LEGISLATIVE-CITIZEN COMMISSION ON MINNESOTA RESOURCES
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Michael McDonough, Interim Director

MINUTES

Subcommittee on Water Treatment Systems

Tuesday, September 26, 2017

3:00 p.m. – 4:00 p.m. or (30 minutes after adjournment of the LCCMR Meeting)

State Office Building, Room 5

St. Paul, MN 55155

Members Present: Jeff Broberg, Gary Lamppa, Rep. Jim Newberger, Sen. David Tomassoni, Rep. Jean Wagenius, Sen. Torrey Westrom

Staff Present: M. McDonough, M. Varien, D. Griffith

Co-Chair: Jeff Broberg

1. Members report potential conflicts of interest regarding today's business

MS 116P.09 Subd 6 Conflict of interest. A commission member, technical advisory committee member, a peer review panelist, or an employee of the commission may not participate in or vote on a decision of the commission, technical advisory committee, or peer review panel relating to an organization in which the member, panelist, or employee has either a direct or indirect personal financial interest. While serving on the commission, technical advisory committee, or peer review panel, or being an employee of the commission, a person shall avoid any potential conflict of interest.

Members reported no conflicts of interest for today's meeting.

2. Discuss potential LCCMR recommendation related to M.L. 2017, Chp. 96, Sec. 2, Subd. 19

- **Subd. 19. Fiscal Year 2019 Recommendations**
  - **(a) "For fiscal year 2019, the commission shall consider recommending loans from the corpus of the trust fund to statutory and home rule charter cities and towns with a population less than 5,000 as provided in the Minnesota Constitution, article XI, section 14. The commission shall work with the Public Facilities Authority in developing its recommendations. The commission shall include in its recommendations an analysis of using trust fund allocations for grants to the same cities and towns, including any necessary statutory changes."**

  - **Discussion LCCMR past appropriations for research on wastewater, drinking water and other water contamination**

    - **Spreadsheet titled "Wastewater - Water Resources Appropriations Funded through LCCMR Process - 2010-2017"**
    - **Spreadsheet titled "Stormwater - Water Resources Appropriations Funded through LCCMR Process - 2010-2017"**
    - **Spreadsheet titled "Drinking Water - Water Resources Appropriations Funded through LCCMR Process - 2010-2017"**

Members started discussions on water treatment systems.

Staff handed out the following additional material:

1. LCCMR Water System Background (See Attachment #1)
2. Water Infrastructure Listening Sessions (See Attachment #2)
3. Community Listening Sessions (See Attachment #3)
4. Water Wastewater Infrastructure Presentation for Breakout Session (See Attachment #4)
5. M.L. 2016, Chp. 186, Sec. 2, Subd. 04k titled "Wastewater Treatment Process Improvements", U of MN, Timothy LaPara, $398,000 (See Attachment #5)
6. M.L. 2016, Chp. 186, Sec. 2, Subd. 04m titled "Analyzing Alternative for Muncipal Wastewater Treatment", MN Pollution Control Agency, Scott Kyser, $180,000 (See Attachment #6)
7. M.L. 2017, Chp. 96, Sec. 2, Subd. 04f titled "Assessment of Water Quality for Reuse", U of MN, Satoshi Ishii, $148,000 (See Attachment #7)
8. 2018 ENRTF ID 035-B Proposal titled "Wastewater Treatment Plant Optimization Pilot Program" , MN Pollution Control Agency, Joel Peck, $236,360 (See Attachment #8)

Members continued discussions.

Greg Knopff, Senate Counsel, provided an overview of the constitutional language and statutes.

Greta Gauthier, MPCA, answered questions related to listening sessions handout.

Elizabeth Wefel, Coalition of Greater Minnesota Cities (CGMC), answered members questions about CGMC.

Jeff Freeman, Public Facilities Authority (PFA), answered member's questions about the PFA.

Barb Huberty, director of LWC, reminded members their Commission is learning about wastewater and LCCMR members are welcome to attend the meetings. Ms. Huberty said their fundamental learning will be completed by their meeting on October 17.

3. Review Legislative Water Commission 2017 schedule related to wastewater

4. Other business (as needed)

- Next steps

Members agreed to schedule the next subcommittee meetings on October 17 and October 18 half an hour after adjournment of the LCCMR Meeting.

5. Adjourn

Meeting adjourned at 4:50 p.m.

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Constitution of the State of Minnesota

ARTICLE XI
APPROPRIATIONS AND FINANCES

Sec. 14. **Environment and natural resources fund.**

A permanent environment and natural resources trust fund is established in the state treasury. Loans may be made of up to five percent of the principal of the fund for water system improvements as provided by law. The assets of the fund shall be appropriated by law for the public purpose of protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources. The amount appropriated each year of a biennium, commencing on July 1 in each odd-numbered year and ending on and including June 30 in the next odd-numbered year, may be up to 5-1/2 percent of the market value of the fund on June 30 one year before the start of the biennium. Not less than 40 percent of the net proceeds from any state-operated lottery must be credited to the fund until the year 2025.

