LCCMR Comparative Comprehensive Wastewater Pond Testing

Legislative-Citizen Commission on Minnesota Resources

MN Pollution Control Agency

Grant # 148605

June 29, 2020

Regents of the University of Minnesota

On behalf of Minnesota Technical Assistance Program

McNamara Alumni Center

200 Oak Street, SE, Suite 350-1

Minneapolis, Minnesota 55455-2070

Section A: Project Management Elements

Section A.1: Approvals

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Section A.3: Distribution List

The listed individuals will receive copies of the approved QAPP and subsequent revisions, if applicable:

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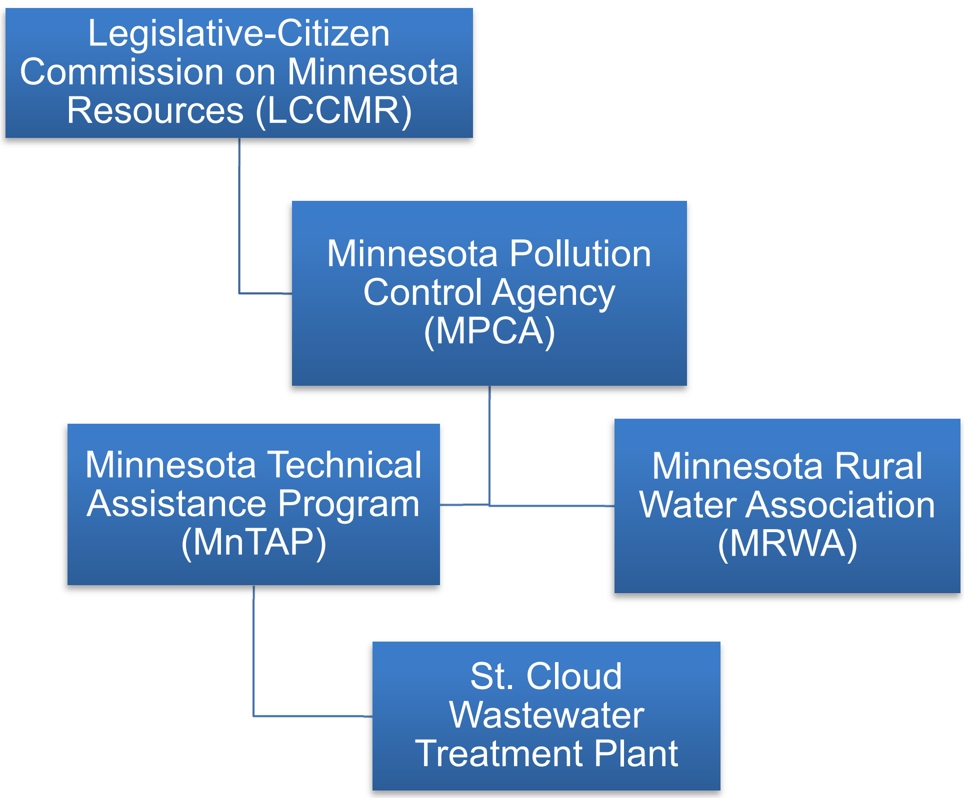
Section A.4: Project and Task Organization

The Minnesota Technical Assistance Program (MnTAP) will conduct project management for the Legislative-Citizen Commission on Minnesota Resources (LCCMR) through the NEW Recovery Facility Nutrient Optimization grant. The funding organizational structure for the project responsibilities is shown in Figure 1.

The following sections will detail the organization, responsibilities, and lines of communications for each of the personnel involved with the project surrounding the subject of quality assurance and quality control.

FIGURE 1: FUNDING ORGANIZATIONAL CHART



Section A.4.1: The MnTAP Grant Manager

The MnTAP Grant Manager will:

- Provide administrative direction to assigned staff and partners as needed.
- Manage the budget to assure that goals are met and funds and resources are responsibly allocated.

- Provide direct supervision and project assignment to assigned staff.
- Serve as primary contact with the Minnesota Pollution Control Agency (MPCA).
- Oversee the preparation of project summaries for the MPCA including updates on results, a financial report, measurable benchmarks, discussions of problems encountered during sampling or analysis, and recommended changes in procedures.
- Provide technical direction for the preparation of work plans and the tasks to be performed.

Section A.4.2: MnTAP Project Lead

The MnTAP Project Lead will:

- Provide administrative direction to assigned staff as needed.
- Implement the elements of the Project
- Manage the budget to assure that goals are met and funds and resources are responsibly allocated.
- Review, approve and maintain the QAPP, including subsequent revisions.
- Follow up with participating companies to document impacts of implementation of solvent replacement.
- Provide technical representation at meetings.
- Lead and oversee data review.
- Finalize the final report.

