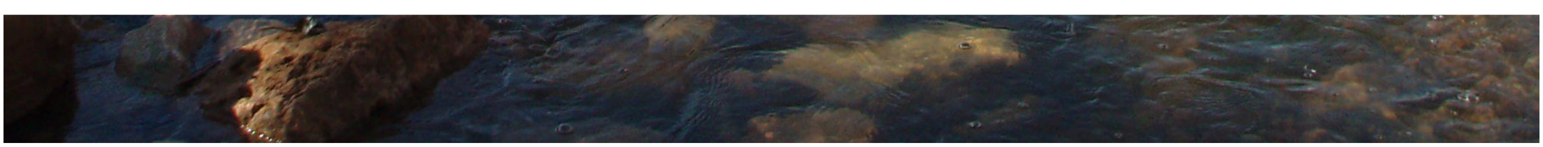
proposal for

2017 water monitoring services

prepared for

Bassett Creek Watershed Management Commission



Submitted by Barr Engineering Co.
April 2016

April 28, 2016

Bassett Creek Watershed Management Commission
Laura Jester, BCWMC Administrator
c/o 16145 Hillcrest Lane
Eden Prairie, MN 55346

Re: Proposal to provide 2017 water quality monitoring services

Dear Ms. Jester and Commissioners:

After 47 years of serving the BCWMC Commissioners, Barr would be pleased to continue serving your organization in 2017 as your water quality consultant. We have worked with BCWMC over the years to refine the approach to water quality monitoring and modeling. We believe that hiring Barr to help complete your 2017 water quality programs will lead to appropriate management actions that gain acceptance, because our:

- **Familiarity with BCWMC's program and continuity of staff will allow the project to run smoothly.** Barr has provided continuity to the BCWMC's water quality program since the lake monitoring program began in 1974. Barr recently worked with the BCWMC to update its water quality goals and monitoring program as part of preparing the *BCWMC 2015-2025 Watershed Management Plan*. Beyond organizational continuity, the individual Barr staff who will be performing the tasks described in this proposal are intimately familiar with past BCWMC monitoring, projects, and actions targeting the resources to be assessed by the 2017 water quality monitoring program. Meg Rattei, the biologist who designed the original routine lake water quality monitoring program and has managed and implemented the program for more than four decades, will manage and implement the 2017 program. Keith Pilgrim, who completed the water quality modeling for the Sweeney Lake TMDL and associated monitoring of Schaper Pond inflows and outflows, will serve as the technical lead for the Sweeney Lake aeration study and 2017 Schaper pond monitoring. Karen Chandler and Keith Pilgrim were involved in the Schaper Pond feasibility study and construction and will play roles in the 2017 Schaper Pond Monitoring. Greg Wilson assisted BCWMC in technical discussions about Sweeney Lake aeration with the MnDNR and oversaw the Twin Lake alum treatment. Our familiarity with the 2017 water quality programs is unparalleled. Because of our previous and ongoing BCWMC work, we will not require historical water quality information from the Administrator.

- **Unmatched technical services provide comprehensive understanding of your lake water quality.** Our depth and breadth of technical expertise is unmatched locally, allowing us to provide you with comprehensive water quality services. Barr is the only local firm to provide phytoplankton and zooplankton analyses in our unique microscope laboratory, which includes a Wild Inverted Microscope, typically only found in university research laboratories. We also use a camera to capture microscopic images of phytoplankton and zooplankton when appropriate, such as during analyses of algae samples from the 2014 Sweeney Lake blue-green algae blooms. Our phytoplankton and zooplankton skills will be particularly valuable to BCWMC for the lake monitoring program and Sweeney Lake aeration study. Understanding and modeling the relationships between physical, chemical, and biological processes in Sweeney Lake is critical to understanding the impact of the aeration system and determining whether or not the system improves, degrades, or has no impact on lake water quality. Our modeling team's skill in using complex models that consider the impact of sediment chemistry, aeration, and biological processes on lake water quality is also unmatched.

- **Regional credibility helps obtain support from local municipalities and government agencies.** Barr has established a reputation as a regional expert in water quality monitoring, modeling, and water resource management as a result of performing a significant number of water quality projects for the Riley-Purgatory-Bluff Creek Watershed District, Nine Mile Creek Watershed District, Valley Branch Watershed District, and other WMOs. BCWMC will continue to benefit from Barr's expertise attained from decades of water quality monitoring, modeling, and water resource management. And, BCWMC will benefit from our strong working relationship with the municipalities within the Bassett Creek watershed and government agencies.