116P.08 TRUST FUND EXPENDITURES.

Subdivision 1. Expenditures.

(a) Money in the trust fund may be spent only for:

(1) the reinvest in Minnesota program as provided in section 84.95, subdivision 2;

(2) research that contributes to increasing the effectiveness of protecting or managing the state's environment or natural resources;

(3) collection and analysis of information that assists in developing the state's environmental and natural resources policies;

(4) enhancement of public education, awareness, and understanding necessary for the protection, conservation, restoration, and enhancement of air, land, water, forests, fish, wildlife, and other natural resources;

(5) capital projects for the preservation and protection of unique natural resources;

(6) activities that preserve or enhance fish, wildlife, land, air, water, and other natural resources that otherwise may be substantially impaired or destroyed in any area of the state;

(7) administrative and investment expenses incurred by the State Board of Investment in investing deposits to the trust fund; and

(8) administrative expenses subject to the limits in section 116P.09.

(b) In making recommendations for expenditures from the trust fund, the commission shall give priority to funding programs and projects under paragraph (a), clauses (1) and (6). Any requests for proposals issued by the commission shall clearly indicate these priorities.

Subd. 2. Exceptions.

Money from the trust fund may not be spent for:

(1) purposes of environmental compensation and liability under chapter 115B and response actions under chapter 115C;

(2) purposes of municipal water pollution control under the authority of chapters 115 and 116;

(3) costs associated with the decommissioning of nuclear power plants;

(4) hazardous waste disposal facilities;

(5) solid waste disposal facilities; or

(6) projects or purposes inconsistent with the strategic plan.

116P.12 WATER SYSTEM IMPROVEMENT LOAN PROGRAM.

Subdivision 1. Loans authorized.

(a) If the principal of the trust fund equals or exceeds $200,000,000, the commission may vote to set aside up to five percent of the principal of the trust fund for water system improvement loans. The purpose of water system improvement loans is to offer below market rate interest loans to local units of government for the purposes of water system improvements.

(b) The interest on a loan shall be calculated on the declining balance at a rate four percentage points below the secondary market yield of one-year United States Treasury bills calculated according to section 549.09, subdivision 1, paragraph (c).

(c) An eligible project must prove that existing federal or state loans or grants have not been adequate.

(d) Payments on the principal and interest of loans under this section must be credited to the trust fund.

(e) Repayment of loans made under this section must be completed within 20 years.

(f) The Minnesota Public Facilities Authority must report to the commission each year on the loan program under this section.

Subd. 2. Application and administration.

(a) The commission must adopt a procedure for the issuance of the water system improvement loans by the Public Facilities Authority.

(b) The commission also must ensure that the loans are administered according to its fiduciary standards and requirements.

446A.07 CLEAN WATER REVOLVING FUND.

Subdivision 1. Establishment of fund.

The authority shall establish a clean water revolving fund to provide loans for the purposes and eligible costs authorized under title VI of the Federal Water Pollution Control Act. The fund must be credited with repayments.

Subd. 1a. Definitions.

(a) For the purposes of this section, the terms in this subdivision have the meanings given them.

(b) "Eligible recipients" means governmental units or other entities eligible to receive loans or other assistance as provided in title VI of the Federal Water Pollution Control Act.

(c) "Federal Water Pollution Control Act" means the Federal Water Pollution Control Act, as amended, United States Code, title 33, sections 1251 et seq.

Subd. 2. State funds.

A state matching fund is established to be used in compliance with federal matching requirements specified in the Federal Water Pollution Control Act.

446A.072 WATER INFRASTRUCTURE FUNDING PROGRAM.

Subdivision 1. Establishment of program.

The authority will establish a water infrastructure funding program to provide supplemental assistance to governmental units receiving funding through the clean water revolving fund program, the drinking water revolving fund program, or the United States Department of Agriculture Rural Economic and Community Development's (USDA/RECD) Water and Waste Disposal Loans and Grants program for the predesign, design, and construction of municipal wastewater and drinking water systems, including purchase of land and easements. The purpose of the program is to assist governmental units demonstrating financial need to build cost-effective projects to address existing environmental or public health problems. To implement the program, the authority shall establish a water infrastructure fund to provide grants for the purposes authorized under title VI of the Federal Water Pollution Control Act and the federal Safe Drinking Water Act. The fund shall be credited with all investment income from the fund and all repayments of loans, grants, and penalties.

446A.073 POINT SOURCE IMPLEMENTATION GRANTS.

Subdivision 1. Program established.

