Appendix D
Monitoring Program

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Shingle Creek and West Mississippi Watershed Management Commissions
Third Generation Watershed Management Plan
Monitoring Program

Minnesota Rules 8410.0100 Subp. 5 states that:

> A. Each plan must establish water quality and quantity monitoring programs that are capable of producing accurate data to the extent necessary to determine whether the water quality and quantity goals of the organization are being achieved. The programs shall, at a minimum, include the location of sampling, the frequency of sampling, the proposed parameters to be measured, and the requirement of periodic analysis of the data.

The Third Generation Monitoring Program has two organizing principles: continuation of routine flow and water quality monitoring in Shingle Creek and volunteer monitoring of lake water quality; and periodic special monitoring to evaluate progress towards meeting TMDL goals.

Each year the Commissions will evaluate this proposed program and make modifications as necessary based on the most current data needs. The monitoring objectives guiding the Shingle Creek and West Mississippi monitoring program and the assessment of data are:

- To quantify the current status of streams and lakes throughout the watersheds in comparison to state water quality standards.
- To quantify changes over time, or trends, in stream and lake water quality in the watersheds.
- To quantify the effectiveness of implemented BMPs throughout the watersheds for the protection of water quality.
- To evaluate progress toward meeting TMDL load reduction and other goals.

Link to TMDLs

In each of the TMDL Implementation Plans, the Shingle Creek Commission committed to performing stream and lake monitoring to track the effectiveness of BMPs at reducing load and improving water quality. For lakes this included both CAMP monitoring and every 4-5 years more detailed lake water column profiling and aquatic vegetation surveys. The plans also included the following: “At the end of each five year period this report [the Annual Water Quality Report] will include an assessment of progress and identification of any revisions to the implementation plan.”

Table D.1 shows the dates of TMDL Implementation Plan approvals and the year of expected 5-year progress evaluation. Although Lake Success is not an Impaired Water and thus it has no TMDL, this monitoring framework assumes that it would be evaluated for conditions and trends along with the other lakes.

Because the Commissions' goals include achieving delisting of lakes that meet their TMDLs and water quality, the framework includes more rigorous lake monitoring sufficient to demonstrate to the MPCA and EPA that conditions have improved. The monitoring framework also includes activities such as aquatic vegetation monitoring to assist in the adaptive management process.

TMDL	EPA Approval	Implementation Plan Approval	5 Year Progress Review
Shingle Creek Chloride	February 12, 2007	March 5, 2007	2010, 2017
Twin and Ryan	November 9, 2007	November 13, 2007	2013, 2018
Crystal, (Success)	March 25, 2009	July 7, 2009	2014, 2019
Pomerleau, Bass, and Schmidt	September 25, 2009	December 3, 2009	2015, 2020
Meadow	March 23, 2010	June 14, 2010	2017, 2022
Cedar Island, Pike, and Eagle	April 14, 2010	May 18, 2010	2016, 2021
Magda	September 30, 2010	October 1, 2010	2017, 2022
Shingle and Bass Creeks Biotic Integrity and Dissolved Oxygen	November 4, 2011	January 30, 2012	2018, 2023
Bass Creek Chloride	Not yet started	Not yet started	

Routine Stream Flow and Water Quality Monitoring

The Commission routinely conducts continuous flow monitoring and monitors water quality data at two locations on Shingle Creek. Station SC-0, also referred to as the outlet monitoring site, is located upstream of the 45th Avenue crossing in Minneapolis, and has been monitored since 1996. SC-0 collects drainage from about 41 square miles, or approximately 92% of the watershed. The SC-3 monitoring station, also referred to as the upper monitoring site, is located where Shingle Creek crosses Brooklyn Boulevard in Brooklyn Park, just upstream from Zane Avenue. The SC-3 drainage area covers about 17 square miles which is approximately 39% of the Shingle Creek watershed. This site has been monitored since 2007. Between 1996-2006 the upper site was monitored about 1,500 feet downstream at Zane as site SC-2.