The attached proposal provides scopes, estimated costs, timelines, deliverables, and examples for each of the three projects included as part of your request for proposal. The estimates costs identified in this proposal for each project are independent of the other projects; the total estimated cost for all three projects ranges from **$137,000** to **$152,000**. Completion of all three projects in a coordinated manner will promote overall project efficiency with potential benefits to schedule and cost.

We appreciate the opportunity to share our qualifications and look forward to continuing to serve as your water quality consultant in 2017. If you have any questions, please feel free to contact us.

Sincerely,

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1. scope of work

Project #1: routine lake monitoring program

introduction

The Barr approach to the 2017 routine lake monitoring program will fulfill not only the goals set forth in the BCWMC Watershed Management Plan, but will also answer the following important questions:

1. Are blue-green algae a serious problem and do blue-green algae pose a public health threat to users of Sweeney and Lost Lake? Serious blue green algae blooms in Sweeney Lake during 2014 were accompanied by algal toxins with the potential to create a public health threat. Significant blue-green algae blooms were observed in Lost Lake in August 1982. A lake resident alleged that the death of his dog shortly before the August 1982 monitoring event was due to algal toxins from these blooms.
2. What changes in phytoplankton and zooplankton species occur when the Sweeney Lake aeration system is turned off? Does turning off the aeration system result in fewer algae, a change in algae species, and are the changes in algae species is favorable or unfavorable?
3. What are the water quality benefits from the recent alum treatment of Twin Lake?
4. What changes in phytoplankton and zooplankton species and numbers have resulted from the Twin Lake alum treatment?

tasks and activities

The 2017 routine lake monitoring program consists of monitoring Sweeney Lake and Twin Lake, Priority 1 deep lakes, and Lost Lake, a Priority 2 shallow lake. Monitoring methods are consistent with monitoring recommendations included in Appendix A of the BCWMC 2015-2025 Watershed Management Plan. Routine lake monitoring will include chemical water quality monitoring, phytoplankton/zooplankton monitoring, and macrophyte monitoring.

chemical water quality monitoring

Samples will be collected from one sample station in Twin Lake and Lost Lake and two sample stations in Sweeney Lake. Sample stations will represent the deepest location(s). Lakes will be monitored on six occasions from April through September: (1) within two weeks after ice-out (2) mid-June (3) mid-July, biweekly during (4) 1st and (5) 3rd weeks of August, and (6) first week of September. Dissolved oxygen, temperature, specific conductance, pH, oxidation reduction potential (ORP) will be measured at 1-meter intervals from surface to bottom. The depth of Secchi disc transparency will be measured from the surface to the depth it can no longer be seen. During each sample event: (1) A 0-2 meter composite water sample will be collected for laboratory analysis for soluble reactive phosphorus, total nitrogen, and chlorophyll *a* (2) water samples will be collected from 0-2 meters, above and below the thermocline, whenever present, and 0.5 meters above the bottom and analyzed for total phosphorus, and (3) water samples will be collected from 0-2 meters and from 0.5 meters above the bottom and analyzed for chloride. Tabular summaries of parameters measured, depth interval, and analytical methods details are found in Appendix A of the BCWMC 2015-2025 Watershed Management Plan at the following web address: http://www.bassettcreekwmo.org/application/files/3114/4676/8825/BCWMC_2015_Watershed_Mgmt_Plan_Appendices.pdf

Water quality data will be summarized in tabular and graphic format. Temperature, dissolved oxygen, specific conductance, and total phosphorus isopleths will be created to evaluate stratification and determine whether internal phosphorus loading from sediment appears to be occurring. 2017 data will be compared graphically with historical data and a trend analyses will be completed on the past ten years of total phosphorus, chlorophyll *a*. and Secchi disc data to determine whether statistically significant changes have occurred.

phytoplankton/zooplankton monitoring

During each of the six monitoring 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 will be completed using the inverted microscope procedure of Utermohl as described in Appendix A of the BCWMC 2015-2025 Watershed Management Plan. Phytoplankton will generally be identified to either species or genus. A list of algal units identified as part of this monitoring is provided in Table MP-3 of Appendix A of the BCWMC 2015-2025 Watershed Management Plan.

Zooplankton analyses will be completed using the Sedgwick Rafter procedure described in Standard Methods. Zooplankton will generally be identified to species or genus (see Table MP-4 of Appendix A of the BCWMC 2015-2025 Watershed Management Plan). Results will be expressed as number of zooplankton per square meter.

macrophyte monitoring

Point intercept macrophyte surveys of the lakes will be performed. Each lake shall be surveyed twice, once in June and once in August. Plant surveys will assess the distribution and growth density of all plants. All sampling and data analysis will be conducted according to the methodologies described in the MNDNR protocol for aquatic vegetation surveys. This methodology is based upon the point intercept survey method developed by John Madsen in Aquatic Plant Control Technical Note MI-02, 1999. This method is described in greater detail in Appendix A of the BCWMC 2015-2025 Watershed Management Plan.