Section A.4.3: St. Cloud NEW Recovery Facility Laboratory

The St.Cloud NEW Recovery Facility laboratory (the Laboratory) will:

- Be responsible for laboratory analysis of samples collected for their review.
- Hold samples in proper conditions to be potentially released to a secondary laboratory for further analysis.
- Conduct all calibrations necessary for equipment prior to analysis.
- Maintain proper quality assurance (QA) and quality control (QC) procedures.
- Maintain Minnesota Pollution Control Agency (MPCA) accredidation

Section A.4.4: Minnesota Rural Water Association (MRWA)

The Minnesota Rural Water Association (MRWA) will:

- Be responsible for conducting quality assurance (QA) on the site.
- Conduct all field sampling.
- Manage all samples under proper chain-of-custody (COC) before delivering samples to the Laboratory.

Section A.4.5: Minnesota Valley Testing Laboratories, Inc. (MVTL)

The Minnesota Valley Testing Laboratory (MVTL) will:

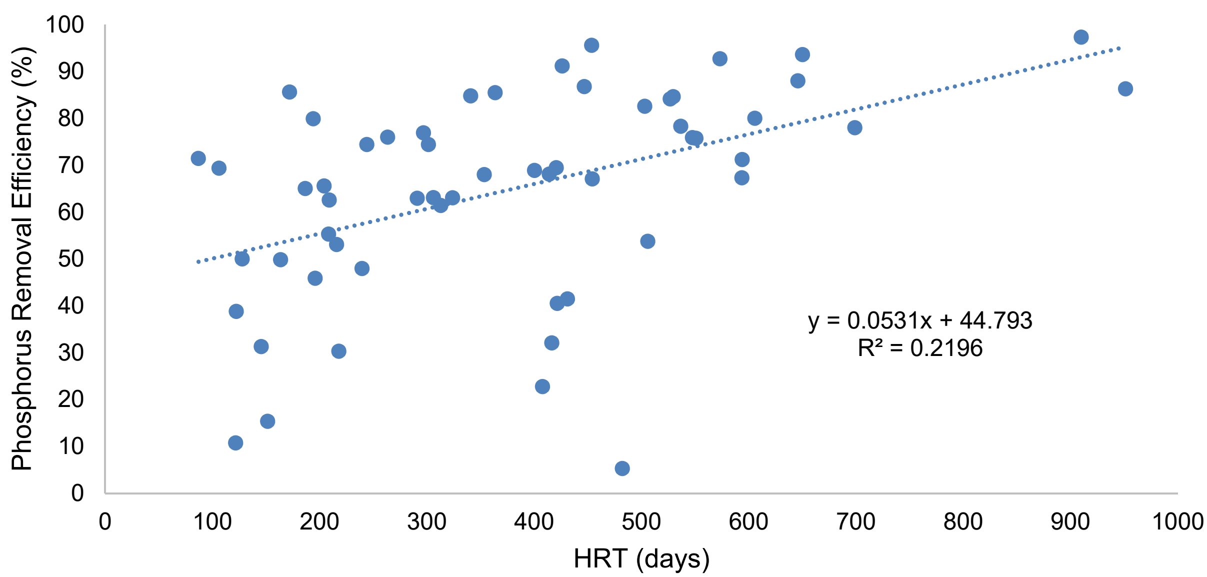
- Be responsible for laboratory analysis of samples collected for their review.
- Store samples in proper conditions.
- Conduct all calibrations necessary for equipment prior to analysis.
- Maintain proper quality assurance (QA) and quality control (QC) procedures.
- MVTL is not certified by Minnesota Pollution Control Agency (MPCA)

Section A.5: Problem Definition and Background

A portion of the funding for the LCCMR Small Wastewater Treatment Plant (WWTP) Nutrient Removal Optimization grant is dedicated towards wastewater treatment pond systems. These systems are typically located in small municipalities, and generally serve less than 5000 people. The systems that the project team has worked with so far have consisted almost exclusively of three-celled facultative pond systems that have seasonal discharges to a receiving waterbody. Many of these ponds struggle with phosphorus removal, and have limited options as far as adjusting operations in order to improve or optimize removal. Through an extensive correlation analysis examining 41 parameters across 327 facultative pond systems in the state of Minnesota, the MnTAP team found that one of the only informative, statistically significant correlations was between phosphorus removal efficiency and hydraulic residence time (HRT). This was not a very surprising finding, and the fact that the longer wastewater is treated, the better the treatment will be, is intuitive and expected. While this correlation did encourage the project team to recommend maximizing the holding time of water within the ponds, it had limited utility, as many ponds that are struggling with poor phosphorus removal efficiencies already are running close to their theoretical maximum HRT, and cannot conduct complete overhauls of these treatment systems.

Upon applying a linear regression on the phosphorus removal efficiencies versus the HRTs of 57 pond systems in the state of Minnesota, the MnTAP team confirmed that the correlation between phosphorus removal efficiency and HRT was positive, and could be roughly represented by the equation shown in Figure 2, which displays the regressed data.