There is also a long-term USGS monitoring station on Shingle Creek at Queen Avenue near the border of Minneapolis and Brooklyn Center. This station was installed and operated as part of the USGS's National Water Quality Assessment Program (NAWQA). This site, which is SC-1 but referred to as the USGS site, drains approximately 31 square miles (70% of the watershed). The Shingle Creek WMC and USGS collected continuous flow and storm event samples at this location from 1996 through 1999. The USGS continued monitoring continuous flow at this site in 2001 and then began monitoring continuous conductivity at this site year around beginning in 2004. Real-time data is available through the USGS website (http://waterdata.usgs.gov/mn/nwis/uv?05288705).

Table D.2 sets forth the framework for stream monitoring in the Shingle Creek watershed for 2013-2022. The Commission will continue routine flow and water quality monitoring at SC-0 and SC-3 and continue to partner with the USGS to operate the USGS site. Monitored parameters may vary from year to year based on current data needs such as obtaining baseline data for upcoming new standards or collecting additional data to assist in evaluating progress towards TMDL goals. The estimated cost of this monitoring program is shown on Table D.3.

Table D.5 sets forth the framework for monitoring in the West Mississippi watershed. There is only one stream outletting into the Mississippi River, Mattson Brook. Edinbrook and Century Channels, which drain much of the central part of Brooklyn Park, flow into Mattson Brook. Mattson Brook and the storm sewer outfalls to the Mississippi River have been infrequently monitored in the past 20 years. This monitoring program proposes that Mattson Brook and outfalls be monitored on a rotating basis every three years. Future TMDLs such as the South Metro Turbidity TMDL or the Upper Mississippi Bacterial TMDL may require that program to be revised during the life of this Plan. The estimated cost of this monitoring program is shown on Table D.6.

Lakes

There are sixteen lakes in the Shingle Creek watershed, and none in West Mississippi. It should be noted that Twin Lake is comprised of three basins and is considered as three separate lakes even though it is one chain of lakes.

The Shingle Creek Watershed Management Commission has participated in the Metropolitan Council's Citizen Assisted Lake Monitoring Program (CAMP) since 1996. The program results in the bulk of lake water quality data collected by the Commission. This program is also an NPDES Phase II Education and Public Outreach BMP.

CAMP was initiated by the Met Council to supplement the water quality monitoring performed by Met Council staff and to increase our knowledge of water quality of area lakes. Volunteers in the program monitor the lakes every other week from mid-April to mid-October, approximately 14 sampling events. They measure surface water temperature and Secchi depth, and collect surface water samples that are analyzed by the Met Council for total phosphorous, total Kjeldahl nitrogen, and chlorophyll-a. The volunteers also judge the appearance of the lake, its odor, and its suitability for recreation.

Some additional data is available on the lakes as a result of special studies, including TMDLs, management plans, and monitoring by other agencies such as Three Rivers Park District. The Commission has also performed some special monitoring such as bottom sediment core analysis and aquatic vegetation surveys.

Table D.2 sets forth the framework for lake monitoring in the Shingle Creek watershed for 2013-2022. The Commission will continue participating in the Citizen Assisted Monitoring

Program (CAMP), but will supplement that data with more intensive lake monitoring performed in the year prior to performing the five-year evaluation of progress toward TMDL goals. The Commission will also more systematically obtain aquatic vegetation surveys and complete the sediment core release rate testing for the balance of the shallow lakes in the watershed. The estimated cost of this monitoring program is shown on Table D.3, and the schedule of lake monitoring is shown in Table D.4.

Biological Monitoring

The Commissions do not routinely undertake biological monitoring, but do obtain biological data by sponsoring volunteer monitoring through Hennepin County Environmental Services. High school students and their teachers monitor macroinvertebrates in streams through the River Watch program, and adult volunteers led by trained leaders monitor macroinvertebrates and vegetation in wetlands through the Wetland Health Evaluation Program (WHEP). The Commission has collected macroinvertebrate and fish data through special monitoring performed for the Shingle creek Corridor Study and for the Shingle and Bass Creeks Biota and Dissolved Oxygen TMDL.

Table D.2. Shingle Creek Watershed monitoring framework.

