many positive outcomes. Table 5.01-1 shows the different organizations and key objectives of the organization.

Organization	Objectives
Dane County Lakes and Watershed Commission	Reduce chlorides and phosphorus in Yahara chain of lakes.
Madison Public Health Dept.	Reduce bacteria levels
MMSD	Reduce chlorides in effluent
MMSD and Yahara WINs	Reduce phosphorus and total suspended solids
Clean Lakes Alliance	Improve water quality in Yahara watershed (reduced phosphorus)
Yahara Lakes Association	Waterfront property issues, Yahara Lakes water quality (reduced phosphorus)
Madison Area Municipal Stormwater Partnership (MAMSWAP)	Permitting, reduce stormwater discharge pollution including phosphorus, total suspended solids, and chlorides
City of Madison Engineering	Reduce phosphorus, chlorides, and increase infiltration.
Friends of Lake Wingra (FOLW)	Phosphorus, infiltration, and chlorides, within Wingra watershed

Table 5.01-1 Organizations with Similar Objectives

5.02 COLLABORATIVE EFFORTS

The numerous organizations and initiatives throughout the Yahara Lakes and Rock River Basin provide the opportunity for partnerships, capitalizing on joint efforts. The following paragraphs describe types of collaborative efforts proposed for the watershed plan engagement and implementation.

A. Pilot Projects

Most changes in legislation, policy, or management require a track record of success, both in implementation and effectiveness. Pilot projects are an excellent way to build this track record. The small scale implementation trial allows managers the opportunity to work out bugs/logistics of implementing a measure. Pilot projects oftentimes include an effectiveness evaluation, providing data on the merits of the project. The Lake Wingra watershed could host pilot projects that align with objectives of the above-listed organizations. Advantages of using the Lake Wingra Watershed for pilot projects include the following:

1. The watershed is made up of well-organized neighborhoods.
2. Many residents already have an environmental stewardship ethos.
3. The watershed has a dedicated advocacy organization focused on Lake Wingra watershed water quality.
4. The watershed provides a smaller water-body for evaluation.

B. Governmental Advocacy

There are numerous water quality issues being discussed within the City and Dane County government committee structure. For example, Dane County’s Lakes and Watershed Commission has been discussing the use of chlorides in winter maintenance and Madison’s Committee on the Environment is scheduled to review chloride use. As these regional water quality and management issues are discussed in the government setting, the benefits could be experienced within the Lake Wingra Watershed. Therefore Lake Wingra residents and advocates could support initiatives within the government committee structure. Table 5.02-1 lists possible critical actions, the government department responsible for management of that action, and the corresponding government committee associated with that government department. Some government departments, such as Madison Streets, report directly to the mayor and do not have an associated government committee. Interacting with these departments may require interacting with appropriate council members and the mayor’s office.

Responsibility	Associated Government Committee	Government Department	Critical Action
Madison Mayor/ Common Council	None	Madison Streets	Madison street salt usage Madison leaf management Madison street sweeping
	None	Planning and Community and Economic Development, Building Inspection	Private development erosion control
	Board of Public Works	Madison Engineering	Stormwater basin construction Alum treatment Stream bank stabilization Street construction erosion control Green street construction Terrace rain garden construction Infiltration facilities Wildlife management (carp and geese)
County Executive (Board of Supervisors)	Board of Public Works (Lakes and Watershed Commission)	Dane County Public Works	Highway salt usage Wetland harvesting
County Board of Supervisors	Lakes and Watershed Commission		Fertilizer Phosphorus Ordinance TSS
Madison Common Council or Dane County Board of Supervisors			Salt ordinances

Table 5.02-1 Governmental Advocacy Structure

C. Interdepartmental Partnerships

Table 5.02-1 illustrates the importance of interdepartmental partnerships. The Madison Engineering department is largely responsible for water quality (MS4 permit and TMDL compliance) and the corresponding measures needed to reduce water pollutants. Yet Madison Engineering is not directly responsible for measures that influence water quality, such as street sweeping and leaf management. Similarly, some critical actions being proposed by this watershed management plan, such as commercial applicator certification for winter snow maintenance or maximum salt use guidelines, do not necessarily fall under any government department. Because of this organizational structure, it is difficult for a city department to unilaterally act on a specific measure. Partnerships between departments are needed to move on these water quality measures. These collaborative efforts are already occurring, such as in the leaf management pilot project. Even greater collaboration will be needed to achieve the goals of the watershed plan.

D. Neighborhood Organizations

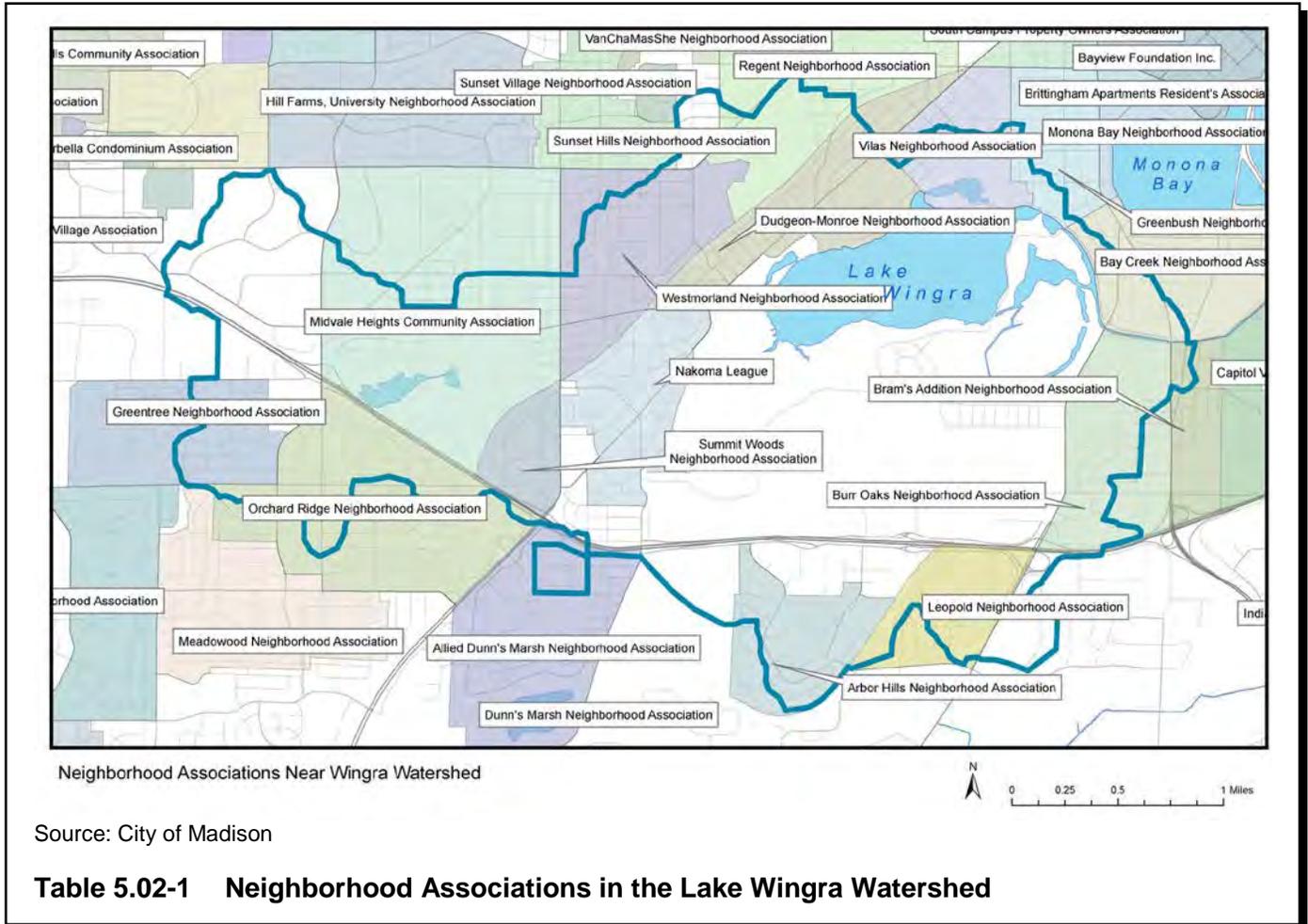
There are many neighborhood organizations within the Wingra Watershed. Their role is important because they influence the priorities of their representative alderpersons. The Wingra Watershed plan requires changes in budget priorities, management practices, and the behavior of watershed residents. Neighborhood support is essential for movement on these initiatives. City budget, policy, and management are influenced by elected representatives. An alderperson's/supervisor's priorities reflect those of their constituents, which most often are voiced by neighborhood associations. As these critical actions become priorities to residents, often voiced through the neighborhood organizations, they become priorities to the elected officials and momentum builds toward implementing the measures.

Additionally, some critical actions require behavior and management changes by residents within the watershed. Members within neighborhood organizations are leaders within their community and are best-suited to communicating information and changing norms. Implementation of the full watershed plan can only occur by having neighborhood organizations fully engaged in the process.

The Watershed Plan process has and will have several meetings with neighborhood organizations. Neighborhood organization interaction will need to continue to achieve the watershed plan goals. The following is a list neighborhood organizations within the watershed as illustrated in Figure 5.02-1.

1. Arbor Hills
2. Burr Oaks
3. Dudgeon-Monroe
4. Faircrest
5. Greenbush
6. Greentree
7. Hill Farms University
8. Midvale Heights Community Association
9. Nakoma League
10. Orchard Ridge Community Club
11. Regent
12. Summit Woods

- 13. Sunset Hills
- 14. Sunset Village
- 15. Vilas
- 16. Westmorland
- 17. South Metropolitan Business Association
- 18. Bay Creek Neighborhood
- 19. Friends of Lake Wingra

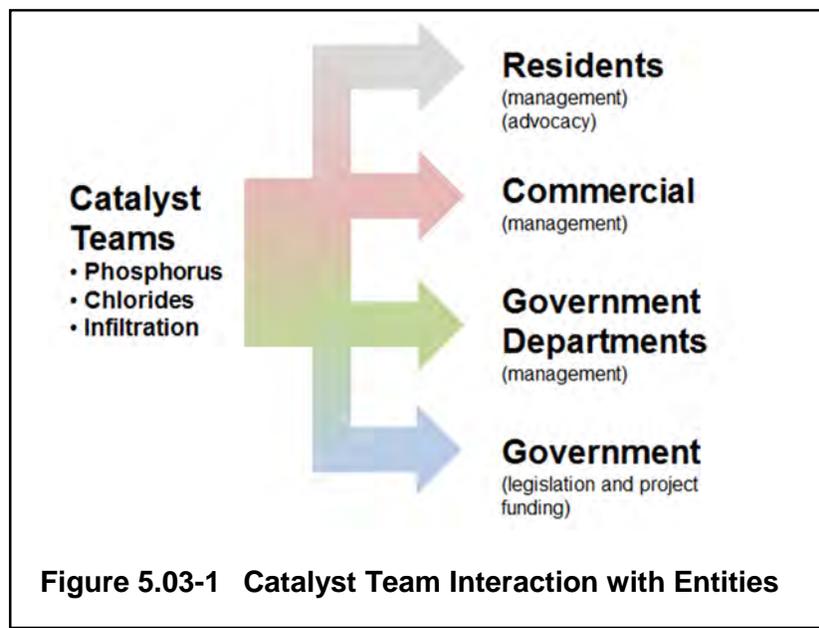


E. General Public

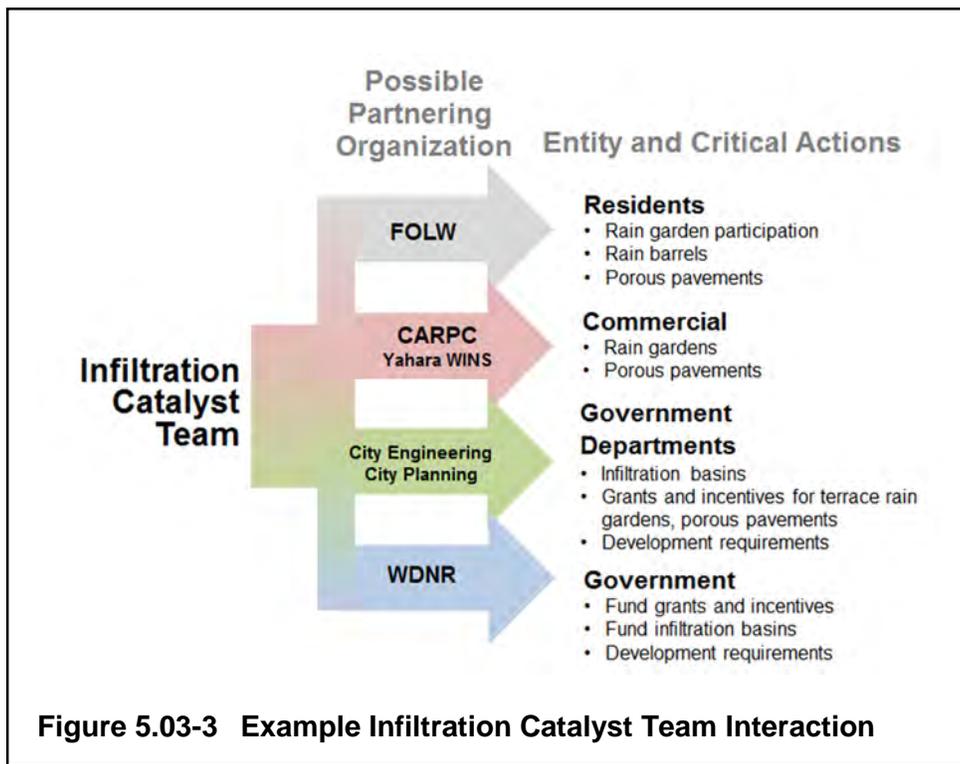
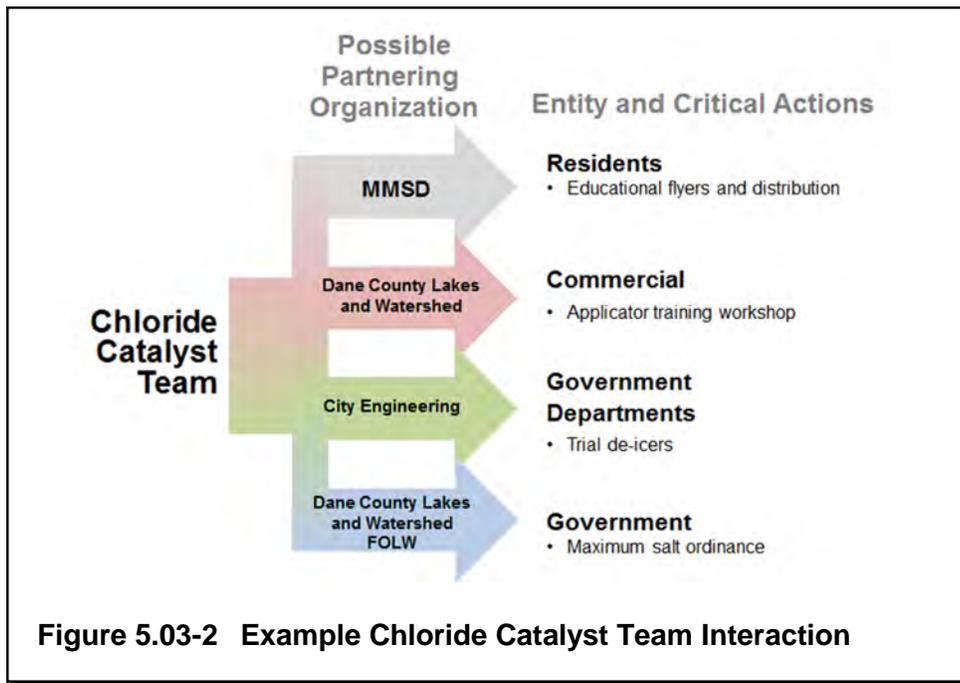
As mentioned, many watershed critical actions require either behavior change by residents or acceptance/support of management changes by government entities. General public information and engagement are generally parts of government-sponsored programs and need to be part of implementing the Wingra Watershed Plan. Two public involvement meetings were held in September 2014 and March 2015 and there are plans for two more. Public meetings should accompany the implementation of critical actions associated with the plan.

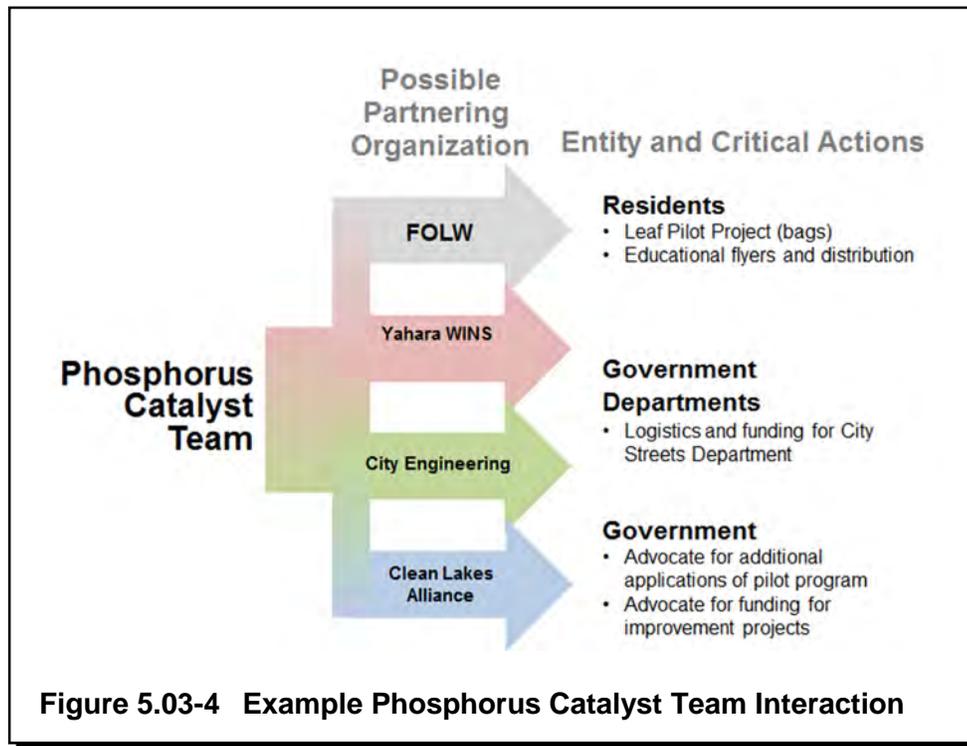
5.03 IMPLEMENTATION AND ENGAGEMENT

The Lake Wingra Watershed Management Plan recommends the use of catalyst teams for implementing the recommendations of the watershed plan and engaging the appropriate entities for the recommended critical actions. There would be three catalyst teams, each with a specific focus of the watershed plan: phosphorus, chlorides, and infiltration. These catalyst teams would be headed by a champion from/advocating for the Lake Wingra Watershed. The catalyst teams would then have the liberty to engage the appropriate entities, and partner with other organizations, to achieve the goals of the watershed plan. Figure 5.03-1 schematically illustrates how a catalyst team would engage different entities. Because of significant overlap between infiltration and phosphorus management measures, consideration should be given to coordination between infiltration and phosphorus catalyst teams.



Figures 5.03-2, 5.03-3, and 5.03-4 illustrate how catalyst teams, partnering with other organizations with similar objectives, could move toward implementing critical actions that improve Lake Wingra Water quality and infiltration.





Catalyst teams have several advantages:

1. They are dynamic, allowing the team to capitalize on opportunities as they arise.
2. They are collaborative, partnering with organizations that have similar objectives.
3. They are focused, consistently advocating for the water quality issue they are tasked with.

5.04 SUGGESTED STEERING COMMITTEE AND CATALYST TEAM ORGANIZATION

The watershed plan recommends that the watershed plan steering committee continue as the Lake Wingra Watershed Management Advisory Committee and meet biyearly. The catalyst teams could function as an extension of the advisory committee. Tables 5.04-1 through 5.04-3 suggest representation in the formation of the catalyst teams. Each catalyst team should have a lead organization and report regularly to the advisory committee on activities and progress each year. Both the Lake Wingra Watershed Management Advisory Committee and the catalyst teams could be formed through the resolution that adopts this watershed plan. Additionally, the resolution could allocate staff support for both the advisory committee and the catalyst teams. The teams may need technical assistance, so the City may want to budget for this assistance to support Catalyst Team activities. Because of overlap between infiltration and phosphorus management measures, consideration should be given to coordination between infiltration and phosphorus catalyst teams.

Friends of Lake Wingra
Madison Metropolitan Sewerage District
Dane County Lakes & Watershed Commission
Madison Engineering Division
Madison Streets and Recycling Division
Dane County Highway and Transportation Division
Edgewood College
Madison and Dane County Public Health
Commercial applicators
Madison Metropolitan School District

Table 5.04-1 Suggested Chloride Catalyst Team Representation

Friends of Lake Wingra
Madison City Parks
Madison Engineering Division
Madison City Planning
Madison Streets and Recycling Division
Dudgeon Monroe Neighborhood Association and/or other neighborhood organizations.

Table 5.04-2 Suggested Infiltration Catalyst Team Representation

Friends of Lake Wingra
Clean Lakes Alliance
Madison City Parks
Madison Engineering Division
Madison Streets and Recycling Division
Dudgeon Monroe Neighborhood Association and/or other neighborhood organizations.

Table 5.04-3 Suggested Phosphorus Catalyst Team Representation

5.05 CRITICAL ACTIONS

Sections 2 through 4 of this report discuss critical actions that address water quality and infiltration in the Lake Wingra Watershed. Many of the critical actions, such as the Westmorland Park Bioretention Basin, are project-based requiring a government department to be the lead agency, with funding approval by the government legislative body. Others require a collaboration of government and community actions that require both behavior change by residents and management change by a government. An example would be bagging leaves, which requires residents to change the way they rake/collect leaves and government to change how they collect and dispose of leaves. This section focuses on the implementation plan for the critical actions. Table 5.05-1 summarizes some of the critical actions and whether the action is management-based (government department lead), project-based (government lead), legislative-based (government body lead) or residential-/commercial-based. The table also indicates which water quality improvement goal the action targets: chloride reduction, phosphorus reduction, or infiltration.

Table 5.05-1 Possible Critical Actions

Lake Wingra Watershed Plan	Gov Legis Based Critical Action	Gov Project Based Critical Action	Gov Dept Management Based Critical Action	Resident/ Commercial Based Critical Action	Addressed in Engagement and Implementation Plan?
Measure		Chloride Focused	Phosphorus Focused	Infiltration Focused	
Westmorland Park Bioretention Basin			X	X	No
Monroe Street Reconstruction With Green Features			X	X	No
Downspout Disconnection Program (35% watershed participation)			x	X	Yes
Terrace Rain Gardens			x	X	Yes
Private Residential Rain Gardens (serving roofs only)			x	X	Yes
Private Commercial Rain Gardens (serving roofs only)			x	X	Yes
Rain Barrel Program (25% watershed participation)			x	X	Yes
Arbor Hills Infiltration Facility (1.63 in/hr)			X	X	No
Devolis Park Bioretention (Axel Avenue)			X	X	No
4 Acres Porous Pavement (serving 12 acres)			x	X	Yes
Wingra Park Wet Pond			X	X	No
Wetland Harvesting			X		No
Modified Street Sweeping Methods/Schedule			X		No
Pet Waste Enforcement			X		No
Grandview Boulevard Bioswales			X	X	No
Glenway Golf Course Wet Pond and Infiltration			X	X	No
Modified City Leaf Collection Methods			X		Yes
Property Owner Leaf Storage Modification			X		Yes
Water Fowl Management (50 geese/yr)			X		No
Construction Site Erosion Control Enforcement (enhanced)			X		Yes
Alum Addition at Manitou Pond			X		No
Alum Addition at Marion Dunn Pond			X		No
Streambank Restoration at Henry David Thoreau School			X		No
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond			X		No
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)			X		No
Establish Certification Program and Require Certification for Government Snow Removal Contractors		X			Yes
Implement Certification Program for Commercial Salt Applicators		X			Yes
Establish Maximum Salt Guidelines		X			Yes
Establish Maximum Salt Ordinances		X			Yes
Encourage Less Residential Salt Use		X			Yes
Reduce Municipal Salt Use					Yes
Expand Practice of Anti-icing–Municipal					
Reduce Salt Route Mileage		X			
Investigate Alternate Deicers					
Reduce Number of Applications per Event–Municipal					

5.06 COMMUNITY-BASED SOCIAL MARKETING PRINCIPLES GUIDING CATALYST TEAMS

Many of the measures will require changing behaviors within the community. Behavior change initiatives can be largely ineffective if not designed properly. Guiding principles that should be used in engagement programs to increase the likelihood of success include the following:

1. Interpersonal communication is most effective at changing attitudes and behaviors.
2. Opinion leaders within affinity circles can have a large influence on individual actions. People look to others to guide their behavior.
3. Modifying a social norm can have a large effect on day-to-day behaviors.
4. Convenience (eliminating barriers) can make a substantial difference in participation.
5. Expressed commitment (particularly written) increases compliance.
6. Public recognition can help initiate and sustain behavior change.

The goals of the community engagement and implementation plan include the following:

1. Identify critical actions where community behavior change is essential to achieve water quality goals.
2. Identify perceived barriers and benefits of current and preferred behaviors.
3. Provide an outline of behavior change tools that could address the target behavior.
4. Suggest a program outline to initiate and maintain behavior change.

5.07 GOVERNMENT INTERACTION PRINCIPLES GUIDING CATALYST TEAMS

A. Project-Based Measures

Many critical actions of the Watershed Management Plan are project-based, meaning a government entity would be the lead agency or primary responsible party. Project-based critical actions must obtain funding and typically compete against other potential capital projects. In order to implement many of the Lake Wingra Watershed Plan critical actions, proponents including catalyst teams will need to advocate strongly for project funding.

The following list is the current City’s New Capital Budget Request Procedure for discretionary projects. Discretionary projects include shorelines, pond/greenway construction/repair, and dredging. Nondiscretionary projects include street reconstruction, projects associated with the UW-Arboretum agreement, and WDNR-mandated improvements.

1. Projects can be proposed by staff, citizens, or representatives.
2. If project has merit, proposed project is put into a 6-year budget timeline (current year + 5 years). Budgetary restraints are addressed by staff.
3. Proposed budget is submitted to the mayor.
 - a. List of proposed projects includes any budget cuts.
 - b. Additional project requests are submitted separately as “exceptions.”

4. Mayor reviews budget.
5. Common Council approves budget.
6. If the project is proposed beyond the current year, the process is repeated annually until it is in the current year’s approved budget.
7. Staff proposes project to neighborhood and alder(s).
 - a. First public informational meeting is held–Project need is discussed prior to design.
 - b. Project timeline is established.
 - c. Survey, borings, and wetland delineations are requested (as needed).
8. Draft design is completed.
 - a. Second public informational meeting is held.
 - b. Plan may be revised, dropped, or proceed to final design (followed by bid and construction).

B. Management-Based Measures (Government Department)

Several of the critical actions are management-based measures where a government department would be the primary acting body. Management changes, such as modified leaf collection methods, are discussed in this report because they are a key component to achieving the watershed plan objectives. Within the government structure, management changes can face challenges even with upper management support. These challenges include the following: (1) priorities within budgets, (2) prioritization of staff resources, (3) varied and multiple stakeholder expectations, (4) coordination between city/county departments with different missions, and (5) entrenched institutional norms.

1. Operational Budget and Staff Resources

Much of the City’s operational budget is fixed and is based on wages/benefits and payments to other agencies (e.g., MMSD). Often there are budget cuts for various city departments. The operational budget for the City’s Engineering Department has been cut by 5 to 10 percent annually in the last three budget cycles (as of 2014). Many of the critical actions associated with this watershed plan, such as street sweeping and leaf collection, are not within the Engineering Department budget but rather are in the Streets Department budget. Storm Water Utility funds pay for much of the sweeping and leaf collection programs, but the operational procedures are controlled by the Streets Department management rather than Engineering Department staff. Therefore, management changes are approached on a cooperative basis between the Engineering and Streets Departments. Changes in resource (both money and staff) allocation follow this process (see Section 5.02).

2. Changes to Operational Budget
 - a. A change to the Operational Budget that reduces cost to comply with a mayoral budget reduction mandate can be offered by a Department head. The mayor decides what to accept as part of his/her budget proposal to the Common Council.
 - b. A change that would increase costs can be proposed by a Department head as a supplemental request to the mayor. This would likely be due to a regulatory requirement, offset by another Department's budget, or an increase in benefits/service to justify the increase.
 - c. If the proposed change is accepted by the mayor, it is then presented to the Common Council. Once approved, it is included in the adopted budget and implemented by the appropriate Department(s).

Resource allocation may be a continuing challenge. However, changes can occur through sequential and consistent efforts. If one compares management practices in 2014 to those in effect in 2000, there are numerous success stories of change in the midst of budget and staff scarcity.

Continued and even greater interdepartmental coordination and cooperation will be needed to obtain the greatest gains. As each Department understands and embraces a broader set of objectives, it is able to effectively apply that expertise toward the broader set of objectives.

5.08 CHLORIDE CATALYST TEAM

The chloride catalyst team will need to influence several fronts to achieve measurable chloride reductions within Lake Wingra. The greatest chloride reductions are likely to be achieved through winter maintenance changes of government and commercial applicators. Yet these management changes will not occur without legislative support and public acceptance.

Critical and supporting actions available for the chloride catalyst team include the following:

1. Reduce commercial applicator salt use through:
 - a. Developing a commercial applicator training program.
 - b. Developing a commercial applicator certification program.
 - c. Developing county-wide salt application guidelines.
 - d. Developing county-wide salt application ordinance.
2. Reduce municipal applicator salt use through:
 - a. Expanding the use of anti-icing.
 - b. Exploring the use of alternate deicers through pilot projects.
 - c. Exploring different winter management techniques on salt routes.
 - d. Fostering public acceptance of different winter driving conditions.
3. Reduce residential salt application through educating homeowners on appropriate salt application and the consequences of using salt for winter maintenance.

The following paragraphs describe efforts the chloride catalyst team can consider.

A. Training and Certification Program for Commercial Salt Applicators

Commercial applicators represent the single largest contributor of chlorides to Lake Wingra. This critical action builds on the training workshop efforts that have occurred in 2009 and again in 2014 for salt applicators. This critical action would implement a certification for commercial salt applicators and expand the use of certified salt applicators by commercial and government property owners. This critical action faces difficulties associated with the perception of possible litigation resulting from reduced salt use. There are numerous challenges and opportunities the catalyst team could consider in advocating for this measure. These include the following:

1. Identifying a government body that would be responsible for certification.
2. Advocating for funding and staffing needed to run a certification program.
3. Advocating for incentives to applicators and property owners who participate in the certification program. These incentives could include:
 - a. Favored status when bidding on government winter maintenance contracts
 - b. Providing stormwater utility fee reductions for property owners using certified contractors.
 - c. Creating an “Environmental Winter Maintenance” branding that recognizes contractors and property owners that practice environmentally friendly winter maintenance practices

B. Maximum Salt Use Guidelines and Ordinances

Commercial applicators have a variety of barriers that reduce their willingness to use less salt. These include the following:

1. Winter maintenance contracts that use quantity of salt as a payment item, encouraging abundant application of salt.
2. The absence of maximum salt guidelines or ordinances provides commercial applicators with limited defense against torts.
3. Customer expectations for bare pavement in winter months.
4. The reluctance to treat pavements multiple times (rather than once) during a winter storm.

This critical action addresses the second bullet and would first establish maximum salt use guidelines for either the City or Dane County or both. As public and government norms change further with the guidelines, there may be political support and opportunity to establish maximum salt use ordinances. Providing both the guidelines and the ordinances could help provide an objective application baseline when commercial applicators are faced with legal tort action.

Actions the catalyst team could take to establish the maximum salt use guidelines and ordinances are multifaceted. An approach will probably need to include some or all of the following:

1. Presentations to applicable city/county committees.
2. Briefings with key elected officials.
3. Development of guideline and ordinance text.
4. Interaction with area commercial salt applicators and property managers.
5. Council or board sponsor.
6. Presentation of guidelines/ordinances and justification to referred committees as well as common council/board.

Enforcement of ordinances could prove particularly challenging. When guidelines and/or ordinances are enacted, other efforts to educate applicators on the guidelines/ordinance, as well as methods to enforce an ordinance, will need to be developed.

C. Reduction of Municipal Salt Use

Government application of salt represents the second greatest contributor to chlorides in Lake Wingra, contributing about one-third of the chlorides that reach the lake. The salt application by City winter maintenance staff has been growing though the decades. In the 1970s, City forces spread an average of 400 pounds of salt per mile per salt event. In the 2000s, the rate has grown to almost 1,100 pounds of salt per mile per salt event. This critical action would reduce the amount of salt spread by both city and county forces during a salt event.

Since this deals with a change in management by city forces, advocating for change by a catalyst team will be challenging. The City Streets and Recycling Department receives much more public feedback requesting more salt use, rather than less salt use. A change in winter maintenance practices may lead to public comment, both to the Streets Department and to City Alders. The greatest success will probably be achieved by incrementally changing management practices while concurrently changing public expectations.

The following paragraphs describe possible measures the chloride catalyst team could pursue to reduce municipal salt usage. With all these measures, the catalyst team will need to find avenues to influence management practices of City departments. This could be through partnership with certain City departments (for example City Engineering) and/or interacting with elected officials and the mayor's office.

1. Expanding the practice of Anti-Icing. Anti-icing helps provide extra time for winter pavement maintenance and helps reduce overall road salt application. The Streets Department has recently purchased additional equipment to expand the practice of anti-icing. This practice should be encouraged, and data should be collected to see how the additional equipment will affect salt usage.

2. Pilot Projects. The widespread change in management practices is unlikely to occur without supporting experiences and data from a smaller area. Pilot projects that could be explored include:
 - a. Reducing the number of applications per snow event on a section of a salt route. The current application rate per event is several times the recommended application rate per pass. Altering management techniques might allow the City/County to make fewer salt passes, reducing the overall salt usage per event.
 - b. Investigating the feasibility of having a two-tier salt route structure, with one tier receiving more frequent applications and another tier receiving less frequent applications.
 - c. Investigating alternate deicers. Several municipalities are using different deicers, such as agricultural byproducts, as part of their snow removal strategy. The Madison Health Department has cautioned the use of deicers having a biological oxygen demand (BOD), citing it could result in fish kills. Additional research to understand the aquatic effects is necessary. Additionally, other deicers with nominal could be explored.
 - d. Monitoring salt application using GIS technologies. Monitoring the salt application rate on different salt routes within the City could help the Streets Department better manage its winter maintenance activities.
3. Public Norm Changing. The Streets/Engineering Department could continue to educate Madison residents on the effects of winter salt use. Examples of this include the summer 2015 newsletter that was mailed to Madison residents. Other measures that could be considered include:
 - a. Providing an informative e-mail on the effect of salt when responding to winter maintenance complaints.
 - b. Using the Street’s Department winter Web site to educate residents on the effects of salt use.
 - c. Engaging the media with feature stories on salt’s effects on the lakes. (Similar engagement efforts have occurred with recycling efforts.)

D. Reduction of Residential Salt Use

While residential salt use is not a major chloride contributor to the lake system, changing salt use behavior with residents is essential for changing the overall social norms that are necessary to get guidelines and ordinances enacted. This education also could temper customer expectations for street pavements as well as commercial property pavements. The catalyst team could use residential salt use education as part of the larger effort of chloride reductions. Types of activities the catalyst team could consider include:

1. Educating homeowners of the unwanted effects of winter salt on wildlife and our lakes.
2. Educating homeowners on best winter maintenance practices.
3. Providing greater access to materials (e.g., sand drop-offs).

MMSD is making a concerted effort in this area and could provide a valuable partnership.

5.09 INFILTRATION CATALYST TEAM

This report provides critical actions to increase infiltration in an effort to maintain and restore spring flow in the Lake Wingra watershed. As with the phosphorus critical actions, some infiltration measures are project-based while others are community-based. Fewer of the infiltration measures are management-based. The following paragraphs describe potential focus areas for the infiltration catalyst team. As mentioned, the efforts of the catalyst team are not intended to be prescriptive, which constrains the team and effectiveness. But rather they are intended to be responsive and dynamic, capitalizing on opportunities as they develop.

A. Project-Based Measures (Government)

This report lists some project-based critical actions that could increase infiltration:

1. Westmorland Park Bioretention
2. Devolis Park (Axel Avenue) Bioretention
3. Arbor Hills Greenway Infiltration
4. Glenway Golf Course Wet Pond and Infiltration
5. Grandview Blvd Bioswales
6. Monroe Street Green Reconstruction

Many of these measures also have phosphorus reduction benefits. Some of the listed projects have been presented to residents and have not experienced broad support. As mentioned previously, the infiltration catalyst team may need to partner with government sponsors of these projects to develop a proactive information program that enables community and council/board support. It is difficult to advocate for project funding when there is not broad neighborhood support of an initiative.

The catalyst team could work with the neighborhood alders to introduce projects into the City's Capital Budget. Section 5.07 describes the City's New Capital Budget Request Procedure for discretionary projects.

B. Community-Based Measures

There are several critical actions that are focused on residential and commercial properties. Governments and advocacy groups sometimes use incentives to increase participation in the critical action. The infiltration catalyst group could work on several fronts to broaden involvement of these programs. This includes:

1. Initiating, maintaining, or increasing funding for incentive programs.
2. Educating watershed residents regarding infiltration measures and the availability of incentive programs.
3. Recruiting residents to participate in the infiltration programs and practice good rain water management.

The following paragraphs describe some of these critical actions in more detail.

1. Rain Gardens, Downspout Redirection, and Rain Barrels

This critical measure seeks to divert roof rainwater destined for the storm sewer to areas where the water can infiltrate. Measures that achieve this can be somewhat simple and very cost-effective. Examples include the following:

- a. Relocating gutter downspout discharges away from pavements and onto pervious areas. Currently the City does not have a downspout disconnection program. The catalyst team could advocate for a downspout disconnection program or partner with other organizations to help homeowners with rainwater management.
- b. Installing rain barrels. Local organizations² sold and installed rain barrels. The City Streets and Recycling, with Dane County, provides discounted rain barrels to the public every spring (about \$120 in spring 2015). There is no organization that helps install these rain barrels. The catalyst team could increase the momentum associated with the rain barrel program, providing deeper discounts and/or helping with rain barrel installation.
- c. Disconnecting rainwater discharges that are directly connected to the storm sewer system or flow directly into the gutter pan on the street. Current disconnection permit fees, according to Madison General Ordinance 37.05 (7)(a)3. is \$1,000 with a possible \$900 refund once completed. Additional costs are incurred with contracting for the disconnection. The catalyst team could work with the City to initiate a grant program for property owners wishing to disconnect from the storm sewer system.
- d. Constructing rain gardens to collect roof runoff. Plant Dane (My Fair Lakes) provides a cost-sharing program that helps subsidize rain garden plantings. The City's 1,000 rain garden program seeks to increase rain garden installation through education and recognition.
- e. Installing terrace rain gardens. The City Engineering currently offers cost-sharing for rain gardens in terraces in conjunction with street

² Sustain Dane installed rain barrels until 2011.

reconstructions and resurfacing projects, where they are appropriate.³ The rain gardens must be installed where the terrace is at least 10 feet wide, relatively flat, and limited trees. The catalyst teams could work with city engineering to recruit homeowners to participate in this program. The catalyst team could also advocate to maintain funding for the cost-sharing program and even increasing the City share of the construction costs.

This discussion is focused on residential rainwater drainage. Rainwater management measures for commercial roofs could also be implemented through the City’s review process for commercial/construction permitting.

2. Permeable Pavement

This critical action would have to have property owners, including residential, multifamily residential, commercial, institutional, and government, reduce impermeable pavement installations. This can occur in a variety of ways (Figure 5.09-1), such as the following:

- a. Reducing pavement, such as installing driveway tracks instead of driveways.
- b. Using nonengineered pavement grids (without a subpavement water storage layer) for little-used parking areas.
- c. Installing porous pavements.

For porous pavement, initial efforts could focus on collecting a series of early success pilot projects to serve as examples to others. Eventually porous pavements, pavement grids, and driveway tracks could become a requirement of the design approval process.

There are many directions the catalyst team could seek to start and increase porous pavement installations. The following describes a couple of possible examples.

1. Advocate for a porous pavement pilot project on a City-owned property (government-sponsored discretionary capital project). Parking lot pavements within Vilas Park or the zoo could serve as pilot projects and are within the watershed.

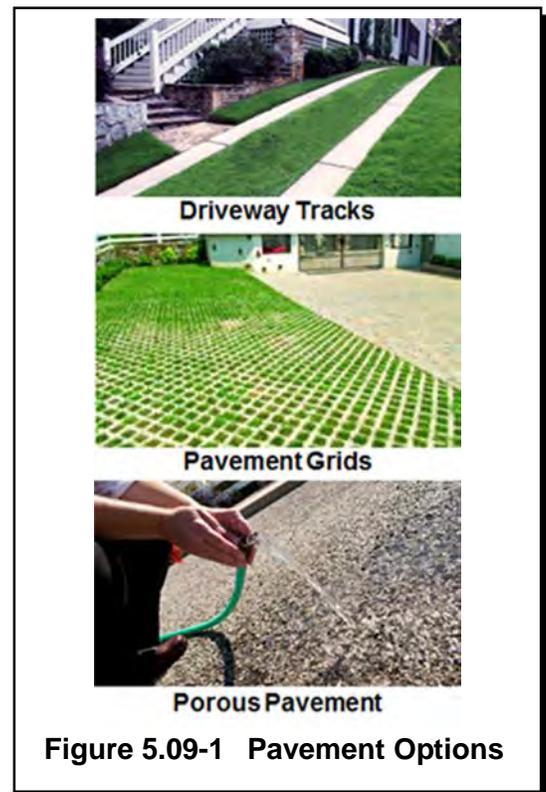


Figure 5.09-1 Pavement Options

³ see <http://www.cityofmadison.com/engineering/stormwater/raingardens/terraceraingardens.cfm>

2. Encourage City staff and legislators to consider infiltration, including use of porous pavements, in the plan review process.
3. Advocate for initiating City-sponsored grant program subsidizing a portion of driveway tracks, pavement grids, or permeable pavement installation as an expansion/formalization of the City’s stormwater utility credit policy.
4. Advocate for requiring porous pavements for parking lots when commercial properties are redeveloped.

5.10 PHOSPHORUS CATALYST TEAM

This report provides critical actions to achieve targeted phosphorus reductions in Lake Wingra. As mentioned, the efforts of the catalyst team are not intended to be prescriptive, which constrains the team and effectiveness. But rather they are intended to be responsive and dynamic, capitalizing on opportunities as they develop.

A. Advocating for Project-Based Measures

Project-based critical actions are essential for achieving the phosphorus reductions necessary to meet the watershed objectives. The catalyst team can work with elected officials (and city staff) to using the methods described in Section 5.07 to introduce projects that will have a positive effect on Lake Wingra water quality. Critical actions that are project-based include the following:

1. Westmorland Park Bioretention Basin
2. Monroe Street Reconstruction
3. Arbor Hills Infiltration Facility
4. Devolis Park Bioretention
5. Grandview Boulevard Bioswales
6. Glenway Golf Course Wet Pond and Infiltration
7. Alum Treatment in Manitou Pond
8. Alum Treatment at Marion Dunn Pond
9. Streambank Restoration at Henry David Thoreau School
10. Diversion of Basin W102-D-0193-H-MAC-C to Manitou Pond
11. Streambank Restoration on Cherokee Drive
12. Wingra Park Wet Pond

The watershed plan recommends aligning these project-based measures with other city efforts to meet the TSS and TP reductions associated with the Rock River TMDL requirements. This would have the effect of moving the project from discretionary to regulatory, which would increase their chances for implementation. A funding and credit structure may be available through Yahara WINs.

In addition to advocating for project funding, the phosphorus catalyst team should partner with government sponsors to develop a proactive and strategic information program that enables future community and council/board support.

B. Advocating for Management Changes

Management changes are also necessary to achieve the needed phosphorus reductions. Possible management changes include the following:

1. Modified leaf collection methods.
2. Water fowl management (harvesting).
3. Wetland harvesting.
4. Modified street sweeping methods/schedule.
5. Commercial fertilizer application at Nakoma Golf Course and Odana Hills Golf Course.

Influencing management changes within city and county departments is more difficult. Budgets, staff resources, and known methods hinder the ability/willingness to change management measures. Within this structure, probably the greatest gains can be made by partnering with other city departments. Pilot projects provide an excellent opportunity to test management changes to better understand the actual effect on staffing, resources, and budgets. The catalyst team, in partnership with other city departments could strongly advocate for pilot projects focusing on management change. One example is the pilot project being conducted with the Wingra Watershed Plan that focuses on leaf collection methods (see Section 5.12). This small scale project will help The City Engineering and Streets departments understand the effect of bagging leaves on city crews and pickup schedules.

The departments typically report directly to the mayor or county executive. Continuing to inform these elected officials of benefits of management changes will provide support for these measures.

C. Enforcement-Based Measures

Some of the possible critical actions focus on the enforcement of regulations. The phosphorus catalyst group can influence enforcement-based measures by advocating for funding of positions responsible for enforcement. In some instances, advocating for and influencing legislation, on both the local and statewide level, will be necessary to achieve the Lake Wingra watershed goals. The following paragraphs describe some of the enforcement-based critical actions.

1. Construction Site Erosion

This critical action seeks to increase compliance with construction site erosion control regulations. Three entities monitor erosion control. On July 21, 2014, watershed team members met with City staff to discuss current enforcement efforts. The City Engineering Department monitors erosion control on larger commercial and institutional projects. On the engineering Web page, a link is provided for community members to review larger construction projects erosion control inspections (<http://www.cityofmadison.com/engineering/erosionActive.cfm>).

The City Engineering Department received a Yahara Wins grant from MMSD for an erosion control inspector for the 2013-2014 season. The intent would be to continue having a dedicated erosion control inspector in future years.

The Wisconsin Department of Commerce (Commerce) has authority and the responsibility for construction site erosion control for building sites for public buildings and places of employment and one- and two-family dwellings. All commercial building construction sites disturbing 1 acre or more need to submit a Notice of Intent (NOI) to Commerce. If a one- or two-family dwelling construction site disturbs less than 1 acre, the specific erosion control requirements in the Uniform Dwelling Code, Comm Chapters 20 and 21, must be met. For one- or two-family dwelling sites where 1 acre or more is disturbed, in addition to the requirements in the Uniform Dwelling Code, to WDNR requires the submittal of the NOI to its department. The City Building Inspection Division, part of the Department of Planning and Community and Economic Development, inspects erosion control for residential properties.

This critical action focuses on City-based management change regarding enforcement. As mentioned, two City Departments are responsible for erosion control enforcement. The City Engineering Department is responsible for road construction projects on city streets and commercial projects. The Building Inspection Division is responsible for residential erosion control. There are three specific areas the phosphorus catalyst team could work to improve enforcement efforts.

- a. Proper funding for enforcement–As mentioned, two agencies are responsible for erosion control enforcement. The catalyst team could consistently advocate for appropriately staffing these positions.
 - b. Regulation consistency–Discussions with enforcement personnel indicate that legally they have had difficulty enforcing regulations that are more stringent than the state statutes. Consistency between regulations would aid their enforcement efforts.
 - c. Regulation type–The current regulations are reactive rather than proactive, meaning that contractors will receive a citation *after* there has been erosion control infraction. Regulations that focus on preventive measures would provide enforcement personnel the authority to issue citations before there is an infraction.
2. Pet Waste Enforcement

For this critical action, the catalyst team could focus on either education or enforcement of Madison’s General Ordinance 7.322. This ordinance requires all dog owners/keepers to have a means of removing pet waste on their person while in public with the fine ranging from \$25 to \$200. Greater gains may be obtained in education of this ordinance.

5.11 OTHER MEASURES

In the spring and summer of 2015 community meetings, there were several measures suggested that could be employed by any catalyst team or government agency. The following paragraphs briefly describe these potential measures.

A. Watershed Sustainability Audit

A Watershed Sustainability Audit could be similar to an energy audit once conducted by Focus on Energy. A catalyst team or government agency could send out letters offering volunteers/block leaders to perform watershed sustainability audits at residential or commercial properties. These audits would document measures that currently fall into best practices and additional measures that could be implemented for better stewardship. Similar to the Focus on Energy Audits, the audits could be coupled with incentives to the property owner.