FIGURE 2: REGRESSION OF HRT VERSUS PHOSPHORUS REMOVAL EFFICIENCY FOR 57 FACULTATIVE POND SYSTEMS



While the relationship displayed in Figure 2 is certainly meaningful, there is a great amount of dispersion around the trendline; some ponds that have low HRTs have excellent phosphorus removal, while some ponds that have higher HRTs have poor phosphorus removal. Therefore, the MnTAP team concluded there had to be other factors that significantly influenced phosphorus removal in facultative pond systems besides HRT. In order to elucidate these factors, the project team has deemed it prudent to conduct a comprehensive testing regime on six pond systems with below average HRTs, three of which have poor phosphorus removal efficiencies, and three of which have excellent phosphorus removal efficiencies. This testing regime will involve quarterly sampling for an exhaustive list of parameters, from multiple points through the pond, spread both vertically through the water column, and horizontally at different locations around the system. Once this data has been collected and compiled, the project team will be able to analyze trends in the data, and identify specific parameters that may differ from ponds with poor phosphorus removal to ponds with good phosphorus removal. Once these critical parameters have been identified, strategies will be developed to modify operation or somehow adjust the parameters in the poorly performing ponds to fall in the ranges that have been found to be critical for effective phosphorus removal.

Section A.6: Project Description

MRWA will collect water samples from vertical water columns in various wastewater ponds and effluent channels between the ponds to characterize the water quality and microbial communities present in the various settings and depths. Sludge samples will also be collected from the solids at the bottom of the ponds to further characterize the micorbes in the solid material. If time allows, further Sonde readings will be collected around the pond to get spatial characterization of the ponds. The sampling program is not part of any regulatory program and data will not be compared to any state or federal action levels.

Section A.7: Quality Assurance Objectives

This testing serves to compare various wastewater parameters between wastewater ponds with good treatment and poor treatment in order to find practical differences that can be used to promote better treatment in wastewater ponds. Members of the planning team can be found in Table 1. Jon Vanyo is MnTAP's Project Lead and will have authority on final decisions made.

TABLE 1: MEMBERS OF PLANNING TEAM

Member	Organization
Joel Peck	Minnesota Pollution Control Agency (MPCA)
Tim Hagemeirer	Minnesota Rural Water Association (MRWA)
Frank Stuemke	Minnesota Rural Water Association (MRWA)
Lori Blair	Minnesota Rural Water Association (MRWA)
Rocio Durkot	St. Cloud NEW Recovery Facility (St. Cloud WWTF)
Emma Larson	St. Cloud NEW Recovery Facility (St. Cloud WWTF)

Tracy Hodel	City of St. Cloud
Laura Babcock	Minnesota Technical Assistance Program (MnTAP)
Jon Vanyo	Minnesota Technical Assistance Program (MnTAP)
Joshua Kirk	Minnesota Technical Assistance Program (MnTAP)
Daniel Chang	Minnesota Technical Assistance Program (MnTAP)
Taylor Borgfeldt	Minnesota Technical Assistance Program (MnTAP)

The research objective is to characterize water quality in wastewater treatment ponds to then recommend optimization techniques to enhance biological nutrient removal without adding infrastructure to the pond system. The characterization of the various pond's water quality will be collected through water sampling, water quality measurements and sludge blanket samples (Section B: Data Generation and Criteria). To understand how weather affects water quality and conditions of microbial communities, field campaigns are planned once per season for one year, sampling in the summer, fall, winter and spring.

The deadline for the Project is June 2021. All samples and analysis will be completed prior to the deadline and a final report will be issued to the LCCMR team. The resources readily available for the project include established staff members at each organization and MRWA vehicles to transport field staff and watercraft. Historical data for each facility will be accessed through the MPCA's Wastewater Data Browser (https://www.pca.state.mn.us/data/wastewater-data-browser).

During sampling events, water quality parameters that will be measured with a Sonde include turbidity, dissolved oxygen (DO), pH, oxidation reduction potential (ORP), specific conductance (Spec. Cond.), nitrate and ammonia. For a complete list of analytes, refer to Table 7 and Table 8.

The sampling will be conducted at six wastewater pond treatment facilities once during each season from summer, fall, winter and spring. The locations of the sampling itself will be located in the center of each pond as a vertical sampling column, as well as at the influent, effluent, and all transfer structures. If time allows, additional water quality readings will be collected in center of the north, south, east and west sides of the ponds (Figure 3).

There are no decision rules for this project since it is a research investigation. Tolerable limits are not applicable because there is no decision rule for the project.

Design of the sampling and data acquisition process has been reviewed by at least four individuals, not all from the same organization, and has been mutually accepted as sufficient. Parameters all are important to quantify, and decreasing the number or diversity of samples could adversely impact the outcome of the study.

