

## **Appendix A**

### **BCWMC Monitoring Plan**

# BCWMC Monitoring Plan - DRAFT

## Bassett Creek Monitoring Programs

### Detailed Chemical Water Quality Monitoring

**Monitoring Plan ID:** BC-WQ

**Planned Interval:** 3 years (Priority I management classification)  
5 years (Priority II management classification)

**Description:**

Samples shall be collected from one or two (depending on the lake) lake sampling stations representing the deepest location(s). Lakes shall be monitored on six occasions from April through September. Details follow:

1. One sample shall be collected within two weeks after ice out
2. One sample shall be collected in mid-June
3. One sample shall be collected in mid-July
4. Two samples shall be collected in August, biweekly, during 1<sup>st</sup> and 3<sup>rd</sup> weeks
5. One sample shall be collected during the first week of September

To insure the safety of staff collecting the samples, two individuals must be present in the boat and collect the samples during each sample event.

**Table 1** Parameters measured and depth interval

Parameter	Sample Depth (Meters)	Sampled or Measured During Each Sample Event
Dissolved Oxygen	Surface to bottom (1-meter intervals)	X
Temperature	Surface to bottom (1-meter intervals)	X
Specific Conductance	Surface to bottom (1-meter intervals)	X
pH	Surface to bottom (1-meter intervals)	X
Oxidation Reduction Potential (ORP)	Surface to bottom (1-meter intervals)	X
Secchi Disc	Measured from surface	X
Total Phosphorus	0-2 Meter Composite Sample; Above Thermocline Sample; Below Thermocline Sample; 0.5 meters above bottom	X
Soluble Reactive Phosphorus	0-2 Meter Composite Sample	X
Total Nitrogen	0-2 Meter Composite Sample	X
Chlorophyll <i>a</i>	0-2 Meter Composite Sample	X
Chloride	0-2 Meter Composite Sample	X

Dissolved oxygen, temperature, specific conductance, pH, Oxidation Reduction Potential (ORP), and Secchi disc transparency shall be measured in the field at depths shown in Table 1. Water samples will be collected for laboratory analysis for total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll *a*, and chloride at depths as specified in Table 1. Analytical details for phosphorus, nitrogen, and chlorophyll *a* analyses are presented in Table 2. All analyses shall attain the MDL, MRL, DUP RPD, Matrix Spike %R and RPD, and Blank Spike %R and RPD shown in Table 2.

**Table 2 Analytical Method Details**

Method	Analyte	MDL	MRL	Units	DUP	Matrix Spike		Blank Spike	
					RPD	%R	RPD	%R	RPD
EPA 351.2	Total Kjeldahl Nitrogen	0.17	0.50	mg/L	20	90-110	20	90-110	20
EPA 365.3	Orthophosphate as P	0.0005	0.0060	mg/L	20	75-125	20	80-120	20
EPA 365.3	Phosphorus, Total as P	0.0007	0.010	mg/L	20	75-125	20	80-120	20
SM 10200H	Chlorophyll <i>a</i> -Pheophytin	0.50	0.50	µg/L	20	75-125	20	80-120	20
SM4500 NO3F	Nitrate + Nitrite as N	0.0069	0.020	mg/L	20	75-125	20	80-120	20

## Zooplankton and Phytoplankton Monitoring

**Monitoring Plan ID:** ZOO

**Planned Interval:** 3 years (Priority I management classification)  
5 years (Priority II management classification)

### Description:

Lakes shall be monitored on six occasions from April through September concurrent with water quality sampling events. Phytoplankton will be sampled as a single 0-2 meter composite sample at the location of water quality sampling. Zooplankton will be sampled using a bottom to surface tow with a zooplankton net at the location of water quality sampling.

Phytoplankton analyses shall be completed using the inverted microscope procedure of Utermohl as described by Lund et al. (1958). Subsamples shall be settled in a 5 milliliter inverted microscope settling chamber for approximately 24 hours prior to counting. Replicate fields of view located in a transect across the center of the counting chamber shall be enumerated at a magnification of at least 500 times until the entire transect has been enumerated or at least 500 algal units have been counted. An algal unit is 1 single cell, 1 colony, or 1 filament. Results shall be expressed as units per milliliter. Algal units shown in Table 3 shall be identified to the species level and other algal units in the samples shall be identified to the genus level.