B. County and MLS Listings

The watershed a property lies in could be included as part of a property's tax records. This would help promote an awareness of watershed stewardship. This awareness could be developed further, such as promoting stewardship competitions between watersheds and joint meetings between watersheds.

C. Recognition Certifications

A certification program could recognize commercial applicators, lawn care professionals, business properties, and residential properties. Much like the LEED certification from the US Green Building Council, a certification program could capitalize the environmental ethos of the Madison community. For example, corporate properties could have special signage on their property indicating that they are “Gold Star Environmentally Managed.” Similarly, winter and summer maintenance contractors could claim that they are Gold Star Environmentally certified and use this in their marketing efforts.

5.12 PILOT PROJECT

A. Pilot Project Selection

The Lake Wingra Watershed Plan includes a pilot project. A series of potential pilot projects was presented at the March 25, 2014, Wingra Watershed Steering Committee Meeting. The proposed projects included targeting phosphorus reduction, increased infiltration, and reductions in the use of chlorides. Many of the potential pilot projects could address both infiltration and phosphorus reduction. The steering committee decided to pursue leaf management modifications as the pilot project. The pilot project seeks to have property owners keep their leaves out of the street and off of other impervious surfaces. This was done by keeping well-managed piles and then eventually through bagging their leaves. This critical action seeks to prevent leaves leaching phosphorus that runs into the storm sewer system and eventually into the lake. Property owners often pile their leaves on the terrace. These piles, if left for long periods, can be subject to rainfall and also creep into the adjoining gutter. Additionally, street trees often shed their seeds and leaves into the street and may not be collected. These leaves and/or their leaching can be transmitted to the lake through the storm sewer system. The following outline provides a framework to address this problem for these reasons:

1. Leaf management appears to be a highly effective measure to reduce phosphorus within the watershed.

2. The City Streets Department and its contractor are willing to test this in the 2015 leaf collection.
3. There seems to be an opportunity for collaboration between government entities' ability to fund a program and the need for community behavior change.

The pilot project was started with the 2014 fall season as a baseline. During this season, property owners were made aware of the project and on-site leaf management measures were encouraged. With the 2015 fall season, plans are to encourage property owners to bag their leaves and to be collected by the City.

Recruitment of leaders and participants has been done and needs to continue to occur throughout the whole Wingra watershed (and beyond). Yet only a portion of the watershed would use staff resources to canvass households and monitor participation levels in the pilot project area. The extent and location of this canvassed area (Figure 5.12-1) would be the same for 2014 and 2015.

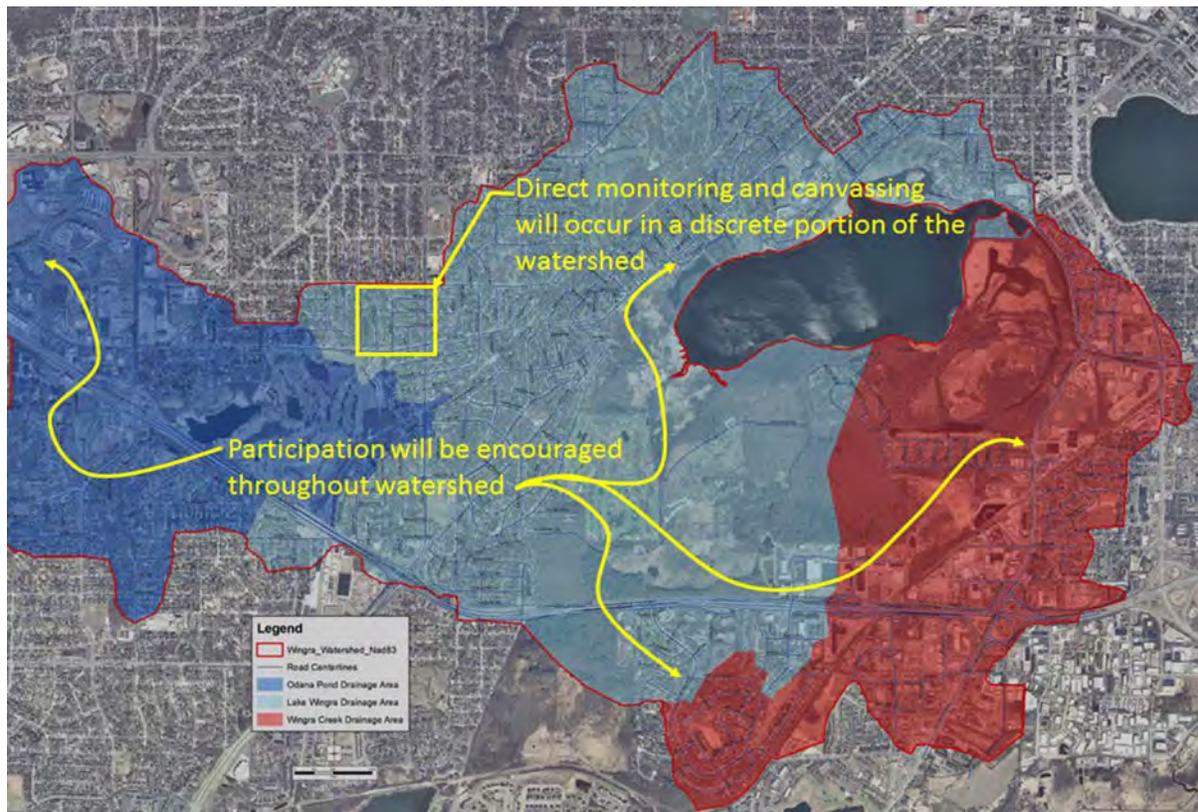


Figure 5.12-1 Pilot Project Focus Area

B. 2014 Season

During the 2014 season, the goal of the pilot project was to keep “leaves out of the street,” which was the motto of the program. To alert homeowners in the watershed, the City hosted a public informational meeting on September 18, 2014, to introduce the pilot project to property owners. Community members (led by three block leaders) also canvassed the three-block focus area, handing out pilot project information, providing a survey sheet for return, and securing commitment cards to encourage residents to participate. Figure 5.12-2 shows the focus area of the pilot project. The surveys were meant to provide baseline data and were delivered to 84 homes in the area of Piper Drive, Orchard Drive, and Charles Lane; just over one-half were returned. Figures 5.12-3 through 5.12-5 summarize some of the key findings from the pilot project survey responses.

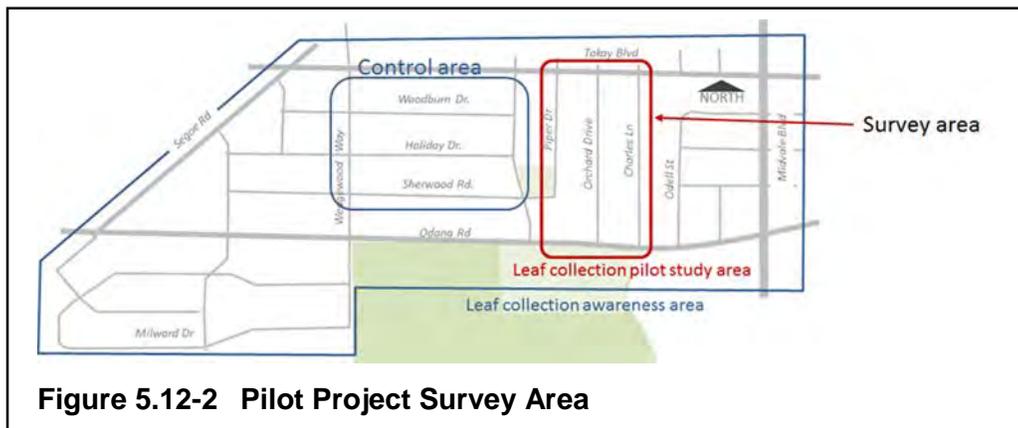


Figure 5.12-2 Pilot Project Survey Area

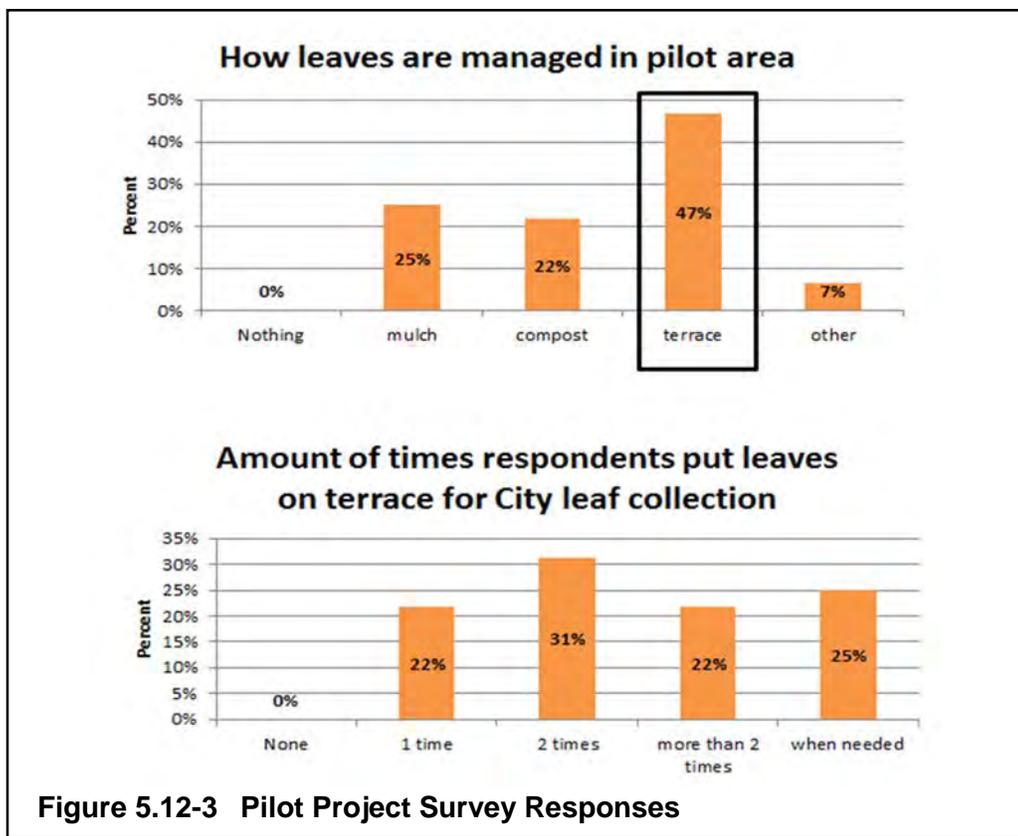


Figure 5.12-3 Pilot Project Survey Responses

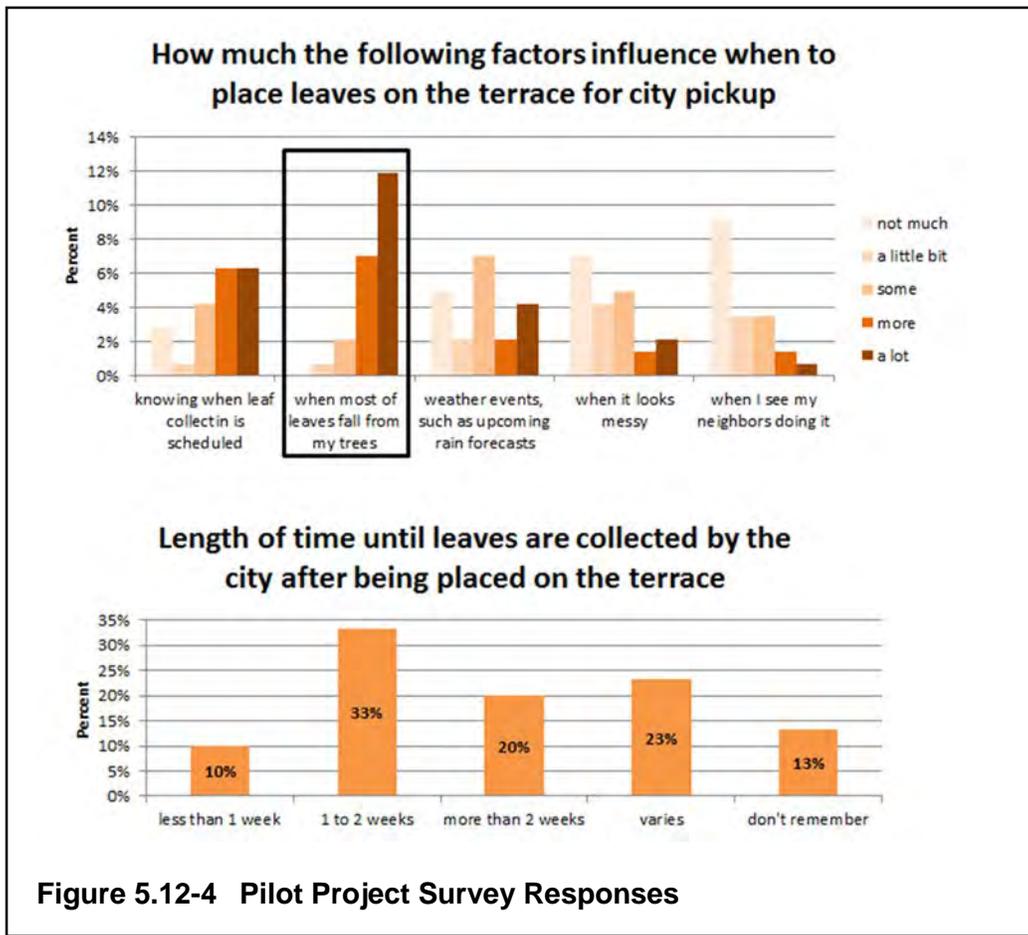


Figure 5.12-4 Pilot Project Survey Responses

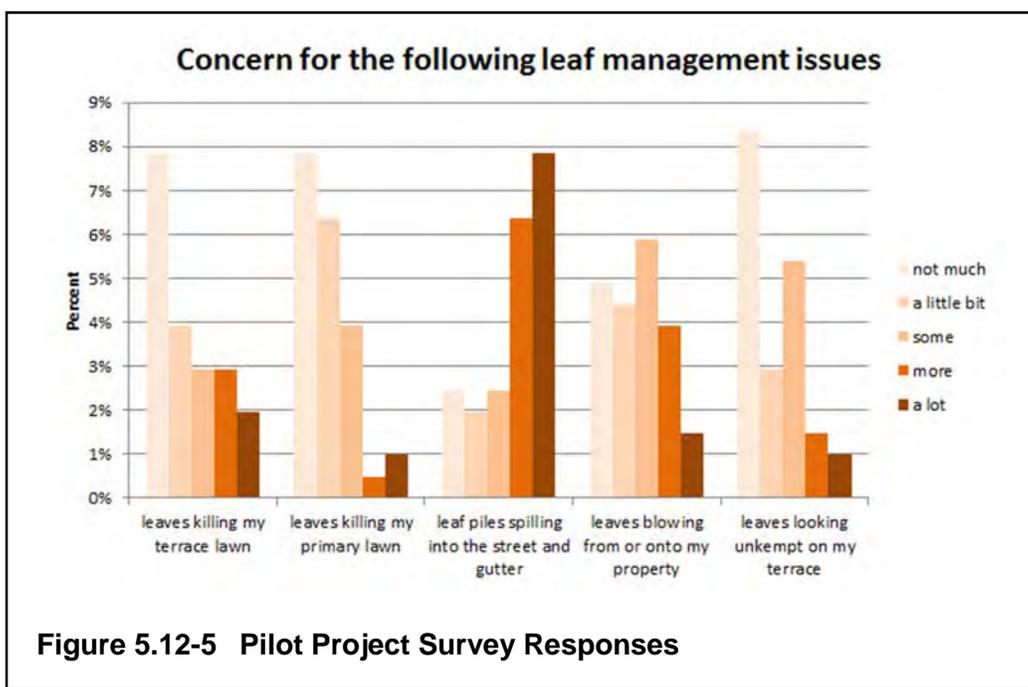


Figure 5.12-5 Pilot Project Survey Responses

A major factor leading to unkempt leaf piles is the inability for homeowners to predict when City forces are coming to collect leaf piles. To address this concern, the homeowners in the pilot project area were encouraged to sign up for an e-mail notification that sought to provide advance notice of when leaf piles would be collected by City forces. Additionally, lawn signs placed in the terrace were used to alert homeowners of leaf pickup times.

The leaf piles in the pilot project area streets were compared to streets in the nearby control area that did not have the extra education and notification efforts. Generally the pilot project area had better leaf management practices than the adjacent control areas. In observations during the second round of city leaf pickup, 46 of the 84 homes in the pilot project area had put leaves on the terrace, with 30 of the piles having no leaves in the gutter.

C. 2015 Season

The 2015 season will build on the program infrastructure developed during the 2014 season. Residents in the pilot project area will be asked to bag their leaves. City forces will collect those bags and use an existing shredder to process the leaf material. Notification and awareness activities similar to those used in 2014 yet with improvements will be performed during the 2015 season. See Appendix G for the pilot project results.

If successful, the program could be expanded to other portions of the city, leading to greater phosphorus reductions.

6.01 GENERAL

Specific recommendations are presented here for achieving the goals of the watershed management plan that include the following.

1. Chlorides—Work toward changing the Lake Wingra chloride concentration from 120 mg/l to 40 mg/L that existed in the early 1970s.
2. Infiltration—Recover 10 percent of the 742 million gallons of lost infiltration because of development in the Lake Wingra Watershed.
3. Phosphorus—Of the 1,900 pounds of phosphorus generated in the watershed each year, reduce the phosphorus load reaching Lake Wingra by 50 percent compared to no controls.

6.02 RECOMMENDATIONS

The following recommendations are based on the discussion and analysis in the preceding sections.

1. Chlorides—Create and initiate an active Chloride Catalyst Team to work toward chloride reduction goals with actions identified in Section 2 of this plan.
2. Infiltration—Create and initiate an active Infiltration Catalyst Team to work toward infiltration goals with actions identified in Section 3 of this plan; 12 specific projects are identified for implementation.
3. Phosphorus—Create and initiate an active Phosphorus Catalyst Team to work toward infiltration goals with actions identified in Section 4 of this plan. At this time, five alternatives have been identified. It is recommended that the Steering Team choose one of these alternatives to move forward with into implementation.
4. The City of Madison should budget a yearly dollar amount for implementation of both infiltration and phosphorus-based projects seeking to implement all the projects recommended for construction in this plan.
5. Track yearly Catalyst Team activities and progress.
6. Consistently pilot new programs and initiatives for potential expansion of programs to larger geographic areas.
7. Periodically review the City's Stormwater Utility Rate Adjustment Policy for effectiveness in incentivizing construction of stormwater BMPs.
8. Maintain the City's P8 model to track progress on phosphorus reductions.
9. Maintain the chloride mass balance spreadsheet.

10. Apply for grant opportunities through WDNR's Urban Nonpoint Source and Stormwater Program, Dane County's Urban Water Quality Management Program, Yahara WINs Phosphorus Reducing Grant Program, among others.
11. The City of Madison should budget for yearly assistance by a consultant (as recommended by the Steering Team) to support Catalyst Team activities.

6.03 IMPLEMENTATION PLAN

For purposes of an implementation timeline, Table 6.03-1 is presents an initial look at how catalyst teams and projects could be implemented. It is intended to change and it is recommended that it be updated from time to time. It is envisioned that the City of Madison and the Friends of Lake Wingra will lead the Catalyst Teams and recruit/appoint team members.

**APPENDIX A
MEETING SUMMARIES**



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 February 21, 2013 2 P.M.
 Strand Associates, Inc.[®]
 Kickoff Meeting Summary

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Plan Kick-Off Meeting	

Meeting Handouts:	
Meeting Agenda	Attachment B: Summary of Scope
Attachment A: Steering/Issue Team Roles	Attachment C: Work Program–PowerPoint

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Steve Arnold, Chair	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Review and Confirmation of Steering Team/Issue Team Roles</u> <i>Review of Attachment A:</i> The Steering Team reviewed Attachment A-Steering Team/Issue Team Roles. Membership on the Steering Team will be expanded to include a UW-Madison Arboretum representative, possibly Mark Wegener. The meeting frequency of the Steering Team will be every 7 weeks, with Issue Teams meeting between Steering Team meetings. These changes have been made to Attachment A. <i>Note: A 6-week frequency was discussed at the meeting. However, adjusting the Work Program according to discussions at the meeting shifts the meeting frequency to 7 weeks.</i></p> <p><i>Decision Making Protocol:</i> It was agreed that the decision making protocol will generally involve a “thumbs” approach with thumbs up, thumbs down, and sideways thumbs meaning in favor, not in favor, and more discussion necessary, respectively. Colored cards could also be used to accomplish the same objective. Generally, the Steering Team will operate under a “consensus” approach whereby gaining consensus on an issue should be achieved at the meeting.</p>	<p>Defined protocol for Meeting Summaries will be followed.</p>

Discussion:	Action:
<p>If general consensus cannot be reached, the issue would likely be tabled until the next meeting. When consensus is achieved on an issue, it will be summarized in the meeting summary. Opinions will be noted in the meeting summary if requested by the person with a different view. The Steering Team will help identify alternate opinions that should be documented in the meeting minutes. As appropriate, alternate opinions will also be noted in the draft and final reports.</p> <p><i>Meeting Summaries Protocol:</i> The following items were agreed upon. Strand will take notes and provide meeting summaries. Meeting summaries will be provided via e-mail to Steering Team and Issue Team members within one week of a particular meeting. Steering Team and Issue Team members will provide comments on the submitted meeting summary within one week of receipt of the meeting summary. Revisions can be made with the sticky note function in Adobe Reader and e-mailed to Strand with the file name modified to include the author's name and date. Strand will then modify and submit the final meeting summary document to the Steering Team. Genesis will post the final meeting summary document to the City of Madison Web site.</p>	
<p>2. <u>Review and Confirmation of Critical Actions</u> <i>Review of Attachment B:</i> Strand provided a brief summary of Attachment B-Summary of Scope. The original schedule and a tentative schedule are included. The tentative schedule corresponds to the Work Program. Comments about the schedule are described under the Item 4. Work Program Components and Sequence Workshop heading below.</p>	
<p>3. <u>Status Update of Supporting Studies and Information</u> a. Lake Response Analysis (UW-Madison)–This study was started in 2012 and will continue through the summer of 2013 (data collection) with a final report expected in early 2014. Recoding of SWAT computer model to allow for use of subhourly rainfall data is complete. Strand will be using City of Madison's P8 computer model results and Strand-generated stormwater quality modeling for purposes of this study. Greg said P8 results are similar to the results in the Rock River Basin Total Maximum Daily Load (TMDL) document. The difference in results between the models is quite small. Once the Lake Response Analysis is complete, there will need to be discussion on what the results mean and how they will be incorporated into the Wingra Watershed Plan document.</p>	



Discussion:	Action:
<p>f. Wisconsin Urban Forestry Council (City of Madison and WDNR)–Roger said this committee has been discussing the use of trees in bioretention basins. Roger said there may be grant opportunities in this area. Marla Eddy, City Forester, is the contact at the City.</p> <p>g. Marion-Dunn/Glenway Alum Pilot Project–Greg said the City will be moving forward with a project to pilot the use of alum to reduce P at the Marion-Dunn/Glenway Pond along Monroe Street. The UW-Madison Arboretum has provided its support for the project. The City will be holding a stakeholder meeting at Edgewood College on March 7, 2013. Some asked whether the Friends of Lake Wingra could be provided information more in advance of the meeting.</p>	<p>Greg will send formal invites for the stakeholder meeting to the Steering Team.</p>
<p>4. <u>Work Program Components and Sequence Workshop</u> Tom led the Steering Team through a workshop using the draft Work Program. Agreed-upon changes to the Work Program include the following:</p> <ul style="list-style-type: none"> a. Move the Lake Response Model Steering Team meeting to after the Pollutant Reduction Opportunities meeting. b. Move the Lake Response Analysis to be complete in early 2014. c. Generally, spread out the project to have the draft report and final draft report to be one month later, March and May, 2014, respectively. This will allow for better incorporation of the results of the Lake Response Analysis due to be completed in early 2014. It will push the Steering Team and Issue Team meetings to an approximate 7-week frequency. <p>Discussions on stakeholder engagement include the following:</p> <ul style="list-style-type: none"> a. Early stakeholder engagement will occur in the first part of the study where we include stakeholders and enlist their help in formulating solutions. b. Late stakeholder engagement will occur in the second part of the study and will focus on behavior change to a broader audience. <p>The revised Work Program chart is attached to this meeting summary.</p>	



Discussion:	Action:
<p>5. <u>Issue Team Membership</u></p> <p>Chloride Meeting: Greg said MG&E is required to participate in chloride reduction projects related to its infiltration facility at the Odana Golf Course and is anxious to initiate a project. Madison Metropolitan Sewerage District (MMSD) is currently undertaking a Chloride Reduction Plan that it intends to complete in about six months. MMSD has seen huge spikes in chlorides in its effluent (high of 500 mg/l recently). MMSD has been monitoring chlorides in a storm sewer pipe in the Wingra Watershed (by the Zoo downstream of the dam). This may be an opportunity to leverage project dollars with these utilities if the Steering Team wanted to pursue it. The coordination would have to start soon. MG&E contact is Bob Stoffs and the MMSD contact is Kathy Lake and/or Ralph Erickson. Roger thought that real time monitoring of chlorides around Lake Wingra would be a possibility for a project. Genesis said the Mayor is interested in investigating regulation of private applicators. Steering Team discussion via e-mail after the meeting resulted in the decision to invite Mark Barnes from Barnes, Inc., a private snow removal and deicing contractor/applicator, to the Chloride Meeting.</p> <p>Chloride Issue Team Membership: All on the Steering Team except Greg, Steve, and Rebecca would like to be on the Chloride Issue Team. The Chloride Meeting described above will begin the chloride discussion, but the formal Chloride Issue Team membership will be determined at a later time, likely at the next Steering Team meeting.</p>	<p>Jon will set up the Chloride Meeting in the next two weeks to engage MG&E and MMSD to explore options and possibilities. David will contact Mark Barnes.</p>
<p>6. <u>Upcoming Schedule and Next Meeting</u></p> <p>The next Steering Team meeting will be on Thursday, April 4, 2013 from 3 to 5 P.M. at Strand. The remaining six Steering Team meetings are tentatively set up for Thursdays from 3 to 5 P.M. at Strand on the following days: May 23, July 11, August 29, October 17, December 5, 2013 and January 23, 2014. Issue Team meetings will be set up as instructed at the Steering Team meetings.</p>	

c/enc: All Participants

ATTACHMENT A-STEERING TEAM/ISSUE TEAM ROLES

- **Steering Team**
 - Membership: Those invited to the Kickoff Meeting plus a UW-Madison Arboretum representative.
 - Role: Attend Steering Team meetings and Issue Team meetings, if interested. Provide review, comments and advice to the Strand team. Provide case studies and literature reviews to help guide the Strand team.
 - Meeting Frequency: Meetings every 7 weeks anticipated.
 - Decision Making Protocol: See Kickoff Meeting Summary document.

- **Issue Team**
 - Membership: Issue Teams would be made up of interested Steering Team members plus invited experts. Three Issue Teams are anticipated, one each for Chlorides, Phosphorus, and Infiltration.
 - Role: Delve deeper into specific issues.
 - Meeting Frequency: Generally every 7 weeks between Steering Team meetings, as necessary
 - Decision Making Protocol: See Kickoff Meeting Summary document.

ATTACHMENT B-SUMMARY OF SCOPE

1. Steering Team (8) and Issue Team (6) Meetings
 - Work Program and Deliverables
 - Pollutant Sources: Sediment and Total Phosphorus
 - Pollutant Sources: Chlorides
 - Pollutant Reduction Strategies
 - Infiltration Opportunities
 - University of Wisconsin-Madison Loading and Lake Response Model
 - Pilot Project Recommendations
 - Social Marketing Strategies

2. Identification of Critical Actions
 - Pollutant Loading Analysis
 - Document Baseline and Existing Loads
 - 4 Strategies for 50% P Reduction
 - Incorporation of Social Science Methods
 - Deliverable: Prioritized List of Public/Private Practices, Policies, Procedures, Projects considering cost, cost-effectiveness, maintenance, responsible parties.

 - Chloride Reduction
 - Document Current Road Salt Use
 - Mass Balance of Chloride Input and Output
 - Recommendations for Incrementally Meeting 40 mg/L Road Salt Concentration
 - Incorporation of Social Science Methods
 - Deliverable: Prioritized List of Public/Private Practices, Policies, Procedures, Projects

 - Infiltration/Groundwater
 - Document Existing Infiltration in the Watershed and Set Achievable Infiltration Target
 - 5 Alternatives for Incremental Infiltration Increases In Watershed
 - Incorporation of Social Science Methods
 - Deliverable: Prioritized List of Public/Private Practices, Policies, Procedures, Projects considering cost, cost-effectiveness, maintenance, responsible parties.

 - Pilot Project Recommendation
 - Identify one Pilot Project to Address one Critical Action (Pollutant Loading, Chlorides, and/or Infiltration)
 - Incorporation of Social Science Methods
 - Deliverable: Pilot Project Plan That Can Be Completed in One Year Considering Costs, Maintenance, and Responsible Parties

3. Stakeholder Engagement
 - Identify Target Audiences for Each Critical Action Including Interaction With Them
 - Develop Social Marketing Strategy
 - Present Potential Behavior Change Strategies to Steering Team

- Develop Written Strategy For Engagement of Those Responsible for Critical Actions
- Develop Framework for Unnamed Social Marketing Pilot Project
- Prepare Implementation Plan
 - Engagement of Those Responsible to for Critical Actions To Understand Techniques Most Likely to Result in Behavior Change
 - Deliverable: Written Implementation Plan Based on Feedback from Engagement Activities Including Roles and Responsibilities Memorandum Including Next Steps

4. Deliverables

- Draft and Final Plan
- GIS-based Watershed Inventory
 - TP and TSS Loading Reduction Opportunities in the Watershed
 - Known BMPs in the Watershed
 - Approx. Chloride Loading in Watershed
 - Historic and Current Spring Locations in the Watershed
- Prepare WDNR Urban Nonpoint Source and Stormwater Grant Application

5. Final Report Presentations (4 Presentations)

6. Social Marketing Strategies (Pilot Project): Detailed Scope of Services To Be Determined

7. Original/Tentative Schedule

<u>Task</u>	<u>Original Completion Date</u>	<u>Tentative Completion Date</u>
Notice to Proceed	November 1, 2012	January 4, 2013
Steering Team Meetings	December 2012 - August, 2013	February 21, 2013-February 2014
Issue Team Meetings	January, 2012 - August, 2013	March 2013-January 2014
Draft Pollutant Loading Analysis	May, 2013	January 2014
Draft Social Marketing Framework Strategy	May, 2013	May 2013
Draft Chloride Reduction Prioritization	July, 2013	August 2013
Draft Infiltration Prioritization	July, 2013	November 2013
Draft Pilot Project Recommendation	July, 2013	February 2014
Draft Implementation Plan	August, 2013	March 2014
Draft Watershed Plan	September, 2013	April 2014
GIS Based Watershed Inventory	September, 2013	April 2014
Final Watershed Plan	January, 2014	May 2014
Final Report Presentations	Winter, 2014	Summer 2014
Grant Application Submittal	Spring, 2014	Spring 2014
Social Marketing Pilot Project	Summer, 2014	Summer/Fall 2014



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 April 4, 2013 3 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 2–Chlorides

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Steering Team Meeting No. 2-Chlorides	

Meeting Handouts:	
Meeting Agenda	

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Steve Arnold	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Nancy Sheehan	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	University of Wisconsin-Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	University of Wisconsin–Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action or Decision:
<p>1. <u>Kickoff Meeting Summary–Confirmation of Action Items</u> Jon presented the action items remaining from the first Steering Committee Meeting. The action column to the right indicates pending items.</p>	<p>City will post Kickoff Meeting summary on the City Web site.</p> <p>Genesis will check with Professor Chin to see if it is okay to upload the Lake Response Analysis to the City Web site.</p> <p>Jim Lorman will provide an e-mail to Strand with a written description of various watershed-related studies, and relevant attachments.</p>
<p>2. <u>Chlorides History, Guidance, Standards, Background</u> Jon presented nine slides summarizing the issue and history of chlorides in Lake Wingra. These slides included the following:</p> <p style="margin-left: 20px;">a. <i>Wingra Watershed Plan Goal</i>: 40 milligrams per liter (mg/L), whereas it currently is closer to 100 mg/L. The increase in chlorides corresponds roughly to tons of road salt use.</p> <p style="margin-left: 20px;">b. Chloride and sodium levels have been rising in Madison’s water supply wells. The various regulatory limits on chloride are the following. Some Madison wells levels are starting to exceed 100 mg/L. (1) EPA Drinking Water Secondary Standard = 250 mg/L</p>	

Discussion:	Action or Decision:
<p>(2) EPA Chronic Toxicity Limit = 230 mg/L (3) WI Chronic Toxicity Limit = 395 mg/L</p> <p>c. Chloride Levels in the Area</p> <p>(1) There are high chloride level plumes near storm sewer outfalls, some as high as 3300 mg/L. (2) Odana pond monitoring data showed levels above 125 mg/L occurred in 7 of 12 months in 2012. 125 mg/L is when MG&E stops pumping from the pond into groundwater. (3) Chloride reduction strategies.</p> <p>d. Government Actions</p> <p>(1) In 2006-2008, recommendations from a report by the Commission on the Environment was circulated to Madison and Dane County committees. No official action was taken. It did result in some management practices and equipment upgrades, but no ordinance was enacted. (2) In 2013, the Dane County Lakes and Watershed Commission is reviewing salt use with prompting from Madison Metropolitan Sewerage District. They are reviewing water softener replacement regulations (for instance, when a house is sold). They are also looking at liability limits for private applicators, similar to what is occurring in New Hampshire. The commission is at the beginning of looking at these issues. (3) One person felt ordinances should again be advocated. While politically difficult to implement, they may be one of the most effective methods for getting a handle on salt use. A licensing procedure could be used. Dane County does have precedent in implementing ordinances, such as the phosphorus in fertilizer. Roger stated that even guidelines endorsed by the government would help.</p>	
<p><u>Non-Agenda Item</u></p> <p>Jon showed the Wingra Watershed boundaries in the project materials, compared with the actual watershed that flows into Lake Wingra. The effective watershed does not include the “head of the fish,” which instead drains to Wingra Creek and does not influence water quality in Lake Wingra. One person asked if this was also true of groundwater flow; this is currently unknown. The group agreed that as the study evaluates pollutant contributors to Lake Wingra, only the area actually draining to Lake Wingra should be used in the calculations. The findings of the study, however, could be used across city watersheds.</p>	<p>For analysis purposes, Strand will only use the tributary area flowing into Lake Wingra, rather than the defined Lake Wingra Watershed area.</p>

Discussion:	Action or Decision:
<p>3. <u>Critical Action-Chlorides</u></p> <ul style="list-style-type: none"> a. Jon shared the percentage of types of impervious areas within the watershed that drain to Lake Wingra, excluding rooftops since they do not receive salt. About 54 percent of the impervious area draining to the lake is right-of-way (e.g. roads), while 20 percent is commercial properties. Strand then applied the typical application rates obtained from the City of Madison (salt and nonsalt routes, Dane County, and the UW). The application rates were preliminary and need to be further confirmed. b. Roger mentioned it might be possible to normalize rates for the Madison data by looking at the number of storm events per year of data. c. The rough analysis indicated that commercial properties (and commercial applicators) were a much larger contributor than originally expected. The initial analysis suggests the commercial properties could account for as much as 60 to 80 percent of the salt making it into the lakes. By contrast, road right-of-way contributes between 20 and 40 percent of the salt flowing towards Lake Wingra. d. Jon stated by the next meeting we would have the salt mass balance for the lake. Roger encouraged Strand not to underestimate the springflow in the mass balance equation. Springs flow 24/7 and they contribute a lot of water to Lake Wingra. e. The commercial application rates need to be confirmed and refined, but it appears there could be measurable gains by targeting commercial applicators. Tom stated we needed to contact more commercial applicators to fully understand application rates. f. Rebecca suggested that contacting commercial applicators could be an opportunity to engage these stakeholders employing social marketing methods. There was considerable discussion, including: <ul style="list-style-type: none"> (1) The need to contact owners to get permission to question the contractors they employ for snow removal. (2) The need to know which contractors are being used in the Wingra Watershed. (3) The opportunity to gain an understanding of leaf collection practices from these same contractors, because many of them probably also provide landscape services for these properties. 	<p>Strand will consider influence of springs in salt mass balance of Lake Wingra.</p>

Discussion:	Action or Decision:
<p>(4) Owners and property managers play a key role in the equation, and they should be part of the engagement.</p> <p>(5) The opportunity to follow-up with commercial applicators that participated in training that the City of Madison offered several years ago.</p> <p>(6) Connie Fortin (Fortin Consulting, Inc.) from Minnesota has had considerable experience in this area, and a phone conversation with her could provide insight into the challenges of changing salt practices on commercial properties.</p> <p>(Some of this discussion was then put on hold to be referred to in the next agenda item.)</p>	
<p>5. <u>Stakeholder Engagement-Chlorides</u></p> <p>a. Tom outlined the stakeholder engagement that is being proposed for the project. The early stakeholder engagement would occur while the study is determining the dominant factors. Early stakeholder engagement would be performed with institutions to establish an understanding of their management practices as well as benefits and barriers. By engaging with them early, they will be more receptive to management changes because they have some ownership. He stated this early engagement would enlist these stakeholders in issue meetings and interviews, there would not be a social marketing campaign. Tom stated the late stakeholder engagement block would occur in the second half of the project and would focus on behavior change.</p> <p>b. Brett started the discussion by reviewing what social marketing intends to do. He stated information alone has little effect on changing behaviors. Social marketing is the use of marketing principles and techniques to change behaviors. It is laser focused on behavior change, not perception change or simply education. He went on to describe factors to consider in using community based social marketing, as well as social marketing tools, such as benefits and barriers, norms, prompts, effective message creation, and the encouragement of commitment. Brett said often a pilot study is used to test a social marketing strategy before it is more widely implemented. Most programs need to refine or “tweak” some methods.</p> <p>c. Tom stated the late stakeholder engagement would incorporate determining the audience, engaging them, and implementing a social marketing campaign, which will</p>	



Discussion:	Action or Decision:
<p>include a pilot project. Determining the desired behavior change will come from the analysis, and the committee.</p> <p>d. Discussion then turned to stakeholder engagement and chlorides.</p> <p>e. Did the committee want to investigate a social marketing pilot project with MG&E and the Odana pond since MG&E is motivated to do something? Genesis felt the City could work independently with MG&E and the Wingra study did not need to address it (but be aware of it.)</p> <p>f. Did the committee want to use social marketing techniques with commercial applicators? Brett state a lot of information could be gained by doing phone interviews. Genesis felt she and Brett could develop a strategy to interview commercial applicators that attended the City’s workshop a few years ago. If the interviews were “follow-up” applicators may be less guarded and we may get better information.</p> <p>g. Tom asked if Strand could phone some of the applicators in the mean time to determine actual application rates.</p>	<p>Odana Pond will not be used as a pilot project for the Lake Wingra Watershed plan.</p> <p>Brett will work with Genesis to contact commercial applicators to get feedback on application rates, application techniques, benefits and barriers, including development of a questionnaire.</p> <p>Strand will contact three applicators to get application rates in order to finish their analysis.</p>
<p>6. <u>Work Program Schedule</u></p> <p>At the next Steering Committee meeting we should have the chloride issue completed. This means the analysis is basically finished and there are a set of recommendations to present before the committee. Most in the group did not feel another issue team meeting was needed.</p> <p>The next Steering Committee meeting will discuss infiltration.</p>	<p>At the next meeting Strand will have their chlorides analysis complete and present a set of recommendations to the committee for discussion.</p>

Prepared and respectfully submitted by Tom Lynch.

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 May 23, 2013 3 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 3

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Steering Team Meeting No. 3	

Meeting Handouts:

Meeting Agenda

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Steve Arnold	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Nancy Sheehan	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	University of Wisconsin-Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	University of Wisconsin-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action or Decision:
<p>1. <u>Kickoff Meeting Summary–Confirmation of Action Items</u> Jon presented the action items remaining from the first Steering Committee Meeting. The action column to the right indicates pending items.</p> <p>Jim said that there are two landscape architecture projects and a map of a proposed Vilas Park redevelopment by Lauren Brown.</p>	<p>City will post Steering Team and Issue Team Meeting summaries on the City Web site.</p> <p>Jim will provide an e-mail to Strand with a written description of various watershed-related studies and relevant attachments.</p> <p>Genesis will provide information on the Monroe Street Commercial/Business Development plan.</p>
<p>2. <u>Stakeholder Engagement</u> Bret summarized the findings from the telephone interviews completed by one of his grad students. Bret worked with Genesis and others on the Steering Team to develop a <i>Salt Application Interview Script</i>. The findings of the interviews are included in a document titled <i>Salt Use in Snow and Ice Removal by Private Applicators in the Madison Area</i>. Bret discussed the following.</p> <p style="margin-left: 20px;">a. <i>Interviewees</i>: Eight private companies that attended the 2008 salt application training sponsored by the City of Madison were contacted. Five companies were interviewed. The other three were contacted several</p>	

Discussion:	Action or Decision:
<p>times but never reached.</p> <p>b. Numerous and candid responses were received. Some of the more noteworthy comments/findings are the following.</p> <ol style="list-style-type: none"> (1) <i>Deicer Products Applied:</i> Three of the five used basic rock salt as the deicer of choice. Two companies used an “environmentally-friendly” mix. (2) <i>Barriers to Change:</i> Identified barriers included public safety, customer expectations, and liability. (3) <i>Common Sense Approach:</i> One respondent did not buy in to some of the training in 2008 stating that practical implementation of some of the techniques was not feasible in the field. The Steering Team acknowledged that credibility of the presenter is a key factor in change. Techniques to be used in the future should include testimonials of successful alternative salt application techniques by practitioners rather than educators. The idea of helping to move people along the adoption curve was stated as important. (4) <i>Client-Driven Application Methods/Rates:</i> It was found that in most cases the clients are driving what the applicators are doing in the field. The importance of engaging the property owners and inviting them to future training sessions was stated as an important next step. Genesis stated that the Madison Area Municipal Stormwater Partnership (MAMSWAP) has \$5,000 earmarked for information and education that could potentially be leveraged for this training. It was noted that Minnesota has two different training sessions, one for private applicators and one for municipal applicators. Jim said that record keeping and sharing records of salt usage is important to this issue. (5) <i>Development of a Wisconsin-Specific Salt Application Rate Guide:</i> Development of a guide for Wisconsin was discussed as being important. The Minnesota salt application guide was referenced as was a Michigan guide that is currently under development. 	
<p>3. <u>Chlorides-Draft Report Section</u> Tom Lynch handed out Strand’s draft report section on Chlorides and then presented PowerPoint slides of the findings.</p> <ol style="list-style-type: none"> a. <i>Primary Contributors and Actual Use:</i> A table was 	

Discussion:	Action or Decision:
<p>presented showing the stated salt application rates per application of the various pavement maintainers in the watershed. The table compared stated rate per event with the actual rate per event derived from actual data received from the City of Madison and the Wisconsin Department of Transportation. It appears the salt application rate per event could be 4 to 7 times higher than the stated rate. It was acknowledged that salt is typically applied on the average of 3 to 4 times during each salting event, but as many as 7 applications is common. Strand’s analysis indicates that the primary contributors (on a yearly tons of salt basis) are Commercial/Business/Institutional/Multifamily (45% to 50%), Madison Salt Routes (23% to 38%), and County-Maintained Roads of Fish Hatchery Road, Beltline, and Verona Road (12% to 17%).</p> <p>Rebecca stated the chloride concentrations in groundwater are not ambient; they result from salt applied on impervious surfaces in the watershed and surrounding area.</p> <p>b. <i>Chloride Mass Balance Predictive Tool:</i> Jon and Roger met on two occasions prior to the meeting to discuss and agree upon parameters used in Strand’s Chloride Mass Balance Predictive Tool. Numerous assumptions were made within the predictive tool as described in the draft report section. Based on Roger’s late winter 2008 chloride concentration readings, a factor was introduced to account for the vertical chloride gradient within the lake. The factor used accounts for the average lake chloride concentration. A factor of 3.25 times the surface concentration produced the best results in the modeling. A chart showing the predicted surface chloride concentration tracking closely with the observed surface chloride concentration was presented. The predicted and observed concentration diverged in 2007 and 2008 but tracked well in 2006, 2008, 2009, 2010, 2011, and 2012. Genesis said she thought that the City may have sold salt to surrounding communities in 2007 and 2008 which may have resulted in an overestimation of salt applied in the predictive tool.</p> <p>c. <i>Improvement Analysis:</i> Five management scenarios were presented showing the resultant long-term surface concentration in the lake. The predictive tool predicts that the resulting chloride concentration of a particular scenario will occur about 6 years after the scenario was fully implemented. Scenario 1 implemented a</p>	<p>Genesis will investigate what years and how much salt was sold to surrounding communities to attempt to resolve the discrepancy of surface chloride concentration in 2007 and 2008.</p>

Discussion:	Action or Decision:
<p>do-nothing approach that would result in a long-term 116 mg/L concentration in the lake. It was noted that a do-nothing approach is not really do-nothing, it means maintaining current application levels. Actually doing nothing would mean salt usage would continue to rise increasing chloride concentrations in the lake. Scenario 2 implemented a 70 percent reduction from all pavement maintainers, which resulted in a 41 mg/L surface chloride concentration. Scenario 3 implemented a 100 percent reduction from commercial applicators only which resulted in a 64 mg/L surface chloride concentration. Scenario 4 implemented a 50 percent reduction in every pavement applicator except the Beltline and resulted in a 68 mg/L surface chloride concentration. Scenario 5 implemented a 50 percent reduction from municipal and county applicators and a 75 percent reduction from commercial applicators that resulted in a 52 mg/L surface chloride concentration.</p> <p>David said the timing of chloride loadings to the lake could be discerned from the chloride concentrations being monitored at Odana Pond. Rebecca felt it would be useful to see the yearly chloride concentration profile.</p> <p>d. <i>Draft Recommendations:</i> Tom presented proposed management changes including a feasibility rating and an implementation priority.</p> <p>It was noted that based on the results of the predictive tool and the various chloride contributors that perhaps the 40 mg/L goal for the lake was overly aggressive. Jim stated that in the 1950's and 1960's chloride levels were low and therefore it should be feasible. Roger said that studies have shown that a 50 percent reduction in salt usage is achievable and he believes that is an achievable goal in the Wingra watershed. This would equate to about a 68 mg/L long-term surface concentration in the lake.</p> <p>It was requested that Strand estimate a reduction per management change.</p> <p>e. <i>Social Marketing Issues:</i> It was discussed that the Improvement Analysis should include a true do nothing alternative that shows increasing snowfall/ice and resultant increasing salt usage. There was discussion that indicated the severity index could be used in the Worst-Case Projection. Perhaps using the average of the</p>	<p>Strand will show graphs illustrating yearly chloride concentration profiles.</p> <p>Strand will estimate production per management change.</p>



Discussion:	Action or Decision:
<p>last 3 to 5 years of snowfall/precipitation to project to the future rather than using the statistical average year. The last 3 to 5 years have shown the steady increase in surface chloride concentrations.</p> <p>It was noted that the salt applicators need to know what part of the equation they can do something about. It should be conveyed that while they have no control over the weather, they certainly have control over their salt application behaviors. Salt applicators should be referred to as Problem Solvers rather than managers.</p> <p>A Chloride Pilot Project that would look at the various management changes to see whether 40 mg/l is possible or whether there is a level of chloride reduction that is feasible could be considered.</p> <p>The State of Michigan DOT has performed studies on the effectiveness of salt application with varying truck speeds (i.e., 25 miles per hour vs. 35 miles per hour) which show great potential for lower salt application rates with lower speeds because salt sticks to the road better at a lower speed.</p> <p>Canada has recently declared chloride as a toxic chemical.</p>	
<p>4. <u>Infiltration</u> Strand prepared seventeen slides to present initial findings and request guidance from the Steering Team on completion of the infiltration analysis. The discussion on Chlorides, however, took up the bulk of the meeting. It was decided that the initial infiltration findings will be presented at an Infiltration Issue Team meeting to be set up by Strand in a few weeks. It was decided that Mike Parsen and Ken Bradbury from the Wisconsin Geological and Natural History Survey should be invited to provide expertise on infiltration and groundwater issues in the Wingra Watershed and surrounding groundwatershed.</p>	<p>Strand will contact Mike and Ken to invite them to a meeting. A Doodle poll will be sent out to establish a date for the meeting.</p>
<p>5. <u>Work Program Schedule</u> An Infiltration Issue Team Meeting will be held before the next Steering Team Meeting. The next Steering Team meeting is scheduled for July 11, 2013. Initial findings of the Phosphorus Analysis will be presented as well as additional Infiltration Analysis findings.</p>	

Prepared and respectfully submitted by Jon Lindert.