Section A.8: Specialized Training and Certifications

Section A.8.1: Field

Personnel assigned to the Task 2 Site Assessments will meet the educational, work experience, responsibility and training requirements for their positions. At a minimum, the field personnel and those visiting the sites will review the Project QAPP and safety documentation. Prior to conducting field work, all field personnel will have a Heptitis A vaccination. Tim Hagemeier will be the Safety Lead for MRWA while conducting sampling.

Section A.8.2: Laboratory

The Laboratory staff will be appropriately trained and certified based on the facility standards at the City of St. Cloud NEW Recovery Facility.

Section A.9: Documentation and Records

Daily field forms will be completed by field personnel and will be kept in their possession until providing the hardcopies to MnTAP for storage of records. Blank field documents can be found in Appendix 1: . During sampling (see Section B: Data Generation and Criteria) specified field parameters are recorded on paper as an abbreviated backup to digital data recorded on the data logger. All hard copies of field forms will be kept by MnTAP through the end of the grant program.

For both profiling and sampling accompanied by bottle filling, the EXO Sonde will record data in continuous mode. For sampling, measurements by the Sonde will automatically be averaged over 1 second periods, and recorded in the internal memory of the EXO Handheld device as well as in the internal memory of the Sonde. Templates for sampling and profiling will be established before the first deployment, and edited between each pond sampling within a pond system. Table 2 below shows the deployment settings for each sampling type. The settings will be adjusted using the EXO software on a laptop. This program will also be used to deploy the sonde to start taking measurements. When taking water samples using the submersible pump, the time each sample bottle was sealed will be recorded on the label of the bottle. This time will be used to reference the data collected by the Sonde, which will inherently be time-stamped. Therefore, the time recorded on each sample bottle should match the time in the sonde software. When the data is extracted after each sampling day it will be in aggregate form. However, when the water samples are processed, the Sonde data can be parsed to correspond to each sample bottle. Because multiple sample bottles will be collected per sampling point, the data for each sampling point will be averaged from the Sonde data surrounding many sample bottles. The first value that should be used in this average should be the Sonde data point that is time-stamped immediately after the time on the first bottle collected at the sample point. The last value that should be used in the average should be the Sonde data point that is immediately proceeding the time written on the last bottle collected at the sample point. This should result in representative values for the water conditions at the sampling points that are less susceptible to random variation or outliers than if only one discrete data point was collected for each sampling point.

TABLE 2: SONDE DEPLOYMENT SETTINGS

Deployment Type	**Sampling**	**Profiling**
Deployment Template Name	“Sampling”	“Profiling”
Logging Interval Time	1	1
File Name Prefix	“Sampling_*PondSystemName_Pond#_Season*”	“Profiling_*PondSystemName_Pond#_Profile#_RorL_Season”*
Site Name	“*PondSystemName*”	“*PondSystemName*”
User Name	“*User*”	“*User*”
Logging Mode	Normal	Normal
System-wide Averaging Mode	DEFAULT	ACCELERATED/RAPID

**Items written in italics are to be replaced with the appropriate name or identifier.*

For the profiling deployments, the pond number is not a specific-enough identifier, as there will be multiple profiles taken per pond in a pond system. Therefore, we have introduced a profile number, as shown in

Figure 65. This numerical format is applicable to every pond, with 1 corresponding to the center profile, 2 to the north profile, 3 to the east profile, 4 to the south profile, and 5 to the west profile. Each profile will also be done off the right (R) and left (L) side of the boat. Profiles off the right side will be done with the ammonium sensor attached to the Sonde, while profiles off the left side will be done with the nitrate sensor attached to the Sonde.

For the tracer testing process, deployment will be initiated immediately before the Sonde is submerged in the pond and stopped at the end of the sampling run. Because the Sonde records time, GPS coordinates as well as depth, a three-dimensional model of the pond can be created.

Data should be retrieved from the handheld device after every sampling day via the KorEXO software. Data should be exported in a CSV format, saved locally on the computer running the KorEXO software, and sent to MnTAP project partners that same day via email attachment or Google Drive if the file is too large.

Section B: Data Generation and Criteria

Section B.1: Sampling Process Design

WWTP pond surface water sampling will be conducted to characterize the spatial and depth-dependent attributes of the water conditions and bacterial colonies present. To characterize the seasonal dependency of various conditions, the sampling program will conduct a total of four (4) instances for each pond system, in the summer, fall, winter, and spring seasons respectively. Daily weather conditions will be accounted for with a temporary weather station. Parameters, as specified in the Appendix 1: Standard Operating Procedures – Field Data Collection, will be collected at the beginning, middle and end of the workday.

To best characterize the most stable conditions of the individual ponds, a sequence of vertical water samples will be collected at the center of each pond. Pond water samples will be collected at the intervals shown in Table 3 with 25 water samples collection points per three-pond site, plus two duplicate sample collection points. The spatial and depth distribution of the sampling scheme is shown in Table 3. All water samples will be grab samples using a submersible pump. Grab samples are appropriate to characterize the conditions at discrete locations and depths.