	Activity	Purpose	Requirement	Frequency	Comments/Standards	Cost
Streams	Water quality/quantity monitoring - 2 sites on Shingle Creek; USGS Queen Avenue	Long-term trends	Meets the standard set forth in MR 8410.0100 Subp. 5	Annually	Proposed nutrient criteria (TP, DO flux, chl-a, BOD_5)	$32,500 annually
		Stream WQ standards			NO_3, TSS, bacteria, chloride	
		Volume/rate			Volume control	
		Base flow			TMDL compliance	
	DO 72-hour diurnal survey	TMDL compliance	TMDL compliance	Every 10 years/ 2 sites	DO standards/nutrient control	$15,000
	Longitudinal dissolved oxygen survey	TMDL compliance	TMDL compliance	2x Annually	DO standards/criteria	$1,000
	Macroinvertebrate community	TMDL compliance	TMDL compliance	Every 5 years	IBI standards	$3,500
	RiverWatch volunteer stream monitoring	Education & trends	Voluntary	Annually	Educational activity	$3,000
	Fish community	TMDL compliance	TMDL compliance	Every 5 years	IBI standards	$3,000
	Emerging contaminants	Problem ID	Voluntary	As needed	New standards; sediment disposal costs; USGS partner	$500 annually
Lakes	Citizens Assisted Monitoring Program (CAMP)	Education & trends	MR 8410.0100 Subp. 5 / TMDL compliance / voluntary	Major lakes every 2 years; Minor lakes every 3 years	Lake water quality standards; Educational activities	$550/lake plus $1,400 labor
	Intensive monitoring	Add Dissolved Oxygen and Temperature; QAQC		Every 5 years	Lake water quality standards	$3,500/lake
	Chloride	Identify lakes with chloride exceedances	Voluntary	1x for baseline	Chloride standards (14 lakes)	$2,500/lake
	Internal load assessments	Quantify internal phosphorus release rates	TMDL compliance/ voluntary	One time per lake	TMDL compliance/lake management	$5,000/lake
	Vegetation surveys	Monitor trends in community change	TMDL compliance/ voluntary	Spring and Fall Every 5 years	Lake restoration (14 lakes)	$3,100/lake
	Fish surveys	Monitor Lakes not done by DNR	TMDL compliance/ voluntary	DNR schedule	Lake restoration	
Wetlands	Wetland Health Evaluation Program	Wetland health	Voluntary	Annually	Baseline wetland health	$1,000/site/year
Groundwater	Quantify County well data	Baseline for ground-water recharge/ discharge	Voluntary	As needed		
Special	Storm sewer	P8 calibration, project development	Voluntary, required for Phase I cities	As needed	Refine P8/project development, MS4 compliance	$15,000/site

Table D.3. Shingle Creek watershed monitoring program.

Note: Costs are presented in constant dollars

Activity	Resource and Site(s)	Parameters	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
STREAM MONITORING													
Routine flow and water quality monitoring	Shingle Creek: sites SC-0,SC-3	Flow, temp, pH, TP, DO, BOD_5, TKN, TSS, bacteria, chloride, specific conductance, bimonthly and storm event	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750	$28,750
Partnership with USGS at Queen Avenue NAWQA site (SC-1)	SC-1 (USGS)	Flow, temp, specific conductance	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750	$3,750
DO 72-hour Diurnal Survey	Shingle Creek: SC-1, Palmer Out, Xerxes, SC-3; Bass Cr: Bass Cr Park	Flow, temp, pH, continuous DO, conductivity, once at average flow										$15,000	
Longitudinal DO Survey	Multiple Locations on Bass and Shingle Creeks	DO (grab), temp, pH, conductivity, twice annually at high, low flows	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Macroinvertebrate Monitoring	Shingle Cr: SC-0, SC-1, Brookdale Park; Bass Cr: Bass Cr Park; Pike Creek	Macroinvertebrates, once in Aug-Sep	$3,000				$3,500					$3,500	
Fish Monitoring	Shingle Creek: SC-1, Brookdale Park, Rock Cascade; Bass Creek: Bass Cr Park	Fish community, once in Aug-Sep					$3,000					$3,000	
RiverWatch Volunteer Stream Monitoring	Shingle Creek: Varies, expected to be Webber Park, Park Center HS, Boone Avenue	Macroinvertebrates, twice in spring, fall	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
LAKE MONITORING													
Citizen Assisted Lake Monitoring Program (CAMP)	13 lakes on scheduled rotation (Table D.4)	Surface water TP, chl-a, temp, water condition observations, biweekly, Apr-Oct	$3,050	$3,600	$5,250	$3,050	$4,150	$4,700	$4,150	$2,500	$5,250	$4,700	$3,600
Intensive monitoring	13 lakes on scheduled rotation (Table D.4)	DO and temperature profiles, TP, OP, chl-a, biweekly Apr-Oct	$10,550	$7,000	$7,000	$10,500	$7,000	$10,500	$7,000	$10,500	$10,500	$7,000	$7,000
Aquatic vegetation surveys	14 lakes on scheduled rotation (Table D.4)	Aquatic vegetation, spring and fall	$6,400	$4,200	$4,200	$6,300	$4,200	$6,300	$4,200	$6,300	$6,300	$4,200	$6,300
Internal load assessments	5 lakes to complete (Table D.4)	Sediment core analyzed to determine internal phosphorus release rates		$10,000	$10,000								
Chloride baseline	8 lakes (Table D.4)	Winter chloride profile											
SPECIAL MONITORING													
Wetland Health Evaluation Program	Select wetlands around watershed	Vegetation, macroinvertebrates											
Storm sewer monitoring													
Groundwater elevation	Select wells	Groundwater elevation											
			$59,500	**$61,300**	**$62,950**	**$56,350**	**$58,350**	**$58,000**	**$51,850**	**$55,800**	**$58,550**	**$73,900**	**$53,400**