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 July 11, 2013, 3 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 4–Infiltration and Phosphorus

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Steering Team Meeting No. 4-Infiltration and Phosphorus	

Meeting Handouts:	
Meeting Agenda	

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Thompson	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	University of Wisconsin-Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	University of Wisconsin–Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Luke Hellermann	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Action Items for Chlorides and Infiltration were discussed. Genesis previously e-mailed that the City does not sell salt to other communities including no sales in 2007 and 2008 to other communities. It is Strand’s intent to complete the chloride and infiltration analysis by the next Steering Team meeting on August 29, 2013, contingent upon receipt of the infiltration information described below.</p> <p style="margin-left: 40px;">a. <i>Chlorides:</i> Strand will modify Lake Wingra input of chlorides and runoff in the early winter months and review data from MG&E’s monitoring of Odana Pond. Strand will also provide a chart showing worst-case scenarios of chloride concentrations. Strand will estimate resulting Lake Wingra chloride levels per management change.</p> <p style="margin-left: 40px;">b. <i>Infiltration:</i> Genesis previously provided the City’s GIS file that includes rain gardens from the City’s 1,000 Rain Gardens Program and the Terrace Rain Garden Program. Strand has revised their maps to show number of rain gardens at each locating using information in the GIS</p>	

Discussion:	Action:
<p>database. Genesis previously provided the City’s Potential Rain Garden Map (i.e., those with 10 foot wide terraces or greater). The following are yet to be completed.</p> <ol style="list-style-type: none"> (1) Tim Troester will provide design drawings and stormwater calculations for the Westmorland Bioretention Basin. (2) Mike Parsen from WGNHS will provide information described in the June 28, 2013, Infiltration Issue Team Meeting summary. (3) Strand will contact David Benforado at MG&E to obtain an updated estimate of projected infiltration at the MG&E Infiltration Facility. (4) Strand will provide calculations on rain gardens serving residential roof areas and porous pavement serving non-residential area. (5) David Liebl will track down the Arbor Hills Greenway Infiltration Study P8 model and provide to Strand. 	<p>See responsibilities in the list to the left.</p> <p>Strand contacted David Benforado on July 5, 2013. David left a message that he will not be able to provide this information until the later part of July 2013 because of vacations and other commitments. He does intend to provide the information.</p>
<p>2. <u>Chlorides Update</u> It is Strand’s intent to complete the chloride analysis by the next Steering Team meeting on August 29, 2013. There was considerable discussion on the Lake Wingra volume with recent calculations from Dr. Chin Wu showing the lake volume as 102,925,973 cubic feet compared to 211,888,000 cubic feet Strand had been using that was based on the best available information at the time. A July 2, 2013, e-mail from David L. provides an estimate of the amount of chloride in the lake in March 2008 as 346 tons compared to Strand’s estimate of 4,015 tons.</p> <p>Genesis said that MAMSWAP and MMSD are planning to sponsor two workshops in the fall of 2013 targeting salt applicators as well as salt application contract writers for private properties. Genesis intends to have one of the presenters be an actual practitioner in the field that will bring credibility to the recommendations. There also will be discussion on practices that are occurring in McHenry County, Illinois, including certification and training.</p>	<p>Strand will review and revise predictive model based on new lake volume information.</p>
<p>3. <u>Infiltration Update</u> Because some of the Steering Team members were not able to be at the June 28, 2013, Infiltration Issue Team meeting, a condensed version (12 slides) of the PowerPoint presented at the June 28, 2013, meeting was presented. It is Strand’s intent to complete the infiltration analysis by the next Steering Team meeting on August 29, 2013, contingent upon receipt of the information defined above.</p>	



Discussion:	Action:
<p>a. <i>Strategies to Increase Infiltration:</i> Infiltration best management practices (BMPs) will be considered as follows:</p> <ul style="list-style-type: none"> (1) For source area-type BMPs at residential and nonresidential properties, BMPs only in the surface water watershed. (2) For larger infiltration-type projects, BMPs to be within the groundwater watershed but not necessarily within the surface water watershed. <p>b. <i>Methods to Increase Groundwater to Lake by 25 Percent:</i> It was generally agreed that increasing infiltration in the surface water watershed/groundwater watershed by an amount equivalent to 25 percent of the current estimated groundwater flow to the lake is an appropriate assumption for trying to meet the 25 percent increase in spring flow target from the <i>Lake Wingra: A Vision for the Future</i> document. It was acknowledged by the group that the link between infiltration and spring flow rates is more complex but that increasing infiltration by the 25 percent amount is an understandable goal that will increase spring flow.</p> <p>c. Comments from the Steering Team</p> <ul style="list-style-type: none"> (1) David said that he has heard complaints of increased artesian flows in low lying basements during the summer of 2012 in the Carver-Martin neighborhood. David thinks that the upstream marsh is creating additional head on the groundwater because of lack of maintenance on the marsh outlet. The proposed Arbor Hills Greenway infiltration project could be perceived to exacerbate this problem. (2) Jim Baumann provided information on the MG&E Infiltration Facility from a WDNR perspective. Jim said that because of chloride contamination concerns, MG&E was required to submit a Chloride Management Plan to the WDNR that modifies MG&E’s pumping schedule. In general, the infiltration facility pumps continuously until the chlorides levels of the water exceed the Preventative Action Limit (PAL) of 125 mg/l. Jim said that the facility generally does not pump from the end of December through late June/early July, leaving approximately six months (July through December) to pump to the infiltration facility. Other limitations on pumping include maintaining certain minimum water surface elevations in the ponds as well as the actual capacity of the infiltration facility. After the meeting, Jim e-mailed Strand a spreadsheet of the chloride monitoring data that MG&E submitted to the WDNR. 	

Discussion:	Action:
<p>(3) <i>Potential Management Changes:</i> There was discussion relative to the desire to increase the amount of time that MG&E can infiltrate by reducing chloride use and increasing infiltration in the Odana Ponds watershed. It should be noted that, depending on the year, the chloride concentrations from January through mid-July can range from 16 mg/l to 120 mg/l in mid-July and from 280 mg/l to 2700 mg/l in March. It is questionable whether chloride reductions will significantly increase the number of days where the chloride concentrations in the ponds are less than the PAL of 125 mg/l (and thus pumping is allowed) though some level of increase would likely be expected. It was generally agreed that residential areas should be targeted for increasing infiltration because of the lower chloride concentration in residential areas.</p> <p>(4) <i>Infiltration Projects-</i>In addition to the MG&E Infiltration Facility, the Arbor Hills Greenway Infiltration Facility provides considerable promise for meeting the infiltration target in addition to decentralized/source area infiltration BMPs. There was discussion that even if the 25 percent infiltration goal could be met by a single facility (i.e., Arbor Hills Greenway), multiple strategies should be pursued. Strand also may want to consider bounding (0.3 in/hr as low and a higher number) the infiltration rates for proposed projects because there is little in-situ infiltration rate information available in the watershed.</p> <p>(5) For additional infiltration comments, please see the June 28, 2013, Issue Team Meeting No. 2 Infiltration summary.</p>	
<p>4. <u>Lake Response Model Update</u> Genesis said that the Lake Response Model is about 60 percent complete. It has been somewhat delayed because of the decision to collect additional samples (140 instead of 100) for phosphorus as a result of the above average rainfall in the spring and early summer of 2013. Genesis envisions that either Dr. Chin Wu or one of his students could give a presentation at the next Issue or Steering Team Meeting. Several of the Steering Team members would like to have the Lake Response Model predict the target total phosphorus reduction to be used in the Wingra Watershed Study rather than simply using the 50 percent reduction number in Strand’s agreement with the City.</p>	



Discussion:	Action:
<p>5. <u>USGS Leaf Study Update</u> Roger said that the leaf study is ongoing and that results will be coming out over the next three years. For purposes of the Wingra Watershed Plan, Roger volunteered to present the results and findings to date on the project, similar to the presentation by Bill Selbig of the USGS at the Spring 2013 NASECA conference if desired by the City of Madison.</p>	
<p>6. <u>Strand Presentation–Phosphorus</u> Strand presented 15 slides on the preliminary phosphorus analysis.</p> <p>a. <i>Phosphorus Goals/Target:</i> The goal in Strand’s agreement with the City is a 50 percent total phosphorus (TP) reduction compared to No Controls while accounting for existing controls. The Steering Team would like to see whether the Lake Response Model can help define a better target TP that will provide the needed reduction to benefit Lake Wingra water clarity. Genesis will check with Greg Fries and John Riemer to see whether they have calculated the total suspended solids (TSS) and TP reductions required by the Rock River TMDL for the Wingra Watershed. Jim L. felt the target should be a 50 percent reduction from existing controls rather than from a baseline number with no controls. A target coming from a combination of the Lake Response Model and the Rock River TMDL would go a long way in conveying the reasoning behind the target. In addition, it likely will be easier for the public to understand if stating phosphorus reductions in pounds rather than percent.</p> <p>b. <i>Modeled TSS and Phosphorus Loads:</i> Strand used the City’s P8 model to show the existing TSS reduction is 57 percent and the existing TP reduction is 33 percent. Strand will be meeting with John Reimer on Thursday July 18, 2013, to ensure Strand is interpreting the model correctly. Strand will check that Pond 3 and Pond 4 are not in the calculations since they are in the watershed downstream of the lake that discharges to Wingra Creek. Strand will work with the City to estimate the watershed draining to and the water quality performance of the rain gardens, terrace rain gardens, and private bioretention basins in the watershed since they are not in the City’s P8 model but are providing treatment. The City’s P8 model is a regulatory model that cannot take credit for private BMPs unless a stormwater maintenance agreement is signed with the property owner. In the case of Terrace Rain Gardens, the City’s program requires the homeowner to maintain the rain garden but there is nothing to stop the next owner of the property from filling in the rain</p>	<p>After the meeting, Strand reviewed the Rock River TMDL requirements. The TMDL requires a 78.9 percent TP reduction and a 83.4 percent TSS reduction. It was also confirmed that the Clean Lakes Alliance goal was a 50 percent reduction in existing total phosphorus loads from the water years 1996 to 2008 (i.e., reduction from existing TP loads (with existing controls), not from a baseline TP load with no controls)</p> <p>Strand will provide additional information described to the left.</p>

Discussion:	Action:
<p>garden (i.e., no deed restriction on the rain gardens). Strand will provide a graphic showing TP hot spots within the watershed under a no controls and existing controls condition including showing the subwatersheds. Strand will report on the performance of each modeled BMP in the watershed in a table.</p> <p>c. <i>Nonmodeled Phosphorus Loads:</i> Strand presented information on the potential TP reduction resulting from increased leaf collection, increased street sweeping, pet waste enforcement, active waterfowl management, streambank restoration, and wetland plant harvesting. It was agreed that the idea of a delivery factor is confusing and should not be used unless it is applicable to the Wingra Watershed Plan. Other comments include the following.</p> <p>(1) <i>Increased Leaf Collection:</i> Genesis will provide Strand with the City’s 2011 and 2012 Leaf Collection and Street Sweeping quantities and costs. Strand will modify the Wingra Watershed to remove the golf courses and the Arboretum to get TP loads that are better comparable to the P8 generated phosphorus loads for the watershed. Leaf collection has the potential to close some of the phosphorus reduction gap to get to 50 percent phosphorus reduction. Because of this, several Steering Team members recommended proceeding with management changes that will increase the effectiveness of leaf collection including:</p> <p>(a) Modifying the leaf collection schedule and timing to collect leaves before they begin leaching phosphorus.</p> <p>(b) Bagging of leaves with compostable bags since Dane County accepts compostable bags at its compost site. Jim suggested contacting McHenry County, Illinois, to learn more about its requirement to bag leaves. Strand will contact McHenry County to obtain costs for bags, cost savings compared to conventional methods, and barriers to implementation. Champaign, Illinois also has a program in place.</p> <p>(c) Compost Bins–Paul said he would like the capital cost of compost bins documented in the plan.</p> <p>(2) <i>Streambank Restoration:</i> The Steering Team said there are very few streambank erosion areas. Strand has identified streambank erosion problems at the Glenway Golf Course, some bare slopes along the Southwest Commuter Bike Path ditches, and the Curtis Flume leading to Curtis Pond in the</p>	



Discussion:	Action:																											
<p>UW-Madison Arboretum which is being addressed by a UW-Madison Arboretum project. Jim suggested that Strand bring a board to his July 30, 2013, charette so that participants can draw the locations of known erosion on the map.</p> <p>(3) <i>Construction Site Erosion Control:</i> Several Steering Team Members recommended that construction site erosion control be added to the list. While it is difficult to quantify the size of redevelopment projects, it was recommended that an example construction site be used to provide an order of magnitude estimate of potential phosphorus load discharged from a site for comparison to other phosphorus contributors. Strand will provide an estimate of phosphorus load from an example construction site. It was discussed that enhanced construction site erosion control enforcement can be a cost-effective method and critical component of a strategy to keep phosphorus out of Lake Wingra.</p>	<p>Strand will provide additional information described to the left.</p>																											
<p>7. <u>Upcoming Schedule and Next Meeting</u> The work program schedule was reviewed. Upcoming steering team meetings are as follows. No additional issue team meetings have been identified at this time.</p> <table border="1"> <thead> <tr> <th>Steering Team Meeting</th> <th>Date</th> <th>Topic</th> </tr> </thead> <tbody> <tr> <td>Meeting No. 1</td> <td>March 21, 2013</td> <td>Kickoff Meeting</td> </tr> <tr> <td>Meeting No. 2</td> <td>April 4, 2013</td> <td>Chlorides/Social Marketing</td> </tr> <tr> <td>Meeting No. 3</td> <td>May 23, 2013</td> <td>Chlorides/Infiltration</td> </tr> <tr> <td>Meeting No. 4</td> <td>July 11, 2013</td> <td>Pollutant–Sediment and Phosphorus</td> </tr> <tr> <td>Meeting No. 5</td> <td>August 29, 2013</td> <td>Pollutant–Reduction Opportunities</td> </tr> <tr> <td>Meeting No. 6</td> <td>October 17, 2013</td> <td>Lake Response Model</td> </tr> <tr> <td>Meeting No. 7</td> <td>December 5, 2013</td> <td>Social Marketing–Strategies</td> </tr> <tr> <td>Meeting No. 8</td> <td>January 23, 2014</td> <td>Social Marketing–Pilot Project</td> </tr> </tbody> </table>	Steering Team Meeting	Date	Topic	Meeting No. 1	March 21, 2013	Kickoff Meeting	Meeting No. 2	April 4, 2013	Chlorides/Social Marketing	Meeting No. 3	May 23, 2013	Chlorides/Infiltration	Meeting No. 4	July 11, 2013	Pollutant–Sediment and Phosphorus	Meeting No. 5	August 29, 2013	Pollutant–Reduction Opportunities	Meeting No. 6	October 17, 2013	Lake Response Model	Meeting No. 7	December 5, 2013	Social Marketing–Strategies	Meeting No. 8	January 23, 2014	Social Marketing–Pilot Project	
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Prepared and respectfully submitted by Jon Lindert.

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 October 17, 2013, 8 A.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 5–Pollutant Reduction Opportunities
 Meeting Summary

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Pollutant Reduction Opportunities	

Meeting Handouts:	
Meeting Agenda	Attachment A: Pollutant Reduction Graphs

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> <i>Infiltration:</i> All items complete except the City of Madison will provide Westmorland Bioretention Basin design drawings.</p> <p><i>Phosphorus:</i> All items complete except Strand will provide the cost of compost bins in the plan.</p> <p><i>Chlorides:</i> All items complete; some items in progress.</p>	<p>Received after the meeting.</p> <p>Strand will complete.</p>
<p>2. <u>Lake Response Model Update</u> Greg said the most recent update from the UW-Madison concludes that carp (around 80 percent) and wind/waves (around 6 percent) are the key contributors to sediment and phosphorus in Lake Wingra. Jim L. said that phosphorus loads from storm runoff (14 percent) will continue to build up in the lake and that storm-related phosphorus should not be discounted as a source.</p>	
<p>3. <u>USGS Leaf Study Update</u> This item was not discussed. The study is ongoing and an update will be included on the agenda of the next Steering Team Meeting.</p>	

Discussion:

Action:

4. Infiltration Update
PowerPoint slides were presented discussing the infiltration goal and strategies for achieving the infiltration goal.

Discussion included the following:

- a. Is the infiltration goal appropriate? Strand, as generally agreed upon at Steering Team No. 4, is using an infiltration target of infiltrating runoff equivalent to 25 percent of the Wisconsin Geological and Natural History Survey estimate of groundwater flow to the lake (25 percent x 39,010,105 cubic feet = 9,752,526 cubic feet). It was discussed that all the projects Strand presented would need to be constructed to achieve this goal. Jim L. asked whether an estimate could be made of the amount of predevelopment infiltration in the landscape for comparison purposes. After the meeting, Strand ran the City P8 model and arrived at an annual average “percolation/infiltration” rate under both existing conditions and predevelopment conditions as described in the table below.

Existing Conditions	Volume (cf)	% of Annual Precipitation
Annual Precipitation	401,844,360 cf (31 inches x 3,571 acres = 9,225 ac-ft)	100
Annual Runoff to Lake	82,842,408 cf	21
Annual Percolation/ Infiltration	278,400,672 cf	69
Other Losses	40,601,550 cf	10
Predevelopment Conditions		
Annual Percolation	377,634,700 cf	
<i>Lost Infiltration: Difference in Existing and Predevelopment Percolation/ Infiltration</i>	99,234,028 cf	
<i>10% of Lost Infiltration</i>	9,923,403 cf	
<i>25% of Lost Infiltration</i>	24,808,507 cf	

Discussion after the meeting with the City of Madison centered on setting two infiltration goals as follows. For purposes of the plan, Strand will provide analysis and costs for meeting the short-term goal only. The long-term goal will exist to guide future discussion of infiltration opportunities.



Discussion:	Action:
<p>(1) <i>Short-Term Goal:</i> Recover 10 percent of the lost infiltration due to development. See table above.</p> <p>(2) <i>Proposed Long-Term Goal (Open For Discussion):</i> Recover 25 percent of the lost infiltration due to development. See table above.</p> <p>(It should be noted that Strand’s agreement with the City of Madison calls for an achievable infiltration target to be set based on an estimate of current/baseline infiltration rates in the watershed.)</p> <p>b. Fourteen strategies/projects were presented that would all have to completed to meet the presented infiltration goal. It was discussed that Strand should add in bioretention/rain gardens for commercial properties. Strand should have an estimate of total amount of commercial roof area in the watershed from the City of Madison GIS layer.</p>	<p>Strand will add in bioretention/rain gardens for commercial properties.</p>
<p>5. <u>Phosphorus Update</u></p> <p>PowerPoint slides were presented discussing the phosphorus goal and strategies for achieving the phosphorus goal. The goal as described in Strand’s agreement is a 50 percent total phosphorus reduction compared to no controls. It was discussed that the Rock River total maximum daily load requires a 78.9 percent total phosphorus reduction compared to no controls.</p> <p>Greg said this is unachievable without chemical controls (e.g., alum). Also, the Clean Lakes Alliance calls for a 50 percent reduction in total phosphorus (TP) control compared to existing controls but relies heavily on agricultural best management practices for implementation.</p> <p>Discussion included the following:</p> <p>a. Is the phosphorus reduction goal appropriate? Jim L. stated the FOLW understanding was a 50 percent reduction compared to existing controls, not no controls. It was discussed that the 50 percent reduction from no controls goal (265 pounds TP reduction, a 50 percent reduction from no controls) could be a good 10-year or 20-year goal, but that a 50 percent reduction from existing controls goal (607 pounds TP reduction, a 50 percent reduction from no controls) could be a good 10-year or 20-year goal, but that a 50 percent reduction from existing controls goal (607 pounds TP reduction, a 50 percent reduction from no controls) could be a good 10–year or 20–year goal, but that a 50 percent reduction</p>	



Discussion:	Action:
<p>from existing controls goal (607 pounds TP reduction, a 68 percent reduction from no controls) could be a longer 100-year type of goal. Jon said that modifying the goal would create additional work for Strand. Genesis and Greg requested that Strand conference call with them to discuss additional costs and efforts before proceeding with the additional work.</p> <p>Discussion after the meeting with the City of Madison centered on setting two phosphorus reduction goals as follows. For purposes of the plan, Strand will provide analysis and costs for meeting the short term-goal only. The long-term goal will exist to guide future discussion of phosphorus reduction opportunities.</p> <p><i>Short-Term Goal:</i> Continue to use the 50 percent reduction compared to no controls.</p> <p><i>Long-Term Goal:</i> To be consistent with the Rock River Total Maximum Daily Load (and the City’s requirement for redevelopment sites), use an 80 percent total phosphorus reduction compared to no controls.</p> <p>b. Sources of Phosphorus: A slide was presented showing the sources of phosphorus in the watershed. It was discussed that some of these sources are already accounted for in the P8 model. However, it was agreed the P8 model does not break them out specifically, so there is no way to know exactly how P8 is accounting for them. Strand will present this information in a different format showing that these are accounted for in the P8 model but only in a general fashion based on the program’s routines. Roger said the team needed to be careful to not double-count reductions in phosphorus that would occur. For example, constructing a wet pond may remove the same phosphorus that was intended to be removed by modified leaf collection strategies.</p> <p>c. Twenty five strategies and projects were presented that could be implemented to meet the phosphorus reduction goal. These projects include approximately 761 pounds of potential TP reduction (not accounting for double counting). Only Odana Pond Alum Addition or the Manitou Pond Alum Addition Project would probably be done rather than the Odana Pond Alum Addition Project because they both have about the same reduction effect. Also, Jim B. said it is possible the Odana Pond will be designated a water of the state in the future, thus removing it from consideration for alum addition.</p>	



Discussion:	Action:																																				
<p>David requested the graphs of the potential TP and Infiltration projects be in order of smallest reduction to largest reduction. It was discussed that these graphs could include cost-effectiveness (\$/pound removed) to aid in decision-making. Strand will do so once it begins the opinion of probable cost phase of the project.</p>	<p>Strand will reorder the project list and add cost/effectiveness to the graphs.</p>																																				
<p>6. <u>Chlorides Update</u> This item was not discussed because time ran out at the meeting. Strand was requested to send the PowerPoint containing the chloride information, and a determination will be made by the City of Madison and FOLW on the need for a Chloride Issue Team Meeting before the next Steering Team Meeting.</p>																																					
<p>7. <u>Upcoming Schedule and Next Meeting</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #4F81BD; color: white;"> <th>Steering Team Meeting</th> <th>Date</th> <th>Time</th> <th>Topic</th> </tr> </thead> <tbody> <tr> <td>Meeting No. 1</td> <td>March 21, 2013</td> <td>3 pm</td> <td>Kickoff Meeting</td> </tr> <tr> <td>Meeting No. 2</td> <td>April 4, 2013</td> <td>3 pm</td> <td>Chlorides/Social Marketing</td> </tr> <tr> <td>Meeting No. 3</td> <td>May 23, 2013</td> <td>3 pm</td> <td>Chlorides/Infiltration</td> </tr> <tr> <td>Meeting No. 4</td> <td>July 11, 2013</td> <td>3 pm</td> <td>Pollutant-Sediment and Phosphorus</td> </tr> <tr> <td>Meeting No. 5</td> <td>October 17, 2013</td> <td>8 am</td> <td>Pollutant-Reduction Opportunities</td> </tr> <tr> <td>Meeting No. 6</td> <td>December 11, 2013</td> <td>8 am</td> <td>Chlorides</td> </tr> <tr> <td>Meeting No. 7</td> <td>January 23, 2014</td> <td>8 am</td> <td>Social Marketing-Strategies</td> </tr> <tr> <td>Meeting No. 8</td> <td>March 13, 2014</td> <td>8 am</td> <td>Social Marketing-Pilot Project Lake Response Model</td> </tr> </tbody> </table>	Steering Team Meeting	Date	Time	Topic	Meeting No. 1	March 21, 2013	3 pm	Kickoff Meeting	Meeting No. 2	April 4, 2013	3 pm	Chlorides/Social Marketing	Meeting No. 3	May 23, 2013	3 pm	Chlorides/Infiltration	Meeting No. 4	July 11, 2013	3 pm	Pollutant-Sediment and Phosphorus	Meeting No. 5	October 17, 2013	8 am	Pollutant-Reduction Opportunities	Meeting No. 6	December 11, 2013	8 am	Chlorides	Meeting No. 7	January 23, 2014	8 am	Social Marketing-Strategies	Meeting No. 8	March 13, 2014	8 am	Social Marketing-Pilot Project Lake Response Model	
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c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 December 11, 2013, 8 A.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 6–Chlorides
 Meeting Summary

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Pollutant Reduction Opportunities: Chlorides	

Meeting Handouts:	
N/A	

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ben Jordan	UW–Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
1. <u>Confirmation of Action Items Completion</u> There were no comments.	
2. <u>Lake Response Model Update</u> Greg said the finalization of this study is delayed because of stolen monitoring equipment.	
3. <u>USGS Leaf Study Update</u> There were no comments.	
4. <u>Infiltration and Phosphorus Update</u> Strand is currently working on finalizing this analysis and draft report section based on comments received at Steering Team Meeting No. 5.	
5. <u>Chlorides Update</u> PowerPoint slides were presented discussing the chlorides goal and strategies for achieving the chlorides goal. The goal, as described in Strand’s, agreement, is to recommend practices for reducing chloride levels in Lake Wingra to the target provided in <i>Lake</i>	



Discussion:	Action:
<p><i>Wingra: A Vision for the Future</i> (average annual level of 40 mg/L).</p> <p>Discussion included the following:</p> <ol style="list-style-type: none"> a. Chloride Mass Balance Predictive Tool—This tool has been updated with the following new information received after completion of the original tool: new lake volume, monthly chloride data from the City of Madison Health Department, new P8 runoff volumes based on changes to the P8 model, and new groundwater inflow/outflow values from WGNHS. An adjustment factor of 0.18 (82 percent of the chloride is retained and does not reach the lake) was used to bring applied salt rates/amounts to a level reflective of observed chloride concentrations in the lake. It was requested that Strand do a literature search to see whether any other studies would support use of the 0.18 adjustment factor. b. End of Pipe Chloride Data—Roger requested that Strand work with him to develop a chloride load from the watershed based on end of pipe chloride concentrations that he has collected for comparison to the chloride mass balance predictive tool numbers. This number could provide an order of magnitude check on the adjustment factor. c. WisDOT Brine Use on the Beltline—It was requested that Strand attempt to obtain this information from WisDOT. d. City of Madison Salt Usage Data—Greg requested that Strand send its calculations regarding this information to the City of Madison (City). It was also requested that Strand provide some discussion on why there is a difference between the City data and the Dane County data. There was discussion about the City turning on GPS to track salt usage data on two city trucks to get better salt usage data than that contained in the City’s yearly salt report. e. Future Refinements of Chloride Mass Balance Predictive Tool—Strand stated that numerous professional judgments and assumptions were made in crafting the tool. A considerable amount of refinements were made to the predictive tool over the past 5 months. Even with the refinements, the chloride retention rate within the watershed appears to be substantial. The report should include areas where additional information could be gathered in the future to refine the assumptions including the following: 	<p>Strand will perform a literature search of similar chloride mass balance studies. Strand did so in mid-December including an e-mail on December 24, 2013, that suggests modifications to Strand’s tool that would bring the adjustment factor to 0.22, an adjustment factor that is similar to the 0.23 adjustment factor used in a Twin Cities metropolitan area study.</p> <p>Strand will work with Roger to develop a chloride load from end of pipe chloride concentration numbers.</p> <p>Strand will request Beltline brine usage data from WisDOT.</p> <p>Strand sent calculations to the City on December 23, 2013.</p>

Discussion:	Action:
<p>(1) Lake bottom sediment (interstitial water) sequestration of chloride.</p> <p>(2) Detention pond sequestration of chloride.</p> <p>(3) Wetland sequestration of chloride.</p> <p>(4) Continuous simulation (daily) rather than monthly timestep chloride calculations.</p> <p>(5) Sanitary sewer diversion of chloride from the watershed.</p> <p>(6) Infiltration of chlorides through pavements</p> <p>(7) Infiltration of chlorides through terraces.</p> <p>f. Do Nothing Alternatives—Two slides were presented showing the projected chloride levels if:</p> <p>(1) Salting continues at an average of 2006 to 2012 with average annual rainfall and snowfall amounts.</p> <p>(2) Salt at 2011 winter rates with 2011 rainfall and snowfall amounts.</p> <p>Scenario (1) results in chloride levels fluctuating between 90 and 150 mg/L over the next 10 years. Scenario (2) results in chloride levels fluctuating between 130 and 200 mg/L over the next 10 years. It was noted that after a couple of years, the concentrations stabilize because of the consistent inputs every year under this analysis.</p> <p>g. Chloride Reductions Necessary to Meet Goal—Slides were presented showing three scenarios of salt reduction including the following:</p> <p>(1) 50 percent commercial applicator reduction and 10 percent reduction for all others.</p> <p>(2) 65 percent commercial and residential applicator reduction and 20 percent reduction for all others.</p> <p>(3) 70 percent reduction for all applicators.</p> <p>These three scenarios resulted in a chloride concentration in the lake of 60 to 100 mg/L, 50 to 80 mg/L, and 30 to 50 mg/L, respectively. The feasibility of achieving a 70 percent reduction and thus meeting the FOLW 40 mg/L goal was discussed. Information was presented showing both a 35 percent (15 percent all others) and a 65 percent (20 percent all others) reduction in commercial application. These two scenarios are predicted to result in chloride concentration between 65 and 100 mg/L (stabilization of existing conditions) and 55 and 80 mg/L, respectively, basically maintenance of the status quo chloride concentration in the lake.</p> <p>h. Alternatives to Rock Salt (NaCl)—These should be well documented in the report. There is a good comparison table (Page 17) in <i>Minnesota's Winter Parking Lot and Sidewalk Maintenance Manual for Alternative Deicing Chemicals</i></p>	

Discussion:	Action:
<p>including sodium chloride, magnesium chloride, calcium chloride, calcium magnesium acetate, and potassium acetate. The comparison discusses melting point, corrosivity, and other environmental issues. Genesis said the City is going to try beet juice (prewet dry salt) again in a pilot arraignment on the west side of the city by a detention basin though there are still concerns with phosphorus and BOD when using beet juice.</p> <p>i. Chloride Report Section–It was discussed that the report should be framed to focus on short-term and long-term goals. The short-term goals should be focused on what is achievable with current technologies and should include an implementation plan. The long-term goals should provide a vision as technologies evolve allowing for greater reductions. The overall philosophy of the report should include the following:</p> <ol style="list-style-type: none"> (1) Public and private entities the opportunity to do good together. (2) Chloride reductions are ecologically important. (3) Improvement over time is important. 	
<p>6. <u>Stakeholder Engagement/Social Marketing</u> It was discussed that Steering Team Meeting No. 7 will bring the analysis for phosphorus, infiltration, and chlorides to conclusion which will allow for the stakeholder engagement/social marketing phase of this project to continue now that the main contributors to each pollutant are known. Draft report sections for phosphorus, infiltration, and chlorides will be sent out to Steering Team members on January 14, 2014. Issue Team Meeting No. 3 will be held approximately three weeks after Steering Team Meeting No. 7 to discuss social marketing and the pilot project. The possibility exists to do a SurveyMonkey survey to rate different pilot projects. Strand’s contract (along with the Social Marketing Consultant) calls for the following to occur next.</p> <p>a. Pilot Project Recommendation</p> <ol style="list-style-type: none"> (1) Identify pilot project to address one critical action. (2) Prepare pilot project plan. <p>b. Stakeholder Engagement</p> <ol style="list-style-type: none"> (1) <i>Identify/Interact With Target Audiences</i>–Identify, communicate, and interact with target audiences and identify those responsible for critical actions. Roger has been in contact with commercial managers responsible for salt application contracts and has learned some valuable information 	

Discussion:	Action:																																								
<p>including the need to take liability away from salt applicators and property managers when using alternative strategies and application rates.</p> <p>(2) <i>Develop Social Marketing Strategy</i>–Identify potential behavior change strategies, develop written strategy for engagement with those responsible for critical actions, and develop a framework for social marketing pilot project.</p> <p>(3) <i>Implementation Plan</i>–Using the social marketing strategy, provide engagement activities with those responsible for critical actions to understand techniques most likely to be effective in creating behavior change. From these activities, provide an implementation plan for plan components including a roles and responsibilities memorandum.</p> <p>c. <i>Social Marketing Strategies (Pilot Project Implementation)</i>–This will consist of creation, management, and tracking of a pilot project potentially consisting of the following: identify barriers, partnerships, and current commitments, identify partners, recruit partners, obtain baseline data, assist with pilot project implementation, and evaluate pilot project.</p>																																									
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c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 January 23, 2014, 8 A.M.
 Strand Associates, Inc.[®]

Steering Team Meeting No. 7–Chlorides, Phosphorus, Infiltration Draft Report Sections and
 Stakeholder Engagement/Social Marketing Framework
 Meeting Summary

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Chlorides, Phosphorus, Infiltration Draft Report Sections and Stakeholder Engagement/Social Marketing Framework	

Meeting Handouts:	
Meeting attendees were provided with draft report sections one week before the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Ben Jordan	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
1. <u>Confirmation of Action Items Completion</u> Seven items were discussed with four completed and the following three ongoing. a. Phosphorus–Strand will include the cost of the compost bins in the plan. b. Chlorides–The City of Madison (City) will review Strand’s December 23, 2013, e-mail with calculations using the City’s salt usage data. c. Chlorides–Strand will request brine usage data from the Wisconsin Department of Transportation (WisDOT).	See action items at left.
2. <u>Lake Response Model Update</u> Greg will speak with Professor ChinWu regarding the status of the model and will report back to the Steering Team.	See action item at left.
3. <u>USGS Leaf Study Update</u> Roger will be meeting with Bill Selbig to go over data collection to date and will report back to the Steering Team.	See action item at left.

Discussion:	Action:
<p>4. <u>Draft Infiltration Report Section</u> Strand presented eight PowerPoint slides providing a summary of the draft infiltration report section. It was discussed that the total cost of a particular project should differentiate between the cost to the City, cost to the homeowner or business (i.e., the City incentive for terrace rain gardens where the City pays for 75 percent (minus the cost of plants) and the homeowner pays 25 percent (plus the cost of plants) of the construction cost through an assessment). The costs should also include, as appropriate, a 15 percent design contingency and a 15 percent construction contingency. If there is only an incremental cost over what would ordinarily be done, then the incremental cost should be broken out (i.e., traditional pavement needs to be replaced and porous pavement installed instead. What is the difference in cost?). Strand will meet with the City to work through the cost discussion. Discussion included the following.</p> <ul style="list-style-type: none"> a. Porous Pavement Cost—The incremental cost should be used to replace traditional pavement with porous pavement rather than the total cost presented. This change would entail subtracting out the cost of the traditional pavement layer (i.e., asphalt only, assuming existing parking lots have an asphalt surface). Strand will revise the calculations to provide a 3:1 ratio of drainage area to paved area, which will increase the cost-effectiveness of the BMP. Also, Strand should see how this could affect chloride reductions using an assumed 70 percent reduction in salt usage for these areas. b. Rain Barrels—It was requested that Strand include the cost and effectiveness of rain barrels as part of the alternatives analysis. c. Downspout Disconnection—It was requested that Strand include the cost and effectiveness of downspout disconnection as part of the alternatives analysis. Greg believes the City ordinance states that downspouts must be connected to storm drains in downtown areas. Jim Lorman thought the City ordinance required disconnection. Greg will look into the City ordinances and provide to the Steering Team. d. Assumptions for Each BMP—Strand will include base assumptions for each recommended BMP in the report. e. Operation and Maintenance—Strand has accounted for operation and maintenance in the 20-Year Net Present Worth costs. BMPs that are not under City control (i.e., 	<p>See Strand action items at left.</p> <p>Greg will look into existing City ordinances that address downspout disconnection and report back to the Steering Team.</p>

Discussion:	Action:
<p>not City-owned or non-stormwater-permitted facilities) present a challenge in terms of maintaining the performance of the BMPs over time. These same facilities are at risk of being removed or filled in over time (i.e., a home gets sold and the next homeowner it does not want the facility). This would also reduce their effectiveness.</p> <p>f. Incentives–The City Rate Adjustment Policy for the storm water utility currently provides incentives for various BMPs.</p>	
<p>5. <u>Draft Phosphorus Report Section</u> Strand presented thirteen PowerPoint slides providing a summary of the draft phosphorus report section. Discussion included the following.</p> <p>a. Phosphorus Goal–To better communicate the goals to the reader, Strand will include a bar chart in the report showing the existing phosphorus reduction and the short- and long-term goals for further reduction.</p> <p>b. Lake Wingra Watershed Plan as an EPA-Recognized TMDL Document–There was discussion that the Lake Wingra Watershed Plan could serve as a TMDL document to address the lake’s 303 (d) designation. Jim Baumann has considerable experience in Wisconsin TMDLs and said he would look into this with key individuals at the Wisconsin Department of Natural Resources (WDNR). Jim followed up with an e-mail on January 23, 2014, with initial feedback from the key WDNR individuals and will provide additional information at the next Steering Team meeting.</p> <p>c. Figure 4.03-4–Switch the red watersheds to pink because the red seems to convey necessary action, when in reality they are Arboretum lands with low pollutant load.</p> <p>d. Figure 4.03-5–Switch the red watersheds to pink and the pink watersheds to more of a red.</p> <p>e. BMP Performance Table–Strand will insert this table into the report and the wetland basin and Pond 2 will be combined to be one BMP.</p> <p>f. MG&E Infiltration Facility at Odana Golf Course–It was requested that Strand account for the phosphorus reduction achieved from this facility. Jim Baumann said</p>	<p>See Strand action items at left.</p>



Discussion:	Action:
<p>he thought the reduction was probably in the 80 pound/year (lb/yr) range. After the meeting, Strand did a quick modification to the City P8 model and found that loss of 3.6 million cubic feet of water downstream of the East Odana Hills Pond would reduce the total phosphorus load by about 27 lb/yr (26.928 million gallons). Using an average Odana Pond TP concentration of 347 micrograms/liter (from Jim Baumann provided data) and an average of 3.6 million cubic feet of diverted water, the total annual reduced TP load is 77.5 pounds. Jon will contact MG&E and MMSD to see whether there are any monitoring numbers for the flow diverted to the sanitary sewers contributory to the MMSD WWTP.</p> <p>g. Phosphorus Performance of Alternative Components–Remove the infiltration rates from this table since each component is independent of infiltration rate at the location of the component.</p> <p>h. Construction Site Erosion Control–Greg and Genesis will provide an estimate of the area of land-disturbing construction activity that occurs on average each year in the Lake Wingra Watershed.</p> <p>i. Modified Leaf Collection Methods–It was requested that Strand work with the City to develop incremental costs for:</p> <ul style="list-style-type: none"> (1) Increased street sweeping schedule; (2) Bagging of leaves. <p>Ben Jordan will provide additional information on leaf collection from his and others experiences in Illinois. It was discussed that bagging leaves could ultimately be less expensive.</p> <p>j. Assumptions for Each BMP–Strand will include assumptions for each BMP in the report.</p> <p>k. Public Informational Meeting–It was requested that a public informational meeting be held soon now that the draft analysis is complete.</p>	
<p>6. <u>Draft Chloride Report Section</u> Strand prepared eleven PowerPoint slides providing a summary of the draft chloride report section. These slides were not presented because of time constraints. They will be presented at the next meeting; however, Ben Jordan and David Liebl provided comments after the meeting.</p>	

Discussion:	Action:																																																
<p>7. <u>Stakeholder Engagement/Social Marketing Framework</u> This topic will be presented at the next meeting when Brett Shaw is able to attend.</p>																																																	
<p>8. <u>Urban Non-Point Source and Stormwater Grant Application</u> Strand was directed by the City to prepare this grant application, which is part of the Scope of Services of the agreement for the streambank/channel restoration on city land at Thoreau Elementary School, which is located between the Nakoma Road/Cherokee Drive and Cherokee Drive/Naheda Trail intersections. This project is already in the City's Capital Improvement Plan. If there are any comments from Steering Team members regarding this grant application, please contact Greg, Genesis, or Jon.</p>																																																	
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c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 March 25, 2014, 10 A.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 8–Stakeholder Engagement/Social Marketing
 and Community Engagement Strategy Workshop

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Stakeholder Engagement/Social Marketing and Community Engagement Strategy Workshop	

Meeting Handouts:	
Meeting attendees were provided with draft report sections one week before the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
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Ben Jordan	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
1. <u>Confirmation of Action Items Completion</u> Seven items were discussed with four completed and the following three ongoing. <ol style="list-style-type: none"> a. Phosphorus–Strand is finalizing the report section. The City will work with Strand on the cost for the increased street sweeping schedule. b. Infiltration–Strand is finalizing the report section. c. Chlorides–Strand is finalizing the report section. d. Community Engagement–Strand and Bret Shaw will work with the City and FOLW to set dates for community engagement activities including a public informational meeting. Genesis will add the timeline for the City’s Project-Based and Management-Based Measures. 	See action items at left.
2. <u>Lake Response Model Update</u> There was no discussion.	
3. <u>USGS Leaf Study Update</u> There was no discussion	

Discussion:	Action:
<p>4. <u>Final Infiltration, Phosphorus, and Chlorides Analysis Update</u> Strand presented eight PowerPoint slides providing a summary of these analyses.</p> <ul style="list-style-type: none"> a. Infiltration–Jon said the major changes to this analysis included the performance and number of terrace rain gardens, private rain gardens, commercial rain gardens, and porous pavement as shown in Slide 8. b. Phosphorus–David requested that Strand repeat the existing controls bar next to both the short-term goal and the long-term goal on Slide 9. See major changes in 4.a. above. c. Chlorides–Slide 14 Chloride Management Measures was discussed. <ul style="list-style-type: none"> (1) David Liebl suggested that BMPs and performance standards for chloride usage be established rather than seeking to meet a certain lake chloride level through efforts that could sacrifice public safety. (2) Dane County Lakes and Watershed Commission has taken on chlorides as an issue. (3) City of Madison–Well No. 14: The City is pursuing a chloride reduction pilot in the Well No. 14 ground watershed. This will require WisDOT’s cooperation on University Avenue where it is responsible for deicing and plowing. The City is writing a white paper on proposed management change for deicing. Another option for the well is to case the well to separate the upper and lower aquifer, although this is a major expense that the City is trying to avoid. (4) Investigate Alternate Deicers–Calcium magnesium acetate was discussed as an alternative. The City’s Streets Department is adverse to its use because it turns snow into “oatmeal” and is very corrosive. The City is considering beet juice again as an alternative to brine although it has an oxygen demand. The City is contemplating installation of air bubble diffusers in storm sewers to add oxygen before the beet juice reaches the lake. (5) There was strong support for certification and training of deicing applicators. 	<p>See action items at left.</p>

Discussion:	Action:
<p>5. <u>Stakeholder Engagement/Social Marketing Framework And Critical Action Prioritization Exercise</u> Strand presented six PowerPoint slides on this topic. Discussion included the following.</p> <ul style="list-style-type: none"> a. <u>Timeline</u>–A timeline was presented showing this phase of the project and the remaining meetings. b. <u>Identification of Critical Actions</u>–The analysis portion of this project identified the actions necessary to meet the performance goals for infiltration, phosphorus, and chlorides. With this information now complete, the Stakeholder Engagement/Social Marketing portion of this project can continue. The discussion for this meeting will focus on possible engagement activities. c. <u>Community Engagement Strategy</u>–Strand’s Agreement includes approximately 415 hours of work related to development of a social marketing/community engagement strategy, social marketing/community engagement implementation plan, identification of a pilot project, and implementation of a pilot project. There are two ways to use these hours and meetings. The first would be to use the hours and meetings to <u>develop</u> the community engagement implementation plan. The second would be to use the hours and meetings to <u>implement</u> the community engagement implementation plan. d. <u>Critical Action Prioritization Exercise</u>–Tom presented a slide showing the results of the Survey Monkey poll for infiltration, phosphorus, and chloride. The results of this prioritization exercise will be used to help focus the project’s social marketing efforts. However, there was group consensus that the results should not be documented in the report as it was more of a “straw poll” of the steering team’s direction than a definitive scientific survey. e. <u>Pilot Project Discussion</u>–Ongoing and potential pilot projects were presented in a table. 	
<p>6. <u>Community Engagement Strategy Workshop</u> As mentioned, there are two options for community engagement.</p> <ul style="list-style-type: none"> a. <u>Option No. 1–Community Engagement Before Implementation Plan:</u> Information from engagement efforts (assumed to be six meetings) used by Strand and Bret Shaw to develop a social marketing implementation plan to be implemented by others in the future. The 	

Discussion:	Action:
<p>information gained from the engagement efforts will assist in identifying the best way to perform social marketing in the future on the various critical actions. Option No. 1 would have a broader focus on many of the higher priority critical actions. The pilot project is for a single action implemented as part of Strand and Bret Shaw's efforts. A draft table outlining Option No. 1 activities was presented.</p> <p>b. Option No. 2–Community Engagement <u>After</u> Implementation Plan: Develop a plan to social market the community while conducting the community engagement activities. This option would be more focused on critical actions that create meaningful behavior change as a result of the meeting(s). The pilot project would likely be introduced at the end of these engagement activities to transition the project into the pilot project stage. A draft table outlining Option No. 2 activities was presented.</p> <p>c. Community Engagement Discussion Groups–Bret Shaw collaborated with Strand on a slide that showed a possible agenda for the discussion group meetings that would maximize the social marketing content of the meetings. Bret said the meetings can be conducted with tools that work to convince the public they can be part of the solution. They can be used to build momentum (e.g., we did this well in 2013; we can do even better in 2014). Greg said these meetings should be as specific as possible.</p> <p>d. Public Information Meeting(s): Whereas Option No. 1 has a public informational meeting in early summer 2014, Option No. 2 has two public informational meetings, one in early summer 2014 and another in fall 2014.</p> <p>e. Selection of Community Engagement Option–It was discussed that Option No. 1 was redundant and that Option No. 2 is more appropriate for moving forward. In implementing Option No. 2, Strand, Bret Shaw, and the steering team should prioritize the actions that have the highest likelihood of success and then engage the public on the specific actions. Strand should proceed with completing a draft implementation plan for the next steering team meeting in May 2014. Some ideas for community engagement include the following:</p> <p>(1) Residential Social Marketing Package: Couple</p>	

Discussion:	Action:
<p>the rain barrel, downspout disconnection, and residential rain garden activities as a suite of BMPs that are incentivized by Plant Dane and Rain Reserve/Sustain Dane.</p> <p>(2) Leaves–All agreed this is a high priority and should be the focus of the pilot project. It was discussed that this could be a two-stage program</p> <p>(a) 2014–Increase Stewardship and Awareness (potentially coupled with Love Your Lakes, Don’t Leaf Them).</p> <p>(b) 2015–Implement Bagging Pilot Project. Greg said the window of opportunity to do this right is small. Ideas for development of functional networks such as neighborhood captains, midblock signs, Facebook, ListServ, sign-up for text messages, and neighborhood groups in charge of notifications were discussed. Jim Bauman said the connection between leaves and water quality should be made at each engagement meeting.</p> <p>(3) Monroe Street Reconstruction: Greg said the City has hired a facilitator who will engage the public and businesses. While Wingra Watershed objectives will be included in the visioning discussion, other factors such as businesses viability and vitality will also be part of the discussion. Greg said that Wingra efforts will not drive the Monroe Street process but that he invites steering team members to attend the Monroe Street reconstruction project public meetings to provide input. After further discussion, Greg said he will include a couple of slides in the Monroe Street reconstruction public informational meeting slides that specifically discuss how the Wingra Watershed Plan might be integrated into the Monroe Street reconstruction process. The current schedule is for Monroe Street to be reconstructed in 2016 with a two-phase bid process in late 2015 and early 2016.</p> <p>(4) Meeting Notifications–Multiple notification modes (public notice, newspaper article, newsletter) should be employed for the community engagement activities.</p> <p>(5) Public Meeting–Strand should work with the City and FOLW to set up for the first Public Informational meeting to be held in mid-June</p>	<p>Focus on leaf management in the community engagement implementation plan.</p> <p>Strand will work with the City and FOLW to set up the first public informational meeting to be held in</p>