All data will be recorded. In addition to basic parameters and species statistics, the following indices will be reported (described in greater detail in Appendix A of the BCWMC 2015-2025 Watershed Management Plan:

- **Simpson Diversity Index Value**—an index used to measure plant diversity.
- **C value—**a measure of the average tolerance of the plant community to degraded conditions.
- **Floristic Quality Index (FQI) value—**a value to assess the overall quality of the plant communities that considers both the quality and number of native species present.

June and August data from each lake will be analyzed using Chi Squared analyses to identify any significant changes in species frequency of occurrence between June and August. In addition, Chi squared analyses will identify any significant changes in species frequency of occurrence in Sweeney Lake and Twin Lake since 2014.

subcontractors and laboratories

subconsultant: Three Rivers Park District

Barr has a strong and successful working relationship with Three Rivers Park District (TRPD). During 2006 through 2010, TRPD teamed with Barr to provide water quality monitoring of BCWMC lakes and laboratory analyses of lake samples. This partnership resulted in significant cost savings to BCWMC. TRPD has teamed with Barr to provide lake monitoring/laboratory analyses services during 2016 to assist BCWMC with the monitoring of Medicine Lake. TRPD is interested in teaming with Barr to provide monitoring and laboratory services for Sweeney Lake and Twin Lake in 2017.

subconsultant: Endangered Resource Services, LLC

Endangered Resource Services, LLC (ERS) will complete the aquatic plant surveys, data summaries, and analyses. Barr has a strong and successful working relationship with ERS, who completed aquatic plant surveys on Sweeney Lake and Twin Lake in 2014 and Westwood Lake in 2015.

laboratory: Pace Analytical

Barr has a strong and successful working relationship with Pace Analytical Services Inc. (Pace). Pace completed the Westwood Lake analyses during 2015 and will complete the analyses of Crane Lake and Northwood Lake samples during 2016.

budget and project timeline

Barr intends to team with Three Rivers Park District (TRPD) to complete the water quality monitoring of Sweeney Lake and Twin Lake and analyze the water quality samples. Barr will monitor Lost Lake and Pace Laboratories will analyze the samples. However, should changes in TRPD staffing or workload occur prior to 2017, it may not be possible for TRPD to complete planned monitoring and lab analyses. For this reason, we provide a cost estimate that assumes TRPD will collect and analyze the samples and also show the additional cost incurred if Barr collects the samples and Pace Laboratories analyzes the samples.

BCWMC is considering changing the routine monitoring program report format and evaluated two possible formats at the April 21, 2016 BCWMC meeting. The Commissioners have not yet decided on a format, although it appears BCWMC will adopt a report format that will be less costly to prepare than past reports. For this reason, we provide a cost estimate that assumes a shorter summary report format will be used (see examples provided by the Administrator). We also show the additional cost to prepare a comprehensive report similar to the current format.

As shown in Table 1, project costs for the routine lake monitoring program are expected to range from $52,000 to $67,000, depending upon whether or not TRPD collects and analyzes the Sweeney and Twin Lake samples and the format selected by BCWMC for the final report.

Table 1. Routine lake water quality monitoring budget and timeline

Activity	Est. Cost	Est. Additional Costs	Est. Schedule
Lake Monitoring (Field Labor and Expenses)	$7,000	$3,000 [1]	April – September 2017
Water Chemistry Laboratory Analyses	$5,000	$2,000 [2]	April – September 2017

Activity	Est. Cost	Est. Additional Costs	Est. Schedule
Phytoplankton and Zooplankton Analyses	$10,000		May – October 2017
Aquatic Plant Surveys and Data Summary and Analyses, including Chi Squared Analyses	$6,000		June – September 2017
Data Summary and Analyses	$12,000		October – November 2017
Prepare Project Report	$10,000	$10,000 [3]	December 2017
Prepare Presentation and Present Project Results at a BCWMC Meeting	$2,000		January 2018
Total	**$52,000**	**Up to $67,000**	

[1] Additional cost if Barr collects Sweeney Lake and Twin Lake samples
[2] Additional cost if Pace Analytical analyzes Sweeney Lake and Twin Lake samples
[3] Additional cost for preparation of comprehensive report similar to current format.

project deliverables

- 2017 Routine Lake Water Quality Monitoring Report
- Presentation of results of 2017 routine lake water quality monitoring to the Commission

references

In addition to the water quality monitoring work we perform for the BCWMC that you are familiar with, we offer the following additional project reference:

- **Project:** Water quality monitoring program
  Client: Nine Mile Creek Watershed District
  Project description: available at https://www.barr.com/docs/NMCWD water quality.pdf
  Project report: see report provided by the BCWMC Administrator
  Contact: Kevin Bigalke, administrator, kbigalke@ninemilecreek.org or 952-835-2078

Project #2: Sweeney Lake aeration study

Our approach to this project will use past and existing monitoring data (nutrients, fish, plants, zooplankton, and phytoplankton), professional judgment, and modeling to identify the best approach to meet TMDL requirements, promote fish habitat, and provide improved recreational potential, either by optimizing aeration and/or incorporating other in-lake management actions.

background on aeration and Sweeney Lake water quality

The primary benefit of using bubblers or other similar devices in lakes is to increase the oxygen in the entire water column of a lake. Fish cannot survive in low oxygen conditions, so this allows the fish to move around an entire lake's water column freely. This may provide more habitat or simply room for the fish to live, and may also provide additional food sources, such as aquatic insects that live in the lake's bottom sediments. If waters on the lake bottom are low in oxygen, fish cannot go down to the lake bottom and forage for food.

Aeration is a largely-misunderstood process. Air from the bubblers does not dissolve into the lake water and increase oxygen. Aeration moves water from the bottom of the lake to the surface. When this lake bottom water (which is low in oxygen) is transported to the lake surface, it picks up air from the atmosphere and becomes oxygenated during open water periods. Because this recently moved water is generally cooler than the lake surface waters, it is heavier and begins to fall through the water column. This causes the lake to mix and increase oxygen in much of the lake water column.

The result of aeration is that bottom waters are transported to the lake surface, oxygen concentrations increase in the bottom water with mixing, and the temperature of the lake bottom waters also increase. Phosphorus that is released from lake-bottom sediments (identified as 32% of the current phosphorus loads to Sweeney Lake in the TMDL) is rapidly transported to the surface water where it is available to support phytoplankton growth. Hence, aeration has the potential to increase phosphorus in the surface waters (this will be discussed more in the water monitoring section below). The warming of bottom waters also has the potential to change fish habitat conditions for fish that require cool waters (such as walleye). Modeling results suggest upper temperatures of approximately 26 C which are above the 20-24 C optimum temperature range for adult walleye as indicated in the USFWS Habitat Suitability documentation (McMahon, Thomas E., James W. Terrell and Patrick C. Nelson, 1984. Habitat Suitability Information: Walleye. United States Fish and Wildlife Service OBS-82/10.56). This increase in temperature during a portion of the year may be offset by the gain in useable lake area with adequate oxygen and due to the elimination of the thermocline.

review of past monitoring efforts

Water quality monitoring has been conducted on Sweeney Lake since 1972 with data collected every 4-5 years and more frequently (nearly every year) during the last decade. Since the 1990s, water quality has been fairly consistent, with total phosphorus just above and below 50 ug/L, and chlorophyll *a* between 20 and 40 ug/L. However, during individual seasons such as the summer of 2014, the water quality of Sweeney Lake can be notably variable. In 2014, both total phosphorus and chlorophyll a spiked up to over 200 ug/L. This spike, for example, was likely caused by a series of larger precipitation and stormwater events. This demonstrates that climatic variability can have an effect on lake water quality. It can do this by changing how much phosphorus comes from the watershed (external phosphorus loads) and how much a lake does or does not mix (e.g., movement of water from bottom waters to the lake surface). How much a lake mixes affects how much bottom phosphorus (internal phosphorus loading) is moved to the surface where it can cause algal blooms.

Previous monitoring showed how the operation of the aerator affects the distribution of temperature, dissolved oxygen, and phosphorus throughout the water column of Sweeney Lake. When the aerator was in operation (2005), the lake temperature was largely uniform, dissolved oxygen was higher on the lake bottom, and total phosphorus was largely mixed throughout the water column. When the aerator was off in 2008, lake temperature was higher on the lake surface compared to the lake bottom. This causes stratification, meaning, water on the surface of the lake stays on the surface and water on the bottom stays on the bottom (no or little mixing). The result is that the bottom waters are lower in oxygen (lake bottom sediments consume oxygen), but they are also high in phosphorus (phosphorus comes from the lake bottom sediment). For the most part, phosphorus in the bottom waters is stuck there during the summer months and is not available for phytoplankton growth. Without modeling as proposed below, it is very difficult to trace the effect of aeration on phosphorus release from lake sediment and distinguish it from watershed phosphorus loading. Schaper Pond outflow monitoring (Project #3) will enable us to determine most of the watershed phosphorus loading to Sweeney Lake during 2017, but it is expected that past P8 modeling efforts will be used in the lake water quality modeling to differentiate watershed phosphorus loading for varying climatic conditions during previous years, with (such as 2005) and without (such as 2008) aeration.

what can modeling achieve?