Water sample depths will be taken at 1/6, ½, and 5/6 of the total depth. Additional samples will be taken at 3'' intervals from the bottom of the pond. Please note that this will typically result in two samples with overlapping depths. If two samples have depths within 3'' of one another, adjust the first duplicate to 3'' above the next sample depth, as shown in Table 3: Sample Depths.

TABLE 3: SAMPLE DEPTHS

Sampling Label	Sampling Depths	72" Pond	72" Pond, Adjusted	36" Pond	36" Pond, Adjusted
Depth 1	TD * 1/6	12	12	6	6
Depth 2	TD * 1/2	36	36	18	18
Depth 3	TD * 5/6	60	57	30	21
Depth 4	TD – 12''	60	60	24	24
Depth 5	TD – 9''	63	63	27	27
Depth 6	TD – 6''	66	66	30	30
Depth 7	TD – 3''	69	69	33	33

In addition to water samples, sludge solids samples will be collected at the bottom-center of each pond using a Sludge Judge ®.

Section B.2: Tracer Testing Design

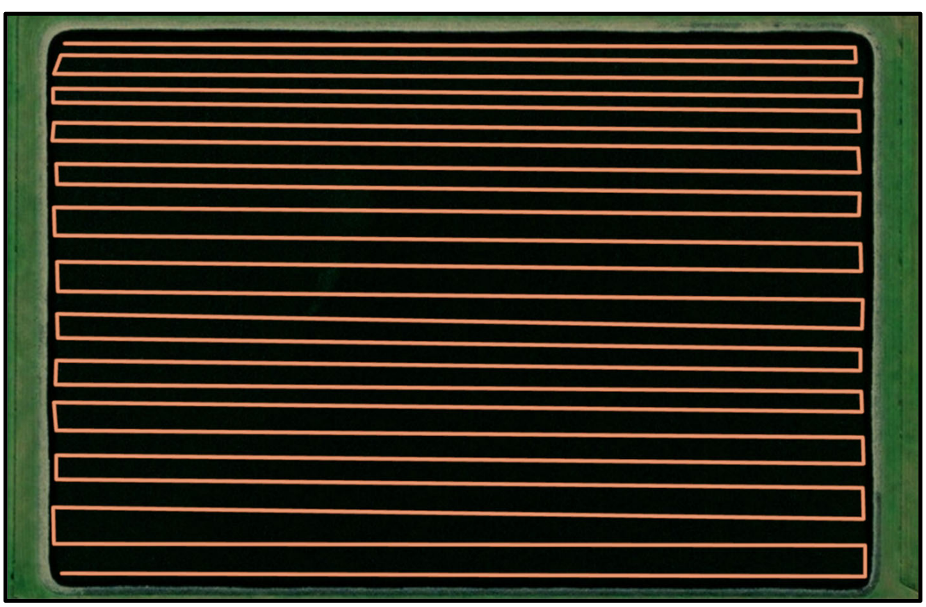
A secondary field investigation will be a tracer test to collect data on the mixing in the various pond systems. The purpose of the tracer test is to elucidate any bias in flowpaths through the pond systems.

If the ponds are observed to be less homogeneous that expected, this is an indication that their actual hydraulic residence time (HRT) is lower than what we would expect using a completely mixed assumption. Tracer testing will be conducted in each pond within each pond system using Rhodamine WT dye and a Rhodamine probe outfitted on the EXO Sonde. Rhodamine tracer will be released in a “pulse” to each pond, either through the transfer structures or the influent pipe to the first primary. If the influent pipe and/or transfer structures are not accessible, the tracer will released as close to the inlet pipes as possible. In order to prevent cross-contamination of Rhodamine from one pond to the next, tracer testing will be performed first at the last pond in series, and subsequently at the second and first primaries, in that particular order. This order is necessary because we will be running a small amount of water through the transfer structures from the previous pond in order to inject the tracer. If the upstream pond had already been dosed with Rhodamine, we could see carryover into the downstream pond.

The sampling procedure for measuring the presence of Rhodamine in the ponds after injection will consist of setting the Sonde on a continuous monitoring mode, and snaking the boat throughout the pond to get full coverage. This snaking will occur by trolling slowly through the pond while raising and lowering the Sonde continuously, in order to get a full picture of the Rhodamine concentrations both laterally and vertically throughout the waterbody. An example of the snaking pattern can be seen in Figure 6. It is intentionally irregular, as the actual sampling path will not be pre-prescribed. The Sonde Handheld device has a GPS function, so all sample points will be geo-tagged, and can be overlayed on a map of the pond afterward. The Sonde also measures depth. The horizontal and vertical measurements of tracer will allow for a 3D visualization of the Rhodamine concentrations in the pond, which will allow for a better understanding of flow bias in the systems. The path intentionally runs along the longer axis of the pond. For each pond system, the longer side of the pond should be determined, and the tracer detection sampling path should run with the long axis of the pond.