Discussion:	Action:																																																																								
<p>2014. A location such as Edgewood College or the UW-Madison Arboretum would be ideal. The meeting should be to inform the public of the findings of the study and to introduce the pilot project and the framework of the community engagement activities.</p>	<p>mid-June</p>																																																																								
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c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 May 22, 2014, 1 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 9–Stakeholder Engagement/Social Marketing
 Framework

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Stakeholder Engagement/Social Marketing Framework	

Meeting Handouts:	
Meeting attendees were provided with a draft report section prior to the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Lucas Dailey District 13 Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ben Jordan	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Seven items were discussed with four completed and the following three ongoing.</p> <p style="margin-left: 20px;">a. Phosphorus–Strand is finalizing the report section. The City will work with Strand on the cost for the increased street sweeping schedule. Slide 9 will be added to the report section and will include addition of an existing controls bar in multiple locations.</p> <p style="margin-left: 20px;">b. Infiltration–Strand is finalizing the report section.</p> <p style="margin-left: 20px;">c. Chlorides–Strand is finalizing the report section.</p> <p style="margin-left: 20px;">d. Community Engagement–Strand and Bret will work with the City and FOLW to set dates for community engagement activities including a public informational meeting. Genesis will add the timeline for the City’s project-based and management-based measures. Steering Team Meeting No. 9 rolled out the draft community engagement plan.</p>	<p>See action items at left.</p>

Discussion:	Action:
<p>2. <u>Lake Response Model Update</u> There was no discussion.</p>	
<p>3. <u>USGS Leaf Study Update</u> Roger said data will be available at the end of 2015 that will provide a better understanding of the leaf issue. 2013 is a baseline year, 2014 is an existing practices year, and 2015 is a modified practices year.</p>	
<p>4. <u>Summary of March 25, 2014 Discussion</u> Strand presented ten PowerPoint slides providing a summary of this discussion.</p> <ul style="list-style-type: none"> a. Critical Action Prioritization Exercise—An informal poll of steering team members was conducted and was useful for helping to focus the project’s social marketing efforts. Results were used to help create a draft of Section 5-Stakeholder Engagement of the report. b. Pilot Project—Modified leaf collection was selected as a pilot project and framework for the pilot project is included in the draft report (Section 5-Stakeholder Engagement). c. Community Engagement Strategy—Section 5 (draft) of the report was developed in a fashion that lays out a community engagement implementation plan, a portion of which will be implemented by Strand and Bret as part of their community engagement services. At Steering Team Meeting No. 8, the steering team decided on having community engagement meetings after the implementation plan was put in place rather than before. 	
<p>5. <u>Stakeholder Engagement/Social Marketing Framework</u> Strand presented eighteen PowerPoint slides on this topic which generally summarized draft Section 5-Stakeholder Engagement (May 19, 2014 Version). Discussion included the following.</p> <ul style="list-style-type: none"> a. Timeline—A timeline will be developed for the next steering team meeting. Two meetings are to be scheduled as discussed below, one each for the construction site erosion control and chlorides measures. b. Critical Action Category—Critical actions were categorized as generally being project-based, management-based, and community-based measures. Some of the measures are cross-categorical, meaning they may be a combination of the three categories. Section 5 includes a stakeholder engagement plan for nine measures including those listed in the following paragraphs. After the meeting, Strand addressed the comments described below and is sending a revised draft 	

Discussion:	Action:
<p>of the stakeholder engagement plan (Section 5) to the City and steering team members.</p> <p><i>Leaf Management (Pilot Project):</i> The steering team agreed that the fall of 2014 should be focused on building awareness and capacity for the 2015 program. It could include a simple checklist survey on existing practices when canvassing to establish a baseline. Strand and the City will work on defining the pilot project area that would be the same for the 2014 and 2015 programs. However, community engagement activities would recruit leaders and participants throughout the entire Lake Wingra watershed. Monitoring of effectiveness of the 2014 and 2015 programs will be both qualitative and quantitative for behavior change. Water quality monitoring will not be included since this is going on as part of a different project (USGS/City of Madison leaf study). Reference was made to a newspaper article that indicated the City will no longer be taking leaves to Dane County facilities, and therefore, the county mulch sites will be shutting down. Rather, the City will be contracting with a firm from DeForest for leaf disposal. Genesis will find more information and see whether this development impacts the Leaf Management Pilot Project.</p> <p><i>Rain Gardens/Downspout Disconnections/Rain Barrels:</i> David said he would e-mail a downspout disconnection master thesis that Eric Booth completed.</p> <p><i>Terrace Rain Gardens:</i> Genesis said the City is expanding its existing program to areas that are not in a street reconstruction area. A couple are being installed in 2014 through this new program.</p> <p><i>Permeable Pavement:</i> No comments.</p> <p><i>Certification Program for Salt Application Contractors Environmental Winter Maintenance Program:</i> Genesis said that in the past, the City has looked to the WDNR for leadership on this measure and would prefer the WDNR take the lead.</p> <p><i>Maximum Salt Use Guidelines and Ordinances:</i> There appears to be political support for guidelines or ordinances with the current mayoral administration. Figure 5.08-1 and the text of this section indicate that maximum salt use guidelines would come after the</p>	

Discussion:	Action:
<p>Certification Program. Steering Team members thought that another option would be to implement Maximum Salt Use Guidelines concurrent with a certification program.</p> <p><i>Reduce Residential Salt Use:</i> There were no comments.</p> <p><i>Activities Needed for Project-Based Measures (Section 5.10):</i> Move this section to the front of the document. The City will add timing element to this section.</p> <p><i>Activities Needed for Management-Based Measures (Section 5.11):</i> Move this section to the front of the document. The City will add timing element to this section.</p> <p><i>Construction Site Erosion:</i> Add community engagement strategy for this tenth measure. Jim felt the implementation plan should not be limited to just community measures; it should also include management measures. Strand and the City should set up a meeting with the City’s building inspection and engineering departments in June 2014 to better understand the benefits and barriers.</p> <p><i>Reduce Municipal Salt Use:</i> Add an engagement strategy for this eleventh measure. Strand and the City should set up a meeting with City and county salt supervisors in June 2014 to better understand the benefits and barriers.</p> <p>c. Stakeholder Engagement Strategy (General Comments)– Discussion included the following.</p> <p><i>Audience:</i> It was discussed that Strand should add an audience paragraph at the beginning of Section 5. This paragraph would describe that Section 5 is written for those who will be involved in moving the critical actions to completion (e.g., the City and potential partners such as Clean Lakes Alliance and FOLW).</p> <p><i>Roles and Responsibilities Paragraph:</i> In Figure 5.01-2, change “co-leader” to “champion.” Include the following sentence: “Developing ownership and maintaining leadership continuity will be important in seeing these actions to full fruition.”</p> <p><i>Benefits/Barriers:</i> Always list benefits first to keep a</p>	

Discussion:	Action:
<p>positive tone. Benefits and barriers will be described as through the eyes of those whose behavior we are trying to change.</p> <p><i>Emphasis of Section 5:</i> There appears to be a lack of emphasis on commercial activities by categorizing measures as community-based. Strand will provide verbiage in the introduction to emphasize that community includes commercial, institutional, residential, and business.</p> <p>d. Strand/Bret Resources–Jon will develop a revised level of effort that fits targeted stakeholder engagement efforts (as defined in Section 5–Stakeholder Engagement) with the remaining budget and discuss with Genesis. Efforts not completed by Strand will fall under the leadership structure shown in Figure 5.01-2 Possible Critical Action Organization that identifies a collaborative Community Champion and City Champion arrangement. After completion of certain efforts by Strand and Bret, this same leadership structure would be responsible for sustaining these efforts.</p> <p>e. Executive Summary and Fact Sheets for Measures (2014/2015 Campaign Document)–It was discussed that for each of the eleven measures, or conversely for only the highest priority ones, a fact sheet could be developed as part of Strand and Bret’s efforts and included in the appendix. The fact sheets could be used as public educational tools while doing stakeholder engagement. A comprehensive executive summary (outside of the engineering report) could also be an effective tool/deliverable. The executive summary could be supported by the various fact sheets. The Milwaukee Metropolitan Sewerage District Regional Green Infrastructure Plan may have some good examples of a potential format for the executive summary and fact sheets.</p>	
<p>6. <u>Urban NonPoint Source and Stormwater Grant Application</u> Strand submitted a grant application to the WDNR on April 15, 2014, for the Nakoma Park streambank restoration project. The total project cost is \$276,075 with possibility of a grant for half of this amount. The WDNR typically announces grant awards in the fall of 2014 with monies available starting January 1, 2015.</p>	

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c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 August 13, 2014, 2:30 P.M.
 Strand Associates, Inc.[®]

Steering Team Meeting No. 10–Stakeholder Engagement/Social Marketing/Pilot Project

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Stakeholder Engagement/Social Marketing Framework/Pilot Project	

Meeting Handouts:	
Meeting attendees were provided with a draft report section prior to the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Eight items were discussed with three completed and the following four ongoing.</p> <ul style="list-style-type: none"> a. Phosphorus–Strand is finalizing the report section. The City will work with Strand on the cost for the increased street sweeping schedule. Slide 9 will be added to the report section and will include addition of an existing controls bar in multiple locations. b. Infiltration–Strand is finalizing the report section. c. Chlorides–Strand is finalizing the report section. d. Community Engagement–Strand and Bret will work with the City and FOLW to set dates for community engagement activities including a public informational meeting. Genesis will add the timeline for the City’s project-based and management-based measures. Steering Team Meeting No. 9 rolled out the draft community engagement plan. 	<p>See action items at left.</p>
<p>2. <u>Lake Response Model Update</u> Greg gave a summary of the results. Greg or Genesis will e-mail the most recent PowerPoint presentation from the UW. In essence, Carp dominate sediment and phosphorus suspension in sunny weather conditions (e.g., 90 percent), but</p>	

Discussion:	Action:
<p>not as much in rainy weather. As far as Orthophosphorus, stormwater runoff plays a greater role. For the yearly average contributors in both rain and sun for Total Phosphorus, it is Carp 60% ± 20%, Wind 10% ± 2%, and Runoff 30% ± 14%. For yearly average contributors in both rain and sun for Orthophosphorus, it is Carp 30% ± 18%, Wind 5% ± 1%, and Runoff 65% ± 22%.</p>	
<p>3. <u>USGS Leaf Study Update</u> Genesis said the leaf study is being extended another two years with monitoring ending in 2017 and the report being issued in 2018. Additional study will be done regarding leaves in the street. Preliminary findings seem to be indicating that leaves that fall in the street are a substantial problem. Right now the City is investigating the possibility of purchasing a special vacuum cleaner which would allow it to study this effect further.</p>	
<p>4. <u>Stakeholder Engagement Social Marketing</u> Strand presented six PowerPoint slides providing a summary of the July 21, 2014, Construction Site Stakeholder Meeting with Tim Toester, Jeff Benedict, and Scott Kerr.</p> <ul style="list-style-type: none"> a. Construction Site Erosion Control Stakeholder Meeting Summary—This discussion revolved around barriers to improved construction site erosion control compliance and incentives or changes that could be made to the City’s construction site erosion control program. <ul style="list-style-type: none"> (1) The challenge is that it is difficult to enforce proactive erosion control when the standards are reactive as they penalize only after there has been a failure. (2) The City can only enforce a stricter standard than the state in the Rock River TMDL zone. For single-family homes, the City also cannot require more than the Uniform Dwelling Code. (3) Future efforts could include a proactive code in the TMDL zone, using an incentive program such as Green Tier, and perhaps using a surety system that allows contractors to get money back for doing a good job. b. Chlorides Stakeholder Meeting Summary—Because of time constraints, this discussion was skipped. c. Partial Implementation of Social Marketing Plan: Efforts to Match Remaining Budget—A timeline of these efforts was presented that contemplated the following: 	

Discussion:	Action:
<ol style="list-style-type: none"> (1) A public meeting in October 2014. (2) Development of three Lake Protection Action Sheets (Phosphorus, Chlorides, Infiltration). (3) Development of an Executive Summary for distribution to the public. (4) Canvassing of the community by champions with the Action Sheets in the fall of 2014 or spring of 2015. (5) Finalization of the report by the end of 2015. <p>The Steering Team indicated it is not quite ready to have the public meeting in October. The team would like to push it back to obtain the maximum opportunity for neighborhood involvement (e.g., get on neighborhood organization schedules). Ideally it would be best if several neighborhood organizations would help sponsor the public involvement meeting. The team also would like the opportunity to be involved in the development of the meeting materials. It was decided to hold another Steering Team Meeting in early December to lay the groundwork for a spring 2015 Public Meeting and completion of the report after the spring 2015 public meeting. The purpose and design of the meeting was discussed at length. There was considerable discussion on the purpose of the public meeting—is it to involve the residents in the formulation of the plan in order to promote ownership and behavior change, or is it to have a watershed plan that is endorsed by the community so there is encouragement for the City (and alders) to fund it in the capital budget?</p> <p>It should be noted there are two Steering Team meetings remaining, the second of which will now be planned for late July or early August of 2015.</p> <p>The group also felt it would be best to wait for the finalization of the report until after the public meeting. Depending on the purpose of the public meeting, perhaps a draft could be distributed before it is endorsed by the various neighborhood organizations.</p>	<p>Strand will work with several Steering Team members to develop options for purpose/design of this meeting and ask for comments prior to the December Steering Team Meeting.</p>
<p>5. <u>Social Marketing-Based Pilot Project</u> Strand presented thirteen PowerPoint slides and Bret presented eighteen PowerPoint slides on this topic. There is continued agreement on using a two-year leaf management program as the pilot project. The first year will focus on leaves off the street, and the second year will introduce bags. The pilot area</p>	



Discussion:	Action:
<p>will be a 2 to 3 block subset of the total watershed. Discussion included the following.</p> <p>a. Potential Pilot Project Area—Three general locations (West, Central, and East) were shown on a map, each located in the neighborhood of some of the Steering Team members. The Steering Team decided to conduct the Leaf Management Pilot Project in the West location, which is in the vicinity of Roger Bannerman’s house and a Strand employee’s house.</p> <p>b. When asked whether the area should be a representation of a typical Madison neighborhood, or instead be an area with a high probability of success, the group eventually decided that having a success story was important for moving forward and implementing the management measure in other parts of the city.</p> <p>c. Implementation of Social Marketing-Based Pilot Project: Efforts to Match Remaining Budget—A timeline of 2014 efforts and 2015 efforts was presented.</p> <p><i>2014 Pilot Project Efforts:</i> 2014 efforts contemplated a public meeting on September 18, 2014, at the Odana Hills Golf Course clubhouse, canvassing citizens in the Pilot Project boundary with a Lake Protection Action Sheet (Leaves), Action Sheet for Neighborhood Leaders (for Block Captains training), Evaluation Survey, Commitment Card and FAQ document, notification program by champions, and monitoring of leaf placement by Strand. The Steering Team decided to have the canvassing done before the Pilot Public Meeting as a way to advertise for the meeting.</p> <p><i>2015 Pilot Project Efforts:</i> 2015 efforts will build on the capacity building from 2014 but will include the introduction of the bagged leaves pickup and the distribution of free bags.</p> <p>d. Bret led the group on a series of discussions and logistics for the pilot project. The discussion included the following issues:</p> <ol style="list-style-type: none"> (1) Branding—The group agreed the pilot project branding will include the City and FOLW. (2) Changing injunctive norms are most effective; signs help provide trigger for action. Block 	<p>Strand will contact Roger to better define this two to three block area to conduct the pilot project.</p> <p>Action items relative to 2014 efforts include the following:</p> <ol style="list-style-type: none"> (1) Strand will reserve the Odana Hills Golf Course Clubhouse on September 18, 2014 (2) Strand and Bret will develop the verbiage for the signs and door hangers by the end of the day on August 22, 2014, and get to Genesis. (3) Genesis will format the sign and door hanger verbiage and submit to printer for printing at City cost. (4) Strand and Bret will finalize the Action Sheets, Survey, Commitment Card, and FAQ Document before its use in canvassing. (5) Strand will develop a database of addresses and a letter inviting the Pilot Project residents to the September 18, 2014, meeting by September 29, 2014. (6) The City will send out invite letters by the end of the day on September 29, 2014.

Discussion:	Action:
<p>competition might be effective.</p> <p>(3) Residents will need to see this pilot project as a long-term investment by the city, not just a one- or two-year event.</p> <p>(4) The e-mail database is valuable, and it should be treated as a foundational communication tool for future years.</p> <p>(5) The pilot project should focus on one behavior change item (e.g., leaves out of the street), not multiple items to be effective.</p> <p>(6) When questioned about potentially targeting people who mulch or allow their leaves to stay on the ground, Bret mentioned he felt these people are already eco-conscious and therefore would not necessarily be the target of the pilot project. Instead, the target would be the normative behavior of people who currently rake their leaves to the terrace.</p> <p>e. Tom referenced the materials that will be used for canvassing. The materials will be visually spruced up, but it would be good if the group could provide comments by August 22, 2014. Tom will send out electronic versions.</p>	<p>(7) Strand, Bret, and Roger will have a phone conference to define the canvassing dates (likely the week of September 8-12, 2014) and the message to convey.</p> <p>(8) Strand, Bret, and Roger will do the canvassing.</p> <p>(9) Strand and Bret will develop a PowerPoint presentation for use at the public meeting by the end of the day on September 8, 2014.</p> <p>(10) Strand will work with block captains on an e-mail notification program (including yard signs) to be used starting September 22, 2014.</p> <p>(11) Block captains will perform notifications as required from September 22 to November 21 according to the City schedule.</p> <p>(12) Genesis and Greg will check with Chris Kelley to see whether the City can commit to leaf pickup on exact dates given to the public in the Pilot Project Area.</p>
<p>6. <u>Urban Nonpoint Source and Stormwater Grant Application</u> Strand submitted a grant application to the WDNR on April 15, 2014, for the Nakoma Park streambank restoration project. The total project cost is \$276,075 with possibility of a grant for half of this amount. On August 11, 2014, the WDNR e-mailed the scores for the grant applications received. The Nakoma Park streambank restoration project ranked 21 out of 31 applications. It appears the project is on the fringe of receiving funding if funding levels are similar to 2013. The WDNR typically announces grant awards in the fall with monies available starting January 1 of the following year.</p>	

Discussion:			Action:
7. Upcoming Schedule and Next Meeting			
Steering Team Meeting	Date	Time	Topic
Meeting No. 9	May 22, 2014	1 pm	Draft Stakeholder Engage./Social Market. Report Section
Community Engagement	July 15, 2014 July 21, 2014		<ul style="list-style-type: none"> Chlorides Meeting with County and City Erosion Control Meeting with City
Meeting No. 10	August 13, 2014	2:30 pm	Social Marketing/Stakeholder Engagement/Pilot Project
2014 Pilot Project Handouts	September 12, 2014		Final Leaves Action Sheets, Survey, Commitment Cards
Community Engagement	September 17, 2014	TBD	Pilot Project Public Meeting
2014 Pilot Project Efforts	Sept./Oct. 2014		Neighborhood Canvassing/Notification Program/Monitoring
Social Marketing Handouts	October 10, 2014		Final Chlorides, Phosphorus, Infiltration Action Sheets & Executive Summary
Pre-Social Marketing Monitoring of Practices	Late-October 2014 or Spring 2105		By Champions
Community Engagement	Oct./Nov. 2014 or Spring 2015		Champions Canvas Community with Action Sheets (Chlorides, Phosphorus, and Infiltration)
Meeting No. 11	December 2014	TBD	Discussion of 2014 Pilot Project Efforts and Spring Public Meeting
Community Engagement	Spring, 2015	TBD	Wingra Watershed Plan Public Meeting
Report Presentation	January 2015 Spring 2015?	TBD	Presentation to City Engineer and Assistant City Engineer
Final Report Presentation	Spring 2015	TBD	Presentation to Alderperson
Meeting No. 12 (Last One)	August 2015	TBD	Final Guidance Regarding 2015 Pilot Project Efforts
Community Engagement	September 16, 2015	TBD	Pilot Project Public Meeting
2015 Pilot Project Efforts	Sept./Oct. 2015		Neighborhood Canvassing/Enhanced Notification Program/Monitoring
Pilot Project Findings Report Supplement	December 2015		
Future Implementation of Social Marketing Plan By Champions	January 1, 2016 and Beyond		

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 December 18, 2014, 2:30 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 11–Leaf Pilot Project Update and
 Spring 2015 Public Involvement Meeting

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Stakeholder Engagement/Social Marketing Framework/Pilot Project	

Meeting Handouts:	
Meeting attendees were provided with a draft report section prior to the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison (City)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Lucas Dailey District 13 Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ben Jordan	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Stephanie Thomsen	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Eight items were discussed with three completed and the following four ongoing.</p> <p style="margin-left: 20px;">a. Phosphorus–Strand is finalizing the report section. The City will work with Strand on the cost for the increased street sweeping schedule. Slide 9 will be added to the report section and will include addition of an existing controls bar in multiple locations.</p> <p style="margin-left: 20px;">b. Infiltration–Strand is finalizing the report section.</p> <p style="margin-left: 20px;">c. Chlorides–Strand is finalizing the report section.</p> <p style="margin-left: 20px;">d. Community Engagement–Work with steering team members before Steering Team Meeting No. 11 to develop options for purpose/design of Steering Team Meeting No. 11 as well as the Spring 2015 Public Involvement Meeting. Rebecca gave input to Strand before the meeting.</p> <p style="margin-left: 20px;">e. Pilot Project (fall 2014 efforts)–Complete.</p> <p style="margin-left: 20px;">f. Report–Finalize the report after the Spring 2015 Public Involvement Meeting.</p>	<p>See action items at left.</p>

Discussion:	Action:
<p>2. <u>Lake Response Model Update</u> Greg will forward the final report to the steering team members. The report was finalized in December 2014.</p>	
<p>3. <u>USGS Leaf Study Update</u> The project is now a 5-year study (2013 through 2018). Monitoring will end in the fall of 2017 with a report issued in 2018. Roger said that fall 2014 rainfall was low. Because of the importance of leaves in the street, targeting/scheduling street cleaning/pickup should be considered based on the type of tree canopy. Roger will forward Bill Selbig's most current PowerPoint regarding the study to the steering team members. There was discussion that the study sites may be conducive to social marketing efforts.</p>	
<p>4. <u>Leaf Collection Pilot Project Update</u> Strand presented twenty-four PowerPoint slides regarding the leaf collection pilot project including the following.</p> <p>a. Survey Results–Survey was delivered to 84 homes in the pilot project area (Piper Drive, Orchard Drive, and Charles Lane between Tokay Boulevard and Odana Road) with a 51 percent response rate (43 surveys). The survey included five questions on leaf collection, five questions on winter maintenance, and two questions on stormwater. A summary of the results is as follows.</p> <ol style="list-style-type: none"> (1) Leaf Management–47 percent of respondents raked leaves to the terrace, while 25 percent mulched, and 22 percent composted. (2) Leaf Management–For those that rake leaves to the terrace, 22 percent do so once in the fall, 31 percent do so twice, and 22 percent do so more than twice; 25 percent do so only when needed. (3) Leaf Management–The main factor that influences when to place leaves in the terrace is when most of the leaves fall from the trees. The second most important factor is knowing when leaf collection is scheduled. (4) Leaf Management–Most respondents reported that the length of time until leaves are collected by the City after being placed on the terrace is 1 to 2 weeks. (5) Leaf Management–Most respondents reported their main concern with leaf management issues are leaf piles spilling into the street and gutter, followed by leaves killing the terrace 	

Discussion:	Action:
<p>lawn, and leaves blowing from or onto their property.</p> <p>(6) Winter Maintenance–58 percent of respondents said they used a shovel or snow blower to clear snow from their sidewalk and driveway; 29 percent said they used salt/chemical ice melter, while 6 percent said others clear their snow.</p> <p>(7) Winter Maintenance–Most respondents said they typically use salt to clear pavement in icy conditions and are less inclined to do so during both light (1 to 3 inches) and heavy (greater than 3 inches) snowfalls.</p> <p>(8) Winter Maintenance–Most respondents indicated the two main factors that affect salt use are fear of others falling on their pavement, and fear of falling on their own pavement.</p> <p>(9) Winter Maintenance–57 percent of respondents said that their perception of snow clearing on local streets is satisfactory, while 19 percent said it could improve and 19 percent said it is excellent.</p> <p>(10) Winter Maintenance–39 percent of respondents said that their perception of snow clearing on City streets and highways is satisfactory, while 15 percent said it could improve, and 46 percent said it is excellent.</p> <p>b. September 18, 2014, Pilot Project Public Involvement Meeting–Seventeen people attended this meeting at the Odana Hills Golf Course Clubhouse. This meeting was the rollout of the Leaf Collection Pilot Project.</p> <p>c. Fall 2014 Pilot Project Efforts Recap–The following was discussed:</p> <p>(1) Study Area–A leaf collection pilot project area was supplemented by a leaf collection awareness area. Canvassing and active social marketing are occurring in the pilot project area while awareness building is occurring in the other areas to expand the influence of the pilot project. Canvassing occurred in early September as organized by Roger and included going door-to-door and handing out a bag of information including the following: commitment card, action card (refrigerator magnet), survey form (with stamped return</p>	

Discussion:	Action:
<p>envelope), pilot area map, and notice of pilot project public information meeting.</p> <p>Jim B. said he was confronted by residents in his neighborhood (Fairway Street) that is in the awareness area. These residents accused the pilot project efforts of being responsible for the streets department handing out either warnings or \$400 tickets (Jim was not sure) for not keeping their leaves out of the street. It appeared the City’s Streets Department was putting orange door hangers that warned of a ticket if the resident did not keep leaves out of the street. Greg was unaware of the City Streets Department actions and said he would look into it. After the meeting, Greg found that it was building inspection who issued the notices and they were only doing so as a response to a complaint from someone in the neighborhood (e.g., they do not do this unless a complaint is received).</p> <p>(2) Fall 2014 Pilot Project Protocol–Strand developed a protocol for administering the pilot project that consisted of a table with the following headings: Leaf Pickup Occurrence, Task, Responsible Party, and Date to Complete. This information guided the putting out of yard signs by block captains, e-mail notifications from the commitment card list by Strand, initiation of block captain/volunteer interaction with neighbors, and monitoring of the raking and leaf collection efforts via pictures and video. These actions were initiated once the City leaf collection District 2 Web page indicated that District 2 will be “NEXT.”</p> <p>(3) Fall 2014 Leaf Pickup Dates–A slide with the October and November 2014 calendars was presented showing the date of leaf pickup and the date of photos taken by Strand. There were four leaf pickups (October 6 and 20 and November 10 and 25). The fall 2014 pilot project protocol for the October 6 leaf pickup was not entirely followed because the City Web site was only updated to “NEXT” a few days before the collection.</p>	

Discussion:	Action:
<p>d. General Observations include the following.</p> <ul style="list-style-type: none"> (1) In the pilot area, after the second round, and before the third pick up, it was observed that 46 out of 84 homes had put leaves on the terrace and 30 of the piles had no leaves on the curb. (2) It was observed that the control areas had more leaves in the street. (3) It was also observed that other streets in the general area had more leaves in the street (e.g., the entire pile raked into the street). (4) Overall, the City did a pretty good job picking up the leaves and sweeping the streets. (5) Roger was happy with the results of the 2014 pilot project efforts. <p>5. <u>Lessons Learned and Improvements for Fall 2015 Pilot Project Efforts</u></p> <ul style="list-style-type: none"> a. Lessons Learned—Because the control area was not in the same collection area as the pilot project area, the control area was moved west of the pilot project area (Woodburn Drive, Holiday Drive, and Sherwood Road between Wedgewood Way and Hilltop Drive). Also, the signs are difficult, if not impossible, to drive into the ground once the ground is frozen. b. Improvements for the fall 2015 Pilot Project Efforts—The following improvements can be made in 2015. <ul style="list-style-type: none"> (1) Enhance the notification protocol. (2) Improve the City notification. (3) Get better quantification of participation and results. (4) Put control area photos in the PowerPoint presentations to show the difference. (5) Craft a bagging protocol. <p>Jim L. wondered whether having a fixed schedule for City leaf collection would be more effective and less costly than the current system. Jim B. said that leaf collection should go into December as some tree types (hickory) drop leaves with the snowfall. Paul said the Clean Lakes Alliance could potentially assist in the 2015 Pilot Project Efforts since leaf collection is a priority for them. It was</p>	

Discussion:	Action:
<p>discussed that it may be beneficial for the Clean Lakes Alliance to spread the message of <i>Leaves Out of the Street</i> rather than the City because of liability issues. Paul said he will share the results of the Clean Lakes Alliance Greater Madison Yard-Care Survey from fall 2014.</p>	
<p>6. <u>Public Involvement Meeting in Spring 2015</u></p> <p>Strand presented seven PowerPoint slides and the following was discussed.</p> <p>a. Meeting Date and Location–It was generally agreed the meeting should be held at Edgewood College as it is the most central to the watershed compared to the UW Madison Arboretum. The meeting should be held in late March 2015 (tentatively set at March 26, 2015). Spring breaks for UW Madison, Edgewood College, Madison College (MATC), and Madison Metropolitan School District are as follows: March 28 through April 5, March 16 through March 20, March 16 through March 20, and March 30 through April 6, respectively.</p> <p>b. Public Meeting Purpose and Invitees–It was discussed that the purpose of the meeting should be to:</p> <ol style="list-style-type: none"> (1) Create community ownership in the watershed plan by giving residents the opportunity to comment on measures and to help establish priorities. (2) Demonstrate community support and priorities to elected officials for capital improvements by obtaining endorsement from neighborhood organizations. (3) Demonstrate community support for management changes. (4) Continue to build social infrastructure for community change. There was some discussion as to whether it is reasonable to establish priorities (in the hope of establishing ownership) when they have very little knowledge of the proposals. Perhaps a better goal is to get their support rather than give them ownership. <p>Note: David gave some additional suggestions after the meeting that are outlined in an accompanying e-mail.</p>	<p>Action items relative to the public involvement meeting include the following:</p> <ol style="list-style-type: none"> (1) Strand will reserve the Edgewood College venue for March 26, 2015. (2) Strand will develop a PowerPoint presentation and exhibits for review by the steering team by March 12, 2015. The steering team review comments will be due by the end of the day on March 19, 2015.

Discussion:	Action:
<p>Invitations should be extended to neighborhood group leaders (those we are seeking endorsement of the final plan from) as well as other public and private leaders. It was stated that 40 of the most influential people should be invited to the meeting to get them to interact with neighborhood leaders. It was stated that personal or other types of creative invitations may be necessary. Greg said that this is an election year (election in April 2015) and that there will be a new alderperson. If the meeting is held before the election, all the individuals vying for the position need to be invited.</p> <p>c. Public Involvement Meeting Framework—There will be an open house with exhibits summarizing the need for new measures (both public and private), the proposed measures (chlorides, phosphorus, and infiltration), and what they and the City can do. This will be followed by a PowerPoint presentation. After the PowerPoint presentation, it was discussed that there could be a group exercise to establish priorities to identify the top 3 private and top 3 public institutional measures.</p> <p>Tom introduced a concept of trade-offs where each action is accompanied by a gradient of how much better or worse off than today each action would be that also addresses cost, cost-effectiveness, effort, and benefit. This “dashboard” can quickly educate attendees of the benefits and cost of the proposed measures. The steering team liked the idea of this concept. The idea of using dots and/or requesting a signature of commitment for certain actions was intended to provide ownership in a particular action. Some in the group discouraged the use of dots because we would be asking residents to prioritize without them fully understanding the benefits, effectiveness, and cost.</p> <p>David said the meeting purpose should be to develop consensus on which actions should be done first and which ones a particular individual or agency would be willing to personally support. He said that we should effectively convey the actions that are important, summarize the analysis that has been done, and request individuals/agencies to support and work on getting projects done.</p>	

Discussion:	Action:
<p>It was suggested that actions be tied to a result. Greg wants informed choice. He said a goal should be that when a known side effect occurs, an individual or agency would still support an action.</p> <p>It was discussed that the meeting should focus on a short-term (3 to 5 years) implementation plan, not all of the actions that are identified in the plan. It was discussed that salt actions were likely a longer-term action item.</p> <p>d. Plan Endorsement Strategy</p> <p>It was discussed that the plan should be finalized after the Public Involvement Meeting, but that there should be a Steering Team Meeting after the Public Involvement Meeting to discuss how the results of the meeting should be incorporated into the final plan. Jon said that one of the two final presentations would need to be shifted to an additional Steering Team Meeting to do so. Strand would finalize the plan after the additional Steering Team Meeting that will be held in April 2015.</p> <p>It was proposed that Strand send or e-mail the finalized plan in June 2015 to the various neighborhood groups seeking their endorsement by September 1, 2015, before the City takes the final plan to the Public Works/City Council for approval/adoption in the fall/winter of 2015.</p>	
<p>7. <u>Urban Nonpoint Source and Stormwater Grant Application</u></p> <p>Strand submitted a grant application to the WDNR on April 15, 2014, for the Nakoma Park Streambank Restoration Project. The total project cost is \$276,075 with the possibility of a grant for half of this amount. On September 25, 2014, the WDNR e-mailed the final scores for the grant applications received. The Nakoma Park Streambank Restoration Project ranked 18 out of 31 applications. The WDNR will only fund the first 11 applications (\$1.2 million out of \$3.2 million requested).</p>	

8. Upcoming Schedule and Next Meeting

Steering Team Meeting	Date	Time	Topic
Meeting No. 10	August 13, 2014	2:30 pm	Social Marketing/Stakeholder Engagement/Pilot Project
2014 Pilot Project Handouts	September 12, 2014		Final Leaves Action Sheets, Survey, Commitment Cards
Community Engagement	September 17, 2014	TBD	Pilot Project Public Meeting
2014 Pilot Project Efforts	Sept./Oct. 2014		Neighborhood Canvassing/Notification Program/Monitoring
Social Marketing Handouts	October 10, 2014		Final Chlorides, Phosphorus, Infiltration Action Sheets & Executive Summary
Pre-Social Marketing Monitoring of Practices	Late-October 2014 or Spring 2105		By Champions
Community Engagement	Oct./Nov. 2014 or Spring 2015		Champions Canvas Community with Action Sheets (Chlorides, Phosphorus, and Infiltration)
Meeting No. 11	December 18, 2014	TBD	Discussion of 2014 Pilot Project Efforts and Spring Public Meeting
Send Meeting Invite Letter	March 5, 2015		Strand draft letter, City to send letter
Personal Invitation Calls to Identified Leaders	March 9-10, 2015		Strand to make personal phone calls to identified leaders
Send Powerpoint for Meeting to Steering Team	March 12, 2015		Strand
Steering Team Provides comments on Powerpoint to Strand	March 19, 2015		Steering Team
Community Engagement	March 26, 2015	6:30 pm	Wingra Watershed Plan Public Involvement Meeting @ Edgewood College
Meeting No. 12	April 16, 2015	TBD	Discuss How Comments from Community Engagement should be incorporated into Final Report
Report Finalization	June 1, 2015		Incorporate Comments from Community Engagement. Send/email final report to Neighborhood Groups seeking endorsement by September 1, 2015.
Final Report Presentation	June 2015	TBD	To City and Asst. City Engineer and Alderperson (2 nd presentation deleted to allow for additional Steering Team Meeting). City takes final report to Public Works/City Council in Fall/Winter 2015 for approval/adoption.
Meeting No. 13	July 16, 2015	TBD	Final Guidance Regarding 2015 Pilot Project Efforts
Community Engagement	September 16, 2015	TBD	Pilot Project Public Meeting
2015 Pilot Project Efforts	Sept./Oct./Nov. 2015		Neighborhood Canvassing/Enhanced Notification Program/Monitoring
Pilot Project Findings Report Supplement	December 2015		
Future Implementation of Social Marketing Plan By Champions	January 1, 2016 and Beyond		

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 April 23, 2015, 1:30 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 12–Discussion on Remaining Efforts

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Stakeholder Engagement/Social Marketing Framework/Pilot Project	

Meeting Handouts:
 Meeting attendees were provided with a draft report section prior to the meeting.

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Phil Gaebler	City of Madison (City)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sara Eskrich District 13 Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ben Jordan	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Stephanie Thomsen	Strand Associates, Inc. [®]	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Eight items were discussed with three completed and the following four ongoing.</p> <ul style="list-style-type: none"> a. Phosphorus–Strand is finalizing the report section. The City will work with Strand on the cost for the increased street sweeping schedule. Slide 9 will be added to the report section and will include addition of an existing controls bar in multiple locations. b. Infiltration–Strand is finalizing the report section. c. Chlorides–Strand is finalizing the report section. d. Community Engagement–Add timeline to City of Madison Project-Based and Management-Based Measures. 	<p>See action items at left.</p>
<p>2. <u>Standing Agenda Items</u></p> <ul style="list-style-type: none"> a. Lake Response Model Update: After the meeting, Greg will forward the March 4, 2015, draft report to Strand. The City will post this to the City’s Wingra Watershed Plan Web site. b. USGS Leaf Study Update: The fall of 2014 was very dry, limiting the number of events where meaningful data could be collected. In the fall of 2015, the study 	

Discussion:	Action:
<p>will try to find a way to get to summertime phosphorus levels in the fall (i.e., keep streets free of leaves including street sweeping once per month).</p> <p>c. UNPS Grant (Nakoma Park Streambank Restoration): City of Madison recently received word from the WDNR this project will be funded when previously it was not. Greg said that the City design and public involvement efforts for this project have already begun. The design concept includes minimal rock and much biostabilization, and the historic stairs will be rebuilt across the channel.</p>	
<p>3. <u>Review of March 25, 2015, Public Information Meeting (PIM)</u> Strand presented three PowerPoint slides regarding the PIM including the following.</p> <p>a. Meeting Invitees/Attendees/Framework–The City sent out postcards inviting all parcel owners in the watershed to the public meeting. Strand e-mailed and called the leader of 18 neighborhood associations and salt, infiltration, and phosphorus leaders; 35 attendees signed the sign-in sheet and a box was provided to ask whether attendees were interested in supporting Lake Wingra and how (infiltration, phosphorus, and chlorides). The meeting consisted of an interactive presentation on the various proposals and feedback from the attendees was requested.</p> <p>b. Strengths and Opportunities–Tom presented the strengths of the format used as well as opportunities for change (attached). Jim Bauman said that he recently presented on the Lake Wingra Watershed Plan at the Dudgeon-Monroe Neighborhood Association Annual Meeting. Jim found that attendees at that meeting generally wanted to learn more, were interested in viewing relevant materials, and were wondering how to comment on the plan but needed to “digest” plan components. Jim B. will be drafting an article for the Friends of Lake Wingra newsletter regarding the Lake Wingra Watershed Plan. Tyler Leper (Owner of Wingra Boats) is the incoming President of the Dudgeon-Monroe Neighborhood Association.</p> <p>Greg said the City will add functionality to the Lake Wingra Watershed Plan Web site allowing for comments to be made. Information on the plan is also available on the Web site.</p> <p>c. PIM Comments–Numerous useful comments were received and recorded. A summary of the comments</p>	<p>City will add functionality to the Lake Wingra Watershed Plan Web site allowing for comments to be posted regarding the plan.</p>

Discussion:	Action:
<p>was listed in the PowerPoint presentation but in respect of time were not gone through in detail at the Steering Team No. 12 meeting.</p>	
<p>4. <u>Overview of Watershed Plan Measures/Audience</u> Strand presented nine PowerPoint slides seeking guidance on where to focus the remaining efforts on the project: report finalization, Fall 2015 Pilot Project, or Outreach/Implementation.</p> <p>a. Outreach/Implementation–Tom presented Word Cloud diagrams that highlighted the expected effectiveness of implementation measures for each specific stakeholder group (Residents, Commercial, Municipal Departments, and Municipal Government). The word clouds focused on action item’s effectiveness for infiltration, phosphorus, and chlorides. The following are points of discussion on this topic.</p> <ol style="list-style-type: none"> (1) Wingra-Specific Issue vs. City-Wide Issue– Jim Lorman wanted to be mindful of where an issue is a Wingra-Specific Issue vs. a City-Wide Issue and thus the responsibility for action technically extends beyond the Wingra Watershed boundary. Jim stated that chlorides are a heightened issue in the Wingra Watershed because of the much higher concentrations of chloride in Lake Wingra compared to other Madison-area lakes. Leveraging existing efforts/organizations to further the cause of Lake Wingra will provide synergies (MMSD, Yahara WINS, MAMSWAP, Clean Lakes Alliance, Dane County Lakes and Watershed Committee). (2) There was discussion that there is merit in having a City-endorsed plan. It does not guarantee funding, but it lays out a framework that is considered with City actions. (3) There was discussion on how to define roles. Is it possible to identify who (in terms of a person and/or an organization) that is best-suited to advocate and implement specific measures? (4) Catalyst/Action Teams–There was significant, positive discussion on the role of Catalyst/Action Teams for each of the Lake Wingra Watershed Plan goals: Chlorides, Infiltration, and Phosphorus. These Catalyst/Action Teams would be “populated” with champions that push on all fronts (residential, municipal government, municipal 	

Discussion:	Action:
<p>departments, commercial) for the Lake Wingra cause. As mentioned above, there may be existing team infrastructure that can be leveraged. The Lake Wingra Watershed Plan existing infrastructure (Chloride Issue Team, Phosphorus Issue Team, and Infiltration Issue Team) could also be adapted into the catalyst/action teams and could either integrate into other teams or interact with existing groups for the cause of Lake Wingra. Roger said that it was important that these Catalyst/Action Teams be provided with some level of technical support by Strand to provide momentum, assistance, and continuity over the years. He also did not want to overcomplicate the methods of implementing the plan. A catalyst team could chose to work with partners they deem might be most effective. Examples of what these catalyst teams could look like include the following.</p> <p>(a) Multi-Agency Chloride Reduction Campaign: This is an existing campaign with partners that include Dane County, City of Madison, Dane County Lakes and Watersheds, Madison Water Utility, Public Health Madison/Dane County, UW-Madison, and Madison Metropolitan Sewerage District in an outreach campaign to encourage chloride use reduction. The target audience is winter maintenance professionals, homeowners, public works and emergency services, motorists, and civic leaders. For more information, see the following Web site: https://wisaltwise.com/. It was stated that while these organizations could be part of a catalyst team, they have a broader interest than just the Wingra Watershed. For instance, MMSD is primarily concerned about reducing chloride entering its pipes. The steering team questioned whether there is a natural champion for this issue, specifically within the watershed.</p> <p>(b) Phosphorus Catalyst/Action Team– Right now, Greg has become the City</p>	

Discussion:	Action:
<p>champion by default because of the involvement and action on the Leaf Collection/Bagging Pilot project. This Team could be expanded to include the FOLW, Clean Lakes Alliance, Yahara WINs, and MAMSWAP to continue action in this area. Again, keeping the focus on Wingra Watershed.</p> <p>(c) Infiltration Catalyst/Action Team– Again, the City of Madison has taken a leadership role here with its rain gardens and terrace rain gardens initiative. Others interested in this are the FOLW, UW-Madison Arboretum, and USGHS, among others.</p> <p>(5) Pilot Projects–Roger said the Wingra Watershed is a great place to pilot certain actions prior to their more-widespread implementation. Other organizations may want to participate in the catalyst teams because it provides opportunities for pilot projects in a neighborhood that generally is receptive to environmental stewardship.</p> <p>(6) Based on these discussions, Strand will revise Section 5 of the watershed plan to reflect catalyst teams.</p> <p>b. Neighborhood Association PIMs–Based on the discussions above, the Steering Team decided to have Strand set up two PIMs for representatives of the various neighborhood associations in the Lake Wingra Watershed. These meetings should be held in June 2015. Two meetings will be held to allow those that cannot make one meeting to be able to make the second meeting. One meeting will be held at Edgewood College (Washburn Heritage Room–Regina Hall) and the other should be held at the Sequoya Library (4340 Tokay Blvd.) to provide easy access to a meeting based on where an attendee lives in the watershed. Tentative dates for the meetings are: Edgewood (Monday, June 8, 2015, 6:30 to 8 P.M.) and Sequoya Library (Wednesday, June 24, 2015). Strand will make arrangements at each facility, e-mail an invite letter to the City for sending out, and prepare a presentation based on the March 26, 2015, PIM.</p>	<p>Strand will revise Section 5 of Watershed Plan.</p> <p>Strand will make arrangements for two neighborhood group public meetings.</p> <p>City will send out invites for the two meetings.</p>



Discussion:	Action:
<p>The meetings should be set up to seek endorsement of the various actions in the plan including seeking input on the alternative to move forward with/recommend for meeting the Phosphorus Short-Term Goal. After the meetings and after compiling feedback on the alternatives from the PIM (and sharing with Steering Team), Strand will send out a Doodle Poll to Steering Team Members requesting a vote on an alternative to meet the Phosphorus Short-Term Goal. One alternative could be to not make a decision and in effect endorse all the alternatives as a means to achieve phosphorus reduction moving forward.</p> <p>c. Plan Endorsement/Adoption/Approval Process–Greg said that at the City, the Committee on the Environment, Board of Public Works, and the Common Council would be interested in the recommendations in the Lake Wingra Watershed Management Plan. However, the Common Council would spend less than 30 seconds on an approval request unless it is accompanied by a specific funding request. The Board of Estimates would become involved if there is an operational expense involved but would not be involved in a capital expense request. Greg said that stormwater plans are typically used as guidance to the engineering department for recommended capital projects.</p> <p>In the case of the Lake Wingra Watershed Plan, Greg envisioned taking the plan to the Common Council for approval in a fashion similar to a neighborhood plan or the Madison Sustainability Plan. Then, as proposals come in in the future, the plan is consulted to determine its consistency with the Lake Wingra Watershed Plan. It was agreed that Common Council approval should be sought in late winter 2016 or early Spring 2016. From an endorsement standpoint, actions in the plan should seek endorsement from the various neighborhood groups. Summer 2015 PIMs with neighborhood groups will be set up to seek this endorsement.</p>	<p>Strand will send out Doodle poll after PIMs regarding alternatives to meet Short-Term Phosphorus Goal.</p>
<p>5. <u>Report Finalization/Implementation Plan</u></p> <p>The following was discussed.</p> <p>a. Report Section 5–Strand will send out to the Steering Team by the end of the day on May 23, 2015. It will</p>	<p>Strand will send report Section 5 by end of day on May 23, 2015. Strand</p>

Discussion:	Action:
<p>include a Strategy/Framework for the Catalyst/Action Teams for Chlorides, Phosphorus, and Infiltration with roles and names/titles identified. The following are guiding principles for these teams.</p> <ol style="list-style-type: none"> 1. How does change occur related to specific actions? 2. Group thinking is good. 3. Let's find a way through team approach (i.e., push and work together). 4. How can Strand assist and provide continuity to what others do, moving forward? <p>b. Full Report–Strand will send out by the end of the day on June 5, 2015. This will include a Section 6 with Conclusions and Recommendations with an Action Schedule similar to the one presented by Tom. Strand will send out a Doodle Poll for purposes of voting on the option to recommend to achieve the Phosphorus Short-Term Goal.</p>	<p>will send a full report by end of day on June 5, 2015.</p>
<p>6. <u>Next Steps</u></p> <p>In addition to the Report Finalization and PIMs with neighborhood groups discussed above, the following are the next steps.</p> <ol style="list-style-type: none"> a. Agenda for Steering Team Meeting No. 13 (tentatively set for the week of July 13-17, 2015) <ol style="list-style-type: none"> 1. Report Sections and Recommendations 2. Catalyst/Action Team Strategy 3. Endorsement/Adoption/Approval Process 4. Fall 2015 Pilot Project (Phase 2) Logistics/Protocol 5. Public Comment Perspective (including deadline for receipt of comments) b. Fall 2015 Pilot Project Logistics/Protocol–Greg has begun and will continue to discuss the logistics/protocol internally and with City's leaf contractor. According to the follow-up e-mail from Greg on May 7, 2015, the City received buy-in from its leaf contractor. Next steps will be figuring out the number of bags to provide to residents based on an estimated quantity of leaves per 50-year-old residential home, revised social marketing protocol similar to last year, Pilot Project Informational Meeting, and Public Relation Plan (according to Greg's e-mail). 	