**Table 3 Algal Units Identified to the Species Level**

<b>Chlorophyta (Green Algae)</b>	<b>Cyanophyta (Blue-Green Algae)</b>	<b>Bacillariophyta (Diatoms)</b>	<b>Other Algae</b>
<i>Actinastrum Hantzschii</i>	<i>Anabaena affinis</i>	<i>Asterionella formosa</i>	<i>Dinobryon sociale</i>
<i>Ankistrodesmus Brauni</i>	<i>Anabaena flos-aquae</i>	<i>Cocconeis placentula</i>	<i>Cryptomonas erosa</i>
<i>Ankistrodesmus falcatus</i>	<i>Anabaena spiroides v. crassa</i>	<i>Fragilaria capucina</i>	<i>Ceratium hirundinella</i>
<i>Chlamydomonas globosa</i>	<i>Aphanizomenon flos-aquae</i>	<i>Fragilaria crotonensis</i>	<i>Peridinium cinctum</i>
<i>Chlamydomonas pseudopertyi</i>	<i>Coelosphaerium Naegelianum</i>	<i>Gomphonema olivaceum</i>	
<i>Coelastrum microporum</i>	<i>Cylindrospermopsis raciborski</i>	<i>Melosira granulata</i>	
<i>Crucigenia quadrata</i>	<i>Lyngbya limnetica</i>	<i>Stephanodiscus Hantzschii</i>	
<i>Dictyosphaerium Ehrenbergianum</i>	<i>Merismopedia tenuissima</i>	<i>Synedra acus</i>	
<i>Elakatothrix gelatinosa</i>	<i>Microcystis aeruginosa</i>	<i>Synedra ulna</i>	
<i>Oocystis parva</i>	<i>Microcystis incerta</i>		
<i>Pandorina morum</i>	<i>Oscillatoria Agardhii</i>		
<i>Pediastrum Boryanum</i>	<i>Oscillatoria limnetica</i>		
<i>Pediastrum duplex v. clathratum</i>	<i>Phormidium mucicola</i>		
<i>Rhizoclonium hieroglyphicum</i>			
<i>Scenedesmus dimorphus</i>			
<i>Scenedesmus quadricauda</i>			
<i>Selenastrum minimum</i>			
<i>Schroederia Judayi</i>			
<i>Sphaerocystis Schroeteri</i>			
<i>Tetraedron minimum</i>			
<i>Tetraedron muticum</i>			
<i>Treubaria setigerum</i>			

Zooplankton analyses shall be completed using the Sedgwick Rafter procedure described in Standard Methods. Zooplankton shown in Table 4 shall be identified to the species level and other zooplankton shall be identified to the genus level. Results shall be expressed as number of zooplankton per square meter.

**Table 4 Zooplankton Identified to the Species Level**

<b>Cladocera</b>	<b>Rotifera</b>
<i>Bosmina longirostris</i>	<i>Asplanchna priodonta</i>
<i>Chydorus sphaericus</i>	<i>Keratella cochlearis</i>
<i>Daphnia galeata mendotae</i>	<i>Keratella quadrata</i>

Cladocera	Rotifera
<i>Daphnia pulex</i>	<i>Kellicottia bostoniensis</i>
<i>Daphnia retrocurva</i>	<i>Polyarthra vulgaris</i>
<i>Diaphanosoma leuchtenbergianum</i>	<i>Trichocerca cylindrica</i>
	<i>Trichocerca multicroinis</i>

### Aquatic Plant (Macrophyte) Monitoring

**Monitoring Plan ID:** PLANT

**Planned Interval:** 3 years (Priority I management classification)  
5 years (Priority II management classification)

#### Description:

The BCWMC will perform qualitative macrophyte surveys of lakes classified as Priority I every 3 years and lake classified as Priority II every 5 years (in the same year as detailed BCWMC water quality monitoring). Each lake shall be surveyed twice, in June and August.

The surveys shall consist of visual boat surveys, accompanied by sample collection as needed, to identify the macrophyte species present in the lake and create a map showing species locations and estimated abundance for each sample date. The estimated abundance shall be on a scale of 1 through 3 with 1 indicating light density, 2 indicating moderate density, and 3 indicating heavy density. Aquatic invasive plant species will be noted, when applicable.

### Stream Biotic Monitoring (Invertebrate Monitoring)

**Monitoring Plan ID:** BIO

**Planned Interval:** 3 years (Priority I streams)

#### Description:

Benthic macroinvertebrate samples were collected from Plymouth Creek and Bassett Creek (North Branch, Main Stem, and Sweeney Lake Branch) during 2012 on the dates indicated below. The sampling locations are identified as follows (Figure 1):

- Plymouth Creek at Industrial Park Boulevard in Plymouth
- North Branch of Bassett Creek at 32nd Avenue North and Adair Avenue in Crystal
- Main Stem of Bassett Creek at Rhode Island Avenue in Golden Valley
- Main Stem of Bassett Creek east of Zane Avenue in Golden Valley
- Main Stem of Bassett Creek at Dresden Lane in Golden Valley
- Main Stem of Bassett Creek at Irving Avenue in Minneapolis

- Sweeney Lake Branch of Bassett Creek at Turner's Crossroad in Golden Valley

At each sample location, macroinvertebrate samples will be collected from riffle areas (areas with fast-moving water) where the substrate is composed of gravel and small stones. Samples will be collected by disturbing the creek bottom and allowing dislodged macroinvertebrates to drift into a D-frame aquatic net positioned downstream. Rocks and other substrate materials will also be examined for macroinvertebrates. Macroinvertebrates will be collected for 30 minutes at each sample location and later identified in the laboratory.