Table D.4. Shingle Creek lake monitoring schedule.

	Water Quality Monitoring											Aquatic Vegetation Survey											Sediment Core Assessment					Chloride Baseline					
Lake	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Bass		x	C	x		x		C		x				X					X											O			
Eagle		x		C		x		x	C	x					X					X						O				O			
Pike		x		C		x		x	C	x					X					X									O				
Twin Middle	C		x		x	C	x		x		x	X					X							O					O				
Ryan	x	C	x		x		C		x		x		X					X						X									
Schmidt		x	C	x		x		C		x				X					X														O
Twin Lower	C		x		x	C	x		x		x	X					X					X		X					O				
Cedar Island	x			C			x		C	x					X					X													O
Crystal		C	x		x		C		x		x		X					X													O		
Pomerleau		C						C					X						X						X								
Twin Upper	C		x		x	C	x		x		C	X					X					X											
Magda	x			x			x			x	C											X			X						O		
Meadow			x		C	x			x	C						X					X												
Success			x		C	x			x	C						X					X												

x Volunteer monitored (CAMP)
C Commission monitored

X Commission monitored

X Commission monitored
O Optional

Table D.5. West Mississippi watershed monitoring framework.

	Activity	Purpose	Requirement	Frequency	Comments/Standards	Cost
Streams	Water Quality/Quantity Monitoring -Mattson Brook	Long-term trends	Meets the standard set forth in MR 8410.0100 Subp. 5	As needed; once every 5 years	Refine P8/project development, MS4 compliance	$8,000/year annually
		Volume/rate			Volume control	
		Base flow			Volume control	
	Macroinvertebrate Community	Trends	Voluntary	Every 5 years	IBI standards	$1,000
	RiverWatch Volunteer Stream Monitoring	Education & trends	Voluntary	Annually	Educational activity	$1,000
	Emerging contaminants	Problem ID	Voluntary	As needed	New standards; sediment disposal costs; USGS partner	$500 annually
Wetlands	Wetland Health Evaluation Program	Wetland health	Voluntary	Annually	Baseline wetland health	$1,000/site/year
Groundwater	Quantify County well data	Baseline for ground-water recharge/ discharge	Voluntary			
Special	Storm sewer	P8 calibration, long term trends	Voluntary, required for Phase I cities	As needed; 2 sites for two years	Refine P8/project development, MS4 compliance	$8,000/year

Table D.6. West Mississippi watershed monitoring program.
Note: Costs are presented in constant dollars

Activity	Resource and Site(s)	Parameters	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
STREAM MONITORING													
Flow and water quality monitoring	Mattson Brook	Flow, temp, pH, TP, DO, BOD5, NO3, TSS, bacteria, chloride, specific conductance, bimonthly and storm event		$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
Macroinvertebrate community	Mattson Brook	Macroinvertebrates, once in Aug-Sep					$1,000				$1,000		
RiverWatch Volunteer Stream Monitoring	Mattson Brook	Macroinvertebrates, twice in spring, fall	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
SPECIAL MONITORING													
Wetland Health Evaluation Program	Select wetlands around watershed	Vegetation, macroinvertebrates	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
Storm sewer monitoring				$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400
Groundwater elevation	Select wells	Groundwater elevation			$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
			$3,000	**$16,400**	**$17,400**	**$17,400**	**$18,400**	**$17,400**	**$17,400**	**$17,400**	**$18,400**	**$17,400**	**$17,400**