Meeting the TMDL requirements of Sweeney Lake (see 2011 TMDL report) requires a 55% reduction of internal phosphorus loading which can be achieved with an alum treatment of lake bottom sediments. The simple modeling approach that was conducted as part of the TMDL study was adequate for understanding the relative contributions of phosphorus loads to the observed concentration of phosphorus in Sweeney Lake. There are still several questions that remain unanswered:

- With large phosphorus inflows from storm events, will aeration make the effect of stormwater events worse or better with respect to phosphorus and large algal blooms in Sweeney Lake?
- Without the effect of large phosphorus inflows, does aeration reduce phytoplankton growth?
- Does aeration create a temperature and dissolved oxygen environment that is conducive to fish habitat?
- Because aeration inhibits phosphorus settling and removal in lakes, how does aeration affect phosphorus removal and hence concentrations of phosphorus in the lake water column? How does aeration affect plankton concentrations and the risk of harmful algal blooms?
- What effect will reduced phosphorus have on lake clarity and hence aquatic plant growth?

All of these questions are interrelated and a good model is needed to answer them. Models are not perfect, but they can be used to better understand how lakes work and how different lake processes work together. Models can be used to understand the outcome of different management actions. Often the outcome is unanticipated and provides critical insight regarding the appropriate management actions.

tasks and activities

monitoring

We can make use of past monitoring data, however, additional data are needed. These include:

1. In-lake nutrients, temperature and dissolved oxygen
2. In-lake biota: aquatic plants, phytoplankton, and zooplankton
3. Stormwater inflows: phosphorus, TSS, VSS, temperature, DO

These data need to be collected during the same growing season. The in-lake data (nutrients, phytoplankton-chlorophyll *a*, temperature, and dissolved oxygen) need to be collected from the bottom of the lake to the surface of this lake, at 1-meter increments. These data are not collected as part of routine monitoring. Supporting data could include: (1) point-intercept survey for aquatic plant mass, (2) zooplankton-tow sample, and (3) phytoplankton (sample of the top 2 meters of the lake water column). These data would need to be collected when the aerator is not operating to allow for comparison with previous years in which aeration has been used.

The Schaper Pond stormwater monitoring (described in more detail in this proposal) will include the continuous flow measurements and composite sampling for water quality constituents during the growing season that will enable us to perform a comprehensive lake evaluation and calibrated modeling of the 2017 phosphorus budget.

modeling and data analysis

Given the complexity of the Sweeney Lake system (two basins, internal phosphorus release, large watershed) and potential management actions (aeration, alum treatment, etc.), we prefer to use a 3-dimensional model, meaning the model covers the entire lake surface and from the lake surface to the lake bottom. It models the entire lake at once. This model will be able to create a clearer picture of the fish habitat (with respect to oxygen and temperature) and the effect aeration and different climate conditions have on that habitat. This model will also be able to trace the movement of phosphorus from the inlet to the outlet, including mixing with the bottom of the lake with and without aeration. This model can also estimate the degree of phosphorus release from the bottom sediments and movement of that phosphorus from the bottom to the top of the lake surface. Finally, the model can also estimate the expected phytoplankton growth and zooplankton dynamics, with and without aeration, and under different management efforts (e.g., alum treatment) and/or climatic conditions.

The model, in combination with the historical and new monitoring data, can be used to generate water quality and physical outputs, which our fisheries biologist and aquatic plant experts can use to better understand the effect of aeration and different management actions on these important biota. For example, increased water clarity is valuable; however, this may also lead to increased aquatic plant growth. The model can also generate estimated clarity (Secchi disc) with the range of potential management activities. Barr's biologists can use the temperature and dissolved oxygen outputs to identify the best habitat for desired fish (e.g., walleye) and zooplankton species, which are important regulators of phytoplankton populations that can occupy lower oxygen areas of the water column not accessed by fish. This study will assess historical dissolved oxygen data to determine whether or not a zooplankton refuge occurs, with and without aeration, as well as whether there is a positive correlation between increased numbers of large-bodied zooplankton species and the thickness of a zooplankton refuge. Specific subtasks include:

1. Build model
2. Collect water quality monitoring data and qualitatively and quantitatively evaluate the data with respect to meeting TMDL goals, biota, and recreation.
3. Conduct modeling to evaluate the following scenarios, following calibration to the current baseline condition:
    a. With aeration and alum treatment of sediments
    b. Without aeration and alum treatment of sediments
    c. Range of climatic conditions that affect external phosphorus loading (combined with "a" and "b" above).
4. Overall assessment and project report:
    a. Examine MnDNR fisheries data
    b. Examine and qualitatively examine historical water quality and biological data
    c. Evaluate effect of different lake management actions on lake clarity, temperature and dissolved oxygen, as well as associated effects on aquatic plants, fish, and recreation.
    d. Complete draft and final versions of Sweeney Lake Aeration Study Report

citizen engagement process

This task will allow the Commission, member cities, MPCA, MnDNR and local stakeholders and citizens to be educated and provided with an opportunity for input on the project goals and objectives before the study is initiated, and the recommended management actions resulting from the water quality analyses.