Analysis will include the calculation of a Macroinvertebrate Index of Biological Integrity (MIBI) at each sampling location. Due to the use of the Hilsenhoff Biotic Index (HBI) and Invertebrate Community Index (ICI) during past monitoring events (prior to the development of the MIBI), HBI and ICI values will also be calculated for comparison the historical record.

### Stream Water Quality Monitoring

**Monitoring Plan ID:** SWQ

**Planned Interval:** 2 consecutive years of monitoring initiated every 6 years (Priority streams)

#### Description:

The BCWMC will initiate a stream water quality monitoring program to monitor the chemical water quality of its priority streams. The exact monitoring locations will be determined based on the feasibility of installing automated samplers, but will be consistent with biotic monitoring locations, where possible.

Automated samplers will be installed and operated for two consecutive years (from snowmelt of year 1 through ice-in of year 2). Continuously monitored parameters will include temperature, dissolved oxygen, pH, conductivity, and stage. Automated samplers will collect water quality samples in periods of high flow (i.e., snowmelt and after storm events) and during periods of baseflow. Parameters analyzed will include chloride, fecal coliform, total suspended solids, total phosphorus, and chlorophyll a.

### Other Monitoring Programs

#### Three Rivers Park District Medicine Lake Water Quality

**Monitoring Plan ID:** TRPD

**Planned Interval:** Annually in Medicine Lake – Main Basin  
3 year intervals in Medicine Lake – Southwest Basin

#### Description:

The Three Rivers Park District (TRPD) performs chemical water quality monitoring in the main basin of Medicine Lake annually. Sampling is performed approximately every two weeks beginning in early May and extending through September. Profiles of dissolved oxygen, temperature, specific conductance, and pH are measured at 1 meter increments. Total nitrogen, chlorophyll a, and Secchi disc transparency are

measured from the surface. Total phosphorus and soluble reactive phosphorus are measured at the surface and at depths of 6 meters and 12 meters.

At three year intervals, the BCWMC will request that the TRPD perform additional sampling and analysis in the southwest basin of Medicine Lake. This sampling and analysis will be performed consistent with the TRPD's protocol for monitoring the main basin.

### **Metropolitan Council Citizen Assisted Monitoring Program (CAMP)**

**Monitoring Plan ID:** CAMP

**Planned Interval:** Annually in Priority I and Priority II waterbodies between detailed monitoring events

**Description:**

The Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) has been collecting water quality data on a number of Twin Cities metropolitan area lakes since 1980. On a bi weekly basis (April - October), citizen volunteers collect a surface water sample for laboratory analysis of total phosphorus, total Kjeldahl-nitrogen, and chlorophyll-a, obtain a Secchi transparency measurement, and provide some user perception information about each lake's physical and recreational condition. Laboratory analysis of collected samples will be performed consistent with CAMP protocols, as determined by the Metropolitan Council Environmental Services.

The BCWMC will fund the inclusion of Priority I and Priority II waterbodies in CAMP during years when detailed water quality monitoring performed by the BCWMC is not planned.

### **Metropolitan Council Watershed Outlet Monitoring Program**

**Monitoring Plan ID:** WOMP

**Planned Interval:** Annually on the Main Stem of Bassett Creek

**Description:**

The Watershed Outlet Monitoring Program (WOMP) is coordinated by the Metropolitan Council Environmental Services (MCES) and consists of a network of monitoring stations located throughout the Metro Area. The Bassett Creek WOMP site is located at Irving Avenue, one-fourth mile upstream of the storm sewer tunnel that runs beneath downtown Minneapolis to the Mississippi River.

The Bassett Creek station shelter is equipped with electricity, heat, and telephone modem. The station measures stage using a bubbler and pressure transducer which is connected to a Campbell data logger. The data logger records and calculates the conversion of stage readings into discharge using a rating curve polynomial. The data are averaged over 15-minute intervals and are downloaded via modem.

The Bassett Creek station also uses an ultrasonic transducer, mounted under a bridge to measure stage. The station is equipped with a non-heated tipping bucket rain gauge. An automatic sampler equipped with 1L sample bottles is also housed at the station. When stream stage increases to a chosen trigger

depth the data logger controls and activates flow pacing to the sampler. The sampler collects up to 96 flow-weighted samples per storm. Conductivity and temperature are continually recorded

During runoff events the individual flow paced samples are collected and combined into one large sample. Grab samples were taken monthly all year during baseflow conditions. To comply with holding times water quality parameters were selected for analysis based on the elapsed time since the end of sample collection. The samples are analyzed in the MCES laboratory for water quality parameters including total suspended solids, total phosphorus, chloride, and other parameters.