7. Upcoming Schedule and Next Meeting

Item	Date	Time	Topic
Public Involvement Meeting #1	March 26, 2015	6:30 pm	Wingra Watershed Plan Public Involvement Meeting @ Edgewood College
Steering Team Meeting No. 12	April 23, 2015	1:30 pm	Discussion of Remaining Efforts.
PIM Arrangements Completed	May 13, 2015		Strand
PIM #2 and #3 Invite to City	May 13, 2015		Strand
City Sends out Invites for PIM #2 and #3	May 19, 2015		City of Madison
Report Section 5 Finalization for Steering Team Review	May 23, 2015		Strand
Full Report Finalization for Steering Team Review	June 8, 2015		Strand (Incl/Draft Section 6-Conclusions and Recommendations)
Public Involvement Meeting #2- Neighborhood Associations	June 8, 2015	6:30 pm	Edgewood College (Washburn Heritage Room-Regina Hall)
Public Involvement Meeting #3- Neighborhood Associations	June 24, 2015	6:30 pm	Sequoia Library (4340 Tokay Blvd.)
Steering Team Voting on Alternative for meeting Phosphorus Short-Term Goal	July 1, 2015		Strand to send out Doodle Poll after compiling PIM feedback on alternatives and sharing with Steering Team
Steering Team Meeting No. 13	Week of July 13-17, 2015	TBD	Final Steering Team Meeting: Strand to Send out Doodle Poll for Best Date
2015 Pilot Project Efforts	Sept./Oct./Nov. 2015		Neighborhood Canvassing/Enhanced Notification Program/Monitoring [Pilot Project Public Meeting tentatively on Sept. 17, 2015]
Pilot Project Findings Report Supplement	December 2015		
Final Report Presentation and Common Council Approval	Winter/Spring 2016	TBD	To City and Asst. City Engineer and Alderperson (2 nd presentation deleted to allow for additional Steering Team Meeting). City takes final report to Board of Public Works/Committee on the Environment/City Council in Winter/Spring 2016 for approval.
Future Implementation of Social Marketing Plan By Champions	January 1, 2016 and Beyond		

c/enc: All Participants

Public Involvement Meeting Review 3-26-2015

PIM Characteristic	Strength	Opportunity for Change
Audience	Many people interested - 35 signed in. (Attendance closer to 45) during tournament game. Many asked questions or provided feedback.	Are we attracting the right people?
Room	Excellent audio-visual facilities. Table arrangement conducive for presenter format.	Too small for exhibits and presentation. Table arrangement did not allow breakout groups. Projector shuts off after 1 hour.
Presentation Format	Able to communicate many ideas quickly. Slideshow graphics generally large enough for audience to see. Lots of information presented. Most attendees appreciated information.	Fewer opportunities for feedback. Sheer number of people vs time available for interaction Possible attendee inhibitions regarding speaking in front of a large group. Presentation generally too long. Could smaller groups have been used?
Exhibits	Contained good information. Trade-off analysis good.	Information too small to use in a break-out section. Too much information?
Presenters	Generally knew information.	Could FOLW have hosted the meeting or been part of the presentation?
Staff Attenders	Provided valuable background information on city policies.	Some interpreted staff responses as defending the status-quo.



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 October 22, 2015, 2:30 P.M.
 Strand Associates, Inc.[®]
 Steering Team Meeting No. 13–Report Finalization and Catalyst Team Strategy

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Report Finalization and Catalyst Team Strategy	

Meeting Handouts:
 Prior to the meeting, attendees were provided with documents highlighting Strand’s responses to Public Involvement Meeting and Draft Final report comments. A draft Fall 2015 Pilot Project survey was also e-mailed out before the meeting.

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Phil Gaebler	City of Madison (City)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sara Eskrich District 13 Alderperson	City of Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ben Jordan	UW-Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Stephanie Thomsen	Strand Associates, Inc. [®]	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Discussion:	Action:
<p>1. <u>Standing Agenda Items</u></p> <p style="margin-left: 20px;">a. Lake Response Model Update: Greg has been in contact with professor Chin Wu. A final report will be issued that is cut down some from the student draft report. A positive outcome from this study and other efforts is that the City will be installing a gauge to monitor the Lake Wingra water level and discharge in the fall of 2015.</p> <p style="margin-left: 20px;">b. USGS Leaf Study Update: The fall of 2015 has been very dry, limiting the number of events where meaningful data could be collected. However, a large approximate 2-inch rainfall event was captured in early fall. In the fall of 2015, the study will try to find a way to get to summertime phosphorus levels in the fall (i.e., keep streets free of leaves including street sweeping more often). The 2015 efforts will seek to find what the maximum benefit could be.</p> <p style="margin-left: 20px;">c. Nakoma Park Streambank Restoration: This project was bid out in June 2015 and constructed in summer/fall 2015. It is now complete and Greg feels that accomplished the goal of environmentally sensitive streambank/channel stabilization.</p>	

Discussion:	Action:
<p>2. <u>Public Involvement Meeting (PIM) and Final Draft Report Comments Strategy</u></p> <p>Strand presented four PowerPoint slides and the following were discussed.</p> <p>a. Public Involvement Meeting Comments–Public Involvement meetings were held on March 26, 2015 (general public), June 24, 2015 (neighborhood association-specific), and July 14, 2015 (neighborhood association-specific). Numerous comments were received at these meetings. Responses to these comments were e-mailed to Steering Team members prior to the meeting. Responses will become Appendix F in the report and generally consist of the following responses: “Comment acknowledged and discussed in Section XXXX” or Comment acknowledged and Catalyst Teams to further consider.” Three black and white copies of the report, with highlighting showing modifications made, were distributed at the Steering Team meeting.</p> <p>b. Draft Final Report Comments–Comments were received from Jim Baumann, David Liebl, and Perry Sandstrom. The City will address Perry Sandstrom’s comments separately through the Park Department. Responses to these comments were e-mailed to Steering Team members prior to the meeting. Responses will become Appendix F in the report and generally consist of modifications to report to address the specific comment. More significant comments include request to create an Executive Summary, an Appendix D showing how the report is consistent with USEPA Nine Minimum Elements for Section 319-Funded Watershed Plans, an Appendix E including the Trade-off Handouts from the PIMs, retention of three catalyst teams rather than merging infiltration and TP teams, and development of Alternatives 6 and 7 in report Section 4-Phosphorus contemplating 75 percent and 50 percent implementation of infiltration BMPs.</p> <p>David Liebl suggested that funding requests for implementation might benefit from associating them with Climate Change, possibly related to icing-issues that may increase because of Climate Change.</p> <p>Greg Fries shared that there are positive developments happening on the chlorides front regarding City of Madison Well No. 14. Dane County and the City of Madison have agreed to modifications to winter snow and ice operations in the vicinity of Well No. 14. The City has purchased two more anti-icing vehicles and will be</p>	

Discussion:	Action:
<p>expanding anti-icing activities in the Well No. 14 watershed. The County will begin anti-icing on its University Avenue salt route which is both in and outside of the Well No. 14 watershed. The County will also make a change from implementing WisDOT recommended salt rates to using the City of Madison recommended salt rates (150 lbs per lane mile per application).</p> <p>c. Additional Public Information Meetings–Jim Baumann said he presented briefings on the Wingra Watershed Plan at the Dudgeon Monroe Neighborhood Association, at a Wingra Boats sponsored event, and at the Dane County Lakes and Watershed Commission in the summer/fall of 2015. These presentations were well-received. Phil said he also presented to the Committee on the Environment in September 2015. A positive outcome of the Dane County presentation was that Dane County requested a proposal from Roger Bannermann for monitoring the outfalls entering Lake Wingra for chlorides. Roger said he submitted the proposal and is awaiting a response from the County. Roger will continue to monitor the springs on his own. After the meeting, Jim Baumann provided the following web links to his presentation and requested feedback from Steering Team members on possible improvements.</p> <p>https://dane.legistar.com/View.ashx?M=M&ID=436768&GUID=A5DD3F04-8314-4AF8-9DA7-16AE175CBB77</p> <p>http://www.danewaters.com/resource/research_report_s.aspx .</p>	
<p>3. <u>Report Finalization and Endorsement/Adoption/Approval Process</u> Strand presented one PowerPoint slide discussing that the report will be finalized by addressing the PIM and Final Report comments as described above. A .pdf of the final report will be transmitted to the City for posting on the City Wingra Watershed Plan webpage. Strand is planning to do so by the end of the day on Friday, October 30, 2015. Once the Pilot Project is complete, a short Appendix G–Pilot Project Results will be provided. At that time, four hard copies (in accordance with the Engineering Services Agreement) of the final report will be printed and transmitted to the City and Friends of Lake Wingra (two to each). Greg said that typically a report of this nature would be introduced to the Common Council and then referred to the Committee on the Environment which would then be subsequently referred to the Board of Public Works prior to going back to Council. See 6. Next Steps below that describes the remaining steps.</p>	

Discussion:	Action:
<p>4. <u>Catalyst Teams Strategy</u> Strand presented eleven Power Point slides discussing how the Lake Wingra Watershed Management Plan addresses the Catalyst Teams Strategy. Prior to the meeting, Jim Baumann e-mailed a FoLW Catalyst Group handout to Steering Team members. The following was discussed.</p> <p>a. General—A lead organization needs to be identified for each Catalyst Team. This may take the form of identifying two or three lead organizations for each Catalyst Team.</p> <p>(1) Chloride Catalyst Team—Greg said he envisioned the Chlorides Catalyst Team should be led by either the Mayor’s office or the Dane County Lakes and Watersheds Commission. If the City leads, then he would envision that a Memorandum of Understanding could be drafted to further define the arrangement. If Dane County leads, he would envision that he would appoint individuals to the Team.</p> <p>(2) Infiltration Catalyst Team—No comments.</p> <p>(3) Phosphorus Catalyst Team—No comments.</p> <p>There was discussion that the steering team should continue as the “Lake Wingra Advisory Committee” which could meet biyearly. Catalyst teams would then report to the advisory committee. The easiest way to establish both the advisory committee and the catalyst teams would be to make it part of the city resolution that adopts the Watershed Plan. The resolution could establish the committee and teams and their representation and commit to staffing the committee and teams. This method probably provides the easiest way to establish the committee and teams.</p>	
<p>5. <u>Fall 2015 Pilot Project Update</u> Strand presented fourteen slides discussing the differences between the Fall 2014 efforts and the Fall 2015 efforts. Strand along with City and Friends of Lake Wingra representatives met twice to develop the Fall 2015 protocol. A Public Involvement Meeting was held at the Odana Golf Course Club House on September 17, 2015. Roger Bannermann has developed a rating system and total phosphorus calculation that he is implementing to have better metrics for the Fall 2015 efforts. Both Phil and Roger are taking pictures to document leaf cover and resident efforts.</p>	
<p>6. <u>Next Steps</u> The following are the next steps.</p> <p>a. Neighborhood Association Letters of Support Request—Jim Baumann and Greg will collaborate on a letter from the City seeking Neighborhood Association support of the Lake Wingra Watershed Management Plan. Strand will finalize the report (with the exception of</p>	

Discussion:	Action:
<p>Appendix G–Pilot Project Results) and get to the City of Madison for posting on the City’s Wingra Watershed Plan webpage. It is envisioned that letters of support would be requested to be sent to the City by the end of 2015 so that they can be mentioned and be part of the Strand Final Report Presentation.</p> <p>b. City Resolution Committing Staff to Convene and Organize the Lake Wingra Management Advisory Committee (formerly Lake Wingra Steering Team) and use of Lake Wingra Watershed Management Plan to Guide City Actions Relative to Reducing Chloride Usage (Road Salt), Increasing Infiltration, and Reducing Total Phosphorus–The resolution could also establish the catalyst teams–Greg will work with the FoLW to craft resolution verbiage that will accompany the Strand Final Report Presentation. Greg said that he envisioned that the City would be the organizing entity for convening the Lake Wingra Advisory Committee (formerly Lake Wingra Steering Team) for the foreseeable future.</p> <p>c. Strand Final Report Presentation–Greg will discuss internally at the City and let Strand and the Steering Team know when and to whom they want present to this presentation. Greg mentioned the possibility of an informational meeting prior (5 to 6 P.M.) to a Common Council meeting may be a possibility. Typically, he has seen up to one-third of the Council members in attendance at these. The presentation will be in early 2016 (January or February) after Fall 2015 budget deliberations are complete.</p> <p>d. Presentation of Plan to WDNR (for consideration as a DNR/USEPA-approved USEPA Nine Minimum Elements for Section 319-Funded Watershed Plan)–Jim Baumann will organize this presentation and request a formal review from the WDNR. It is envisioned the presentation would take place after the Strand Final Report Presentation. Jim said he knows of four or five WDNR individuals at the WDNR that would be appropriate for presenting to, including Andrew Craig.</p> <p>e. Catalyst Teams–The Lake Wingra Management Advisory Committee (formerly Lake Wingra Steering Team) should meet to populate the three Catalyst Teams and set a course for implementation of the plan and collaboration with other entities. Bret Shaw said he was interested in staying involved and advising on Pilot Projects including</p>	

Discussion:	Action:
how they might be “scaled-up” for more-widespread implementation.	

7. Upcoming Schedule and Next Meeting

Item	Date	Time	Comments
Public Involvement Meeting #1	March 26, 2015	6:30 pm	Wingra Watershed Plan Public Involvement Meeting @ Edgewood College
Steering Team Meeting No. 12	April 23, 2015	1:30 pm	Discussion of Remaining Efforts.
Full Report Finalization for Steering Team Review	June 5, 2015		
Fall 2015 Pilot Project Planning Meeting	June 18, 2015	1:30 pm	@ Strand
Public Involvement Meeting #2- Neighborhood Associations	June 24, 2015	6:30 pm	@ Sequoya Library (4340 Tokay Blvd.)
Public Involvement Meeting #3- Neighborhood Associations	July 14, 2015	6:30 pm	@ UW-Madison Arboretum
Fall 2015 Pilot Project Planning Meeting	August 25, 2015	2:00 pm	@ Strand
2015 Pilot Project Efforts	Sept./Oct./Nov. 2015		Neighborhood Canvassing/Enhanced Notification Program/Monitoring
Meeting to Discuss PIM and Report Comments	Sept. 16, 2015	3:30 pm	@ Strand
Fall 2015 Pilot Project PIM	Sept. 17, 2015		@Odana Golf Course Club House
Steering Team Meeting No. 13	October 22, 2015	2:30 pm	Final Steering Team Meeting
Pilot Project Findings Report Supplement-Appendix G	December 2015		
Submit Final Report	January 2016		
Final Report Presentation and Common Council Approval	Winter/Spring 2016	TBD	To City and Asst. City Engineer and Alderperson (2 nd presentation deleted to allow for additional Steering Team Meeting). City takes final report to Board of Public Works/Committee on the Environment/City Council in Winter/Spring 2016 for approval.
Future Implementation of Social Marketing Plan By Catalyst Teams	January 1, 2016 and Beyond		

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 March 21, 2013 3 P.M.
 Strand Associates, Inc.[®]
 Issue Team Meeting No. 1–Chlorides

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Issue Team Meeting No. 1-Chlorides	

Meeting Handouts:	
Meeting Agenda	

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
George Dreckman	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Steve Arnold	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bob Stoffs	Madison Gas and Electric (MG&E)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Don Peterson	Madison Gas and Electric (MG&E)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dave Benforado	Madison Gas and Electric (MG&E)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Kathy Lake	Madison Metropolitan Sewerage District (MMSD)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Ralph Erickson	Madison Metropolitan Sewerage District (MMSD)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Steve Kamps	Barnes, Inc.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Montgomery	Barnes, Inc.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Bret Shaw	University of Wisconsin–Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<ol style="list-style-type: none"> 1. <u>Wingra Watershed Plan Chloride Reduction Goals</u> Jon presented five PowerPoint slides discussing the chloride reduction goals of the Wingra Watershed Plan. The plan includes identifying strategies to work toward the goal of a Lake Wingra chloride concentration of 40 milligrams per liter (mg/L) as described in the document <i>Lake Wingra: A Vision for the Future</i>. Despite significant efforts to reduce road salt usage by the City of Madison, chloride levels in Lake Wingra continue to climb. 2. <u>City of Madison Strategies</u> George provided commentary on the City of Madison’s chloride reduction efforts. <ol style="list-style-type: none"> a. <i>Anti-icing</i>: The City applies a salt-brine along major streets when conditions dictate their beneficial use. These efforts seem to be working. The City has tried beet juice but has significant concerns relative to oxygen demand of the beet juice once it reaches waterbodies. 	

Discussion:

- b. *De-icing:* The City has two main methods of deicing. After plowing, the City either applies salt (along major streets referred to as the salt route) or applies sand mixed with 5 percent salt (in residential areas). Use of anti-icing agents has slightly reduced the deicer usage. Salt is not used once the temperature drops below 12 degrees Fahrenheit.
- c. *Road Salt Application Rate:* George said the City applies salt at approximately a 300 lb/lane mile rate. It was mentioned that Dane County applies salt at between a 600-1200 lb/lane mile rate.
- d. *Budget:* The City’s procedures are not linked to a budget, per se, but rather are dictated by the appropriate techniques and procedures to manage the specific storm.
- e. *Road Salt Report 2012:* The City has been tracking its road salt usage in an annual road salt report.
- f. *Other Salt Reduction Options*
 - (1) *Lowered Driving Public Expectations:* It was discussed that to get true reductions in salt usage, the driving public’s expectations for street conditions must be lowered. This lowered expectation must be coupled with slower vehicle speeds. Signs, such as those in the Arboretum, may be effective in conveying the message and beginning to alter the driving public’s expectations.
 - (2) *Incrementally Less Salt Application:* Roger thought that incrementally decreasing salt application rates may have the effect of slowly lowering the driving public’s expectations.
 - (3) *Street Sweeping:* Spring sweeping helps to pick up some of the salt.
 - (4) *Cost to the Environment:* It was agreed that the cost to the environment must be used in evaluating the trade-offs of salt usage.
 - (5) *Beltline:* Because of WisDOT’s safety-based bare pavement policy on the Beltline, it is unlikely to expect lowered salt application rates

3. MG&E’s Cogen Permit and Odana Golf Course Infiltration Project

Don Peterson of MG&E provided the following information:

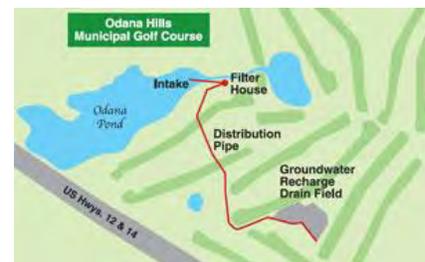
- a. *Cogen Facility:* This facility draws water from Lake Mendota for use in cooling towers on the UW-Madison campus. The facility’s permit requires that the withdrawal of water be offset by pumping groundwater into the Yahara River during low flow periods. Likewise, the groundwater withdrawal used for supplementing Yahara River flows must be offset by infiltrating water at the Odana Golf Course infiltration facility located near the top of the hill along the Beltline.

Action:

Genesis will email the Salt Route GIS shapefile to Strand.

Strand will confirm road salt application rates with the City of Madison, Town of Madison, City of Fitchburg, and Dane County.

Note: Kathy Lake took this picture of a “Low Salt Usage” sign in the Arboretum after the meeting.



Discussion:	Action:
<p>b. <i>Odana Infiltration Facility</i>: This facility was operable in 2006 and is designed to recharge up to 80 million gallons per year (MGPY) of groundwater. Water from the Odana Ponds is pumped to the facility. The highest the facility has operated at is 71 MGPY in 2008. The highest groundwater pumping to the Yahara River was 154 MGPY in 2012. To date, the COGEN facility has withdrawn 221 MG and the infiltration facility has infiltrated 305 MG.</p> <p>c. <i>Chloride Issues</i>: The infiltration facility pumps continuously until the chloride levels of the water exceed the Preventive Action Limit (PAL) of 125 mg/L. The chloride level is monitored in real time by conductivity readings and the measurements are taken after the filter. The chloride concentration in the Odana Ponds drops off quickly with spring rains. Test wells also exist at the infiltration facility to monitor levels beneath the infiltration beds.</p>	
<p>4. <u>MMSD's Chloride Issues and Plans</u> Ralph and Kathy presented nine PowerPoint slides as follows:</p> <p>a. Environmental Impacts</p> <ol style="list-style-type: none"> (1) WWTP chloride discharge has steadily increased with a high of 400 mg/L during a 2013 snow melt. (2) EPA Chronic Toxicity Limit = 230 mg/L. (3) WI Water Quality Standard = 395 mg/L. (4) Ecosystem and Drinking Water Impacts. <p>b. Chloride Sources</p> <ol style="list-style-type: none"> (1) Water Softener Regeneration: Ongoing contribution of approximately 1 pound of salt per day per household. (2) Industrial Usage: Oscar Mayer is a large contributor. (3) Deicing Salt: Deicing salt from snow melt events accounts for 3 to 8 percent of the chloride inflow. (4) WWTP weekly inflow of chlorides is one million pounds. <p>c. Possible Mitigation</p> <ol style="list-style-type: none"> (1) Monitoring–MMSD is currently monitoring slat concentrations at a sanitary sewer in the Wingra Watershed (east of the zoo) and one near West Towne Mall. Data collection and evaluation will be expanded. (2) Water Softener Optimization Pilot Study–MMSD is proceeding with a paired watershed study to determine the effect of replacing old water softeners with newer technology water softeners that use less salt. New softeners (concentrators, evaporators, and no salt softeners) are in development but are not yet technologically feasible. There is one study area in the Wingra Watershed and one study area by Spring Harbor near Lake Mendota. Monitoring of the sanitary sewer 	



Discussion:	Action:
<p>from these areas will be completed. Timeline is homeowner survey in summer 2013 and monitoring from August through November 2013.</p> <ul style="list-style-type: none"> (3) Regulatory and Policy Alternatives– New Hampshire has a private applicator certification that, if trained, the private applicator has some level of protection (reduced liability) against lawsuits stemming from reduced deicing usage. (4) Industrial User Pretreatment. (5) Information and Education Initiatives. (6) Deicing Salt Reduction (households, municipal streets, private applicators). (7) Treatment at WWTP with Reverse Osmosis (expensive). 	
<p>5. <u>Private Applicator Perspective</u> Steve shared the following information:</p> <ul style="list-style-type: none"> a. <i>Anti-icing Pre-application</i>: He has not traditionally used these, but is looking into its use for private properties. b. <i>Deicing</i>: He uses 100 percent road/rock salt. c. <i>Road Salt Application Rate</i>: No rates were mentioned. Steve said lower salt rates are used in later-winter as the sun angle increases. d. <i>Training</i>: Barnes, Inc. participated in the salt application training that the City of Madison sponsored a few years ago. e. <i>Factors Affecting Salt Usage</i>: Steve said public education is huge in terms of public acceptance of lowered salt usage. Also, private applicators are in court every year because of slip and fall incidents and thus are reluctant to reduce salt usage. Steve was not aware of an acceptable salt application rate stemming from these lawsuits. Many private applicator contracts are written based on the amount of salt used, which would work against salt reduction efforts. f. <i>Potential Pilot Projects</i> <ul style="list-style-type: none"> (1) Salt Usage Tracking–Roger asked if there would be resistance from private applicators to have voluntary or required tracking/reporting of application rates and total salt usage each winter. Steve said that Barnes would be willing to participate in this and that Barnes tracks this information already. Barnes does not have a lot of data in the Wingra Watershed. Steve said other applicators would probably be resistant to tracking salt usage because it requires extra effort. (2) State or County Program–Similar to the New Hampshire program described above, the state or country could require training of private applicators, which would reduce their liability when implementing a reduced salt application program. 	<p>Strand will confirm road salt application rates with Steve for commercial, institutional, multi-family, and possibly residential application rates and yearly totals</p>

Discussion:	Action:
<p>g. Other Discussin Steve was asked if it would be helpful to have ordinances limiting the amount of salt applied. He said it would, because in a lawsuit they try and show they were not negligent. Others stated it may be difficult to pass a salt application ordinance in Dane County. Others maintained it was worth pursuing.</p>	
<p>6. <u>Possible Synergies Between Programs and Other Ideas</u></p> <p>a. <i>Public Information and Education for Lowered Winter Driving Expectations</i>–The City of Madison, MG&E, and MMSD all have vested interest in chloride reductions and a collaborative effort would be beneficial to the greater cause. Ideas discussed included low salt zones signage, social marketing and social media campaigns to alter expectations. This in turn could affect driving habits and reduced homeowner salt usage (road salt and water softener replacement/optimization). It was discussed that these efforts would be most effective in January, in the midst of winter.</p> <p>b. <i>Municipal Streets Salt Usage Reduction</i>–There is potential to reduce salt usage coinciding with Public Information and Education efforts that lower winter driving expectations and alter driving habits. Madison’s annual Road Salt Report is important to convey Madison’s efforts at road salt reduction.</p> <p>c. <i>Private Applicator Salt Usage Reduction</i>–A pilot project could be initiated that would require private applicators to track their salt application rate and overall salt usage during the winter using a normal application and a reduced salt usage application rate. A Private Applicator Salt Application Rate Handout could be developed.</p> <p>d. <i>Homeowner Salt Usage Reduction</i>–A Homeowner Salt Application Rate Handout could be developed from existing information. Public information and education efforts would be important.</p> <p>e. <i>MG&E’s Monitoring of Odana Pond</i>–Any salt application reduction efforts could be monitored in the Odana Pond watershed for effectiveness.</p> <p>f. <i>Porous Pavement</i>–Roger said expanding the usage of porous pavement in parking lots and other appropriate locations could lead to less areas that need salt. Porous pavement performs well in the winter and road salt typically is not needed nor recommended.</p> <p>g. <i>Regulation of Salt Usage</i>– The City of Madison or county could pass an ordinance requiring application of salt according to certain guidelines and standards. In New Hampshire, there is a program that limits the liability for</p>	<p>Discuss the possible synergies and other ideas at the next Wingra Watershed Steering Team Meeting.</p> <p>Gain a better understanding of the City’s operations by creating a figure showing the City’s Salt Routes.</p> <p>Correspond with the County to understand its road salt usage procedures and rates.</p> <p>Eventually, develop clear guidelines for salt usage for municipal, homeowner, and private applicators.</p> <p>Further investigate New Hampshire’s private applicator training program for salt usage reduction and related liability issues.</p>



Discussion:	Action:
<p>trained private applicators that are implementing a reduced salt application program.</p>	
<p>7. <u>Next Steps</u> Many thought there was potential to leverage the effort of multiple entities in the Odana Pond watershed. To see if the Odana Pond could be the focus of a pilot project, the following actions will be made.</p> <ol style="list-style-type: none"> a. Determine the relative salt contribution to the pond from: the Beltline, City salt routes, commercial properties, and private residences. b. Develop an understanding of the salt reduction measures proposed in the New Hampshire study. c. Explore if application guidelines could have a measureable impact on chloride levels. 	
<p>8. <u>Upcoming Schedule and Next Meeting</u> All participants will be notified via e-mail should another Issue Team meeting be scheduled. Otherwise, the information discussed at this meeting and summarized in this meeting summary will be considered by the steering team and incorporated into the Wingra Watershed Plan as appropriate.</p>	

Prepared and respectfully submitted by Jon Lindert.

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 June 28, 2013 10 A.M.
 Strand Associates, Inc.[®]
 Issue Team Meeting No. 2–Infiltration

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020-065
Meeting Purpose: Issue Team Meeting No. 2-Infiltration	

Meeting Handouts:	
Meeting Agenda	

Invitee	Representing	Present	Absent
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Steve Arnold	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mark Wegener	University of Wisconsin-Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mike Parsen	Wisconsin Geologic and Natural History Survey	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	University of Wisconsin–Madison	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Luke Hellermann	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Strand Presentation</u> Jon presented 29 PowerPoint slides discussing infiltration-related information for the Wingra Watershed Plan. Sue asked who owns the groundwater. Consensus indicated that the WDNR/state administers state codes that protect the groundwater and thus controls/owns the groundwater.</p> <p style="margin-left: 20px;">a. <i>Goals from Lake Wingra: A Vision for the Future:</i> The goal stated in this plan is “Cool, clean spring water replenishes the lake, and maintains year-round flows into Wingra Creek. Lake Wingra becomes predominantly replenished by groundwater.” The stated target in the plan is “A 25% increase in spring flow.” For purposes of the Wingra Watershed Plan, the 25 percent target will be used.</p> <p style="margin-left: 20px;">b. <i>Groundwater Contours and Spring Locations:</i> Jon presented a figure showing the surface water watershed, groundwater watershed (provided by WGNHS), and spring locations (provided by the UW-Madison Arboretum). The groundwater watershed extends significantly farther southwest than the surface water watershed divide and also does not extend to the west</p>	<p>Genesis will e-mail Strand information relative to the City’s 2013 and 2014 street reconstruction projects that incorporate terrace rain gardens as well as the City’s potential rain garden map (i.e., those with 10-foot-wide terraces).</p>

Discussion:	Action:
<p>end of the surface water watershed. It was agreed by all in attendance that proposed business and residential projects to improve infiltration should be located within both watersheds. However, larger infiltration improvement projects can be identified outside of the surface water watershed but within the groundwater watershed.</p> <p>Eleven spring locations were shown on the figure with two of these locations each having two springs (Golf Course Spring and Council Spring).</p>	
<p>c. <i>Existing, Proposed, and Potential Recharge Locations:</i> Jon presented a table showing existing and potential future infiltration projects in the watershed. The figure included existing rain gardens and existing permitted bioretention facilities (provided by the City of Madison), the MG&E Infiltration Facility on Odana Golf Course, and the proposed Arbor Hills Greenway Infiltration Facility. Genesis indicated some of the rain garden and bioretention locations actually represent more than one rain garden/bioretention site. Strand will update relevant maps with this information. The potential future infiltration projects were identified based on analysis of soils in the watershed including the hydrologic soils group, soil makeup (silty, sandy, clayey), and possible expected infiltration rates. David said that water from Leyton Lane discharges into a permeable area (i.e., the surface runoff disappears) and that this should be mentioned in the report. Genesis said the City tracks the number of street reconstructions that incorporate terrace rain gardens each year. Genesis will e-mail Strand this information. Genesis will also e-mail the City’s map of potential rain garden sites (i.e., those with 10-foot-wide terraces).</p> <p>A table was presented showing the amount of surface runoff that was infiltrated by the MG&E Infiltration Facility on the Odana Golf Course. This information showed that the average yearly infiltration between 2005 and 2012 was 5,862,867 cubic feet with a high of 9,491,351 cubic feet in 2008. David and Roger both said the average number is high because over the last few years MG&E has reduced the amount infiltrated to guard against chloride contamination of the groundwater. David and Roger both recommended contacting David Benforado of MG&E to get an estimate of the projected yearly infiltration amount for Strand’s infiltration analysis.</p>	<p>Strand will update relevant maps with City information on number of rain garden/bioretention facilities at each location contained in the shapefile database.</p> <p>Strand will contact David Benforado of MG&E for an estimate of the projected infiltration amount to be used in Strand’s infiltration analysis.</p>



Discussion:	Action:
<p>Information relative to the Arbor Hills Greenway Infiltration Facility that was studied by UW students was presented. A simple RECARGA model was developed by Strand using the data in the student report which showed that the annual recharge per year is approximately 3,726,084 cubic feet, which is about 76 percent of the annual runoff from the 145-acre watershed. This estimate will be refined after David tracks down the P8 model used for the study.</p>	<p>David will track down the P8 model used in the Arbor Hills Greenway Infiltration Facility study and provide to Strand.</p>
<p>d. <i>Methods to Increase Groundwater to Lake by 25 Percent:</i> It was agreed by all in attendance that increasing infiltration in the surface water watershed/groundwater watershed by an amount equivalent to 25 percent of the current estimated groundwater flow to the lake is an appropriate assumption for trying to meet the 25 percent increase in spring flow target from the <i>Lake Wingra: A Vision for the Future</i> document. It was acknowledged by the group that the link between infiltration and spring flow rates is more complex but that increasing infiltration by the 25 percent amount is an understandable goal that will increase spring flow.</p> <p>Jon presented a slide showing the annual surface runoff to the lake is 82,968,732 cubic feet. The yearly groundwater recharge estimate to the lake is 37,892,637 cubic feet according to Ken Bradbury’s WGNHS estimate. Mike Parsen confirmed the yearly groundwater recharge estimate does not include the infiltration from the MG&E Infiltration Facility. An increase in groundwater recharge of 25 percent would be 9,473,159 cubic feet. Increased recharge would need to come from increased infiltration of surface runoff. It should be noted that the combination of the MG&E Infiltration Facility (5,862,867 cubic feet) and the proposed Arbor Hills Greenway Infiltration Facility (3,726,084 cubic feet) would meet this 25 percent increase. However, it is expected that the estimated MG&E Infiltration Facility contribution will decrease after the discussions with MG&E described above. It is expected then that additional infiltration facilities besides the MG&E Infiltration Facility and the Arbor Hills Greenway Infiltration Facility will be needed.</p> <p>Jon then presented eight options for meeting the 25 percent increase including distributed infiltration facilities such as new rain gardens or bioretention at</p>	

Discussion:	Action:
<p>residential homes and nonresidential properties. These numbers will have to be recalculated once the new MG&E estimate of yearly infiltration is obtained. All agreed that the options for meeting this goal need to be practical.</p> <p>It was suggested that Strand provide the area of residential rooftops and how those might be infiltrated in addition to roadside terrace rain gardens. Strand will also provide calculations on porous pavement. Roger suggested use of a 3:1 watershed to porous pavement area ratio for parking lot facilities. Roger has seen other states using a 2:1 ratio. It was discussed that the Wisconsin Urban Forestry Council as been discussing the use of trees in bioretention areas. The thought is that as ash trees die and are removed, they could be replaced with a terrace rain garden with a tree in the rain garden. Another suggestion was to slightly depress terraces to retain water but otherwise leave them as turf.</p>	<p>Strand will provide calculations on residential roof areas and porous pavement.</p>
<p>e. <i>Infiltration Examples:</i> Jon presented three slides showing examples of rain gardens, bioretention, and porous pavement. A discussion was held relative to planting trees in rain gardens because Madison wants to continue to be a Tree City. Jon showed an example of a bioretention facility in Cincinnati, Ohio, that Strand designed that had numerous trees.</p>	
<p>f. <i>Synergies with Other Initiatives:</i> Jon presented a slide showing other projects in the watershed including Vilas Park and Lake Wingra Shoreline Vision, 2012; Monroe Street Commercial District Plan, 2006; and the Monroe Street and Wingra Park, Design for Healthy Neighborhoods and Lakes, May 2013. It was discussed that, to the extent possible, the Wingra Watershed Plan should be coordinated with these plans to identify collaborative opportunities. To this end, an invitation was given to Jim Lorman’s upcoming charrette.</p> <p>Wingra Watershed Design Charrette: Visioning a Sustainable Wingra Watershed When: Tuesday, July 30, 3:30 to 5 P.M. Where: Washburn Heritage Room, Regina Hall Edgewood College</p>	

Discussion:	Action:
<p>2. <u>Wisconsin Geological and Natural History Survey (WGNHS)-Mike Parsen Presentation</u></p> <p>Mike’s presentation titled “A New Groundwater Flow Model for Dane County” focused on the Wingra Watershed area. It is important to note that the Tunnel City formation is generally believed to be the formation that is most connected to/contributes most water to the majority of the area springs. Also, much of the recharge to Lake Wingra is likely unseen and occurs through the lake bottom rather than at known/visible springs.</p> <p>Mike discussed improvements to the Dane County Regional Groundwater Flow Model that have been made. The model will be released soon to the public and will be useful for many projects and studies. The new model is much more refined than the previous version and the model could be used to identify the potential source areas or recharge areas of specific springs.</p> <p>David said that one drawback of increased infiltration in the watershed could be basement seepage issues. Mike agreed to do the following with the model by the end of 2013.</p> <ol style="list-style-type: none"> a. Provide results of particle tracking simulations and identify groundwater flow to each of the springs surrounding Lake Wingra. b. Provide the well shapefile to Strand for wells in the vicinity of the Lake Wingra watershed that may impact the Lake Wingra springs (provide in July 2013). c. Run the model with various well pumping scenarios and report the effect on spring flow. Take certain wells off-line and report the effect. Wells discussed to model as being off-line were nearby City well(s) and the Nakoma Golf Course and Odana Hills Golf Course wells. d. Incorporate the MG&E Infiltration Facility at Odana Hills Golf Course into the groundwater model to determine its effect. <p>Mike ended with a discussion on things he feels are important to gain a better understanding of the Lake Wingra Springs and to promote a better public understanding of groundwater in the watershed. He suggested the following.</p> <ol style="list-style-type: none"> a. Mike suggested a social way for the public to connect to groundwater would be to instrument the springs so that the public can take a reading and text in the spring flow 	<p>Mike Parsen will provide the information identified by the end of 2013, with the exception of the well shapefile that he will provide in July 2013.</p>

Discussion:	Action:																											
<p>rate or surface water level when they visit the spring.</p> <p>b. Mike suggested establishing a spring flow monitoring program that will demonstrate changes in spring flow over time to help gauge the impact of different management techniques. Mike has pursued this in the past year or so but met resistance from the UW-Madison Arboretum because of the intrusive nature of the instrumentation in the Arboretum’s natural areas. Selling the instrumentation as a way to protect and enhance these natural areas may be a way to appease some of these concerns. Mike will provide information regarding potential grant programs for spring monitoring/instrumentation to Strand.</p> <p>c. Mike and others suggested the potential for the designation of a Spring Protection Zone as a recommendation in the report.</p>	<p>Mike will provide grant information regarding spring monitoring/instrumentation to Strand.</p>																											
<p>3. <u>Upcoming Schedule and Next Meeting:</u> The work program schedule was reviewed. Upcoming steering team meetings are as follows. No additional issue team meetings have been identified at this time.</p> <table border="1"> <thead> <tr> <th>Steering Team Meeting</th> <th>Date</th> <th>Topic</th> </tr> </thead> <tbody> <tr> <td>Meeting No. 1</td> <td>March 21, 2013</td> <td>Kickoff Meeting</td> </tr> <tr> <td>Meeting No. 2</td> <td>April 4, 2013</td> <td>Chlorides/Social Marketing</td> </tr> <tr> <td>Meeting No. 3</td> <td>May 23, 2013</td> <td>Chlorides/Infiltration</td> </tr> <tr> <td>Meeting No. 4</td> <td>July 11, 2013</td> <td>Pollutant–Sediment and Phosphorus</td> </tr> <tr> <td>Meeting No. 5</td> <td>August 29, 2013</td> <td>Pollutant–Reduction Opportunities</td> </tr> <tr> <td>Meeting No. 6</td> <td>October 17, 2013</td> <td>Lake Response Model</td> </tr> <tr> <td>Meeting No. 7</td> <td>December 5, 2013</td> <td>Social Marketing–Strategies</td> </tr> <tr> <td>Meeting No. 8</td> <td>January 23, 2014</td> <td>Social Marketing–Pilot Project</td> </tr> </tbody> </table>	Steering Team Meeting	Date	Topic	Meeting No. 1	March 21, 2013	Kickoff Meeting	Meeting No. 2	April 4, 2013	Chlorides/Social Marketing	Meeting No. 3	May 23, 2013	Chlorides/Infiltration	Meeting No. 4	July 11, 2013	Pollutant–Sediment and Phosphorus	Meeting No. 5	August 29, 2013	Pollutant–Reduction Opportunities	Meeting No. 6	October 17, 2013	Lake Response Model	Meeting No. 7	December 5, 2013	Social Marketing–Strategies	Meeting No. 8	January 23, 2014	Social Marketing–Pilot Project	
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Prepared and respectfully submitted by Jon Lindert.

c/enc: All Participants



Wingra Watershed Plan
 City of Madison and Friends of Lake Wingra
 February 27, 2014, 9 A.M.
 Strand Associates, Inc.[®]
 Issue Team Meeting No. 3–Draft Chlorides Report Section and
 Stakeholder Engagement/Social Marketing Framework
 Meeting Summary

Meeting Location: Strand Associates, Inc. [®]	Job No.: 1020065
Meeting Purpose: Draft Chlorides Report Section and Stakeholder Engagement/Social Marketing Framework	

Meeting Handouts:	
Meeting attendees were provided with meeting handouts before the meeting.	

<u>Invitee</u>	<u>Representing</u>	<u>Present</u>	<u>Absent</u>
Genesis Steinhorst	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Greg Fries	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sue Ellingson, Alderperson	City of Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Paul Dearlove	Friends of Lake Wingra (FOLW)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
David Liebl	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Lorman	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Rebecca Power	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jim Baumann	Friends of Lake Wingra	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roger Bannerman	Wisconsin Department of Natural Resources (WDNR)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Mark Wegener	UW-Madison Arboretum	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ben Jordan	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bret Shaw	UW-Madison	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tom Lynch	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Jon Lindert	Strand Associates, Inc. [®]	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Discussion:	Action:
<p>1. <u>Confirmation of Action Items Completion</u> Four items were discussed with one completed and the following three in progress.</p> <p style="margin-left: 20px;">a. Infiltration–Analysis, cost, and report modifications described in Steering Team Meeting No. 7 Summary are in progress.</p> <p style="margin-left: 20px;">b. Phosphorus–Analysis, cost, and report modifications described in Steering Team Meeting No. 7 Summary are on-going.</p> <p style="margin-left: 20px;">c. Phosphorus–The City of Madison (City) will work with Strand to develop a cost for an increased street sweeping schedule.</p>	<p>See action items at left.</p>
<p>2. <u>Lake Response Model Update</u> Greg provided a brief summary. The model is basically on hold until new flow monitoring can be installed. Four flow monitors are scheduled for installation this spring.</p>	
<p>3. <u>USGS Leaf Study Update</u> Roger provided a brief summary. The initial results are</p>	

Discussion:	Action:
<p>somewhat surprising. It appears that leaves could be contributing double the phosphorus than what was originally thought (up to 40 percent of the phosphorus draining to the lake). The study is also providing an awareness of the phosphorus contribution of spring leaf bud and pollen. Greg mentioned that street sweeping routes/frequency could be modified to address the spring buds that drop on the street and that there is a mechanism with which to estimate the best time to do so.</p>	
<p>4. <u>Infiltration and Phosphorus Analysis Update</u> Strand presented eleven PowerPoint slides providing a summary of updates since Steering Team Meeting No. 7. The changes came in the form of revised costs and calculations for certain measures, addition of rain barrel and downspout disconnection programs, and incorporation of the Odana Hills Infiltration Facility and the WisDOT pond (constructed in 2013) into the P8 model. Discussion included the following.</p> <p>Phosphorus Goal–In addition to the goal as a percent reduction from no controls, add as a percent from existing controls. Change colors to better convey the concepts.</p>	
<p>5. <u>Draft Chloride Report Section</u> Strand presented eleven PowerPoint slides providing a summary of the draft chlorides report section. Discussion included the following.</p> <ul style="list-style-type: none"> a. High Flow Periods–An inverse exponential function had to be added to address high flow periods. The lake measurements show that chloride levels, even during high flushing periods, remain. During these events, there must not be a thorough mixing. b. WisDOT Salt Application Rate–Recent numbers from WisDOT indicate the county may have higher application rates than originally thought. WisDOT is double-checking the figures. c. Groundwater Chloride Levels–Have the groundwater chloride levels seen a similar upward trend similar to the lake levels? If so, could groundwater contribution of chlorides be higher? It was mentioned that groundwater chloride levels around Odana Pond are in the 200 milligrams per liter (mg/L) range. d. Slide 23–Add that chloride levels are also linked to application rate, not just the number of events. 	