Tracer testing will only occur once over the one year test period and is planned for Spring 2021.

FIGURE 3: EXAMPLE OF TRACER DETECTION SAMPLING PATH



Section B.3: Sampling Method Requirements

Field personnel will conduct the sampling for all surface water and sludge solid samples. The MRWA staff will stop work and contact the MnTAP Project Lead if something arises during sampling that requires corrective action. Field personnel will use appropriate personal protective equipment (PPE): nitrile gloves, safety glasses or goggles, personal flotation devices, and rubber or dedicated boots, along with suggested PPE such as a protective face mask or splash-proof face shield and liquid-repellant clothing.

Field sampling will follow the Standard Operating Procedures attached as Appendix 1: Standard Operating Procedures – Field Data Collection. Sampling will follow lab specified management including preservation of samples on ice. All samples will be analyzed for the analytes listed in Table 5.

A sonde will be used to collect water quality readings at sample points and distributed points around each pond. The readings will include turbidity, dissolved oxygen (DO), specific conductance, temperature, pH and oxidation reduction potential (ORP). The readings are to characterize the surface water before sampling and do not need to reach any stabilization criteria.

After water samples have been taken for each pond, water samples will be taken of the influent, effluent, and of the wastewater flowing through the transfer structures between ponds. If water is not actively being transferred, the operator will allow a small amount of water to flow for a short period of time to allow for sampling to occur. If there is a convenient access point to sample the influent before it meets the pond, then the influent sampling will occur there. If not, influent sampling will occur at the closest accessible point to the influent pipe. Similarly, if effluent is being discharged, sampling should be conducted at the outfall. However, if discharge is not occurring, effluent sampling will occur at the closest accessible point to the effluent pipe. These samples should be taken at half of the total depth of the water being sampled. If feasible, the submersible pump will be used to collect a grab water sample. If the sampling point is not conducive to using a submersible pump, field personnel may use a grab sampler.

Upon completion of the sampling, the MRWA staff will deliver the coolers with samples on ice to the St. Cloud Laboratory. There is no requirement to notify the MPCA of the sampling program.

FIGURE 4: AERIAL VIEW OF PONDS AND TRANSFERS SHOWING SAMPLE NUMBERS AND LOCATIONS

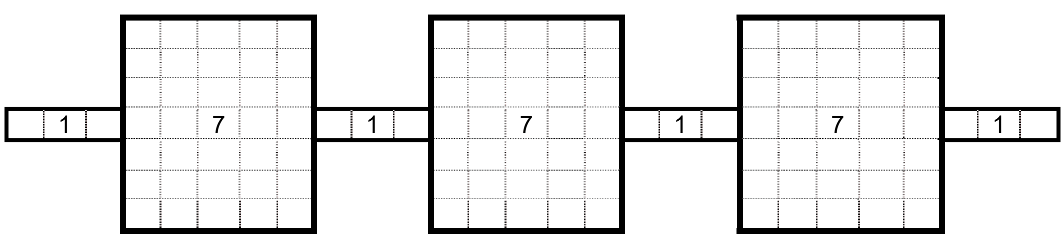


FIGURE 5: CROSS-SECTIONAL VIEW OF BASIC SAMPLING SCHEME FOR 6 FT. POND

Depth (ft)	Surface of Pond
0.25	
0.5	
0.75	
1	X
1.25	
1.5	
1.75	
2	
2.25	
2.5	
2.75	
3	X
3.25	
3.5	
3.75	
4	
4.25	
4.5	
4.75	X
5	X
5.25	X
5.5	X
5.75	X
6	

FIGURE 6: AERIAL VIEW OF SONDE MEASUREMENTS

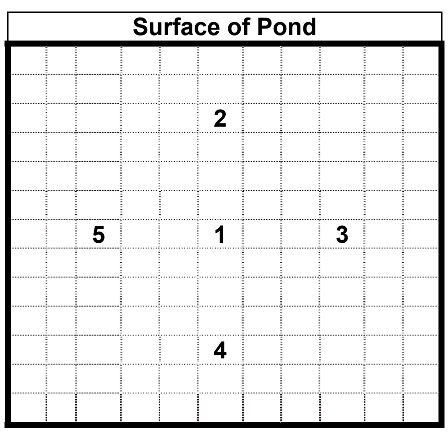


TABLE 4: EQUIPMENT NEEDED FOR SAMPLING

- 5-gallon bucket
- Grab sampling device
- High-density polyethylene (HPDE) tubing
- Ice
- In-line water filters
- Sample cooelrs
- Sludge Judge ®
- Sonde and data logger
- Submersible pump with portable battery
- Watercraft