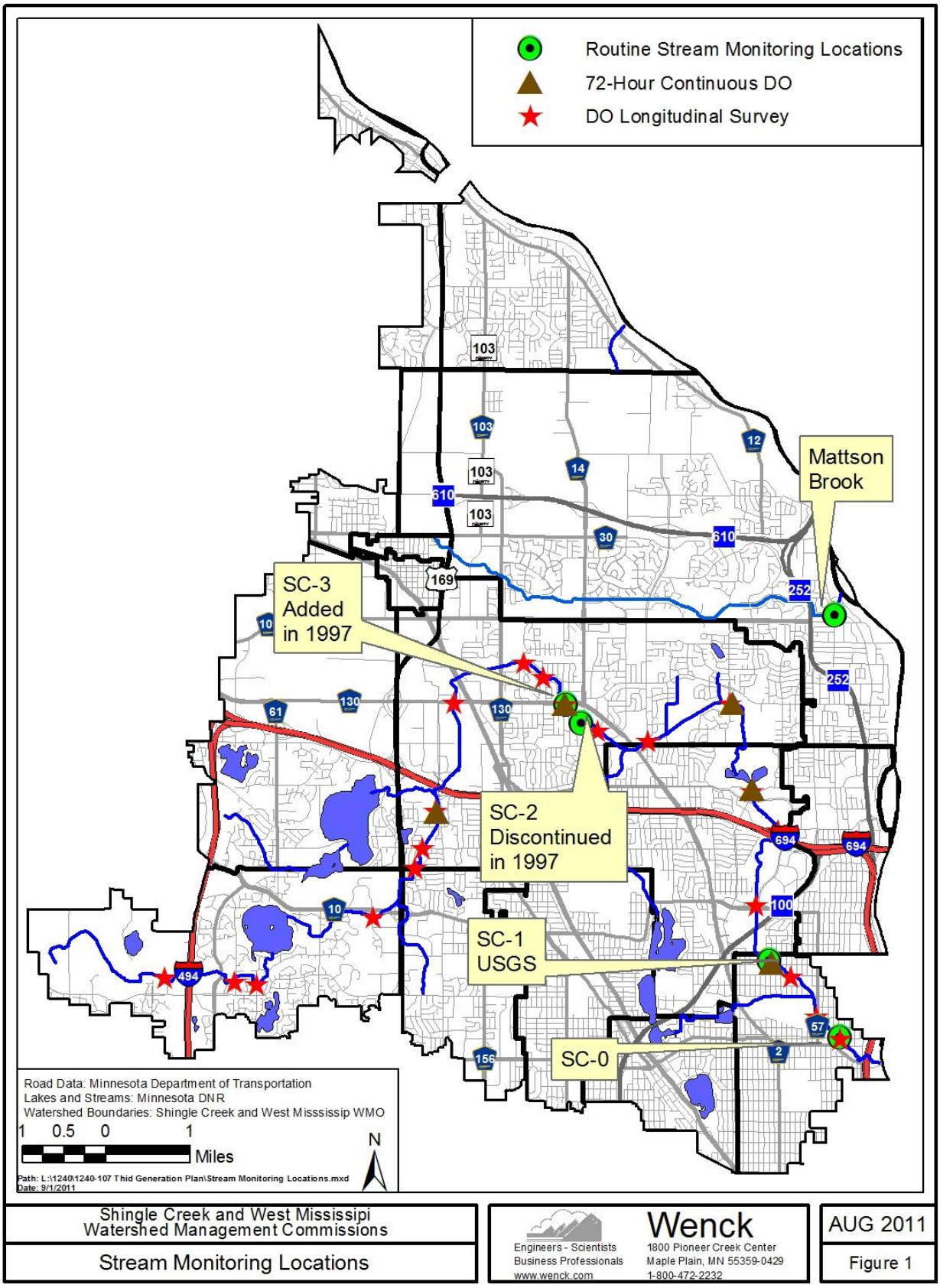
Routine Stream Monitoring Locations
72-Hour Continuous DO
DO Longitudinal Survey
Mattson Brook
SC-3 Added in 1997
SC-2 Discontinued in 1997
SC-1 USGS
SC-0
Road Data: Minnesota Department of Transportation
Lakes and Streams: Minnesota DNR
Watershed Boundaries: Shingle Creek and West Misssissip WMO
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Figure 1