Discussion:	Action:
<p>e. Figure 2.06-1 in report–The City has increased its application rate per road mile per event through the last four decades. Greg said that in the last 40 years there has been significant development surrounding Madison that has caused additional traffic on existing city roads. The road networks are very similar to the way they existed 40 years ago. This may be a contributing factor in why salt application has increased to provide safe travels for the ever increasing demand.</p> <p>f. Slide 25–Slide 25 showed a 30 percent municipal and 50 percent commercial salt reduction is necessary as a short-term goal. Sixty percent across the board reduction is necessary to achieve the 40 mg/L chloride concentration. Ben said that a 20 to 30 percent reduction in chlorides may be feasible but that a 60 percent reduction would require change to a different deicer and could be limited by technological issues.</p> <p>g. Slide 26 Possible Salt Reduction Measures–Slide 26 showed the feasibility and effectiveness of possible salt reduction measures. Jim B. said he thought the potential effectiveness of a commercial certification program would be a medium instead of a low and was probably in the 80 pound per year range.</p>	
<p>6. <u>Stakeholder Engagement/Social Marketing Framework</u> Strand presented ten PowerPoint slides and Bret presented nineteen PowerPoint slides regarding stakeholder engagement and social marketing framework. Discussion included the following.</p> <p>a. During the meeting, Steering Team members were given one red dot to identify their highest priority measure to pursue for the Social Marketing Pilot Project. The nonbinding results were:</p> <ol style="list-style-type: none"> (1) Modified Leaf Collection Methods (5 Votes). (2) Monroe Street Reconstruction with Green Features (2 Votes). (3) Certification Program for Commercial Salt Applicators (2 Votes). (4) Maximum Salt Ordinance (1 Vote). <p>Jim L. stated that the pilot project did not need to involve social marketing and that he would like the discussion broadened. Tom said the total project prioritization exercise might capture his concern. He suggested the group complete the exercise through e-mail and it could be discussed at the next meeting.</p>	

Discussion:	Action:
<p>b. Nonbinding Prioritization Exercise–Strand will e-mail an Excel file of the Action Items Matrix for Infiltration, Phosphorus, and Chlorides. Steering team members are asked to identify their top six priorities from among the project-based, management-based, and community-based measures identified in the matrix. Strand may use Survey Monkey instead. These priorities will be used to develop a draft Community Engagement Strategy and a draft Social Marketing Implementation Plan.</p> <p>c. Leaf Bagging Pilot Project–Dane County is willing to implement a pilot project in 2015. Several on the steering team requested that the team calculate how large of an area would be needed to produce the quantity of leaves that Dane County will require (500 to 800 cubic yards) for the pilot project. Jim L. wondered whether a social marketing strategy was necessary for this action since it has been proven elsewhere that it can work (i.e., why not pass an ordinance requiring bagging of leaves). Several Steering Team members indicated that social norms and acceptance of a practice need to change before an ordinance can receive the support it needs to pass. This pilot project would help to show the need and help educate both residents and City staff.</p> <p>Several steering team members said there may be multiple strategies to keep leaves out of the street besides bagging including composting leaves on the lawn or in compost bins.</p> <p>If a leaf bagging pilot project is chosen, it would make sense to interact holistically with the community. At the same time, downspout disconnection, rain barrels, rain gardens, and reduced salt usage could be discussed as an overarching message.</p> <p>d. Slide 55 (Draft Community Engagement Strategy)–This slide shows a public informational meeting and five Focus Group meetings that comprise a possible draft Community Engagement Strategy. These engagement activities will provide the basis for how Strand and Bret will craft the Social Marketing Implementation Plan as well as provide additional information for choosing a Social Marketing Pilot Project. Jim B. said the location of the focus group meeting should be matched to where a particular action may be best-suited for implementation. For instance, terrace rain gardens might</p>	<p>Strand will e-mail an Excel file of the Action Items Matrix for Infiltration, Phosphorus, and Chlorides. Steering team members are asked to identify their top six priorities from among the project-based, management-based, and community-based measures identified in the matrix.</p>

Discussion:	Action:
<p>be more applicable to the Orchard Ridge Neighborhood (because of the wide terraces) than the Nakoma Neighborhood. Rebecca wondered whether these focus groups should target a single action to implement a social marketing strategy or multiple actions (as is shown on Slide 55) to develop a social marketing strategy. More discussion is needed on this.</p> <p>Rebecca said that Strand and Bret should start developing the written report section on social marketing, with a draft for review at the April 24, 2014, meeting. It is envisioned that Steering Team Meeting No. 8 on March 13, 2014, will provide an overview of the final analysis as well as a Community Engagement Strategy Workshop. Strand and Bret will develop a basic framework for how each of the six meetings could be run and what action items they could cover. The steering team will provide feedback and ideas for modifications to the framework.</p> <p>Sue, Genesis, Greg, and Jon will interact to set the date for the Public Informational Meeting tentatively set for May 7, 2014. Sue will need to be at this meeting, but not necessarily at all of the others.</p> <p>e. Slide 56 and 57—These slides show the process for the City’s Project-Based and Management-Based measures. It shows the number of stakeholders and the interdependent relationships involved in implementing new projects and management changes. Sue requested the timeline for these processes be included in the slide.</p> <p>f. Messaging—After the meeting, Paul said the message of what residents can expect if the short-term goals are met should be conveyed at the community engagement activities.</p>	<p>Strand and Bret will develop a basic framework for how each of the six meetings could be run and what action items they could cover. The steering team will provide feedback and ideas for modifications to the framework.</p> <p>Sue, Genesis, Greg, and Jon will interact to set the date for the Public Informational Meeting tentatively set for May 7, 2014.</p> <p>Genesis will add the timeline for these processes to the slides.</p>

7. Upcoming Schedule and Next Meeting

Steering Team Meeting	Date	Time	Topic
Meeting No. 1	February 21, 2013	2 pm	Kickoff Meeting
Issue Team Meeting No. 1	March 21, 2013	3 pm	Chlorides
Meeting No. 2	April 4, 2013	3 pm	Chlorides/Social Marketing
Meeting No. 3	May 23, 2013	3 pm	Chlorides/Infiltration
Issue Team Meeting No. 2	June 28, 2013	10 am	Infiltration
Meeting No. 4	July 11, 2013	3 pm	Pollutant-Sediment and Phosphorus
Meeting No. 5	October 17, 2013	8 am	Pollutant Reduction Opportunities
Meeting No. 6	December 11, 2013	8 am	Pollutant Reduction Opportunities: Chlorides
Meeting No. 7	January 23, 2014	8 am	Draft Report Sections (Infiltration and Phosphorus)
Issue Team Meeting No. 3	February 27, 2014	9 am	Draft Chloride Report Section, Stakeholder Engagement/Social Marketing Framework, Social Marketing Pilot Project Discussion
Meeting No. 8	March 13, 2014	8 am	FINAL Infiltration, Phosphorus, Chloride Analysis AND Community Engagement Strategy Workshop
Issue Team Meeting No. 4	April 24, 2014	TBD	Final Community Engagement Strategy and Draft Social Marketing Report Section
Implement Social Marketing Strategy	May-June 2014		
Issue Team Meeting No. 5	August 21, 2014	TBD	Draft Report Presentation
Issue Team Meeting No. 6	October 2, 2014	TBD	Final Report Presentation
Final Report Presentations (4)	October / Nov. / Dec. 2014		
Social Marketing Pilot Project	Jan-June 2015		

c/enc: All Participants

**APPENDIX B
COST SPREADSHEETS**

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Glenway Golf Course Wet Pond/Infiltration Basin

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
Miscellaneous/Wet Detention Basin					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$10,000.00	\$10,000
3	Stone Tracking Pad	1	EA	\$500.00	\$500
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$1,000.00	\$1,000
5	Silt Fence	2,000	LF	\$5.00	\$10,000
6	Inlet Protection	4	EA	\$90.00	\$360
7	Dewatering	1	LS	\$1,000.00	\$1,000
8	Unclassified Excavation	11,616	CY	\$13.00	\$151,008
9	Clay Liner	11,616	CY	\$30.00	\$348,480
10	Outlet Control Structure	1	LS	\$20,000.00	\$20,000
11	Construction Staking (By Contractor).....entire project	1	LS	\$1,500.00	\$1,500
12	Rip Rap at Channel Outfall	100	SY	\$40.00	\$4,000
13	Topsoil Stripping and Removal (6")	968	CY	\$4.00	\$3,872
14	Topsoil Stripping and Stockpile (6")	290	CY	\$5.00	\$1,452
15	6-IN Salvaged Topsoil Placement 100%	1,742	SY	\$2.00	\$3,485
16	Erosion Control Mat - Class I, Urban Type A	1,742	SY	\$3.00	\$5,227
17	WisDOT Type 20 Seed and fertilizer	1,742	SY	\$1.50	\$2,614
18	Native Seeding and Plugs (672plugs @ \$6/plug in 224 SY and \$4/SY native seeding)	1,742	SY	\$22.00	\$38,333
Pumping Station/Force Main					
19	Pump House Building	1	LS	\$175,000.00	\$175,000
20	Pump House Equipment	1	LS	\$350,000.00	\$350,000
20	8" HDPE Force Main	870	LF	\$80.00	\$69,600
21	Pond Intake	1	EA	\$20,000.00	\$20,000
21	Sod Restoration	483	SY	\$4.25	\$2,054
22	Watering	1	LS	\$200.00	\$200
Infiltration Basin					
23	Excavation (0.25 acres x 3.5 feet deep)	1,412	CY	\$20.00	\$28,233
24	Backfill with #2 Washed Stone	1,210	CY	\$50.00	\$60,500
25	Geotextile	1,210	SY	\$5.00	\$6,050
26	6" SCH 80 PVC Underdrains (100 x 100 area, so 4 rows at 100 feet long = 400 ft)	400	LF	\$45.00	\$18,000
27	Silt Fence	450	LF	\$5.00	\$2,250
28	Junction Chamber 1	1	EA	\$10,000.00	\$10,000
29	6-IN Salvaged Topsoil Placement 100%	1,573	SY	\$2.00	\$3,146
30	Sod Restoration with Protective Fence	1,573	SY	\$4.00	\$6,292
31	Monitoring Equipment	1	LS	\$25,000.00	\$25,000

Subtotal Project Cost	\$1,384,200
Construction Contingency (15%)	<u>\$207,600</u>
Construction Cost	\$1,591,800
Design Contingency (15%)	\$207,600
Soil Borings	<u>\$20,000</u>
Total Project Cost	\$1,819,400

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Monroe Street Green Street Reconstruction

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
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Bioretention					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Unclassified Excavation	815	CY	\$13.00	\$10,593
4	Bioretention	4,400	SF	\$100.00	\$440,000

Subtotal Project Cost	\$456,600
Construction Contingency (15%)	<u>\$68,500</u>
Construction Cost	\$525,100
Design Contingency (0%)	\$0
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$532,100

City will do design so no design contingency

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Wingra Park Underground Wet Detention

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
Wet Detention Basin					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$1,000.00	\$1,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$2,000.00	\$2,000
5	Silt Fence	1,100	LF	\$5.00	\$5,500
6	Inlet Protection	5	EA	\$100.00	\$500
7	Dewatering	1	LS	\$5,000.00	\$5,000
8	8' Underground Detention Material & Freight Cost (StormTrap)	1	LS	\$750,000.00	\$750,000
9	Underground Detention Installation	1	LS	\$75,000.00	\$75,000
10	Unclassified Excavation (Hauled off)	21,537	CY	\$17.00	\$366,135
11	Unclassified Excavation (Salvaged)	4,728	CY	\$8.00	\$37,822
12	Stone Bedding	2,388	CY	\$26.00	\$62,081
13	Select Granular Fill	4,775	CY	\$10.00	\$47,755
14	4'x3' RCB	30	LF	\$2,000.00	\$60,000
15	36" RCP	60	LF	\$150.00	\$9,000
16	Diversion Structure	1	LS	\$20,000.00	\$20,000
17	Outlet Structure	1	LS	\$20,000.00	\$20,000
18	Construction Staking (By Contractor).....entire project	1	LS	\$1,500.00	\$1,500
19	Topsoil Stripping and Stockpile (6")	1,492	CY	\$4.00	\$5,969
20	6-IN Salvaged Topsoil Placement 100%	8,954	SY	\$2.00	\$17,908
21	Erosion Control Mat - Class I, Urban Type A	8,954	SY	\$3.00	\$26,862
22	Seed and fertilizer	8,954	SY	\$1.50	\$13,431
23	Watering	1	LS	\$500.00	\$500

Subtotal Project Cost	\$1,534,000
Construction Contingency (15%)	\$230,100
Construction Cost	\$1,764,100
Design Contingency (0%)	\$0
Soil Borings	\$7,000
Total Project Cost	\$1,771,100

City would do design so no design contingency

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Westmorland Park Bioretention

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
Bioretention					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$1,000.00	\$1,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$1,000.00	\$1,000
5	Silt Fence	110	LF	\$5.00	\$550
6	36" RCP	200	LF	\$150.00	\$30,000
7	6-FT DIA MH	2	EA	\$6,000.00	\$12,000
8	Outlet Structure	1	LS	\$10,000.00	\$10,000
9	Construction Staking (By Contractor).....entire project	1	LS	\$1,500.00	\$1,500
10	Rip Rap at Outfalls	50	SY	\$40.00	\$2,000
11	Topsoil Stripping and Haul Off (6")	154	CY	\$4.00	\$616
12	Unclassified Excavation	1,541	CY	\$13.00	\$20,030
13	Bioretention	8,320	SF	\$15.00	\$124,799
14	Erosion Control Mat - Class I, Urban Type A	231	SY	\$3.00	\$693
15	Seed and fertilizer	231	SY	\$1.50	\$347
16	Watering	1	LS	\$200.00	\$200

Subtotal Project Cost	\$210,700
Construction Contingency (15%)	<u>\$31,600</u>
Construction Cost	\$242,300
Design Contingency (0%)	\$0
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$249,300

City would do design so no design contingency

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Nakoma Park/Thoreau School Streambank Restoration

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
Nakoma Park/Thoreau School Streambank Restoration					
1	Mobilization	1	LS	\$10,000	\$10,000
2	Clearing and Grubbing	1	LS	\$15,000	\$15,000
3	Dewatering	1	LS	\$10,000	\$10,000
4	Stone Tracking Pad	2	EA	\$1,500	\$3,000
5	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$4,500	\$4,500
6	Silt Fence	200	LF	\$5	\$1,000
7	Inlet Protection	4	EA	\$100	\$400
8	Unclassified Excavation (Assume 4-ft deep by 10-ft wide for length of channel+riffle pool)	1025	CY	\$25	\$25,625
9	Salvaged topsoil placement (6-inches thick)	600	SY	\$3.00	\$1,800
10	Channel Seeding (Native)	1	LS	\$15,000	\$15,000
11	Vegetation Maintenance	1	LS	\$3,000	\$3,000
12	Erosion Mat, Class II, Type C (Assume 12' on each side of channel for length of channel)	600	SY	\$2.50	\$1,500
13	Vegetated Boulder Revetment	850	LF	\$155	\$131,750
14	In-Stream Sediment Trap	2	EA	\$150	\$300
15	In-Stream Boulder	2	EA	\$600	\$1,200
16	Field Stone Riprap & Riffle Pool Sequence (Assume 2- 8' wide by 20' length by 2' deep)	25	CY	\$40	\$1,000
17	43-Inch x 68-Inch Storm Sewer Discharge Modifications	1	LS	\$5,000	\$5,000
18	24-Inch Storm Sewer Discharge Modifications	1	LS	\$5,000	\$5,000
19	38-Inch x 60-Inch Outlet Structure Modifications	1	LS	\$5,000	\$5,000

Total Project Cost	\$240,075
Construction Contingency (15%)	<u>\$36,000</u>
Total Construction Cost	\$276,075

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Cherokee Drive (Yuma to Chippewa) Streambank Restoration

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
Streambank Restoration On Cherokee Drive from Yuma to Chippewa					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$500.00	\$500
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$1,000.00	\$1,000
5	Silt Fence	100	LF	\$5.00	\$500
6	Inlet Protection	4	EA	\$90.00	\$360
7	Streambank Restoration (Centerline Length)	540	LF	\$500.00	\$270,000

Subtotal Project Cost	\$278,400
Construction Contingency (15%)	<u>\$41,800</u>
Construction Cost	\$320,200
Design Contingency (15%)	\$41,800
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$369,000

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Manitou Pond Diversion

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
Miscellaneous/Storm Sewer					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing (Remove 3 Trees Total)	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$1,000.00	\$1,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$2,000.00	\$2,000
5	Silt Fence	110	LF	\$5.00	\$550
6	Dewatering	1	LS	\$1,000.00	\$1,000
7	Diversion Structure	1	LS	\$25,000.00	\$25,000
8	Pretreatment Device	1	LS	\$50,000.00	\$50,000
9	Backwater Valve (Tideflex)	1	LS	\$15,000.00	\$15,000
8	Construction Staking (By Contractor).....entire project	1	LS	\$1,500.00	\$1,500
9	4-FT DIA MH with Casting	1	EA	\$2,300.00	\$2,300
10	24-IN RCP	470	LF	\$100.00	\$47,000
11	24-IN RCP Apron Endwall	2	EA	\$900.00	\$1,800
12	Rip Rap at 24-IN Outfall	50	SY	\$40.00	\$2,000
13	Topsoil Stripping and Stockpile (6")	95	CY	\$4.00	\$381
14	6-IN Salvaged Topsoil Placement 100%	156	SY	\$2.00	\$312
15	Erosion Control Mat - Class I, Urban Type A	156	SY	\$3.00	\$469
16	Seed with Fertilizer	156	SY	\$1.50	\$234
17	Curb and Gutter Removal	400	LF	\$5.00	\$2,000
18	Sidewalk Removal	225	SY	\$2.50	\$563
19	Curb and Gutter Restoration, 24-inch	400	LF	\$25.00	\$10,000
20	Asphalt Restoration	70	TON	\$65.00	\$4,550

Subtotal Project Cost	\$173,700
Construction Contingency (15%)	\$26,100
Construction Cost	\$199,800
Design Contingency (15%)	\$26,100
Soil Borings	\$7,000
Total Project Cost	\$232,900

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Devolis Park Bioretention

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
Bioretention					
1	Mobilization	1	LS	\$5,000.00	\$5,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$1,000.00	\$1,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$2,000.00	\$2,000
5	Silt Fence	100	LF	\$5.00	\$500
6	2'x3' Inlet with Casting	4	EA	\$2,000.00	\$8,000
7	12" RCP	100	LF	\$60.00	\$6,000
8	4-FT DIA MH	1	EA	\$3,500.00	\$3,500
9	24" RCP	50	LF	\$100.00	\$5,000
10	Asphalt Replacement	30	TON	\$65.00	\$1,950
10	Outlet Structure	1	LS	\$10,000.00	\$10,000
11	Construction Staking (By Contractor).....entire project	1	LS	\$1,500.00	\$1,500
12	Rip Rap at Outfalls	25	SY	\$40.00	\$1,000
13	Topsoil Stripping and Haul Off (6")	244	CY	\$4.00	\$978
14	Unclassified Excavation	2,444	CY	\$13.00	\$31,775
15	Bioretention	13,199	SF	\$15.00	\$197,980
16	Erosion Control Mat - Class I, Urban Type A	367	SY	\$3.00	\$1,100
17	Seed and fertilizer	367	SY	\$1.50	\$550
18	Watering	1	LS	\$200.00	\$200
19	Curb and Gutter Removal	50	LF	\$5.00	\$250
20	Sidewalk Removal	28	SY	\$2.50	\$69
21	Curb and Gutter Restoration, 24-inch	50	LF	\$25.00	\$1,250
22	Sidewalk Restoration	28	SY	\$45.00	\$1,250

Subtotal Project Cost	\$281,900
Construction Contingency (15%)	<u>\$42,300</u>
Construction Cost	\$324,200
Design Contingency (0%)	\$0
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$331,200

City would design this so no design contingency.

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Grandview Boulevard Bioswales

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
Bioretention					
1	Mobilization	1	LS	\$7,500.00	\$7,500
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	1	EA	\$1,000.00	\$1,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$1,000.00	\$1,000
5	Silt Fence	200	LF	\$5.00	\$1,000
6	Rip Rap at Outfalls	50	SY	\$40.00	\$2,000
7	Topsoil Stripping and Haul Off (6")	460	CY	\$4.00	\$1,839
8	Erosion Control Mat - Class I, Urban Type A	2,759	SY	\$3.00	\$8,276
9	Seed and fertilizer	2,759	SY	\$1.50	\$4,138
10	Watering	1	LS	\$200.00	\$200
11	Manhole w/Casting	5	EA	\$1,500.00	\$7,500
12	Storm Sewer Inlets w/Casting	10	EA	\$1,500.00	\$15,000
13	12" RCP	10	SY	\$1.50	\$15
14	6" Directionally Drilled Underdrain	900	LF	\$40.00	\$36,000
15	Curb Cuts	10	EA	\$250.00	\$2,500
16	Watermain Modifications	1	LS	\$5,000.00	\$5,000
17	Unclassified Excavation	4,598	CY	\$13.00	\$59,774
18	Bioretention	24,829	SF	\$15.00	\$372,438

Subtotal Project Cost	\$526,200
Construction Contingency (15%)	<u>\$78,900</u>
Construction Cost	\$605,100
Design Contingency (0%)	\$0
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$612,100

City would design this so no design contingency

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Arbor Hills Greenway Infiltration

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
Infiltration					
1	Mobilization	1	LS	\$10,000.00	\$10,000
2	Clearing and Grubbing	1	LS	\$1,000.00	\$1,000
3	Stone Tracking Pad	2	EA	\$1,000.00	\$2,000
4	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	1	LS	\$2,000.00	\$2,000
5	Silt Fence	500	LF	\$5.00	\$2,500
6	Inlet Protection	4	EA	\$100.00	\$400
7	Unclassified Excavation	14,300	CY	\$13.00	\$185,900
8	Engineered Soil	3,850	CY	\$68.00	\$261,800
9	Flow Splitter	3	EA	\$2,000.00	\$6,000
10	Outlet Structure 15" Pipe	65	LF	\$100.00	\$6,500
11	Rip Rap	50	SY	\$40.00	\$2,000
12	Construction Staking (By Contractor).....entire project	1	LS	\$5,000.00	\$5,000
13	Concrete Removal	115	CY	\$25.00	\$2,875
14	Topsoil Stripping and Stockpile (6")	1,900	CY	\$4.00	\$7,600
15	6-IN Salvaged Topsoil Placement 100%	11,230	SY	\$2.00	\$22,460
16	Seed and fertilizer	11,230	SY	\$1.50	\$16,845
17	Plants (1 Plant/SF)	32,250	EA	\$6.00	\$193,500
18	ECRM	11,230	SY	\$3.00	\$33,690
19	Sawcutting	45	LF	\$2.00	\$90

Subtotal Project Cost	\$762,200
Construction Contingency (15%)	<u>\$114,300</u>
Construction Cost	\$876,500
Design Contingency (0%)	\$0
Soil Borings	<u>\$7,000</u>
Total Project Cost	\$883,500

The City would design this, so no design contingency

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
60 Private Commercial Rain Gardens (Serving roofs only)

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
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60 Private Commercial Rain Gardens (Serving Roofs Only)					
1	Mobilization	60	EA	\$150.00	\$9,000
2	Clearing and Grubbing	60	EA	\$75.00	\$4,500
3	Unclassified Excavation (3' depth, 1' ponding, 1' engineered soil, and 1' stone layer)	1,553	CY	\$13.00	\$20,193
4	Raingarden (233 SF per Building)	13,980	SF	\$11.00	\$153,780
5	Downspout Modifications	60	EA	\$500.00	\$30,000

Subtotal Project Cost	\$217,500
Construction Contingency (15%)	<u>\$32,600</u>
Construction Cost	\$250,100
Design Contingency (15%)	<u>\$32,600</u>
Soil Borings	<u>\$7,500</u>
Total Project Cost	\$290,200

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
1,000 Terrace Rain Gardens

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
1,000 Terrace Rain Gardens					
1	Mobilization	1,000	EA	\$0.00	\$0
2	Clearing and Grubbing	1,000	EA	\$0.00	\$0
3	Curb Cut	1,000	EA	\$250.00	\$250,000
4	Unclassified Excavation (8' x 13' x 3' depth=312 cf/27=11.55 cy): 1' ponding, 2' engineered soil, and 0' stone layer	11,550	CY	\$14.00	\$161,700
5	Rain Garden (8' x 13' planted = 104 sf per Rain Garden)	104,000	SF	\$7.50	\$780,000

	Subtotal Project Cost	\$1,191,700
	Construction Contingency (5%)	<u>\$178,800</u>
	Construction Cost	\$1,370,500
Delete per Madison on 2/5/14	Design Contingency (0%)	\$0
Delete per Madison on 2/5/14	Soil Borings	<u>\$0</u>
	Total Project Cost	\$1,370,500

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Porous Pavement

4 Acres of Porous Pavement (Serving 12 Acre Watershed)					
1	Mobilization	8	EA	\$5,000.00	\$40,000
2	Excavation (12"+6"=18")	9,680	CY	\$20.00	\$193,600
3	Porous Concrete (6" Depth)	19,360	SY	\$76.05	\$1,472,328
4	Aggregate Storage Layer (12")	6,453	CY	\$50.00	\$322,667
5	Geotextile	20,533	SY	\$5.00	\$102,665
6	Underdrain	7,200	LF	\$30.00	\$216,000
7	Cleanout	48	EA	\$325.00	\$15,600
8	Connect Cleanout to Existing Structure	16	EA	\$800.00	\$12,800
7	Stone Tracking Pad	8	EA	\$1,000.00	\$8,000
8	Erosion Control and Maintenance (Includes Silt Fence Around Temporary Stock Piles)	8	EA	\$1,000.00	\$8,000
9	Silt Fence	800	LF	\$5.00	\$4,000
10	Inlet Protection	24	EA	\$90.00	\$2,160

Subtotal Project Cost **\$2,397,800**

Construction Cost/SY **\$123.85**

1	Traditional Asphalt (4" Depth)	19,360	SY	\$25.00	\$484,000
2	Traditional Removal of Existing Asphalt (4" Depth)	2,130	CY	\$15.00	\$31,944

Subtotal Traditional Cost \$515,944

Incremental Construction Cost	\$1,881,856
Construction Contingency (15%)	\$282,278
Construction Cost	\$2,164,134
Construction Cost/SY w/Contingency	\$111.78
Design Contingency (15%)	\$282,278
Soil Borings	\$25,000
Total Project Cost	\$2,471,413
Overall Cost/SY	\$127.66

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Rain Barrels

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
				Total Res. Parcels in Watershed	4,620
				Participation Rate	25%
				# Parcels Participating	1,155

Rain Barrels					
1	Mobilization	0	EA	\$0.00	\$0
2	Clearing and Grubbing	0	EA	\$0.00	\$0
3	Rain Barrel	1,155	EA	\$100.00	\$115,500
4	Downspout Modifications	1,155	EA	\$25.00	\$28,875

Subtotal Project Cost	\$144,400
Construction Contingency (5%)	<u>\$7,200</u>
Construction Cost	\$151,600
Design Contingency (0%)	\$0
Soil Borings	<u>\$0</u>
Total Project Cost	\$151,600

Lake Wingra Watershed Management Plan
City of Madison, Wisconsin
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST: PLANNING-LEVEL
Downspout Disconnection

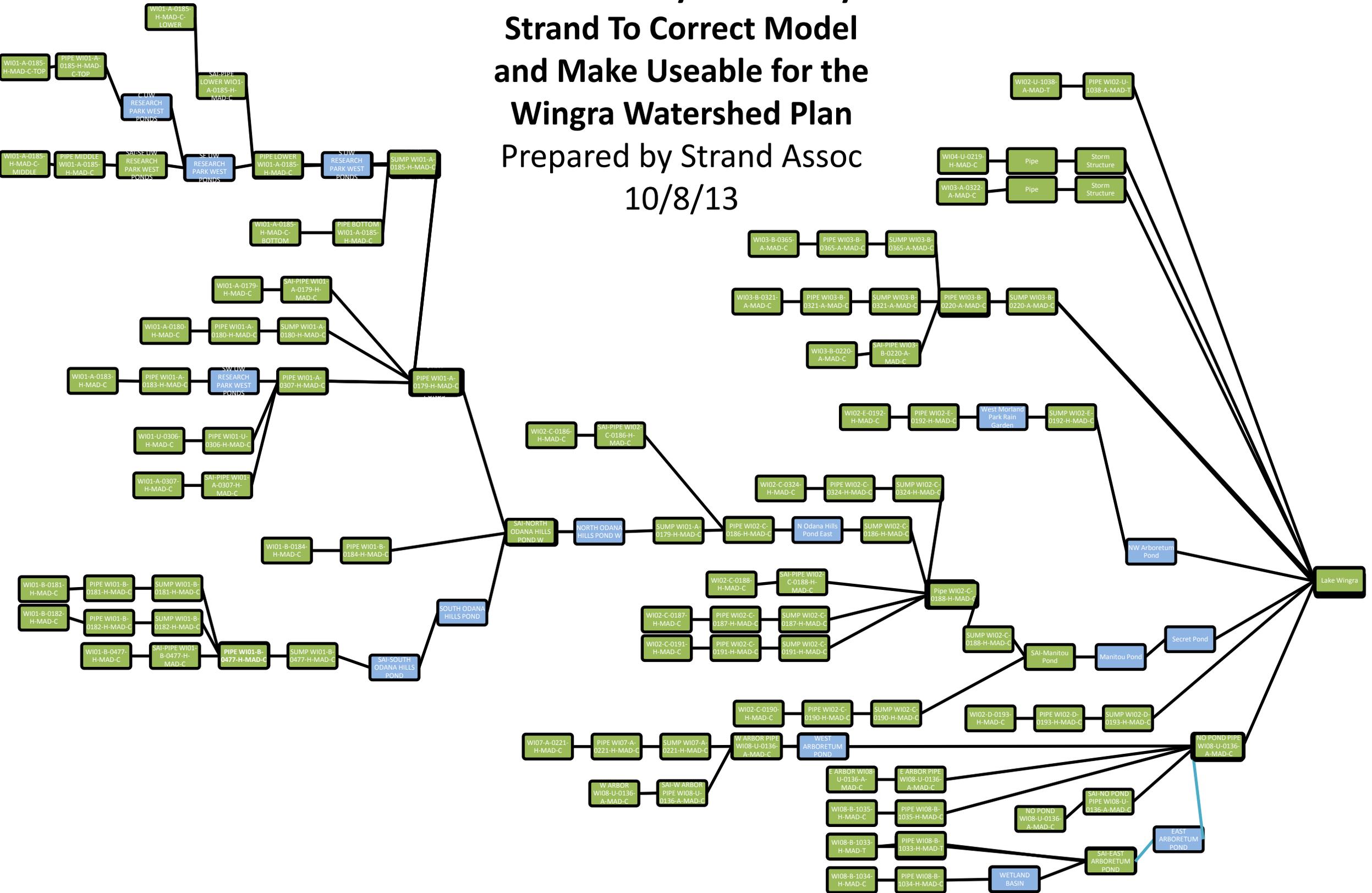
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>Quantity</u>	<u>Units</u>	<u>Unit Price</u>	<u>Total</u>
				Total Res. Parcels in Watershed	4,620
				Participation Rate	35%
				# Parcels Participating	1,617

Downspout Disconnection					
1	Mobilization	0	EA	\$150.00	\$0
2	Clearing and Grubbing	0	EA	\$75.00	\$0
3	Downspout Modifications	1,617	EA	\$275.00	\$444,675

Subtotal Project Cost	\$444,700
Construction Contingency (5%)	<u>\$22,200</u>
Construction Cost	\$466,900
Design Contingency (0%)	\$0
Soil Borings	<u>\$0</u>
Total Project Cost	\$466,900

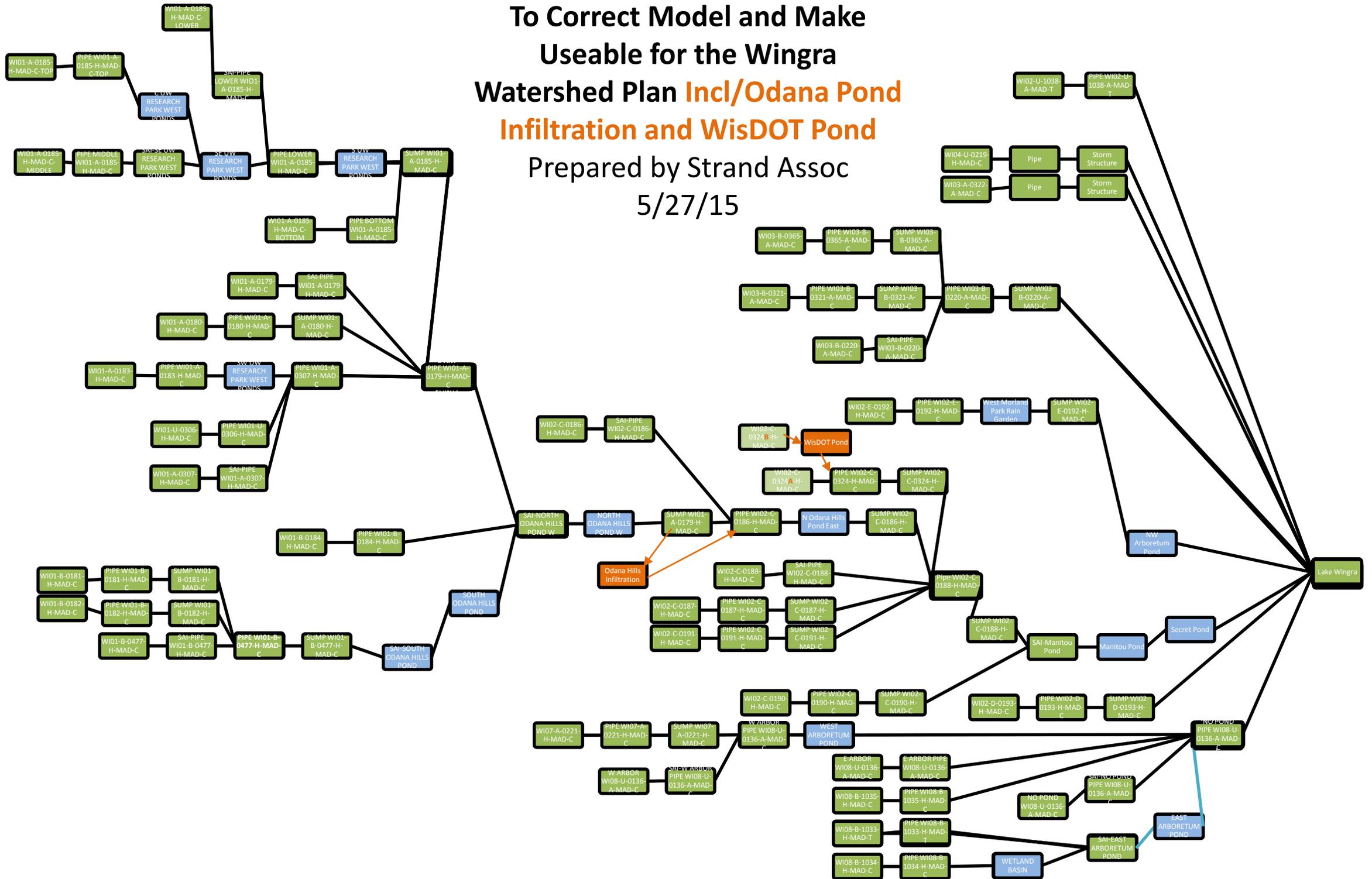
APPENDIX C
WATERSHED MODEL SCHEMATIC

City of Madison P8 Model Schematic: Connectivity Revised By Strand To Correct Model and Make Useable for the Wingra Watershed Plan Prepared by Strand Assoc 10/8/13



City of Madison
P8 Model Schematic:
Connectivity Revised By Strand
To Correct Model and Make
Useable for the Wingra
Watershed Plan Incl/Odana Pond
Infiltration and WisDOT Pond

Prepared by Strand Assoc
 5/27/15



APPENDIX D
USEPA NINE MINIMUM ELEMENTS FOR SECTION 319-FUNDED
WATERSHED PLANS

D.01 INTRODUCTION

The United State Environmental Protection Agency (USEPA) identifies six Steps in the Watershed Planning and Implementation Process as shown in Figure D.01-1. Fitting within these six Steps are the nine minimum elements to be included in Section 319-funded watershed plans for threatened or impaired waters. USEPA’s watershed planning guidance in its entirety is included in *A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters*, May 2013, available at the following link http://water.epa.gov/polwaste/nps/upload/watershed_mgmnt_quick_guide.pdf.

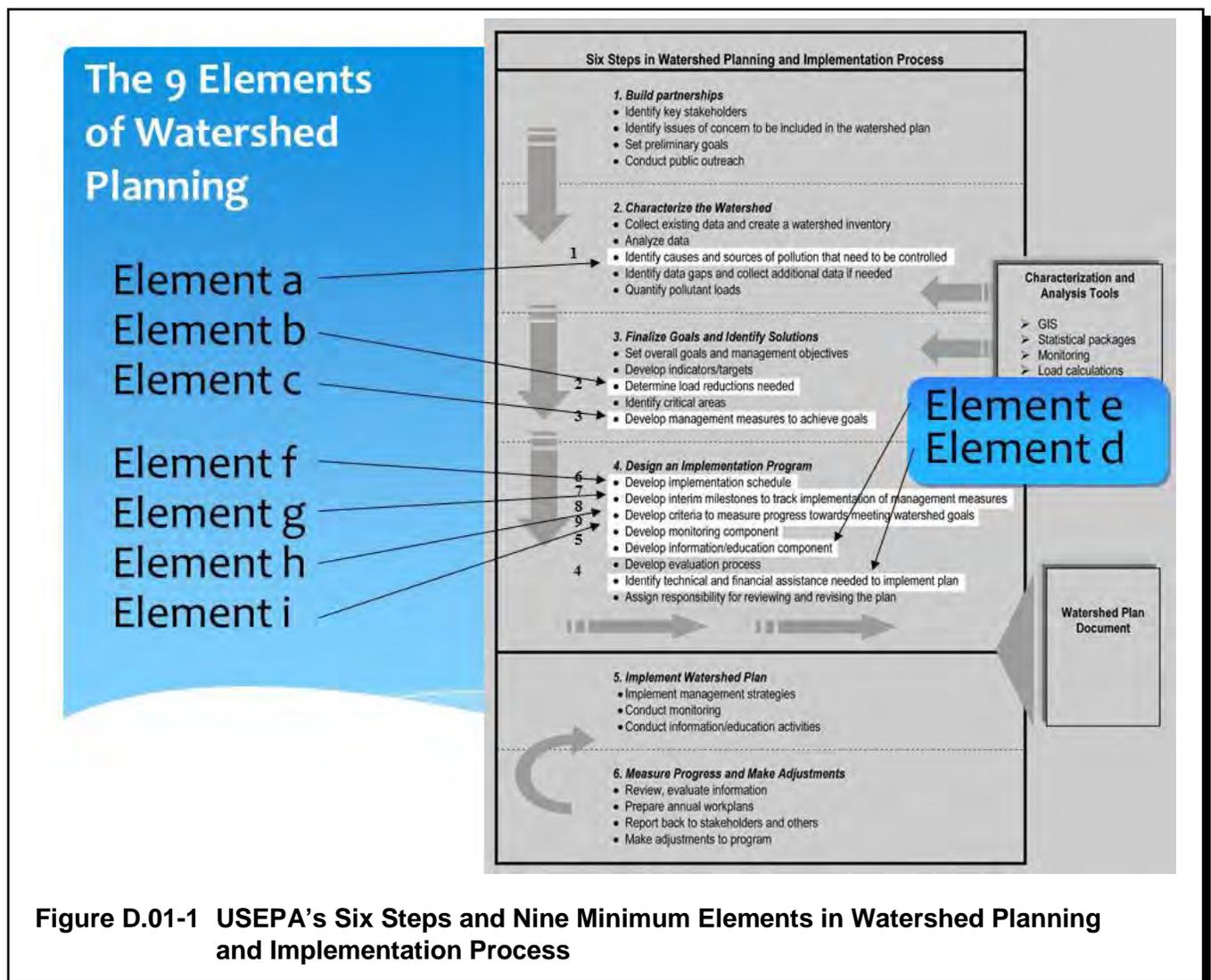


Figure D.01-1 USEPA’s Six Steps and Nine Minimum Elements in Watershed Planning and Implementation Process

Should the City of Madison pursue federal funds for Best Management Practice (BMP) implementation in the Lake Wingra Watershed, a plan consistent with the nine minimum elements would be required. Presently in Wisconsin, there is not a requirement for a watershed plan to be consistent with the nine minimum elements to receive funding from the WDNR’s main funding mechanism for urban stormwater

projects, namely the WDNR Urban Nonpoint Source and Stormwater Grant Program. Table D.01-1 shows the Six Steps in Watershed-Based Plans, the Nine Minimum Elements for Section 319-Funded Watershed Plans, and information showing how the Lake Wingra Watershed Plan is consistent with both.

It should be noted that the Lake Wingra Watershed Plan is focused on chloride reductions, increases in infiltration to promote increases in groundwater and spring flow at Lake Wingra, and phosphorus reductions. Chlorides and phosphorus are considered USEPA pollution sources. Increases in infiltration are not considered USEPA pollution sources and are thus referred to as a watershed issue in Table D.01-1.

Table D.01-1 Lake Wingra Watershed Management Plan’s Consistency With USEPA’s Six Steps and Nine Minimum Elements

Six Steps in Watershed-Based Plans	Nine Minimum Elements for Section 319-Funded Watershed Plans	Lake Wingra Watershed Management Plan (Consistency with Six Steps and Nine Minimum Elements)
1. Build Partnerships	N/A	<p>This project was completed by a partnership between the City of Madison and Friends of Lake Wingra. The project is guided by a Steering Team with representatives of the City of Madison, Friends of Lake Wingra, Clean Lakes Alliance, Wisconsin DNR, University of Wisconsin-Madison, and the University of Madison-Arboretum as shown in Table 1 of the Foreword. Likewise, two Issue Team meetings were held (Meeting No. 1-Chlorides and Meeting No. 2-Infiltration) that brought together representatives from additional organizations including Madison Gas and Electric, Madison Metropolitan Sewerage District, and a local snow removal company. See Appendix A for Steering and Issue Team Meeting summaries.</p> <p>Section 5.02 described Collaborative Efforts that are envisioned for future watershed plan engagement and implementation efforts.</p>
2. Characterize the Watershed	a. Identify causes and sources of pollution that need to be controlled.	<p>Plan Section 2 and Section 4 address the causes and sources of pollution for chlorides and phosphorus and Section 3 addresses the watershed issues related to infiltration/groundwater flow/spring flow. As described in Section 2.04, a Chlorides Mass Balance Predictive Tool was developed to understand chloride sources and factors affecting chloride levels in Lake Wingra. As described in Section 3.02 D. and Section 3.03 E., F, and G., the Dane County Regional Groundwater Model and the City’s Program for Predicting Polluting Particle Passage Through Pits, Puddles, and Ponds (P8) model were used to understand historic and current infiltration and groundwater/spring flows to Lake Wingra. As described in Section 4.03, the City’s P8 model was used to understand phosphorus sources and factors affecting phosphorus loads from the watershed reaching Lake Wingra.</p>
3. Set Goals and Identify Solutions	<p>b. Determine load reductions needed.</p> <p>c. Develop management measures to achieve goals.</p>	<p>The Steering Team described above was instrumental in setting goals for the chloride and phosphorus pollution sources and the infiltration/groundwater/spring flow watershed issue as further described in Section 2.01, Section 3.01, and Section 4.01.</p> <p>Each of the models/tools described above were used to help set goals for the chloride and phosphorus pollution sources and infiltration/groundwater/spring flow watershed issues as further described in Section 2.01, Section 3.01, and Section 4.01.</p> <p>Load reductions and infiltration increases needed to meet the goals are described in Section 2.05 D. (Chlorides), Section 3.03 G. (Infiltration), and Sections 4.03 D. (phosphorus).</p> <p>An Alternatives Analysis describing management measures to achieve the goals are described in Section 2.08 (Chlorides), 3.03 I. and 3.04 (Infiltration), and Section 4.04 B., C., D., and E (phosphorus).</p>
4. Design and Implementation Program	<p>d. Identify technical and financial assistance needed to implement plan</p> <p>e. Develop information/education component.</p> <p>f. Develop implementation schedule.</p> <p>g. Develop interim milestones to track implementation of management measures.</p> <p>h. Develop criteria to measure progress towards meeting watershed goals.</p> <p>i. Develop monitoring component.</p>	<p>d. The Implementation Plan in Table 6.03-1 provides costs for capital improvements and whether a project is grant eligible. The City already provides funding /incentives for many of the described existing initiatives, some of which are recommended for expansion. Catalyst teams will work with appropriate entities to identify needs and request/secure appropriate funding. Section 6.02 4 recommends that the City of Madison budget monies for implementation of infiltration and phosphorus-based recommended projects. Section 6.02 10 recommends applying for grants for implementation of projects. Section 6.02-11 recommends that the City of Madison budget monies for technical assistance by a consultant to support the Catalyst Team Activities.</p> <p>e. Section 5-Engagement and Implementation provides a comprehensive engagement plan that will be implemented by the catalyst teams. The catalyst teams will interact with various entities as further described in Section 5.03 including pilot projects to gauge effectiveness of certain initiatives before their more widespread implementation and use of social marketing techniques to affect behavior change in the watershed.</p> <p>As part of this plan, four public information meetings were held including a March 26, 2015, Public Information Meeting (PIM) at Edgewood College, a June 24, 2015, Neighborhood Association PIM, a July 14, 2015, Neighborhood Association PIM to obtain feedback from stakeholders on the draft Lake Wingra Watershed Management Plan. In addition, PIMs specifically related to the 2014-2015 Leaf Management Improvement Pilot Project were held on September 18, 2014, and September 17, 2015, that provided information/education on leaf management improvement efforts requested of residents in the pilot project area.</p> <p>f. Section 6.03 includes an Implementation Plan as Table 6.03-1 including implementation schedule.</p> <p>g. Section 5.03 recommends the use of catalyst teams for implementing recommendations of the watershed plan and engaging the appropriate entities for the recommended critical actions. These catalyst teams are recommended to be formed in late 2015, to meet quarterly thereafter, and to track their activities and progress each year.</p> <p>Sections 6.02 1, 2, and 3, recommend creation and initiation of Chlorides, Infiltration, and Phosphorus Catalyst Teams. Section 6.02-5 recommends that the City tract yearly Catalyst Team activities and progress.</p> <p>h. As described in Section 2.02 B., the UW-Madison Limnology Department’s North Temperate Lakes Long Term Ecological Research program monitors Lake Wingra chloride concentrations by collecting samples approximately 5 times yearly. This data collection efforts allows the City to measure progress towards meeting the chloride reduction goal. In addition, Section 6.02 9 recommends that the City maintain the Chlorides Mass Balance Predictive Tool to track progress on chloride reductions.</p> <p>Regarding both infiltration and phosphorus, the City tracks projects that are implemented as part of on-going programs including biannual reporting under their MS4 permit. Section 6.02 9 recommends that the City maintain the City’s P8 model to track progress on phosphorus reductions and infiltration increases.</p> <p>i. As described above, long-term Lake Wingra chloride concentration monitoring is in place. It is recommended that the Phosphorus Catalyst Team work with the UW-Madison Limnology Department’s North Temperate Lakes Long Term Ecological Research program to add monitoring/sampling for total phosphorus.</p>
5. Implement the Watershed Plan	N/A	Catalyst teams are responsible for implementation of the Watershed Plan.
6. Measure Progress and make Adjustments	N/A	Catalyst teams are responsible for implementation of Watershed Plan, measurement of progress, and adjustments to recommendations.

Chloride Reduction Initiatives

Residents

- Homeowner education

Commercial Applicators

- Applicator training/certification programs
- County-wide application guidelines/ordinances

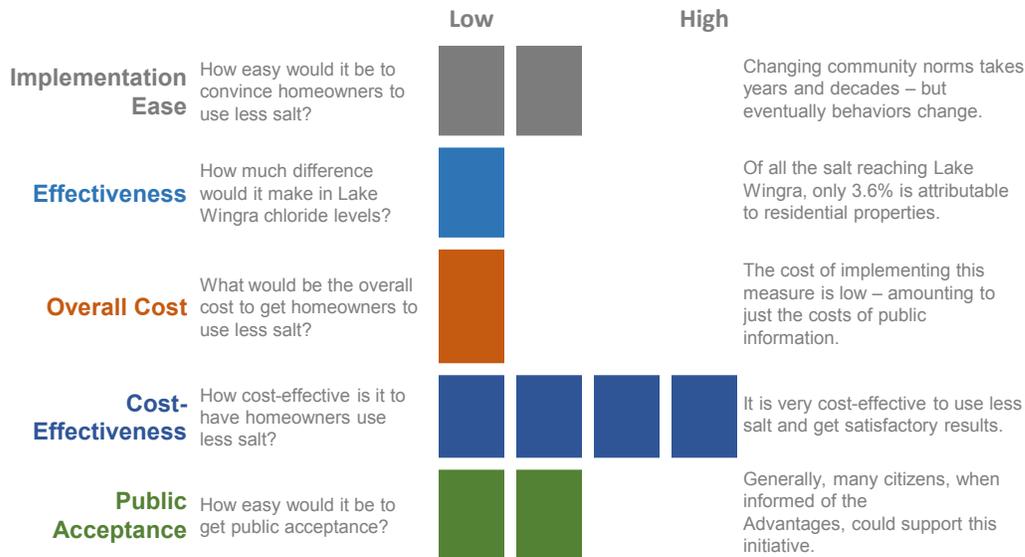
Municipal Based

- Expand anti-icing
- Explore alternate de-icers
- Explore different snow clearing techniques

Resident Based Initiatives

Salt Reduction

Homeowners apply less salt



While residential salt use is not a major chloride contributor to Lake Wingra, changing salt use behavior with residents is essential for changing the community and government attitudes toward salt use. This initiative would seek to educate residential property owners so that they use alternate materials (e.g., sand) or limit their salt application rate to 5 pounds per 1,000 square feet.



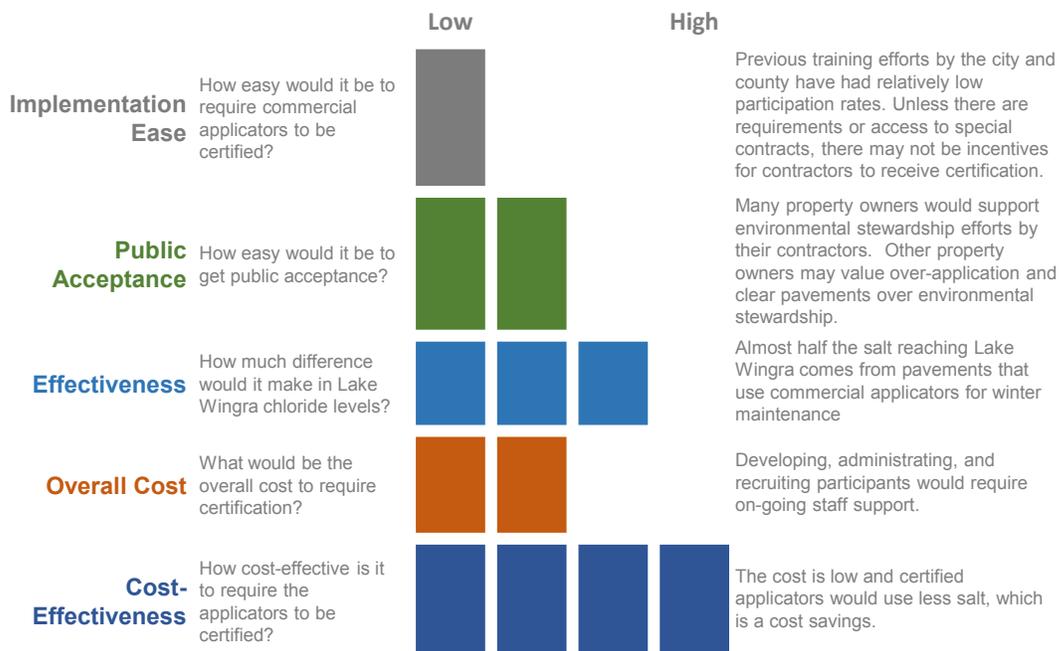
http://nihseniorhealth.gov/falls/homesafety/sand_popup.html

Apply sand instead of salt

Commercial Applicator Based Initiatives

Salt Reduction

Certification Program for Commercial Applicators



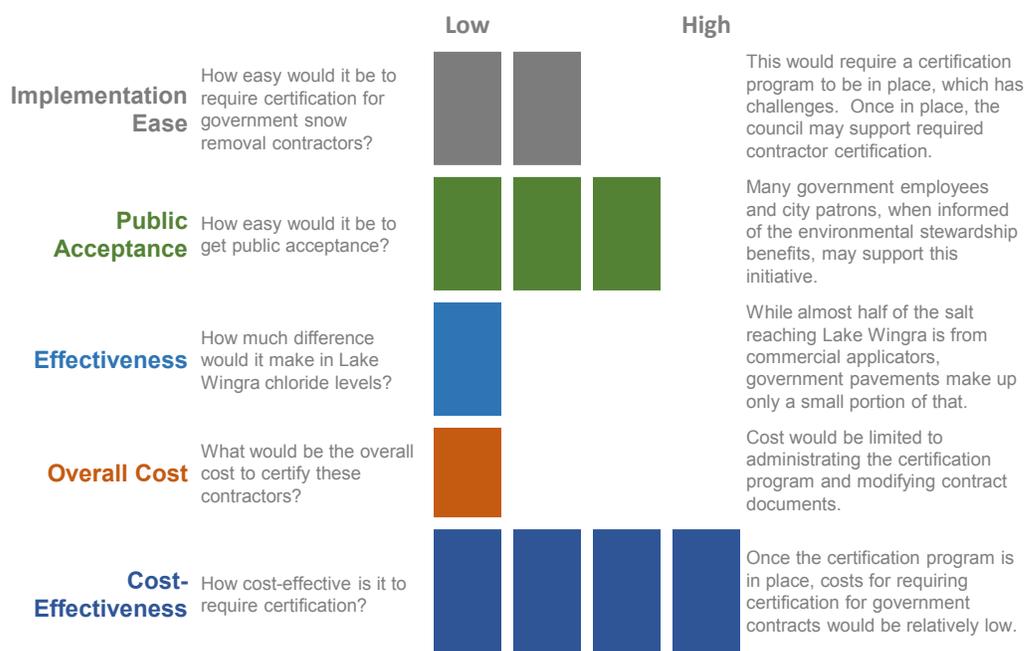
Almost half the salt reaching Lake Wingra comes from commercial applicators. A small survey of commercial applicators indicates some apply up to 5 times more salt than what is currently recommended by the WDNR. Other states have had success with enacting a certification program for commercial salt applicators, either led by the city or the WDNR. Commercial applicators have been able to use their certification in marketing efforts. The certification program provides measurable reductions quicker when property owners also attend training events.