TABLE 5: AQUEOUS - BOTTLES, VOLUME, HOLDING TIME AND PRESERVATION

Set #	Analyses	Preservation	Field Filter	Number – Type of Bottles	Shortest Holding Time	Turnaround Time	Laboratory
1	• Ammonia (NH_3) • Chemical Oxygen Demand (COD) • Nitrogen, Total Kjeldahl (TKN) • Nitrogen, Nitrate + Nitrite • Phosphorous, Total	H_2SO_4 Thermal	No	1 – 1L HDPE	28 days	28 days	St. Cloud
2	• Phosphorous, Ortho	Thermal	Yes	1 – 125mL HDPE	48 hours	28 days	St. Cloud
3	• Solids, Total Suspended (TSS)	Thermal	No	1 – 1L HDPE	48 hours	28 days	St. Cloud
4	• Carbonaceous Biochemical Oxygen Demand (CBOD) • Alkalinity	Thermal	No	1 – 1L HDPE	48 hours	28 days	MVTL
5	• Hardness	Nitric Acid Thermal	No	1 – 500mL HDPE	180 days	TBD	MVTL
6	• 16S rRNA (total bacteria) • amoA • nirK • nirS • nosZ (clades 1 and 2) • hzsA	Thermal	No	1 – 50mL plastic centrifugal tubes	48 hours	1 – 7 weeks	LaPara Laboratory

TABLE 6: SOLIDS - BOTTLES, VOLUME, HOLDING TIME AND PRESERVATION

Set #	Analyses	Preservation	Number – Type of Bottles	Holding Time	Turnaround Time	Laboratory
1	• Ammonia (NH_3) • Chemical Oxygen Demand (COD) • Nitrogen, Total Kjeldahl (TKN) • Phosphorous, Total • Phosphorous, Ortho • Total Nitrate	Thermal	1 – 1L HDPE	7 days	28 days	St. Cloud
2	• Carbonaceous Biochemical Oxygen Demand (CBOD) • Metals • Total Solids (TS)	Thermal	2 – 1L HDPE	48 hours	TBD	MVTL
3	• 16S rRNA (total bacteria) • amoA • nirK • nirS • nosZ (clades 1 and 2) • hzsA	Thermal	1 – 15mL plastic centrifugal tubes	48 hours	1 – 7 weeks	LaPara Laboratory

Section B.4: Sample Handling and Custody

A standardized sample identification format will be used that include site abbreviation, pond number or location and sampling depth. The basic format is: LOC_POND#_DEPTH, which stands for location, pond number, and depth. An example would be B-P1-D1-YYMMDD for Balaton, Primary1, depth 1. Replicate samples will be blind to the Laboratory and named chronologically with the basic format of Dup_##.

Rural Water personnel will collect the samples (see Section B.2: Sampling Method Requirements), immediately place the samples on ice in a cooler, and deliver the samples directly to the Laboratory. Samples will be hand delivered by MRWA to the Laboratory, and therefore, do not need to be in sealed coolers. To maintain chain-of-custody, the samples will remain within view of the sampler(s) or secured within a locked area at all times until signed over to the Laboratory. When samples change custody between MRWA to the Laboratory, both parties will sign and date the Chain-of-Custody (COC) form. MRWA will take a picture of the form at the time of delivery and the Laboratory will keep the hard copy of the COC. The COC will have a place for signature, time and date for exchange of custody between parties. Field notebooks will include forms that include the following: Daily Activity, Daily Safety, Daily Calibration, Sample Log, and Chain-of-Custody. The COC is attached in Appendix 1: Field Forms.

Section B.5: Health and Safety

Health and Safety procedures will follow the guidelines in Appendix 1: Standard Operating Procedures – Field Data Collection and the PPE listed in Section B.3: Sampling Method Requirements and Appendix 1: Standard Operating Procedures – Field Data Collection.

Section B.6: Analytical Methods Requirements

Rocio Durkot, the Lab technician at St. Cloud WWTF Laboratory, is responsible for corrective actions at the laboratory. Staff will adhere to the Laboratory's Quality Assurance Manual procedures. The analytical methods, U.S. Environmental Protection Agency (US EPA) method numbers, and the Laboratory standard operating procedures (SOPs) are listed in Tables 7 and 8.

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TABLE 7: ST. CLOUD METHOD NUMBERS

Analyte	US EPA Method Number	Laboratory SOP Number
Ammonia (NH_3)	EPA Method 350.1	17
Chemical Oxygen Demand (COD)	Hach Method 8000	6
Nitrogen, Nitrate + Nitrite	Hach Method 10206	2
Nitrogen, Total Kjeldahl (TKN)	Hach Method 10242	2
Phosphorous, Ortho	Hach Method 8084 SM 4500-P E	3
Phosphorous, Total	EPA Method 365.3 SM 4500 P E	20
Solids, Total Suspended (TSS)	SM 2540 D	20