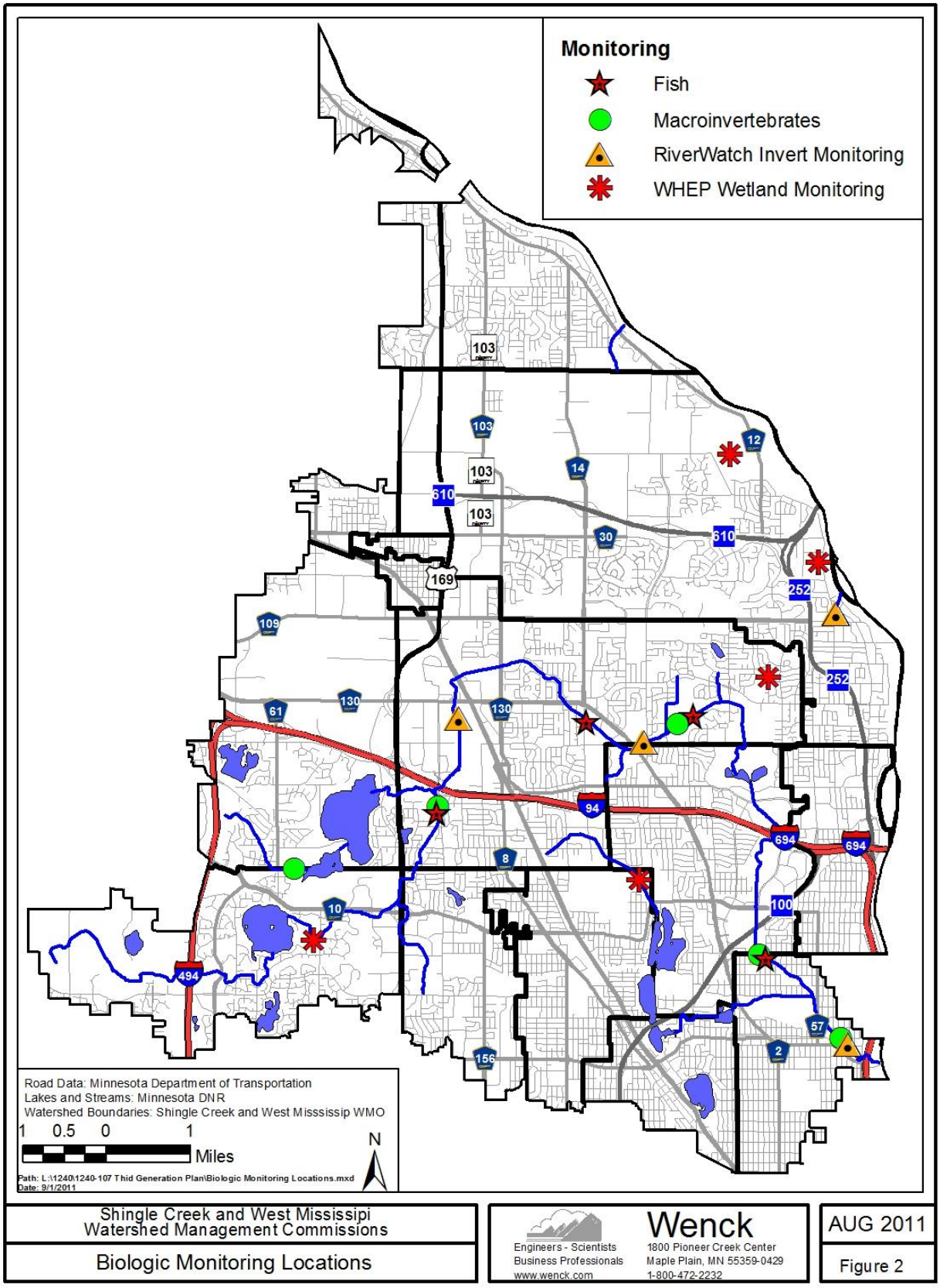
Monitoring
Fish
Macroinvertebrates
RiverWatch Invert Monitoring
WHEP Wetland Monitoring
Road Data: Minnesota Department of Transportation
Lakes and Streams: Minnesota DNR
Watershed Boundaries: Shingle Creek and West Misssissip WMO
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Figure 2