<http://www.cityofmadison.com/engineering/stormwater/RoadSaltWorkshop.cfm>

2007 Workshop

Required Certification for Government Snow Removal Contractors



As mentioned, half the salt reaching Lake Wingra comes from commercial applicators. This measure would provide an incentive for contractors to get certification by requiring that all government contractors go through the certification program and maintain their certification while working on government contracts. Commercial contractors clear many state and municipal buildings, and they also provide almost half the labor force for clearing streets during a major snow event. The required certification could be implemented together or independently at state, county, and local government levels.



Commercial Applicator Based Initiatives

Salt Reduction

Establish Maximum Salt Guidelines

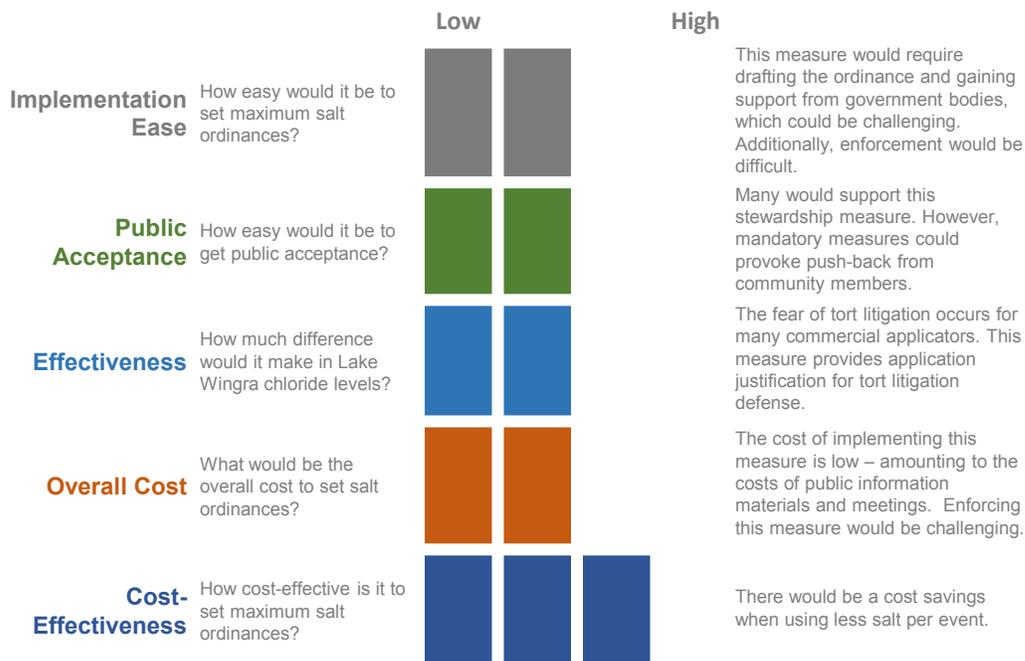


This measure seeks to establish maximum salt use guidelines for either the City of Madison, Dane County, or both. The fear of tort litigation is a factor in the amount of salt commercial applicators use. While not binding, guidelines could help change expectations and provide background information in tort litigation.



<http://www.chrisfoscontractor.com/snowremoval.php>

Establish Maximum Salt Ordinances



This measure seeks to establish maximum salt use ordinances for either the City of Madison, Dane County, or both. The fear of tort litigation is a factor in the amount of salt commercial applicators use. These ordinances would help shift public opinion on acceptable winter management practices. They would also provide better background information for tort litigation.

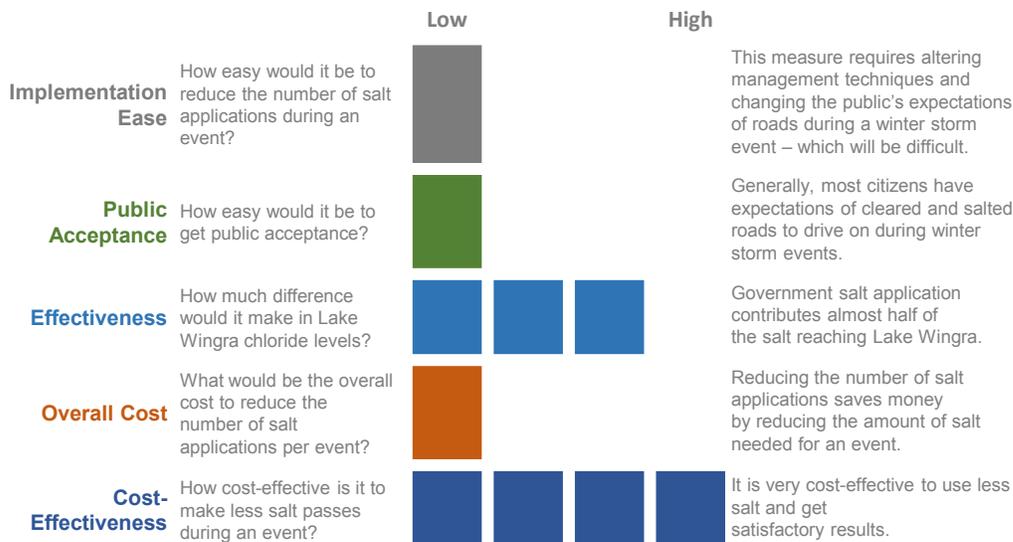


<http://www.wbez.org/series/curious-city/how-much-road-salt-ends-lake-michigan-109814>

Municipal Based Initiatives

Salt Reduction

Reduce Number of Salt Applications per Snow Event



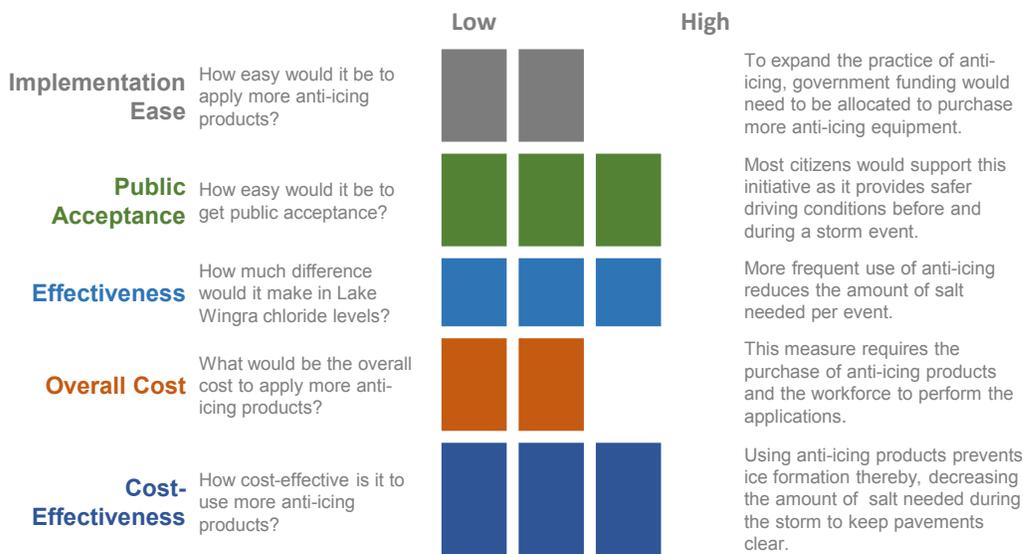
This initiative would reduce the number of salt applications per event by local governments. Currently up to 35 percent of the salt reaching Lake Wingra originates from Madison Salt Routes and about 11 percent originates from County-maintained routes, such as the Beltline. Both governments are trying to reduce salt use. Reducing the number of salt applications per event would need several coordinated efforts to be effective. These include:

- Potentially expanding the practice of anti-icing
- Exploring the use of alternative deicers
- Changing/reducing public expectations

All of these measures include their own challenges.



Expand Practice of Anti-Icing



Anti-icing is the practice of spraying a salt brine on pavements in advance of a winter storm. It helps prevent ice and snow from fusing to the pavement, and operators say it helps them get ahead of the storm. Madison and Dane County already use anti-icing equipment, and Madison is in the process of purchasing more anti-icing equipment. This initiative would purchase more equipment and expand the practice to include more streets.



<http://www.ci.janesville.wi.us/index.aspx?page=425>

Apply anti-icing liquid before storm events to reduce amount of salt needed for winter maintenance

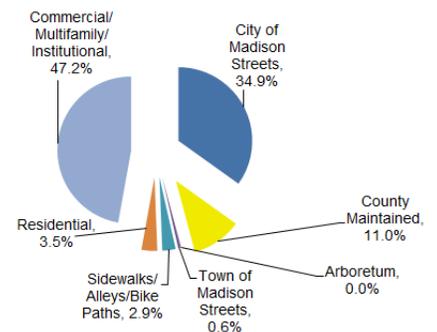
Municipal Based Initiatives

Salt Reduction

Reduce Salt Route Mileage

		Low	High
Implementation Ease	How easy would it be to reduce the salt route mileage?		Changing public expectations for clear pavement is a significant implementation barrier.
Public Acceptance	How easy would it be to get public acceptance?		Citizens have expectations of cleared winter pavements. These expectations have risen during the last several decades. The majority of complaints to the streets department have to do with too little salt being applied, rather than too much salt being applied.
Effectiveness	How much difference would it make in Lake Wingra chloride levels?		Almost half of the salt reaching Lake Wingra comes from city- and county-maintained streets. Reductions in salt route mileage would directly reduce lake chlorides.
Overall Cost	What would be the overall cost to reduce salt route mileage?		Current salt routes could be changed to sand routes. Sand is less expensive than salt.
Cost-Effectiveness	How cost-effective is it to reduce salt route mileage?		It is cost-effective to reduce salt route mileage and get satisfactory results.

Madison's most traveled collectors and arterials are designated salt routes. All other streets, primarily residential, are plowed and sanded. This initiative would convert some currently designated salt routes to sand routes for winter maintenance. For this measure to be implementable, public expectations regarding snow clearance on pavements would have to change.



Approximate Chloride Contributions 2006-2012

Use Alternate Deicers

		Low	High
Implementation Ease	How easy would it be to investigate alternate deicers?		Depending on the type of deicer, different equipment may need to be purchased. Most deicers are more expensive than sodium chloride.
Public Acceptance	How easy would it be to get public acceptance?		Some deicers are more effective, yet more corrosive. Acetates and agricultural byproducts could detrimentally affect aquatic life.
Effectiveness	How much difference would it make in Lake Wingra chloride levels?		Using other deicing products reduces the amount of chloride in the lake.
Overall Cost	What would be the overall cost to investigate alternatives?		The cost of this initiative would include investing in the alternate deicers and equipment necessary for application.
Cost-Effectiveness	How cost-effective is it to investigate alternatives?		While many deicers have lower melting temperatures, many are several times more expensive than salt.

Sodium chloride is the predominant deicer being used by the City of Madison as well as municipalities. There are many different deicers that could be used that would reduce chloride levels in Lake Wingra. Potential deicers and considerations are listed below:

- Inhibited Magnesium Chloride – lower melting temperature yet more expensive and more corrosive.
- Calcium Chloride – lower melting temperature, three times more expensive.
- Potassium Acetate – lower melting temperature, can lead to oxygen depletion in soil and water bodies.
- Calcium Magnesium Acetate – similar melting temperature, twenty times more expensive, can lead to oxygen depletion in soils and water bodies.
- Agricultural byproducts (beet juice and others) – often mixed with anti-icing brine, may increase residual retention time, can create a substantial oxygen demand in water bodies.



<http://www.deeproot.com/blog/blog-entries/deicing-with-beet-juice>

Infiltration Initiatives

Community Based Measures

- Downspouts
- Rain gardens
- Rain barrels
- Permeable pavements

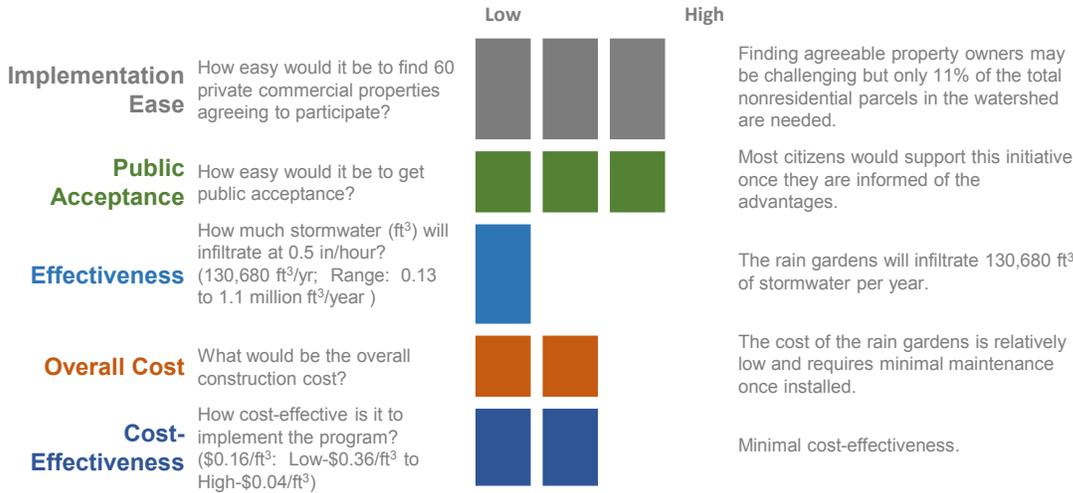
Project Based Measures

- Infiltration basins
- Bioretention ponds/Bioswales
- Terrace rain gardens
- Green streets/permeable pavements

Community Based Measures

Infiltration

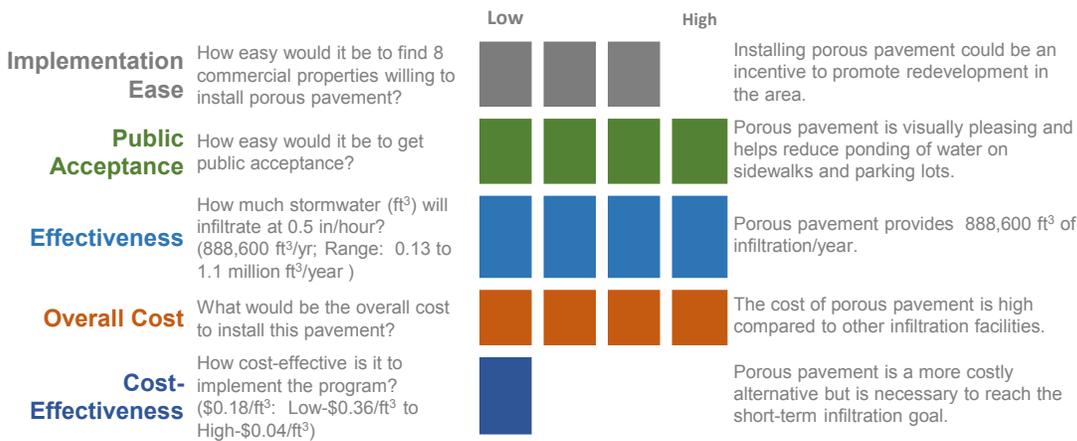
Private Commercial Rain Gardens



Up to 60 private commercial rain gardens would be implemented. This would entail rerouting 25% of a building's roof area to a rain garden. Opportunities exist for reduced cost native plants through Dane County's Plant Dane program. Rain garden average size would be around 225 square feet (15 feet x 15 feet).

Land Use	Parcels in the Watershed	Rooftop Area (acres)
Residential (Single-Family and Duplex)	4,620	183
Nonresidential (Commercial, Business, Institutional, and Multi-family Residential)	460	178

Porous Pavement-Commercial



Up to 4 acres of porous pavement serving 12 acres of drainage area would be implemented. This would entail retrofitting commercial, business, or institutional parking lots. Opportunities exist for cost sharing through the WDNR's Urban Nonpoint Source grant program and Dane County's Urban Water Quality grant program. An equivalent of 8 projects would be sought with a pervious pavement footprint of 150 feet x 150 feet, each.

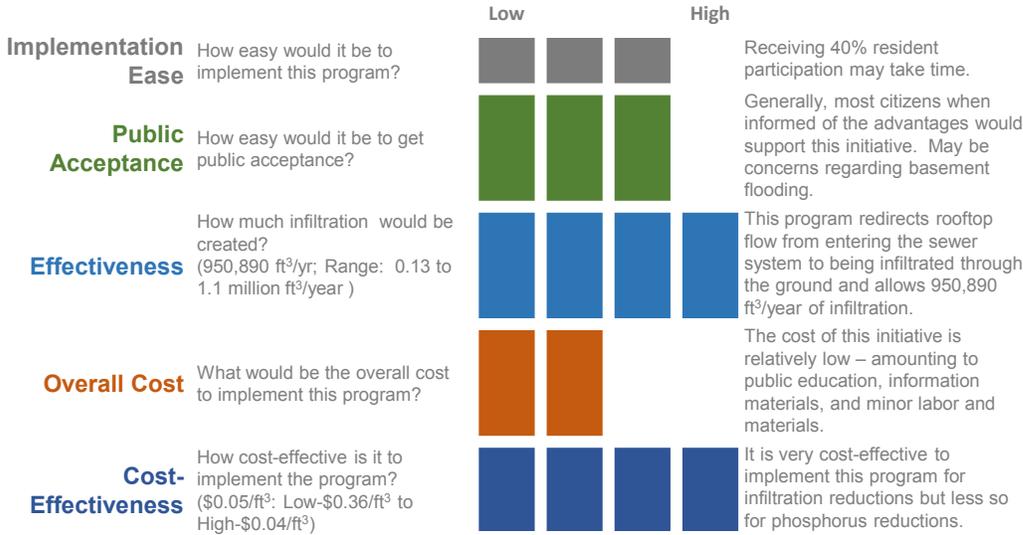


Water quickly infiltrates through porous pavement.

Community Based Measures

Infiltration

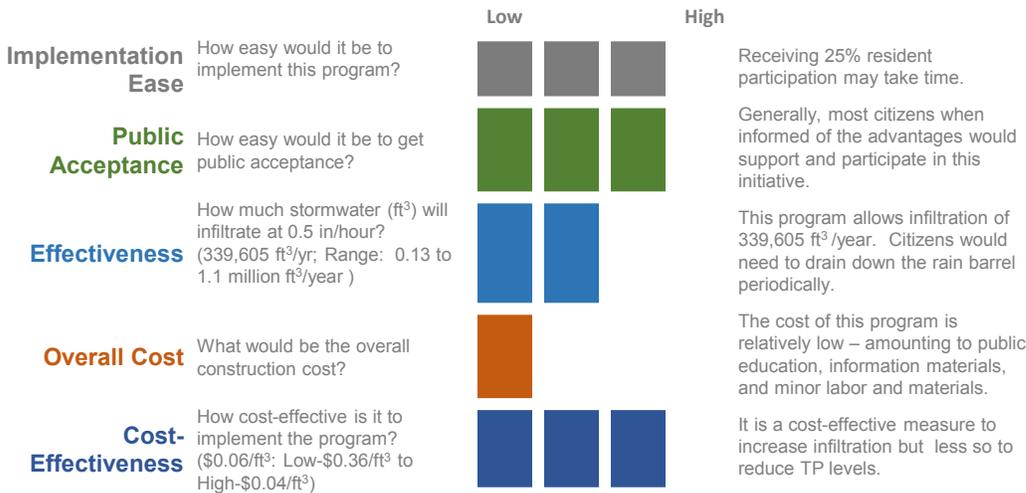
Downspout Disconnection Program



Disconnecting downspouts is an easy process.

Forty percent of the homes in the watershed (1,617 homes) would be disconnected. This would entail rerouting 25% of a home's roof area to a turf area (i.e., 1 of 4 downspouts), rather than a paved area.

Rain Barrel Program



Twenty-five percent of the homes in the watershed (1,155 homes) would be routed to a rain barrel. This would entail routing 25% of a home's roof area to a rain barrel (i.e., 1 of 4 downspouts).

Community Based Measures

Infiltration

1,000 Terrace Rain Gardens

		Low	High
Implementation Ease	How easy would it be to find install 1,000 terrace rain gardens?		Finding residents willing to participate in this program is the largest barrier.
Public Acceptance	How easy would it be to get public acceptance?		Generally, most citizens when informed of the advantages would support this initiative.
Effectiveness	How much stormwater (ft ³) will infiltrate at 0.5 in/hour? (304,920 ft ³ /yr; Range: 0.13 to 1.1 million ft ³ /year)		These terrace rain gardens are instrumental to providing source area infiltration. The total infiltration would be 304,920 ft ³ /year.
Overall Cost	What would be the overall construction cost?		The total cost of this initiative would be high compared to other proposed initiatives.
Cost-Effectiveness	How cost-effective is it to implement the program? (\$0.36/ft ³ : Low-\$0.36/ft ³ to High-\$0.04/ft ³)		Relatively low cost-effectiveness but would be instrumental to retrofit the built community with stormwater features.

Up to 1,000 terrace rain gardens would be implemented. The City's terrace rain garden program requires a homeowner contribution of \$500 on a terrace rain garden that generally costs about \$1,400 to construct as part of a City reconstruction project. A homeowner can either have the City plant the rain garden or homeowner can do on their own. Opportunities exist for reduced cost native plants through Dane County's Plant Dane program. Maintenance of the terrace rain garden is homeowner responsibility. There are currently 12 terrace rain gardens in the Wingra Watershed.

<http://www.cityofmadison.com/engineering/stormwater/raingardens/terraceraingardens.cfm>



Residential terrace rain garden

Private Residential Rain Gardens

		Low	High
Implementation Ease	How easy would it be to find 1,000 private residential homeowners agreeing to participate?		Finding agreeable property owners may be challenging. Twenty-two percent of the total parcels in the watershed would need to participate.
Public Acceptance	How easy would it be to get public acceptance?		Most citizens would support this initiative once they are informed of the advantages. May be concerns about basement flooding.
Effectiveness	How much stormwater (ft ³) will infiltrate at 0.5 in/hour? (1,089,000 ft ³ /yr; Range: 0.13 to 1.1 million ft ³ /year)		The rain gardens will infiltrate 1,089,000 ft ³ /year of stormwater.
Overall Cost	What would be the overall construction cost?		The cost of the rain gardens is moderately high.
Cost-Effectiveness	How cost-effective is it to implement the program? (\$0.08/ft ³ : Low-\$0.36/ft ³ to High-\$0.04/ft ³)		It is cost-effective to install rain gardens for infiltration purposes but less so for TP removal.

Up to 1,000 private residential rain gardens would be implemented. This would entail rerouting 25% of a building's roof area to a rain garden (i.e., 1 of 4 downspouts). Opportunities exist for reduced cost native plants through Dane County's Plant Dane program. Rain garden average size would be around 120 square feet (10 feet x 12 feet). There are currently 65 existing private residential rain gardens in the Wingra Watershed.

<http://www.cityofmadison.com/engineering/stormwater/raingardens/1000raingardens.cfm>



Residential rain garden

Project Based Measures Infiltration

Arbor Hills Infiltration Facility

		Low		High	
Implementation Ease	How easy would it be to construct this infiltration facility?				This construction would have minimal traffic, bicycle, or pedestrian interruptions.
Public Acceptance	How easy would it be to get public acceptance?				Previous opposition to the project may deter implementation. Stormwater treatment and infiltration retrofit opportunity in the built environment important factor to consider where few large-scale opportunities exist.
Effectiveness	How much stormwater (ft ³) will infiltrate at 0.5 in/hour? (535,788 ft ³ /yr; Range: 0.13 to 1.1 million ft ³ /year)				This facility would provide 535,788ft ³ of infiltration/year.
Overall Cost	What would be the overall construction cost?				This facility has a large upfront cost.
Cost-Effectiveness	How cost-effective is it to implement the project? (\$0.12/ft ³ : Low-\$0.36/ft ³ to High-\$0.04/ft ³)				It is moderately cost-effective to pursue this facility but less so for phosphorus control.

Located outside of the surface watershed but inside the groundwater watershed, this proposed facility would consist of 3 infiltration basins serving a 145-acre watershed. It would provide valuable stormwater for recharge of the groundwater aquifer and spring flow. Other than street sweeping and sumps, this 145-acre watershed currently discharges untreated stormwater to the storm sewer system. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



Possible Arbor Hills Infiltration Facility

Grandview Boulevard Bioswales

		Low		High	
Implementation Ease	How easy would it be to construct the bioswales?				Constructing the bioswales will cause minor disturbances in vehicle and bicycle traffic.
Public Acceptance	How easy would it be to get public acceptance?				Generally, most neighborhood residents when informed of the advantages would support this initiative. Much of the existing boulevard would remain unchanged.
Effectiveness	How much stormwater (ft ³) will infiltrate at 0.5 in/hour? (335,400 ft ³ /yr; Range: 0.13 to 1.1 million ft ³ /year)				These bioswales will infiltrate 335,400 ft ³ /year.
Overall Cost	What would be the overall construction cost?				Cost is moderate compared to other opportunities.
Cost-Effectiveness	How cost-effective is it to implement the program? (\$0.13/ft ³ : Low-\$0.36/ft ³ to High-\$0.04/ft ³)				Cost-effectiveness is moderate for Infiltration compared to other opportunities less so for phosphorus.

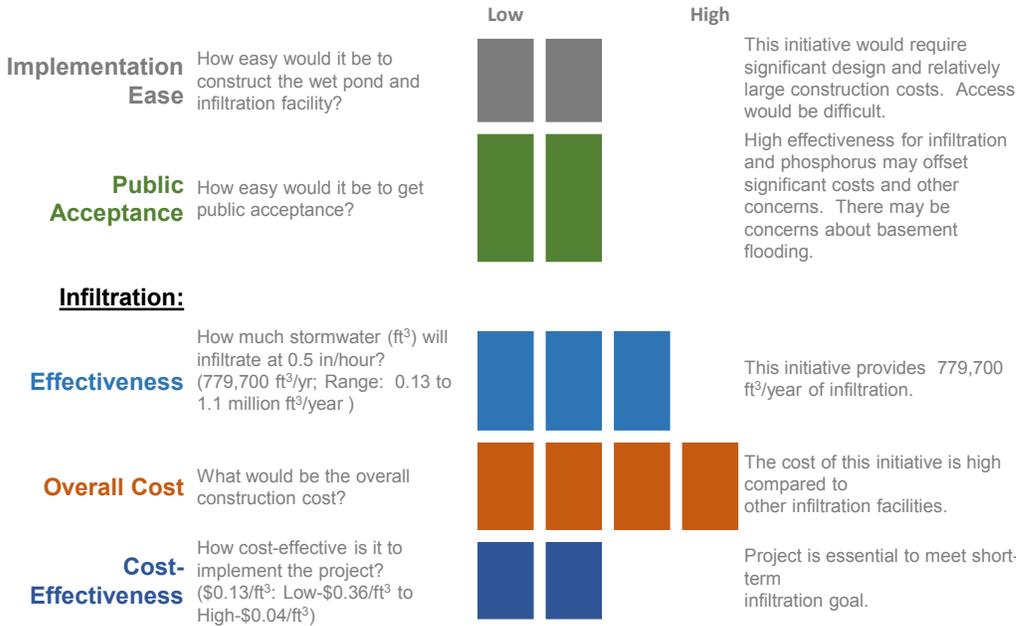
Other than street sweeping and sumps, this 19-acre watershed currently discharges untreated stormwater to the storm sewer system which drains through the UW-Madison Arboretum before reaching Lake Wingra. This proposed facility would consist of 5 bioretention basins depressed into the 40-foot-wide boulevard. It would provide valuable stormwater for recharge of the groundwater aquifer and spring flow. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



Grandview Boulevard Bioswales

Project Based Measures Infiltration

Glenway Golf Course Wet Pond and Infiltration



Similar to MG&E's Infiltration Facility in the Odana Hills Golf Course, this proposed facility would consist of a wet detention basin that would pretreat stormwater prior to pumping flows uphill to an underground infiltration facility. Other than street sweeping and sumps, this 159-acre watershed currently discharges untreated stormwater to Lake Wingra. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



Possible Glenway Golf Course Wet Pond and Infiltration

Monroe St. Reconstruction with Green Features



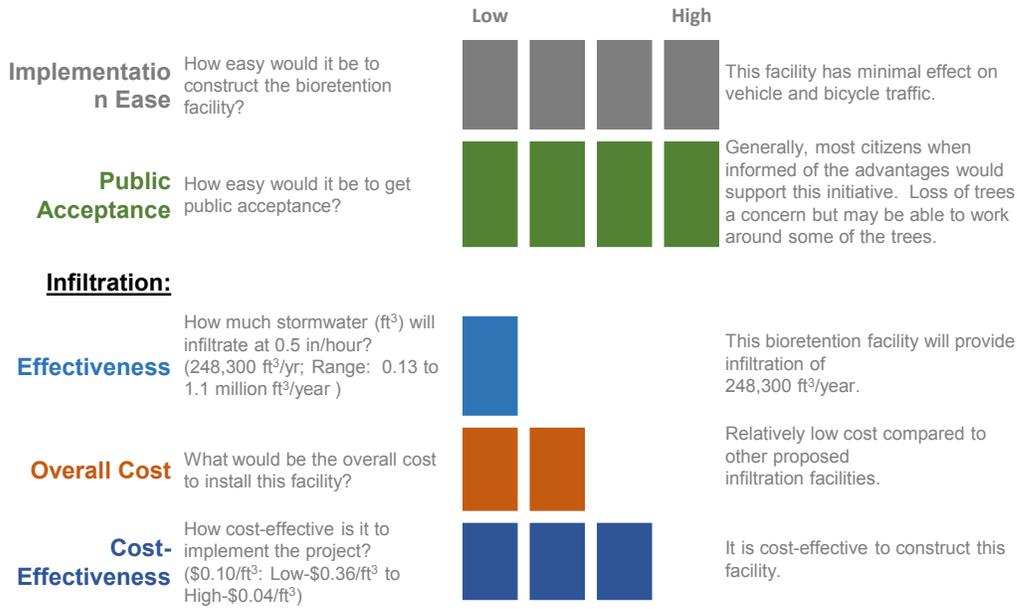
Reconstruction of Monroe Street provides an opportunity to incorporate green features (bioretention, porous pavement) within the street right-of-way. Narrow right-of-way limits the opportunities.



Example of street reconstruction with green features

Project Based Measures Infiltration

Devolis Park Bioretention Facility

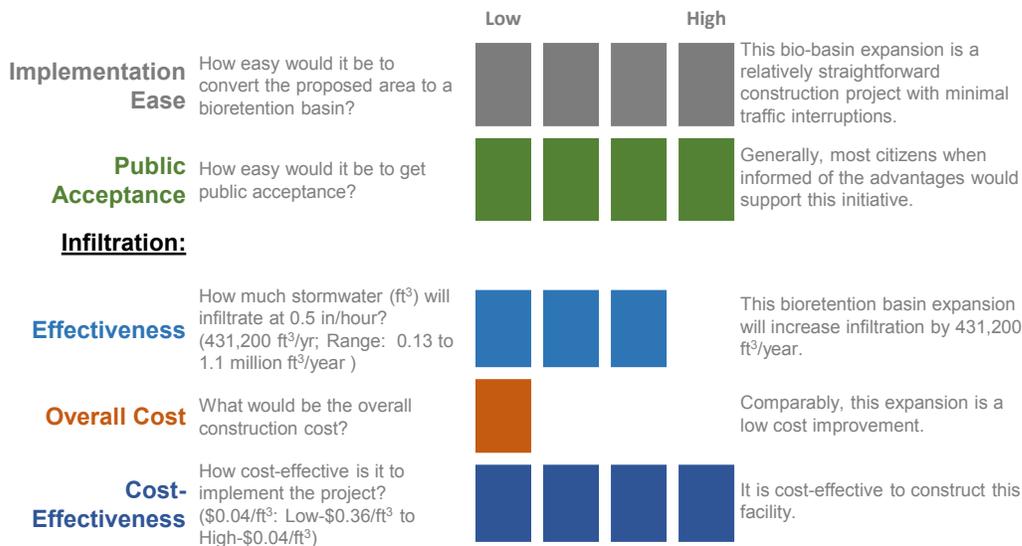


Located outside of the surface watershed but inside the groundwater watershed, this proposed facility would consist of a 115-foot by 115-foot bioretention basin. It would provide valuable stormwater for recharge of the groundwater aquifer and spring flow. Other than street sweeping and sumps, this 11-acre watershed currently discharges untreated stormwater to the storm sewer system. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



East side of Devolis Park

Westmorland Park Bioretention Basin



Eighty-six acres of this 159-acre watershed currently discharge to an existing bioretention basin in Westmorland Park. This depressional area presents an opportunity to expand the facility. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



Westmorland Park-General location of existing bioretention basin.

Phosphorus Reduction Initiatives

Management Based — Non-Structural BMPs

- Modified leaf collection methods
- Modified street sweeping
- Wetland harvesting
- Waterfowl management

Enforcement Based — Non-Structural BMPs

- Construction site erosion
- Pet waste

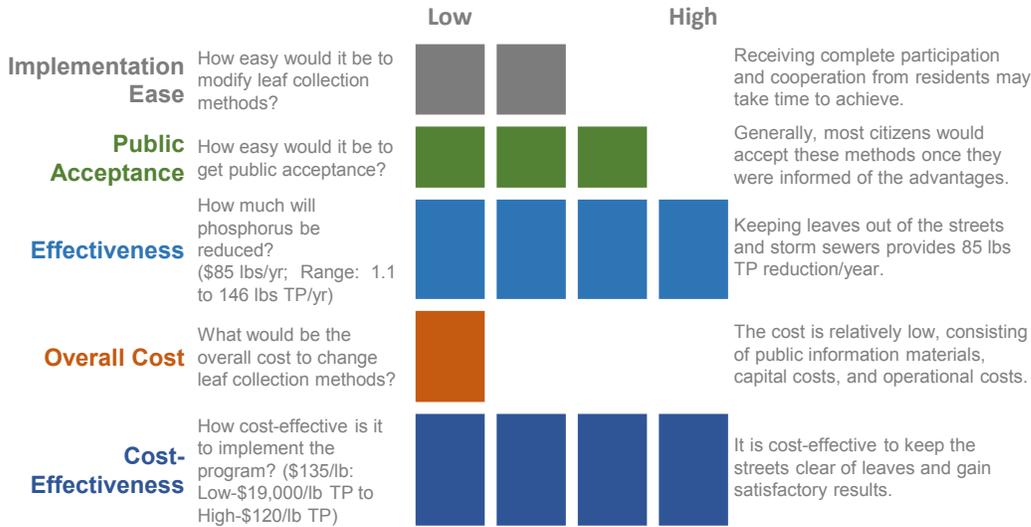
Basin Based — Structural BMPs

- Constructing basins
- Alum treatment
- Streambank restoration

Management Based Measures

Phosphorus Reduction

Modified Leaf Collection Methods

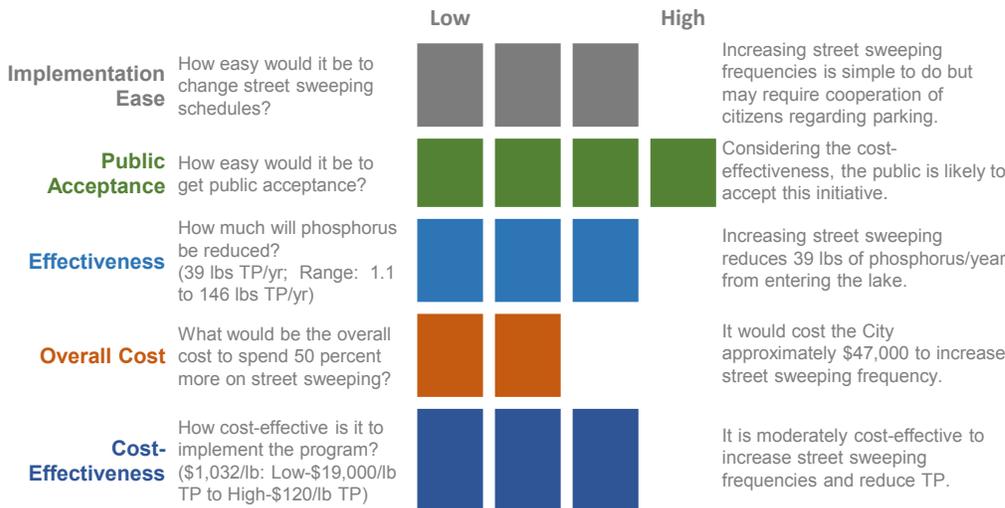


The City of Madison and Friends of Lake Wingra, as part of the Wingra Watershed Plan, are performing a Leaf Collection Pilot Project north of the Odana Golf Course in 2014 and 2015. In 2014, this pilot project sought to improve both the notification of and management of leaves by residents. In 2015, the pilot project will further improve notification of residents and provide bags for bagging of leaves. Both initiatives are intended to improve leaf collection methods and reduce phosphorus loads to the lake with the potential to expand the pilot to a larger area.



Fall Leaf Collection using compostable paper bags

Modified Street Sweeping Methods/Schedule



Studies show that targeted street sweeping can provide significant phosphorus load reductions in consideration of the following.

- Phosphorus-laden pollen/buds in the spring.
- Higher phosphorus loads in commercial/business areas.
- Timing of street sweeping considering weather.
- Fall sweeping alongside leaf collection.

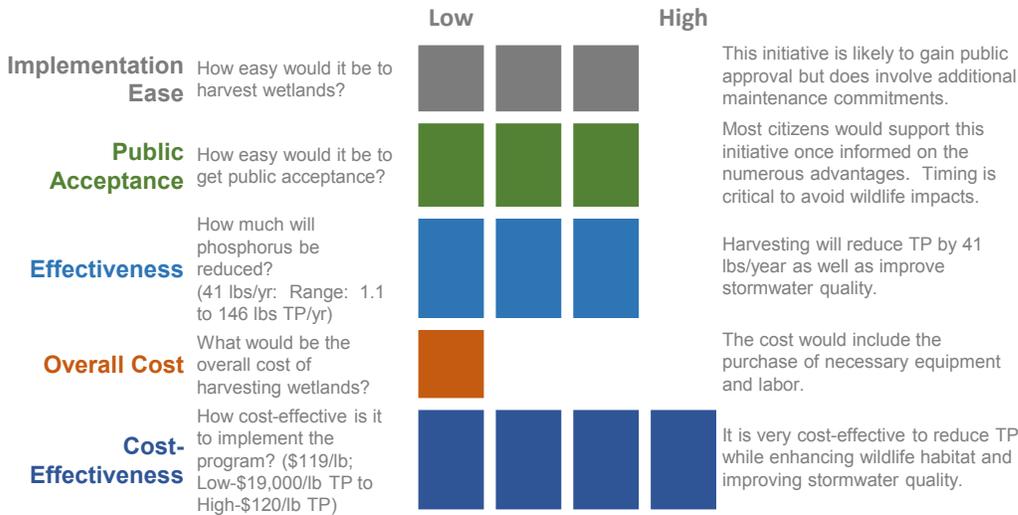
Enhancing current street sweeping efforts is a cost-effective means of decreasing phosphorus loads to the lake.



Street Sweeper

Management Based Measures Phosphorus Reduction

Wetland Harvesting



Wetlands clean stormwater, provide green space in an urban environment, and provide wildlife habitat. The accumulation of phosphorus in the wetland soils occurs as the wetland cleanses stormwater. Some of this phosphorus is taken up by wetland plants, which provides an opportunity to lower the level of phosphorus in the soil by "mining down" soil phosphorus levels through harvesting the plants. Harvested plants could be beneficially reused by a biomass aggregator (e.g.: Virent, Inc.) or other end user.

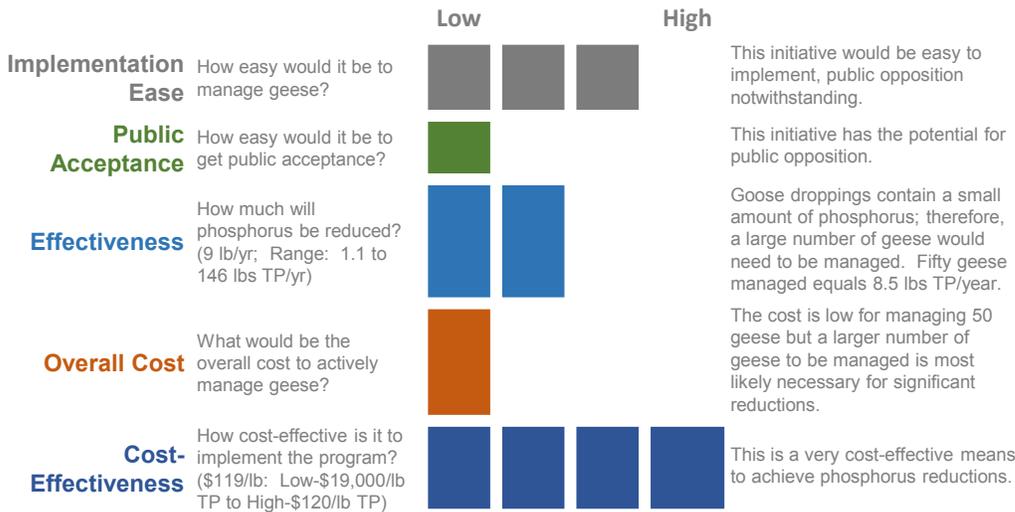
This initiative proposes to harvest 20 percent (4.6 acres) of the 23 acres of wetlands that surround Lake Wingra.



Canadian researcher Richard Grosshans built this cattail harvester that's towed by an 8-wheel Argo amphibious vehicle.

Cattail Harvester

Waterfowl Management



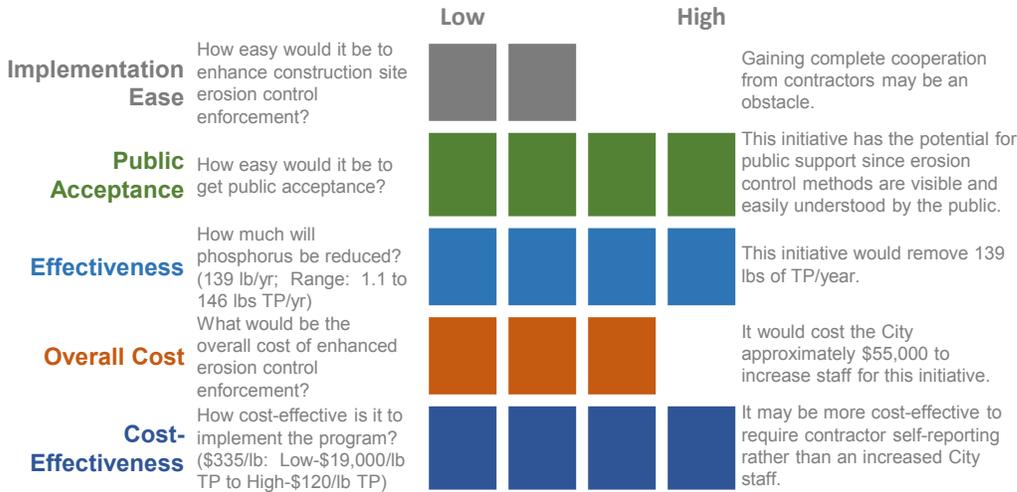
Active management of geese or other waterfowl is an effective strategy to remove what might be considered a nuisance, to reduce bacteria levels near beaches, and to reduce phosphorus loads to the lake. The City of Madison actively managed 200 geese in the summer of 2011 with some level of public opposition. One measure being considered is to actively manage up to 50 geese per year in the Wingra Watershed.



Geese along the shore of Lake Wingra

Enforcement Based Measures Phosphorus Reduction

Construction Site Erosion Control Enforcement



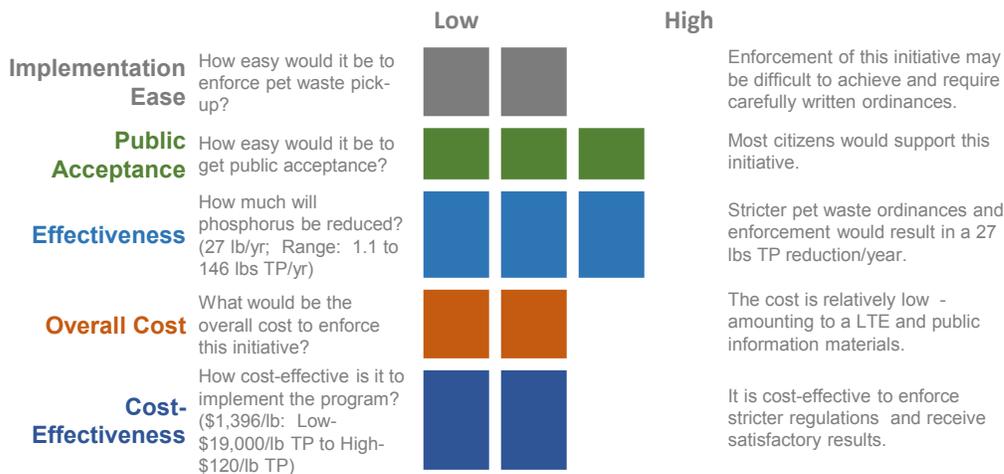
Significant amounts of sediment and phosphorus are released from construction sites when erosion control provisions are not properly installed and maintained. From 2009 to 2013, an average 12.3 acres were disturbed on construction sites in the Wingra Watershed.

In 2014, the City of Madison piloted an enhanced compliance monitoring program in areas of the City draining to the Yahara River through a 2013 MMMSD Yahara WINs grant, including lands in the Wingra Watershed. Under this initiative, the pilot would be implemented and expanded specifically in the Wingra Watershed.



Inlet protection prevents sediment from entering the storm sewer system.

Pet Waste Enforcement



Although our citizens already do a very good job of collecting pet waste in the watershed, even further reduction could be seen through increased regulation/enforcement or improved access to pet waste disposal locations in popular dog walking areas. A stricter ordinance combined with better education, a convenient way to dispose of the waste, and enforcement could reduce phosphorus loadings significantly.

A social marketing campaign whereby public behaviors are changed may provide better cost-effectiveness than hiring enforcement staff.