Barr will work with the Commission administrator, City of Golden Valley staff and MnDNR staff to plan and execute a kickoff meeting with interested stakeholders and citizens, expected to occur as soon as possible in 2017, that will summarize/address the following agenda items:

- Summary of historical lake water quality monitoring data
- Implementation timeline of historical management actions
- MnDNR aeration permit requirements
- Preliminary goals/objectives of the aeration study
- Discussion/input

Following the completion of the 2017 water quality monitoring and Sweeney Lake modeling, Barr will work with the Commission administrator to develop a draft two-page fact sheet summarizing the results of the 2017 monitoring and Sweeney Lake aeration study. We will then meet with City of Golden Valley and MnDNR staff to plan and execute a follow-up meeting with interested stakeholders and citizens, expected to occur during the winter of 2017-2018, that will circulate the fact sheet and summarize/address the following agenda items:

- Summarize and compare 2017 monitoring to historical lake water quality monitoring data
- Recommend watershed and/or in-lake management actions
- Implications for MnDNR aeration permit requirements
- Discussion/input

subcontractors and laboratories

Not applicable.

budget and project timeline

As shown in Table 2, project costs for the Sweeney Lake Aeration Study are expected to range from $34,000 to $41,000, depending upon whether or not we prepare and deliver a presentation at a BCWMC meeting and participate in the citizen engagement process.

Table 2. Sweeney Lake aeration study budget and timeline

Activity	Est. Cost	Est. Schedule
Monitoring (Field Labor and Expenses)	$4,000	April – September 2017
Modeling and Data Analysis	$20,000	October 2017 – December 2017
Prepare Project Report	$10,000	December 2017 – January 2018
Prepare Presentation and Present Project Results at a BCWMC Meeting	$2,000	January 2018

Activity	Est. Cost	Est. Schedule
Citizen Engagement Process	$5,000	March 2017 & February 2018
Total	**$41,000**	

project deliverables

- Two public meetings
- Two-page fact sheet summarizing the results of the 2017 monitoring and Sweeney Lake aeration study
- Sweeney Lake Aeration Study Report
- Presentation of results of the Sweeney Lake aeration study to the Commission

references

In addition to the past Sweeney Lake water quality monitoring work and Sweeney Lake TMDL work that we performed for the BCWMC that you are familiar with, we offer the following additional project reference:

- **Project:** Ford Lake Aeration Study
  Client: Charter Township of Ypsilanti, Michigan
  Project description: available at https://www.barr.com/docs/Ford Lake.pdf
  Project report: available at https://www.barr.com/docs/Ford Lake aeration report.pdf
  Contact: Michael Saranen, Hydro Operations, 734-544-3690

Project #3: Schaper Pond effectiveness monitoring

introduction

The Barr approach to the Schaper Pond effectiveness monitoring will answer this important question—how has Schaper Pond's ability to remove pollutants been affected by the pond improvement project?

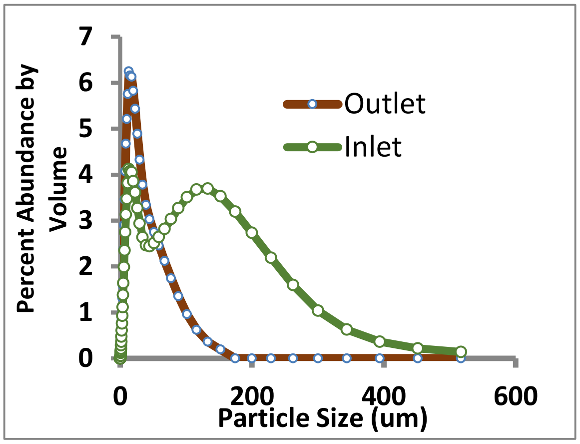
tasks and activities

For this project, Barr will repeat the monitoring program that we previously performed on the two major inlets and outlet from Schaper Pond, as part of the feasibility study we prepared on behalf of BCWMC. The 2017 monitoring results will be used to analyze changes in the pond's ability to remove pollutants since the completion of the pond improvement project.