TABLE 8: MVTL METHOD NUMBERS

Analytical Method Name	US EPA Method Number	SOP number
Ammonia (NH_3)	SM 4500-NH_3 B/C	40-25006
Carbonaceous Biochemical Oxygen Demand (CBOD)	SM 5210 B	40-21003
Chemical Oxygen Demand (COD)	EPA 410.4	40-23011
Hardness	MVTL – Calculated method, SM2340B	TBD (MVTL)
Metals	EPA 6010B / 6020	40-24011 40-24006
Nitrogen, Total Kjeldahl (TKN)	SM 4500-N_3 B/C	40-25010
Phosphorous, Ortho	EPA 365.1	40-22006
Phosphorous, Total	EPA 365.1	40-22006
Solids, Total (TS)	SM 2540 B	40-21004
Total, Nitrate (N + N)	EPA 353.2	40-22001

Section B.7: Quality Control Requirements

Replicate samples will be collected at a rate of one duplicate per ten normal water samples collected.

Section B.8: Instrument and Equipment Testing, Inspection, and Maintenance

The protocols for testing, inspection, and maintenance of laboratory equipment are addressed in the Laboratory. Additionally, the Laboratory's standard operating procedures (SOPs) present the specific protocols to be followed as part of the analysis for the project. A preventative maintenance program has been instituted employed by the laboratory. In general, the preventative maintenance is performed on a scheduled basis on all instruments in the laboratory. The preventive maintenance performed is documented in logbooks kept at the instrument. Irregularities noted during operations are traced through the maintenance logbook to allow for efficient corrective action to solve problems. Analysts are trained in preventive maintenance of their assigned instruments. The laboratory utilizes in-house service technicians in the event of instrument failures.

The field equipment will be inspected and maintained according to factory recommendations. Documentation will be kept to record any inspections and maintenance that occurs. Equipment will be tested at the beginning of each sampling day to ensure functionality.

Section B.9: Instrument Calibration and Frequency

The calibration procedures followed by the Laboratory are outlined in the Laboratory SOPs. The basic procedure for the analyses is to calibrate the analytical instruments at the levels expected to be found in the project.

Prior to sampling, all equipment and instruments will be inspected and checked using the manufacurer's manual or relevant SOP. Field equipment will be calibrated daily before any sampling begins. The calibrations will be recorded for each instrument on a Daily Calibration Log. If the instrument reads zero or a negative value for DO, pH, specific conductance or turbidity (zero value only) during sampling or while in use, the instrument will have a calibration check. A calibration check is performed while in measurement mode to ensure instrument is functioning properly. If there are issues with the readings, the instrument will be recalibrated.

Section B.10: Requirements for Supplies and Consumables

Field personnel will inspect all supplies and consumables for integrity and suitability for use. Any supply or consumable judged to be of inferior quality or not suitable for the intended use will be rejected. All consumables found to be contaminated will be removed from use. All chemicals and solvents used in the Laboratory will be inspected to verify that they are of the appropriate grade for their intended use.

Section B.11: Data Acquisition Requirements for Non-direct Measurements

Historical data will not be used in this project.

Section B.12: Data Management

Internally, each agency and/or company will store all data in their own database. A final report with compiled and summarized field and analytical data will be provided to the MPCA upon the completion of the grant. The report will be reviewed and approved by MnTAP staff before submittal.

Section C: Assessment and Oversight

Section C.1: Assessment and Response Actions

MnTAP staff will conduct an assessment to determine whether the Project QAPP was implemented as approved. These assessments will review the policies and implementation of the policies in the field and at the Laboratory. Any discrepancies will be identified and corrected. If problems occur or corrective action is initiated, the MPCA will be contracted immediately for assistance in corrective actions.

Section C.2: Reports to Management

For each activity employed in this Project, staff will track the performance during the project. When an issue is found to be out of control, Corrective Actions (CA) will be implemented. Corrective actions can and will include re-sampling, re-analysis of samples, flagging of data, or rejection of the data. MPCA will be informed of any major CA that is performed on any sample.

Section D: Data Validation and Usability

Section D.1: Data Review, Validation, and Verification Methods

The Laboratory Technican or designated experienced chemist verifies data is correct as reported. A manager reviews 100% of the raw data against the report (to verify data interpretation made by the chemist) and makes sure no errors were made. The Laboratory stores all raw data according to their retention policy. Raw data are available to MnTAP staff as needed.

Data quality objectives have been met when a complete analytical report (with all data qualifiers) has been provided to MnTAP. The report includes any data issues identified by the Laboratory. The report should point out any limitations on the use of the data to decision makers.

Section D.2: Reconciliation of the Data with User Requirements

Because this investigation is research based, the results do not need to meet regulatory data quality objectives. This is a single research investigation with no planned future work past the end date. Lab generated flags on data quality will be used to assess the analytical results.

Appendix 1: Standard Operating Procedures – Field Data Collection

Appendix 2: Field Forms

Appendix 3: Laboratory Documentation