Example Pet Waste Signage

Basin Based Initiatives Phosphorus Reduction

Alum Addition to Marion Dunn and Manitou Ponds

Marion-Dunn Pond:

		Low	High	
Implementation Ease	How easy would it be to implement alum additions to these three ponds?			Alum additions would require minor construction and pilot projects before it can be implemented in Lake Wingra.
Public Acceptance	How easy would it be to get public acceptance?			Most citizens, once informed of the advantages, would support this treatment.
Effectiveness	How much will phosphorus be reduced? (65 lb/yr; Range: 1.1 to 146 lbs TP/yr)			Alum treatment removes large levels of phosphorus, as well as bacteria and dissolved and suspended solids.
Overall Cost	What would be the overall cost of the alum treatment?			Alum treatment can be costly, including the construction of an alum dosing facility for each pond.
Cost-Effectiveness	How cost-effective is it to implement the project? (\$557/lb: Low-\$19,000/lb TP to High-\$120/lb TP)			Even with a higher cost, alum treatment is cost-effective when looking at long-term benefits.

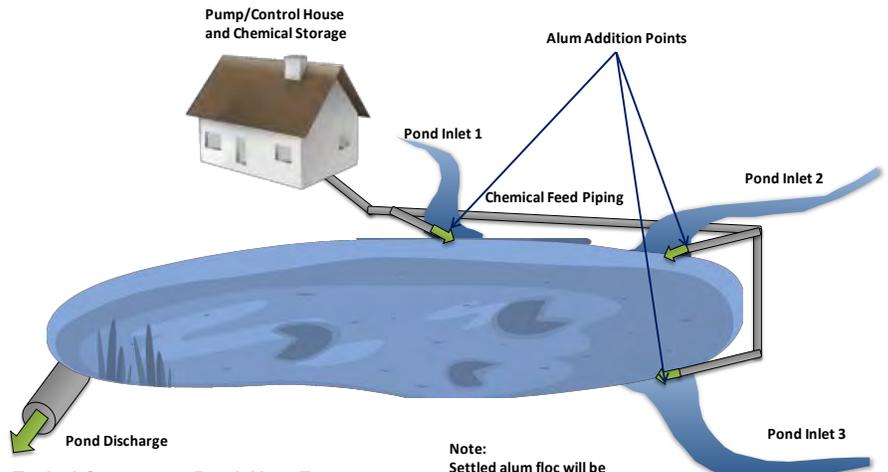
The City of Madison is currently undertaking the Marion-Dunn Pond Alum Treatment Pilot Project. Alum is a coagulant often used for coagulation, flocculation, and settling in drinking water and wastewater treatment processes. Alum treatment of stormwater has been used in Florida at over 60 locations. This method of treatment enhances a wet detention basin's ability to remove phosphorus.



Manitou Pond:

		Low	High	
Implementation Ease	How easy would it be to implement alum additions to these two ponds?			Alum additions would require minor construction and pilot projects before it can be implemented in Lake Wingra.
Public Acceptance	How easy would it be to get public acceptance?			Most citizens, once informed of the advantages, would support this treatment.
Effectiveness	How much will phosphorus be reduced? (139 lb/yr; Range: 1.1 to 146 lbs TP/yr)			Alum treatment removes large levels of phosphorus, as well as bacteria and dissolved and suspended solids.
Overall Cost	What would be the overall cost of the alum treatment?			Alum treatment can be costly, including the construction of an alum dosing facility for each pond.
Cost-Effectiveness	How cost-effective is it to implement the project? (\$293/lb: Low-\$19,000/lb TP to High-\$120/lb TP)			Even with a higher cost, alum treatment is cost-effective when looking at long-term benefits.

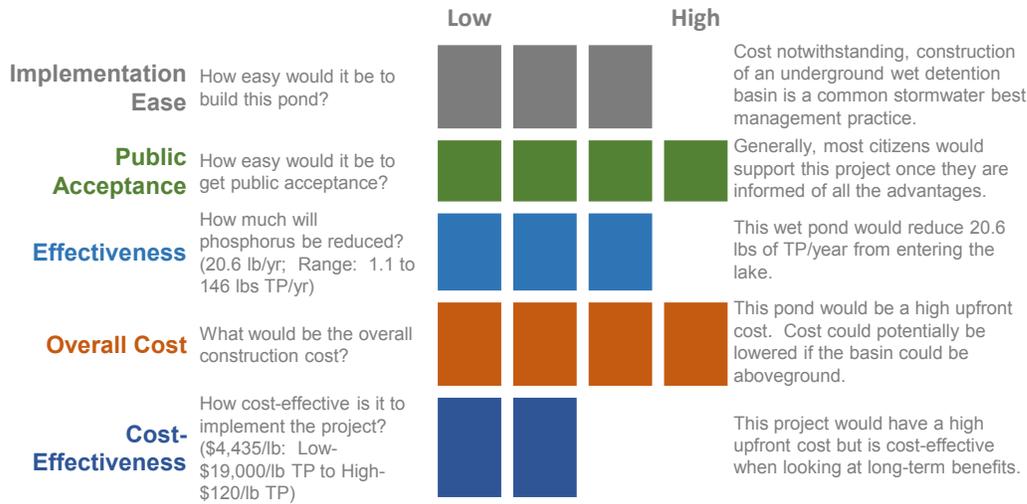
City of Madison's Alum Treatment Pilot Project Marion-Dunn Pond



Typical Stormwater Pond Alum Treatment.

Basin Based Initiatives Phosphorus Reduction

Wingra Park Wet Pond

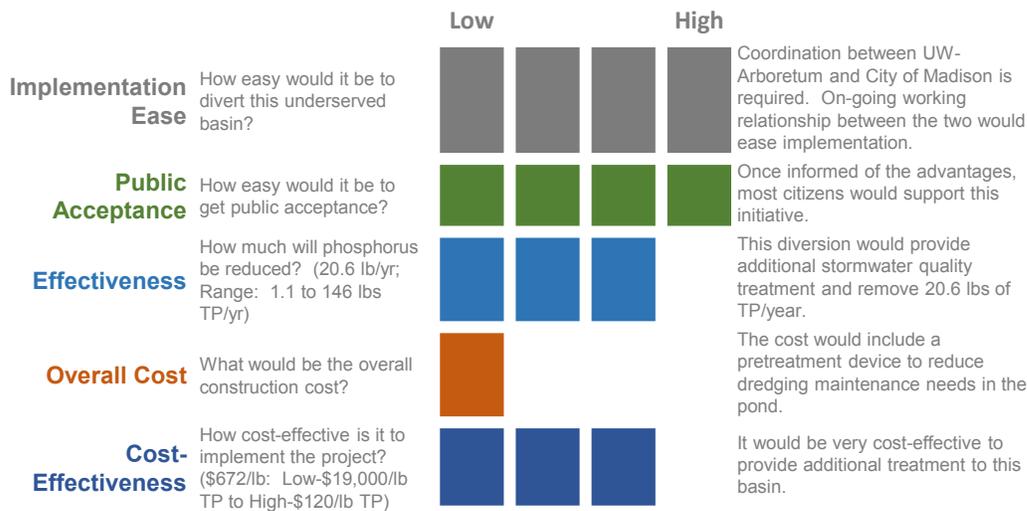


Other than street sweeping and sumps, this 112.5-acre watershed currently discharges untreated stormwater to Lake Wingra. The opportunity exists to provide an underground wet detention basin in the park treating up to a 2-year storm event. Being an underground basin, it will not be visible in the park but will provide valuable stormwater treatment prior to discharge to the lake. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.



Open area in Wingra Park.

Diversion of Basin to Manitou Pond



Other than street sweeping and sumps, this 121-acre watershed currently discharges untreated stormwater to the UW-Madison Arboretum and Lake Wingra. With the construction of the Manitou Pond and Channel Restoration in 2011, the opportunity exists to divert low flows from this watershed to Manitou Pond for treatment. This would entail installing a diversion structure, a stormwater pretreatment device, and diversion pipe to divert flows. Flows larger than a 2-year storm event would continue to discharge along the channel on the north side of Nakoma Golf Course. Opportunities for funding include the Dane County's Urban Water Quality grant program and the WDNR's Urban Nonpoint Source grant program.

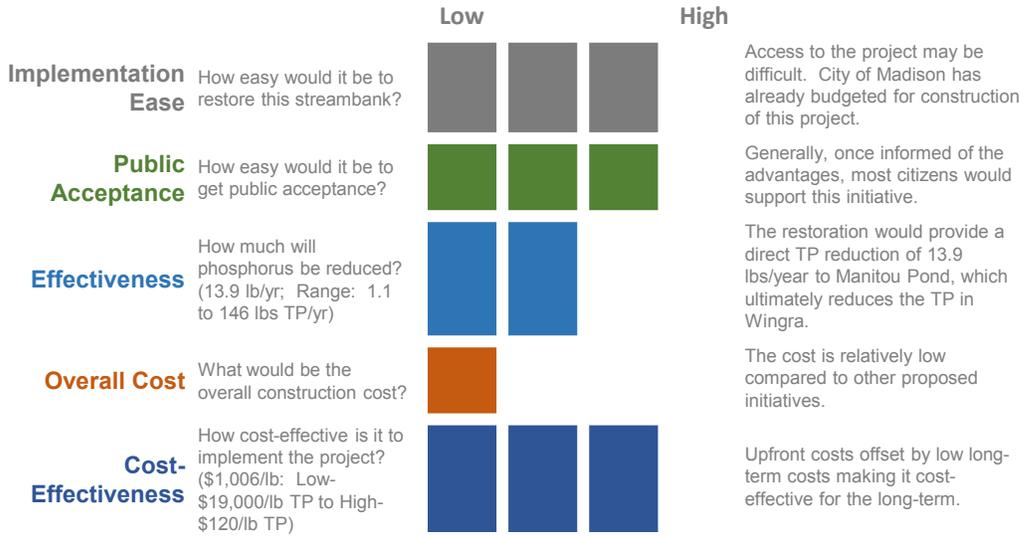


Manitou Pond constructed in 2011.

Basin Based Initiatives

Phosphorus Reduction

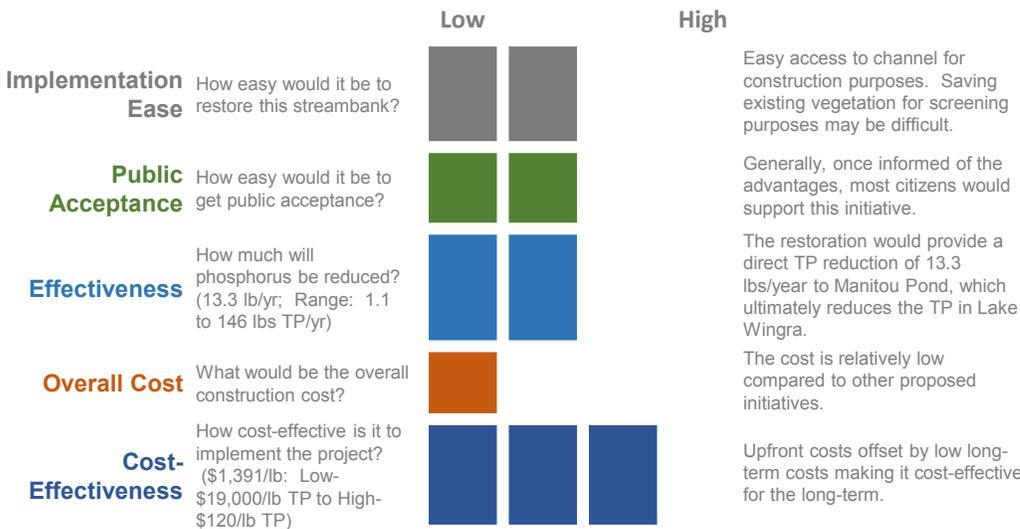
Streambank Restoration at Henry David Thoreau School



Streambank erosion along Cherokee Drive (Thoreau Elementary School Property)

Length of Streambank Restored = 850 lf
 TP Reduction = 13.9 lbs
 Eroding streambanks would be stabilized and restored with native vegetation and hard armoring, as appropriate.

Streambank Restoration on Cherokee Drive



Streambank erosion along Cherokee Drive (Yuma Drive to Chippewa Drive)

Length of Streambank Restored = 1,080 lf
 TP Reduction = 13.3 lbs
 Eroding streambanks would be stabilized and restored with native vegetation and hard armoring, as appropriate.



Restored Stream Channel downstream of Manitou Pond

Appendix F1
Wingra Watershed Plan
Public Involvement Meetings (PIMs) Comments-Strand Response
10/20/15

3/26/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
Chlorides	<p>1. Residential Salt Reduction</p> <ul style="list-style-type: none"> Advertising on salt containers is deceptive. (Should there be regulations on that?) What does governance mean? Responding to constituent complaints, or doing what is right for the City Salt burns dog's feet <p>2. Certification for Commercial Salt Applicators</p> <ul style="list-style-type: none"> Certification is good and should be required, not voluntary. There should be maximum salt application rates (how to enforce?). New Hampshire tried to enact certification/maximum rates, and the bill provided immunity to certified winter maintenance contractors. The bill did not pass, but the concepts were good. Property management companies might be able to circumvent the certification requirements since they are just maintaining their own properties. <p>3. Required certification for Winter Maintenance Contractors working on Government Properties</p> <ul style="list-style-type: none"> (Note: on city streets contractors only plow, they do not place materials). A pilot program would be good. By doing the pilot program, success could be documented and used to build support for broader implementation. Certified contractors should have different performance standards. Instead of (or in addition to) clearing pavements, there should be a stewardship ethos. <p>4. Reduce the number of salt applications per event</p> <ul style="list-style-type: none"> There should be a date limit on when salt can be applied - for instance no salt after March 1. Need more public announcements/information to moderate driver expectations. Education is key. When complaints are made regarding snow removal, there should be follow-up with information regarding how salt affects our lakes and subsurface waters. <p>5. Alternate De-Icers</p> <ul style="list-style-type: none"> Before there is a discussion, should differentiate between biological and nonbiological deicers. When FOLW helped scope the Watershed Plan, they wanted bold action. This discussion seems a justification of existing actions. What would it take for bold action? The status quo is not OK - how can this be much more aggressive? <p>6. Maximum Salt Guidelines and Ordinances</p> <ul style="list-style-type: none"> Great idea - but how to enforce? Should consider building support first. Moves that are too aggressive maybe could be overturned by the legislature. 	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>Comment acknowledged and catalyst teams to further consider.</p> <p>Comment acknowledged and catalyst teams to further consider.</p> <p>Comment acknowledged and Catalyst Teams to further consider.</p> <p>Additional text regarding public education was incorporated in Section 5.08.</p> <p>Section 2.05 contains information regarding different deicers and differentiates between biological and nonbiological deicers. Comment acknowledged. Continued community advocacy before elected and appointed officials will help shape priorities and management measures.</p> <p>Comment acknowledged. Additional text added to Section 5.08.</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p>
Infiltration	<p>1. Porous Pavement and Infiltration</p> <ul style="list-style-type: none"> MG&E, as part of its cogeneration permit, was supposed to infiltrate 50,000,000 gallons a year. That has not been met (due to chlorides in the winter months). That requirement should still be enforced; MG&E should not get a pass. What incentive could be used for porous pavement. People that install rain gardens, porous pavement, etc. should get a credit toward it on their stormwater bill. Currently they are treated the same. 	<p>Yes</p>	<p>Comment acknowledged and discussed in Section 3-Infiltration (Sections 3.03 H. 4, 3.03 I. 3, and 3.04 B.).</p>	<p>N/A</p>	<p>N/A</p>

3/26/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
Phosphorus	1. Leaf Collection <ul style="list-style-type: none"> Why doesn't the city use leaf vacuums? What are the environmental effects of bags. Is there a method that does not require a manufactured product that consumes resources. Can covering the leaves with a tarp produce the same effects? Communication of pickup times is key. 	Yes	Comment discussed in Section 4-Phosphorus (Sections 4.04 B. 5.).	N/A	N/A
	2. Street Sweeping <ul style="list-style-type: none"> Winter parking regulations should be in effect all year to support the street sweeping effort (note - city supports - it's part of the clean streets program). Enact winter parking restrictions year-round in areas where there are not ponds. 	Yes	Comment discussed in Section 4-Phosphorus (4.04 B. 6.).	N/A	N/A
	3. Wetland Harvesting <ul style="list-style-type: none"> Great idea - wetlands can be a source of phosphorus. We have UW here, what if we tried floating eco-islands that collect phosphorus and then harvested the islands? What happens to the harvested wetland materials? 	Yes	Comment acknowledged and Catalyst Teams to further consider.	Alternative 5	N/A
	4. Alum Treatment <ul style="list-style-type: none"> What problems will it cause, introducing a chemical into a natural system. It's a proven technology that's been around for quite a while. Florida uses it extensively. Where does the dredged sediment go that has the alum (Dane County Landfill). 	Yes	Comment acknowledged and Catalyst Teams to further consider.	Alternatives 2 and 3	N/A
	5. Wet Ponds <ul style="list-style-type: none"> It's one thing to build them, but then the city has to commit to maintaining them. 	Yes	Comment acknowledged and Catalyst Teams to further consider.	N/A	N/A
	6. Diversion of Basin to Manitou Pond <ul style="list-style-type: none"> Could stormwater utility funds be used for this measure? 	Yes	Comment acknowledged and Catalyst Teams to further consider.	N/A	N/A

6/24/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
General	1. General <ul style="list-style-type: none"> Is the City working with the County on this plan? Seems like the County has its own phosphorus goals. How much of the sand mixture that Madison uses is salt? One resident said her biggest concern is infiltration because of the upcoming Monroe Street reconstruction project and redevelopments along the corridor. 	Yes	Note: The Catalyst groups set up in a manner so as to foster interaction with County.	N/A	N/A
	2. Strand Draft Report <ul style="list-style-type: none"> In report and during presentation to City, provide a more-comprehensive statement of need that sets the stage for efforts in the watershed. FOLW's Vision for the Future does a nice and comprehensive job of this. 	No	Strand will expand on statement of need in Section 1-Introduction while referencing FOLW document. Strand will also provide an executive summary that also highlights the need.	N/A	N/A
	3. Watershed Sustainability Audit/BMP Synergy/Rallying of Residents <ul style="list-style-type: none"> Much like an energy audit conducted by MG&E, one social marketing strategy could be sending out letters offering volunteers/block leaders to perform watershed sustainability audits at residential or commercial properties. These audits would document things being done and things that could be done and possible incentives for their implementation. 	Yes	Created Section 5.11 to discuss these ideas.	N/A	N/A

6/24/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
	<ul style="list-style-type: none"> This effort would explain and promote the positive synergistic effect on Lake Wingra of multiple practices on-site as well as throughout the watershed. It would also connect their own source area controls to positive effect at Lake Wingra. MLS Listings-It was suggested that MLS listings in the City should include what watershed the home is in as well as the closest watershed-related advocacy group. Greg thought that this information exists or could be added to the assessor's database. Watershed Competitions-It was suggested that the various major watersheds in the City (Greg thought there was probably 10 of them) could annually compete in a competition of some sort to highlight watershed issues and accomplishments. Perhaps this could be done in combination with the Clean Lakes Alliance activities. 				
Chlorides	<ol style="list-style-type: none"> Chlorides and Infiltration <ul style="list-style-type: none"> It was discussed that the interrelationship between chlorides and infiltration should be further developed and explained. Maximum Salt Guidelines and Ordinances <ul style="list-style-type: none"> It was discussed that the City didn't have the authority to do so but that the County might. This should be confirmed. Maximum Salt Guidelines and Ordinances <ul style="list-style-type: none"> It was discussed that the City didn't have the authority to do so but that the County might. This should be confirmed. 	<p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>The interrelationship between chlorides and infiltration is discussed in Sections 2.02 A. and 2.03 D.</p> <p>Comment acknowledged and Catalyst Teams to further consider.</p> <p>Comment acknowledged and Catalyst Teams to further consider.</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>
Infiltration	<ol style="list-style-type: none"> Porous Pavement <ul style="list-style-type: none"> One possible location for porous pavement is at the southern end of the Odana Hills Golf Course Parking lot (approximately one-half acre). Other prime locations are at parks and locations of overflow parking. The City should develop a porous pavement program/strategy that incentivizes incorporation of porous pavement in redevelopment projects. Rain Barrels <ul style="list-style-type: none"> One resident said that she just lets her rain barrel drain out because her system was too complex. Terrace Rain Gardens <ul style="list-style-type: none"> Promotion-It was discussed that the City should improve its promotion of terrace rain gardens to residents, rather than only disseminating information regarding them. This could be a good social marketing strategy whereby neighborhood block leaders could canvas neighborhoods that are slated for street reconstruction. This year, the City prepared a map showing terraces that are conducive to terrace rain gardens to go along with its informational letter. The City could prepare this map for each street reconstruction project moving forward to assist block leaders in canvassing efforts. In general, it was thought that the City should be more persuasive/convincing in signing up residents for terrace rain gardens. It was suggested that all homes with feasible locations of rain gardens be required to have one such that a homeowner would have to opt-out in order to not have one. Because terrace rain gardens require homeowner maintenance, a revised promotion strategy should consider the possibility of maintenance not being completed by residents that have not fully bought in to having a terrace rain garden. Greg said that his department could determine the number of streets up for reconstruction in the next 20 years, when he was asked. The following timeline was also discussed. <ul style="list-style-type: none"> Hold PIM for Street Reconstruction Project. Send out flyer after PIM, inviting residents in the reconstruction area to a Neighborhood Association meeting where the City of Madison will present on Terrace Rain Gardens in more detail. Block leaders canvas the reconstruction area promoting terrace rain gardens. Incentive Program-The City's Terrace Rain Garden program currently requires 25% (up to \$400) of the cost to be paid by the resident and the City pays the remaining 75%. In 2015, the \$400 has been reduced to \$100 resident contribution. Ash Tree Removal-Removal of ash trees in City terraces creates additional opportunities for terrace rain gardens. Redevelopment/Street Reconstruction Standards 	<p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>Comment is discussed in Section 3-Infiltration (3.03 I. 3.).</p> <p>Comment acknowledged and Catalyst Team to further consider.</p> <p>Comment acknowledged and discussed in Section 3-Infiltration (3.03 I. 2.).</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>

7/14/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
	<p>3. Establishing Maximum Salt Guidelines</p> <ul style="list-style-type: none"> Perhaps consider the chloride contribution of salt storage facilities. Sometimes there is runoff from salt piles. Guideline could consider being variable according to season - e.g., late winter/early spring would have more stringent guidelines because the melt off is likely to be sooner. Others countered that sometimes the worst ice conditions come late in the season - e.g., freezing rain. Guidelines based on conditions would be a better measure. We should just adopt Minnesota's guidelines now and stop talking about it. <p>4. Establishing Maximum Salt Ordinance</p> <ul style="list-style-type: none"> Questionable as to whether the City has the legal authority to do it. The county may be able to implement. Salt ordinances need to include storage and disposal guidelines. There may be a safety and tort pushback(?) In order to implement salt use ordinances, there needs to be data that supports the ordinances. Data/science based. How to enforce? Very difficult to measure salt application without sweeping a parking lot. Again, incentives and recognition may be as or more effective than ordinances. <p>5. Reduce the Number of Salt Routes</p> <ul style="list-style-type: none"> Madison drivers would need to be "educated" to lower expectations. There could be two tiers of salted routes, with one tier having less salt applied. Monroe Street could be a second tier salt route. Group supported this initiative. <p>6. Use of Alternative Deicers</p> <ul style="list-style-type: none"> City should perform a pilot project on a nonstreet pavement, perhaps a parking lot. Some opposed the measure. Alternate deicers will just present currently unknown problems in the future. We just need to kick the salt habit. 	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>Potential certification and recognition program discussed in Section 5.11</p> <p>Comment acknowledged and Catalyst Teams to further consider.</p> <p>Comments acknowledged. Catalyst teams will need to explore legal authority for ordinances further. The challenges of enforcement are briefly discussed in Section 5.08.B. A potential certification and recognition program discussed in Section 5.11</p> <p>Further public education, or norm changing, for salt use is discussed briefly in Section 5.08.C. Catalyst team would need to discuss feasibility of two-tiered salt route structure. Consideration of it added to Section 5.08.C. of the report.</p> <p>Alternate deicers are discussed in Sections 2.05, 2.08, and 5.08. Pilot projects are discussed in Section 5.02 and 5.08.</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p> <p>N/A</p>
Infiltration	<p>1. Terrace Rain Gardens</p> <ul style="list-style-type: none"> General consensus that terrace rain gardens are a good thing. Depress terraces when ash trees are removed. Ash tree removal provides synergies for expansion of the terrace rain garden program. Communication with the parks department would help expand this program. Suggestion to have City provide a 10- to 15-minute presentation at neighborhood meetings. 	<p>Yes</p>	<p>Comment is discussed in Section 3-Infiltration (3.03 l. 2.).</p>	<p>N/A</p>	<p>N/A</p>
Phosphorus	<p>1. Leaf Collection</p> <ul style="list-style-type: none"> Suggestion to return to previous system with regularly scheduled leaf pickup. Suggestion to use a vacuum system to better collect leaves with less disturbance to terraces. Suggestion to have City shred leaves on-site for homeowner to reuse on-site. Suggestion to have City or others provide on-site management training for leaf collection and yard BMPs. Suggestion to inform public of the significant cost of leaf collection and that on-site management of leaves at a homeowner's property can reduce those costs. <p>2. Street Sweeper</p> <ul style="list-style-type: none"> Suggestion to have drivers go slower. <p>3. Wetland Harvesting</p> <ul style="list-style-type: none"> Sensitivity to the timing of the harvesting regarding wildlife impacts is necessary. Align harvesting with invasive species control. 	<p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>Comment acknowledged and Catalyst Teams to further consider.</p> <p>Comment acknowledged and Catalyst Teams to further consider.</p> <p>Comment is discussed in Section 4-Phosphorus (4.04 B. 8.).</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>	<p>N/A</p> <p>N/A</p> <p>N/A</p>

7/14/15 Meeting	Comment	Catalyst Team Address	Strand Report Address/How?	Supportive of TP Alternative #	Non-supportive of TP Alternative #
	<ul style="list-style-type: none"> Align program with harvestable buffer program regarding end-use of materials. Potential to feed a biodigester. 				
	<p>4. Waterfowl Management</p> <ul style="list-style-type: none"> There are too many geese. Use of actively managed geese at food pantries/soup kitchens needs to consider bioaccumulation of heavy metals in urban geese. Suggested egg oiling as a less controversial method of waterfowl control. 	Yes	Comment acknowledged and Catalyst Teams to further consider.	N/A	N/A
	<p>5. Erosion Control</p> <ul style="list-style-type: none"> Promote and provide better details on the City's hotline for reporting erosion control concerns. 	Yes	Comment acknowledged and Catalyst Teams to further consider.	N/A	N/A
	<p>6. Pet Waste</p> <ul style="list-style-type: none"> Environmental concern with bagging of pet waste (i.e., bag and waste, not just waste). Concerns regarding logistics of flushing pet waste down the toilet. 	Yes	Comment is discussed in Section 4-Phosphorus (4.04 B. 7.).	N/A	N/A
	<p>7. Wet Detention Basins</p> <ul style="list-style-type: none"> Comment that these were the most cost-effective in reducing phosphorus. 	Yes	Comment acknowledged and Catalyst Teams to further consider.	Alternatives 1, 3, and 5	N/A
	<p>8. Alum Treatment</p> <ul style="list-style-type: none"> At the Marion-Dunn alum treatment pilot project, a slight sulfur smell was reported but also less scum on the pond. One attendee said that alum usage is a good idea. 	Yes	Comment acknowledged and Catalyst Teams to further consider.	Alternatives 2 and 3	N/A
	<p>9. Streambank Restoration</p> <ul style="list-style-type: none"> Suggestion to implement Regenerative Stormwater Conveyance (RSC) concepts similar to the City of Madison's recent project in Owen Park. This is a relatively new stormwater management concept consisting of a step pool conveyance system incorporating specially designed media (i.e., wood chips and sand) focused on nutrient removal. Glenwood Park–Streambanks in this park are in need of restoration. Consensus is needed on restoration technique. 	Yes	Comment is discussed in Section 4-Phosphorus (4.04 B. 3.).	Alternatives 1, 3, and 5.	N/A

Appendix F2
Strand Responses to Comments on the Draft Final Report (DRAFT)
Lake Wingra Watershed Management Plan
10/20/15

Within this document are Strand responses to Perry Sandstrom, Jim Baumann, and David Liebl comments on Strand's 6/5/15 Lake Wingra Watershed Management Plan (Draft Final).

Perry Sandstrom (8/24/15 email)

"Hi David,

Thanks for the reminder!

One of the reasons I contacted the city was as public input to this report. I was concerned that there didn't seem to be any mention of the SW path at all, and it was not noted on any of the maps (e.g. 2.03.02) showing salt routes and bike paths. I thought it a good opportunity to bring up the fact that the plan (and first decade of operations) for the path had NO salt being used.

See item #8 here:

<http://www.dmna.org/1999lettermayor>

In initial years they used a rotary brush, which worked great. Then they switched to the Zamboni-like plows and a habit of going over and over it with every flurry. Then about five years ago, they started putting uncontrolled and undocumented amounts of plain *rock salt* on the path, sometimes up and down the entire length of it. A ~200 year old white oak right below a low spot on the path was an immediate casualty of this change. The summer before it died, it was completely healthy and hosted a colony of tree frogs as it had for countless years prior to that.

The excessive plowing and consequent "need" for salting began about the same time they decided to put high-glare overhead lights in.

I will review that report again about salt- thanks!

-Perry"

Strand Response: City will discuss and address internally with the Parks Department.

Comments on Draft Final "Lake Wingra Watershed Management Plan - Jim Baumann (September 4, 2015)

1. Possible Management Change Tables

More than any other item in the draft plan, I've received comments on the inconsistencies and lack of discussion on the proposed management changes tables, 2.08-1, 3.06-1 and 4.06-1. I concur. Specifically:

- Table 2.08-1 has a column on "potential effectiveness" while tables 3.06-1 and 4.06-1 have "implementation priority".
 - *Strand Response: See text in below paragraphs which provide measures that address these comments. Alternately, these tables could be eliminated from the report if there is concern that they only convey a qualitative assessment.*

- There are no criteria for rating “potential effectiveness” or “implementation priority” offered in the plan. It appears the ratings are arbitrary.
 - **Strand Response:** *These ratings are qualitatively based to assist the reader understand their priority during implementation. Propose to have the following columns in each table (Table 2.08-1, Table 3.06-1, and Table 4.06-1): Implementation Feasibility, Potential Effectiveness, and Implementation Priority to make each of these tables consistent. Also, the following paragraphs will be modified to read as follows.*
 - *Section 2.08 (3rd and 4th Paragraph): “Table 2.08-1 describes potential additional management measures that could be implemented to achieve the necessary salt application reductions to achieve the targeted chloride concentration in Lake Wingra. The table also rates their implementation feasibility and potential effectiveness in reducing Lake Wingra chlorides. Implementation feasibility is a qualitative assessment based on interviews with City Department managers, commercial applicators, and property owners. Potential effectiveness also is a qualitatively assessment based on anticipated participation levels and the actual salt contribution the targeted audience. For example, “Establish Maximum Salt Guidelines” was given a “low” rating in potential effectiveness because it was anticipated that fewer than 25 percent of commercial applicators would participate and they are just guidelines. Yet “Establish Maximum Salt Application Rates by Ordinance” was given a “medium” rating because a law is more likely to garner participation.*

A third column is provided for implementation priority and is left blank. Catalyst teams (See Section 5) can determine the priority of the potential measures. The management changes could be implemented in any order, yet if the target chloride concentrations to be achieved, it is likely that multiple or most measures will need to be implemented. Any combination that provides significant reductions in commercial and municipal application rates will help lower chloride inputs to Lake Wingra.”

- *Section 3.06: “Table 3.06-1 describes potential management measures that could be implemented to achieve the short-term infiltration goal in the Lake Wingra watershed. The table also rates their implementation feasibility, potential effectiveness, and implementation priority. These ratings are a qualitative assessment to an understanding of potential prioritization. As can be seen, each of these measures rank high for each category. Table 3.03-11 shows the necessary projects to meet the short-term infiltration goal. Each of the measures identified in Table 3.06-1 will be necessary to implement the corresponding facilities shown in Table 3.03-11.”*
- *Section 4.06: “Similar to management measures described in Section 3.06 for meeting the short-term infiltration goal, Table 4.06-1 describes potential management measures that could be implemented to achieve the short-term phosphorus reduction goal in the Lake Wingra watershed. The table also rates their implementation feasibility, potential effectiveness, and implementation priority. These ratings are a qualitative assessment to help provide an understanding of potential prioritization. Table 4.04-10 describes the five alternatives considered for meeting the short-term phosphorus reduction goal. Management changes from Table 4.06-1 necessary to implement the recommended alternative should be given the highest priorities.”*

- There is no discussion of the ratings in the text.
 - **Strand Response:** *See text in above paragraph.*
- For chlorides, it is difficult to agree with a “low” rating for establishing salt guidelines and implementing certificate programs. With the exception of establishing maximum salt application rates by ordinance, the only management measures rated medium or high relate to municipal use of deicers. It would seem that certification programs might be necessary to adequately implement an ordinance. There are many examples of ordinances being passed and never implemented due to a lack of an implementation program.
 - **Strand Response:** *In Table 2.08-1, we will change the Feasibility rating for Establish Maximum Salt Application Rates By Ordinance from “Low” to “Medium.” Note that even with an ordinance, enforcement of that ordinance presents a formidable challenge. It would be difficult to accurately assess compliance without sweeping and measuring a recently salted surface and weighing the sweepings.*
- The first sentence in section 4.06 appears to be an incomplete thought and should be clarified. For example, is the intent for the same ratings in table 3.06-1 to apply for phosphorus as well as for infiltration? The sentence only refers to listing of management measures and not their rating.
 - **Strand Response:** *See Section 4.06 text modifications in paragraphs above.*
- I don’t see how fully complying with the city’s state mandated construction site erosion control ordinance is a low implementation priority.
 - **Strand Response:** *We will add a High Implementation Priority Ranking to Table 4.06-1 for construction site erosion control.*

2. Targeting Implementation

Targeting is a key concept for effectively and efficiently implementing the watershed plan. The draft plan has good information for targeting and in some locations actually uses the words “target” or “targeting”. But overall it is difficult to quickly and clearly identify portions of the watershed or activities that should receive emphasis. Specifically:

Chlorides

- Section 2.05 D is labeled “Target Reduction Scenario” and would appear to be a relatively complete list of land use/land management locations or activities. Yet there is no description of what is included in the 67 acres of single-family residential. Obviously, this is not the entire amount of single-family residential land use in the watershed and would appear to be a relatively small percent. What is meant by “sidewalk in right of way”? There is no description of what this includes.
 - **Strand Response:** *The acreage equals the amount of impervious area in residential parcels. Similarly, sidewalk in right of way refers to sidewalks that are not on private property, but are in public right of way (Note, most sidewalk adjacent to streets are on public right of way). Note added to table.*
- Given that alleys constitute 1 acre of the watershed and 0.0% of the chloride contribution, it is difficult to see how alleys should be targeted.
 - **Strand Response:** *Correct. They are not targeted, but simply included in the calculations because they are part of the impervious surfaces in the watershed. If omitted, there probably would be requests to incorporate them in the analysis.*

- Given that bike paths constitute 14 acres of the watershed and 0.2% of the chloride contribution, it is difficult to see how bike paths should be a priority. This is especially true if the application rates of 1.0 lbs/1,000 sq ft is representative. This is much lower than the suggested 4 to 5 lbs/1,000 sq. ft.
 - *Strand Response: Correct. They are not targeted, but simply included in the calculations because they are part of the impervious surfaces in the watershed. If omitted, there probably would be requests to incorporate these pavements.*
 - *Strand will add notes to the bottom of Table 2.05-2 clarifying these issues.*

Infiltration

There is no section on targeting in the Infiltration chapter. One could or should infer that the management measures listed in section 3.05 and 3.06, for example, are to be applied in the groundwater watershed. This is not clear in these sections.

- *Strand Response: We will add the following paragraphs to the end of the 1st paragraph of Section 3.03 I.: "As shown on Figure 3.02-4, the Lake Wingra ground water watershed extends only approximately two-thirds of the way to the western bounds of the surface water watershed. For this reason, additional source-area-type BMPs (downspout disconnection program, rain barrel program, private residential rain gardens, commercial rain gardens, porous pavement, and terrace rain gardens) should be targeted for the eastern two-thirds of the surface water watershed and within the Lake Wingra ground water watershed".*

Phosphorus

This chapter has much information, such as model results and other analysis, that can and should be used for targeting. Yet, it is difficult to impossible for the reader to know which maps and tables to use.

For example, is Figure 4.03-5 the best one to use to target phosphorus control efforts? It is unclear whether this is a map that should be used. For example, the Odana Pond subwatershed has the greatest reduction from existing management practices, but also had some of the highest phosphorus yields for the "no controls" base analysis. It would appear that one would need to take the information on Table 4.03-1, apply the reductions from Table 4.03-2 and then make a map. However, it doesn't appear that the watershed descriptions match. Take, for example, the drainage area labeled WI02-C-0190-H-MAD-C. In Table 4.03-1 it is described as a drainage area with 11.6 acres and a baseline load of 8.5 pounds. In Table 4.03-2, this same area is described as having an incoming load of 1034 pounds.

One way of looking at the watershed is as follows:

- a. Commercial areas, such as those along and north of Odana and west of Segoe will remain relatively significant contributors of phosphorus given their areas and yields even after taking into account the reduction from existing practices. The same may apply to the commercial areas along the beltline. But, none of the management practices described in the plan apply well to these areas.
- b. The drainage areas listed below would seem to also be priority areas for residential management practices since there are no structural management practices in place or planned. All of these are colored red on Figure 4.03-6.

WI03-B-0321-A-MAD-C	0.8 lb/ac	Lower Monroe Street, Fox, Keyes
---------------------	-----------	---------------------------------

W103-A-0322-A-MAD-C	0.6 lb/ac	Monroe Street and north of Edgewood (possible Wingra Park pond?)
W104-U-0219-H-MAD-C	0.7 lb/ac	Vilas neighborhood
W1-02-D-0193-H-MAD-C	0.6 lb/ac	East of Nakoma

- c. All areas for street leaf management to address the soluble phosphorus component.

Strand Responses: Section 4.03 C. paragraph 2 provides the targeting verbiage requested and reads:

“Figure 4.03-5 also shows drainage basins that are underserved in terms of stormwater quality treatment, namely basins W102-D-0193-H-MAD-C, W103-B-0220-A-MAD-C, W103-A-0322-A-MAD-C, and W104-U-0219-H-MAD-C. It should be noted that the basins (W102-U-1038-A-MAD-T, W108-U-0136-A-MAD-C_NP, EARB W108-U-0136-A-MAD-C) in the UW-Madison Arboretum show little treatment; however, because of their location in the UW-Madison Arboretum, they have little pollutant load. Targeting the underserved basins for proposed stormwater controls will allow additional stormwater quality treatment to be pursued for areas in need. Figure 4.03-6 shows the same condition as Figure 4.03-5 but also shows potential projects to gain additional stormwater quality treatment for underserved basins.”

We will also add the following paragraph to the end of the 1st paragraph of Section 4.04 B.: “Potential projects to gain additional stormwater quality treatment for underserved basins are described in Section 4.03 C. and shown on Figure 4.03-6. Identification and analysis of structural improvements has targeted these areas to the extent possible. Additional non-structural-type BMPs (wetland harvesting, modified leaf collection methods, waterfowl management, enhanced construction site erosion control enforcement, modified street sweeping methods/schedule, and pet waste enforcement) should be targeted for the following basins since they currently haven’t been analyzed to be served by a structural BMP: W103-B-0321-A-MAD-C and W104-U-0219-H-MAD-C. In general, modified leaf collection methods and modified street sweeping methods/schedule that address dissolved phosphorus should target all basins.”

Note that a pond at Wingra Park (W103-A-0322-A-MAD-C) is analyzed as described in Section 4.04 B. 4. and shown in Figure 4.04-9.

Note that a diversion of flows from basin W102-D-0193-H-MAD-C is analyzed as described in Section 4.04 B. 2. and shown in Figure 4.04-5.

3. Odana Pond

See e-mail describing that the pond is clearly a water of the state and possibly a water of the US. Also Figure 4.04-4 is missing the sewer pipe from the intersection of Wedgewood Way and Milward to the pond.

Strand Response: *For some reason, the City’s GIS/CAD layer is missing the pipe from Wedgewood Way/Milward Drive intersection to Odana Pond. We will add this pipe in Figure 4.04-4, 4.04-3, and 4.03-1 and add an additional dosing location to Figure 4.04-4. We will also modify paragraph 4.04 B. 1. c. to read as follows: “Odana Pond is located on the west side of the Odana Hills Municipal Golf Course near the intersection of Whitney Way and the Beltline Highway. The pond has four inlets and one outlet. For this project, one alum dosing facility would be constructed and alum would be pumped to each of the four inlets (if deemed necessary). Figure 4.04-4 shows the vicinity of Odana Pond and the proposed dosing facility and dosing locations. It should be noted that there are two Odana Ponds, the upstream Main Odana Pond and the downstream Secondary Odana Pond. The upstream Main Odana Pond is considered a water of the state and is the pond from which water is drawn to feed the Odana Golf Course Infiltration Facility. As a water of the state, it is anticipated*

that there would be significant regulatory hurdles associated with an alum treatment facility at the upstream Main Odana Pond. Likewise, chemical dosing of water that will feed the Odana Golf Course Infiltration Facility is also a concern. For purposes of this plan, the upstream Main Odana Pond has been removed from further consideration as an alum treatment facility. However, chemical dosing of the downstream Secondary Odana Pond may still present opportunities for chemical treatment of stormwater based on the understanding that it is not a water of the state and its water isn't drawn from it for the Odana Golf Course Infiltration Facility."

4. Residential Rain Gardens

Although I like rain gardens and have three on my property, from the phosphorus perspective I question the appropriateness of 1,000 rain gardens to deal with roof runoff that reaches the storm sewer system. A more representative number is needed. I also question whether 35% of residences with downspout redirection is appropriate.

In the western portion of the watershed the properties tend to be larger and less than 25% (possibly 10%) of the houses have downspouts connected to driveways or other impervious surfaces. In most cases where there is a connection, downspout re-direction is a viable and more cost-effective management practice. One could argue that rain gardens are important from the infiltration perspective, but much of the far western portion of the watershed is not in the groundwater watershed.

It would appear that the use of rain gardens would need to be emphasized in the eastern half of the watershed and especially in the drainage areas identified in the table in comment #2. However, much of this area has smaller lots where installing an effective rain garden is not practical for many sites.

Strand Response: *As shown in Table 3.03-11, from an infiltration perspective, residential rain gardens and downspout disconnection are two of the more cost-effective measures to achieve additional infiltration in the watershed.*

As described previously above, we will add the following paragraphs to the end of the 1st paragraph of Section 3.03 I.: "As shown on Figure 3.02-4, the Lake Wingra ground water watershed extends only approximately two-thirds of the way to the western bounds of the surface water watershed. For this reason, additional source-area-type BMPs (downspout disconnection program, rain barrel program, private residential rain gardens, commercial rain gardens, porous pavement, and terrace rain gardens) should be targeted for the eastern two-thirds of the surface water watershed and within the Lake Wingra ground water watershed.

We will add the following paragraph to the end of Section 3.03 I. 1.: "It is recommended that the Infiltration and Phosphorus Catalyst Teams further investigate the assumptions used for the analysis shown in Table 3.03-13 and adjust the relative contribution of these measures toward meeting the short-term infiltration and phosphorus goals."

We will add the following paragraph to the end of Section 3.03 I. 10.: "It is recommended that the Infiltration/Phosphorus Catalyst Team further investigate the assumptions used for the analysis shown in Table 3.03-16 and adjust the relative contribution of these measures toward meeting the short-term infiltration and phosphorus goals."

5. Catalyst Teams

Since there is so much overlap between the infiltration management measures and the phosphorus management measures, consolidating the two teams into one should be considered.

Strand Response: We will add the following sentence to the end of the 1st paragraph of both Sections 5.03 and 5.04: "Because of significant overlap between infiltration and phosphorus management measures, consideration should be given to coordination between infiltration and phosphorus catalyst teams."

Comments on Draft Final Lake Wingra Watershed Management Plan – David Liebl (September 7, 2015)

1. Cover:

I know it's your standard cover...but how about an image of the watershed instead?

Strand Response: Strand will revise the front cover and include the suggested photo of Lake Wingra on the front cover.

2. Front:

Needs an executive summary, or, move 6.01-6.03 to above section 1.0.

Strand Response: Strand will provide an Executive Summary.

3. 1.01, pg.1-1:

I know you guys did most of the heavy lifting...but the City and FOLW should get top billing.

Strand Response: The first sentence of Section 1.01 will be revised to read: "This report summarizes the methods and results of the Lake Wingra Watershed Management Plan commissioned by the City of Madison (City) and the Friends of Lake Wingra (FOLW) to develop a Lake Wingra Watershed Management Plan"

4. Table 1.01-1:

Source of data?

Total P = 0.056mg/L (ppm)

Strand Response: We will add the following note to Table 1.01: "Source: 2014 State of the Lakes Annual Report, Clean Lakes Alliance"

5. Pg 1-5:

UW-Madison Arboretum Facility Stormwater Management Plan, WI-DOA/DSF and UW-Madison, July 2006

Strand Response: Change will be made.

Lake Wingra Watershed Management Plan-Storm Water, Friends of Lake Wingra, August 2003

Strand Response: This document will be added.

6. Figure 3.02-2:

Credit?

Strand Response: The following will be added in Figure 3.02-2: "Source: Groundwater Status Report Prepared for Friends of Lake Wingra, Sustainability Leadership Program, Edgewood College, Maribeth Kniffin, August 2011."

7. Fig. 3.03-12:
Credit Roger Bannerman

Strand Response: *The following will be added to Figure 3.03-12: "Source: Roger Bannerman"*

8. Fig.3.03-12:
Credit Nancy Zolidas

Strand Response: *The following will be added to Figure 3.03-14: "Source: Nancy Zolidis"*

9. Fig. 4.02-3:
Credit Mike Kakuska

Strand Response: *The following will be added to Figure 4.02-3: "Source: Mike Kakuska"*

10. Fig. 4.02-1, -2,-6:
Credit David S. Liebl

Strand Response: *Figures 4.02-1 and 4.02-2 already credit David Liebl. The following will be added to Figure 4.02-6: "Source: David Liebl"*

11. Pg 4-5 2.a. :
...carp-induced sediment re-suspension, and improved aquatic vegetation coverage.

Strand Response: *Last sentence of paragraph 4.02 C. 2. a. will be revised to read: "Lake Wingra water quality in the past five years has been noticeably improved resulting from a reduction in carp-induced sediment resuspension and improved aquatic vegetation coverage."*

12. Missing? is a short bio of the FOLW with webpage URL

Strand Response: *We will add the following short bio as Section 1.05: "The Friends of Lake Wingra was formed in 1998 with an interest in improving the health of Lake Wingra through coordinated watershed management and by engaging the watershed community in stewardship of the lake and its watershed"*

The Friends of Lake Wingra mission, vision, and goals reflects the belief that sustaining the balance of a healthy lake ecosystem requires the participation and collaboration of many citizens, agencies and organizations. FOLW's approach to watershed protection therefore involves partnerships with numerous stakeholders who live, work, and play in the Lake Wingra watershed.

The Friends of Lake Wingra's goals are in the following areas.

Citizen Stewardship—Grow present and future generations of watershed stewards.

Integrated Watershed Management—Protect and improve the 'lake as a system' through innovative and coordinated management practices.

Long-term monitoring and research—Ensure that the information needed to address the mission is available on an ongoing basis.

Organizational Capacity and Resources—Build the internal capacity to achieve the mission

Friends of Lake Wingra is currently engaged in a variety of projects aimed at improving the health of Lake Wingra. Our projects include both outreach to the watershed community and on-the-ground restoration and stewardship efforts.

The Friends of Lake Wingra could not work without the help of our friends and partners — dedicated volunteers, members, and organizations contribute essential time and labor to the preservation and protection of Lake Wingra and the Wingra Watershed

To learn more about the Friends of Lake Wingra or to get involved in one of the Friends of Lake Wingra projects, please visit the FOLW website: <http://www.lakewingra.org>

APPENDIX G
PILOT PROJECT RESULTS (*FORTHCOMING*)

For more location information
please visit www.strand.com

Office Locations

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