Previously, Barr conducted intensive stormwater quality and flow monitoring to assess ways to improve treatment performance of Schaper Pond, which included:

- collection of continuous flows into and out of the pond
- storm event and baseflow autosampling to develop a more complete understanding of loads
- analysis of TSS, VSS, total and dissolved phosphorus, and particle-size distribution (graph, right)

A two-dimensional particle-settling model was developed in 2011 to determine if improved phosphorus removal would result from diversion of in-pond flows to a short-circuited pond area. Modeling and monitoring indicated that pond treatment performance could be improved by installation of an in-pond floating water baffle to protect Sweeney Lake from excessive, summer algal blooms. Technically, placing flow and water quality sampling equipment was difficult due to a drop structure; this challenge was addressed by suspending autosamplers on wires within the manhole. Barr understands that impeccable monitoring execution (no second chances if performed incorrectly) and careful selection of chemical parameters and sampling frequency will be crucial to control expenditures on this work.



Graph illustrates size of particles entering and leaving Schaper Pond and shows effective particle removal.

monitoring

For this project, Barr will install auto samplers, level sensors, and area velocity meters at the outlet of Schaper Pond, at the southern inlet (called Highway 55 inlet in the feasibility study), and the northern inlet (called Rail Road inlet in the feasibility study) to collect enough data to evaluate the phosphorus removal performance of Schaper Pond. Depending on the results of the monitoring, we expect that we may need to use the modeling we previously developed to evaluate why constituent removals are or are not meeting the expectations following the completion of Schaper pond modifications.

We assume that a total of six complete (e.g., samples collected simultaneously at both inlets and at the outlet) storm events will be monitored and analyzed for total phosphorus, total dissolved phosphorus, total suspended solids, and volatile suspended solids. For two events, samples will be analyzed for particle size distribution. Also, flow will be continuously measured for a three-month period during the summer of 2017. If dry conditions persist, as many as three sampling events of baseflow conditions will be conducted.

data analysis and reporting

Monitoring results will be analyzed and discussed in a project report, which will include a summary of the following information:

- Relative contributions of flow and phosphorus (total and dissolved) loadings to Schaper Pond from the Highway 55 inlet and the Rail Road inlet, as well as comparison with the Schaper Pond outlet. The results from 2017 will also be compared to the 2011 monitoring data.
- Relative contributions of solids (total and volatile) loadings to Schaper Pond from the Highway 55 inlet and the Rail Road inlet, as well as comparison with the Schaper Pond outlet. The results from 2017 will also be compared to the 2011 monitoring data.
- We will use the collected particle size distribution data to compare the removal of settleable particles entering Schaper Pond in 2017 to the same data collected in 2011. As discussed in the feasibility study, is expected that additional performance improvements will be achieved by removing particles less than 150 µm in diameter.

subcontractors and laboratories

This task will use Pace Analytical Laboratory, as described in the routine lake monitoring work scope.

budget and project timeline

As shown in Table 3, project costs for the Schaper Pond effectiveness monitoring are expected to range from $42,000 to $44,000, depending upon whether or not we prepare and deliver a presentation at a BCWMC meeting.

Table 3. Schaper Pond effectiveness monitoring budget and timeline

Activity	Est. Cost	Est. Schedule
Monitoring (Field Labor and Expenses)	$29,500	May – August 2017
Water Chemistry Laboratory Analyses	$2,500	May – September 2017
Data Analysis and Project Report	$10,000	September – November 2017
Prepare Presentation and Present Project Results at a BCWMC Meeting	$2,000	December 2017
Total	**$44,000**	

project deliverables

- Schaper Pond Effectiveness Monitoring Report
- Presentation of results of Schaper Pond effectiveness monitoring to the Commission

references

In addition to the Schaper Pond monitoring work we performed for the BCWMC that you are familiar with, we offer the following additional project reference:

- **Project:** Gervais Mill Pond and Owasso Basin stormwater treatment effectiveness monitoring
  Client: Ramsey-Washington Metro Watershed District
  Project description: available at http://www.rwmwd.org/index.asp?Type=B_BASIC&SEC=%7b98DCC988-714F-45B5-B95E-6DF192565329%7d&DE
  Project report: available at https://www.barr.com/docs/Gervais-Owasso report.pdf
  Contact: Cliff Aichinger, Board Manager, 651-238-4448

2. qualifications and experience of staff

project team

Over four decades of studying and caring for the water resources that the BCWMC manages will allow us to work with continuing efficiency and insight. With an average tenure at Barr of 24.25 years, many of whom began their careers working on BCWMC projects, the core team members profiled on the following pages reflect our commitment to long-term client relationships and preserving project knowledge. Full resumes are available upon request.