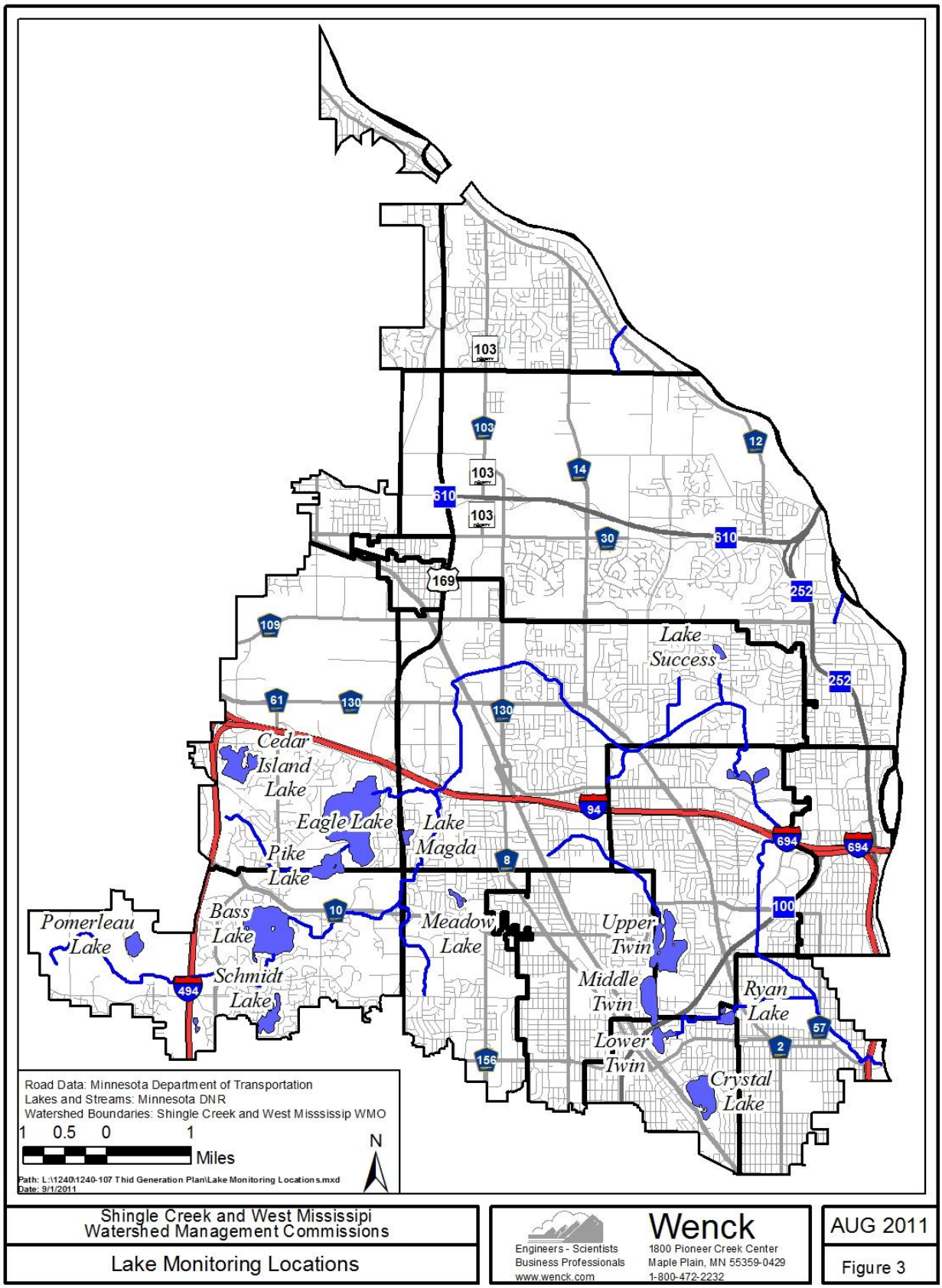

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Figure 3