The BCWMC will fund the continued operation of the Bassett Creek WOMP station.

### **Minneapolis Parks and Recreational Board (Wirth Lake Monitoring)**

**Monitoring Plan ID:** MPRB

**Planned Interval:** Annually in Wirth Lake

#### **Description:**

The Minneapolis Parks and Recreational Board (MPRB) monitors Wirth Lake annually. Monitoring includes one winter sample, on sample in March or April, two samples per month from May through September, and one sample in October. Total Phosphorus, nitrogen, and Secchi depth are measured during all monitoring events. Additional chemical parameters are assessed with less frequency.

All physical measurements and water samples for chemical analyses are obtained from a point directly over the deepest point in Wirth Lake. A multiprobe is used to record temperature, pH, conductivity, and dissolved oxygen profiles at 1 meter intervals. Secchi disk transparency is determined with a black and white 20-cm diameter disk on the shady side of the boat.

Composite surface water samples are collected using a stoppered 2-m long, 2-inch diameter white PVC tube and combined in a white plastic bucket. Water from this mixed sample is decanted into appropriate bottles for analysis. Chlorophyll-a samples are stored in opaque bottles for analysis. Total phosphorus, soluble reactive phosphorus, total nitrogen, and chlorophyll-a concentrations are determined from the surface composite sample for all sampling trips.

Phytoplankton samples are collected each sampling trip April through October for Wirth Lake.

Phytoplankton are collected from the 0-2 m surface composite sample and stored in an opaque plastic container with a 25% glutaraldehyde preservative solution. Vertical zooplankton tow samples are taken at the sampling station for each lake once per month during the growing season. Zooplankton are collected using a Wisconsin vertical tow net. Samples are preserved 90% denatured histological ethanol to a mix of approximately 50% sample 50% ethanol.



# BCWMC Draft Monitoring Plan

Water- body Type	BCWMC Management Classification	Waterbody Name	Year										
			2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Lake	Priority 1 Deep	Medicine Lake	TRPD	TRPD PLANT ZOO	TRPD	TRPD	TRPD PLANT ZOO	TRPD	TRPD	TRPD PLANT ZOO	TRPD	TRPD	TRPD PLANT ZOO
		Parkers Lake	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP
		Sweeney Lake	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP
		Twin Lake	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP
		Wirth Lake	MPRB	MPRB	MPRB	MPRB PLANT	MPRB	MPRB	MPRB PLANT	MPRB	MPRB	MPRB PLANT	MPRB
	Priority 1 Shallow	Northwood Lake	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO
		Westwood Lake	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP
	Priority II Shallow	Crane Lake	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP	BC-WQ PLANT ZOO
		Lost Lake	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP
		Turtle Lake	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP
		Cavanaugh Pond	CAMP	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP	CAMP	CAMP	CAMP	BC-WQ/CAMP PLANT ZOO	CAMP
Stream	Priority 1 Stream	Main Stem Bassett Creek	BIO WOMP	WOMP	WOMP	BIO SWQ WOMP	SWQ WOMP	WOMP	BIO WOMP	WOMP	WOMP	BIO SWQ WOMP	SWQ WOMP
		North Branch Bassett Creek	BIO	--	--	BIO SWQ	SWQ	--	BIO	--	--	BIO SWQ	SWQ
		Plymouth Creek	BIO	--	--	BIO SWQ	SWQ	--	BIO	--	--	BIO SWQ	SWQ
		Sweeney Branch Bassett Creek	BIO	--	--	BIO SWQ	SWQ	--	BIO	--	--	BIO SWQ	SWQ

## Notes:

TRPD	Detailed water quality monitoring performed by Three Rivers Park District of Medicine Lake
BC-WQ	Detailed water quality monitoring performed by BCWMC (or contracted party)
CAMP	Surface water quality monitoring by Metropolitan Council's Citizen Assisted Montioring Program (CAMP), or equivalent program
MPRB	Detailed water quality and phytoplankton/zooplankton monitoring peformed by Minneapolis Park and Recreation Board
ZOO	Zooplankton/phytoplankton monitoring performed by BCWMC
PLANT	Aquatic plant survey performed by BCWMC twice per monitoring season (June and August)
BIO	Invertebrate monitoring and biotic index analysis performed by the BCWMC
SWQ	Automated water quality monitoring of stream locations performeby by BCWMC (or contracted party)
WOMP	Watershed Outlet Monitoring Program facilitated by Metropolitan Council Environmental Services