Karen Chandler will provide overall oversight and coordination for the projects, while Jim Herbert will serve as principal in charge. Meg Rattei will serve as the project manager for the routine lake monitoring program project, while Greg Wilson will serve as the project manager for Schaper Pond effectiveness monitoring and the Sweeney Lake aeration study projects.

Role: principal in charge

Jim Herbert, PE; Vice President, Senior Civil Engineer
BS, Civil Engineering

Jim has over 30 years of experience, primarily in water resources management. He has managed projects related to urban stormwater management, construction administration/management, environmental compliance and dam and tunnel rehabilitation. He has served the BCWMC since 1986. Jim will serve as principal in charge for the BCWMC's 2017 water quality monitoring projects. In addition to his overall quality control role for the BCWMC, his work includes providing assistance to the Schaper Pond Improvement Project, which was substantially completed in 2015.

Role: overall project oversight and coordination

Karen Chandler, PE; Senior Water Resources Engineer
MS, Civil Engineering

Karen has nearly 30 years of experience in water resources management and planning. Her experience also includes overseeing hydrologic, hydraulic, and water quality analyses and the design and construction of stormwater projects; assisting with community relations and public presentations; and facilitating public processes.

Karen has served the BCWMC since 1999. Karen will oversee the BCWMC's 2017 water quality monitoring projects to help the projects meet the BCWMC's goals. She will also provide facilitation support for the public education and outreach component of the Sweeney Lake Aeration Study project. In addition to her overall project management work for the BCWMC, her work includes assisting the BCWMC and the City of Golden Valley in obtaining permission from state agencies to move ahead with construction of the Schaper Pond Improvements Project: and managing the Schaper Pond Improvement Project, which was substantially completed in 2015.

Role: project manager for Schaper Pond monitoring and Sweeney Lake aeration study projects

Greg Wilson, PE; Sr. Water Resources Engineer
MS, Civil Engineering

Greg will manage and provide day-to-day coordination of the Sweeney Lake aeration study and the Schaper Pond effectiveness monitoring. He has more than 25 years of experience that includes water quality modeling, TMDL/WRAPS preparation and reporting, GIS, limnology, water resource design applications, watershed and lake management planning, and public education and outreach. Greg has been **helping the BCWMC with their water quality initiatives since 1993,** including:

- Reviewing and commenting on Medicine Lake and Sweeney Lake TMDL studies. Assisted Commission with technical conversations with the MnDNR regarding aeration permit reissuance for Sweeney Lake.
- Managing preparation of a watershed-wide water-quality model, which updates the P8 urban catchment model water-quality models throughout the watershed.
- Consulting to assess chloride, bacteria and fish bioassessment impairments in Bassett Creek and excess nutrients in Northwood Lake.
- Completed watershed and lake management plans for Parkers, Medicine, Turtle, Wirth and Crane Lakes, and Grimes, North Rice and South Rice Ponds.

Role: project manager for routine lake monitoring project

Meg Rattei; Senior Biologist
BA, Biology

For the routine lake monitoring project component, Meg will manage and provide day-to-day coordination. Meg has 41 years of experience that includes managing lake and stream water-quality studies for several WMOs within the Twin Cities metropolitan area; completing watershed and in-lake modeling; diagnosing lake and stream problems; completing aquatic plant management plans; conducting biological stressor identification analyses; assisting with implementation of management practices, and completing analyses of phytoplankton, zooplankton, and macroinvertebrate samples. She has **provided water-quality related services to the BCWMC for 41 years**, including: performing and managing BCWMC lake and stream monitoring studies since 1974 and stream biotic index studies since 1980; performing P8 water quality modeling of Bassett Creek watersheds; and managing the Twin Lake sediment study.

Role: technical lead for Schaper Pond monitoring and Sweeney Lake aeration study projects

Keith Pilgrim, PhD; Senior Water Resources Scientist
PhD, Water Resources Science; MS, Environmental Management

Keith's 15 years of experience have involved water-quality modelling, BMPs, development and implementation of water monitoring work plans, nutrient management, stormwater treatment and hydrology, NPDES permitting, aquatic chemistry, and toxicology. He also designs and implements surface-water-quality monitoring programs for urban environments. His **work for the BCWMC over the past 10 years** includes preparing the Schaper Pond feasibility study, which included monitoring the pond inflows and outflows, modeling the particle size distribution, and modeling the potential effectiveness of an in-pond diversion to improve water quality treatment; conducting the stormwater modeling and modeling of Sweeney Lake as part of the Sweeny Lake TMDL study; and managing preparation of the Twin Lake water-quality improvement options study and developing alum doses for the Twin Lake alum treatment.