When money is appropriated for grants under this program, the authority shall award grants up to a maximum of $7,000,000 to governmental units to cover 80 percent of the cost of water infrastructure projects made necessary by:

(1) a wasteload reduction prescribed under a total maximum daily load plan required by section 303(d) of the federal Clean Water Act, United States Code, title 33, section 1313(d);

(2) a phosphorus concentration or mass limit which requires discharging one milligram per liter or less at permitted design flow which is incorporated into a permit issued by the Pollution Control Agency;

(3) any other water quality-based effluent limit established under section 115.03, subdivision 1, paragraph (e), clause (8), and incorporated into a permit issued by the Pollution Control Agency that exceeds secondary treatment limits; or

(4) a total nitrogen concentration or mass limit that requires discharging ten milligrams per liter or less at permitted design flow.

446A.075 SMALL COMMUNITY WASTEWATER TREATMENT PROGRAM.

Subdivision 1. **Creation of account.**

A small community wastewater treatment account is created in the special revenue fund. The authority shall make loans and grants from the account as provided in this section. Money in the fund is annually appropriated to the authority and does not lapse. The account shall be credited with all loan repayments and investment income from the account and servicing fees assessed under section446A.04, subdivision 5. The authority shall manage and administer the small community wastewater treatment account and for these purposes, may exercise all powers provided in this chapter.

446A.081 DRINKING WATER REVOLVING FUND.

Subdivision 1. **Definitions.**

(a) For the purposes of this section, the terms in this subdivision have the meanings given them.

(b) "Eligible recipient" means governmental units or other entities eligible to receive loans or other assistance as provided in the federal Safe Drinking Water Act.

(c) "Federal Safe Drinking Water Act" means the federal Safe Drinking Water Act, as amended, United States Code, title 42, sections 300f et seq.

Subd. 2. **Establishment of fund.**

The authority shall establish a drinking water revolving fund to provide loans and other forms of financial assistance authorized by the federal Safe Drinking Water Act, as determined by the authority under the rules adopted under this section for the purposes and eligible costs authorized under the federal Safe Drinking Water Act. The fund must be credited with repayments. The federal Safe Drinking Water Act requires that the fund corpus must be managed so as to be available in perpetuity for the financing of drinking water systems in the state. At a minimum, 15 percent of the funds received each federal fiscal year shall be available solely for providing loans to public water systems which regularly serve fewer than 10,000 individuals.

Subd. 3. **State funds.**

A state matching fund is established to be used in compliance with federal matching requirements specified in the federal Safe Drinking Water Act.

Water Infrastructure Listening Sessions Summary

The Governor's Office, Minnesota Department of Health, Minnesota Pollution Control Agency and Minnesota Public Facilities Authority hosted listening sessions around the state to hear concerns from Minnesota communities about the water and wastewater infrastructure. This is a summary of what they heard:

Funding

- Without more funding assistance, increases in water and wastewater bills could easily outpace resident's ability to pay, especially in communities with significant numbers of low- or fixed-income residents.
- Many communities can't afford improvements to meet anticipated regulatory changes without more grant funds.
- Maintaining and replacing aging infrastructure combined with stricter regulations present huge challenges for rural cities with small tax and customer bases.
- Cost differences in water and wastewater rates can place border towns at an economic disadvantage with neighboring states.
- The costs to treat drinking water and wastewater can vary throughout the state. Certain regions of the state have more difficult drinking water to treat. These regions also tend to be in area where wastewater regulations may be more stringent due to the quality of the receiving water.

Regulations

- State agencies should coordinate regulatory changes and think comprehensively so that impacts do not conflict or compete with other regulations.
- Effluent standards can be difficult to meet and involve tradeoffs; chemicals used to meet standards can harm equipment and degrade receiving waters.
- Timing of improvements needs to be coordinated with street repairs, changes in regulations, and fund availability.
- Non-point sources of nutrients need to be addressed as well.
- Clear standards are needed for water reuse.

Sustainability

- Asset management is essential, but many systems lack resources/expertise.
- As plant complexity increases, employing and retaining qualified operators is growing more difficult.
- Increasing costs could drive industries to move.
- Declining water quality means a declining economy.
- Drinking water, wastewater, and stormwater management should be integrated and coordinated across agencies and local government.

Community listening sessions 2016

Minnesota's water infrastructure

Minnesota communities need an estimated $11 billion over the next 20 years for new water infrastructure projects to replace aging wastewater and drinking water systems, upgrade treatment facilities to meet higher standards, and expand systems to accommodate growth.

Why it matters

Managing wastewater, stormwater, and drinking water supplies is important for our health and safety. It also critical for ensuring the economic vitality and future competitiveness of a community. Minnesota communities — both rural and metro — face serious challenges to making these improvements to their water infrastructures.

Listening sessions

To better understand these challenges, state representatives — Molly Pederson, senior policy advisor to Governor Dayton, along with the John Stine, commissioner of the Minnesota Pollution Control Agency, Dr. Ed Ehlinger, commissioner of the Department of Health, and Jeff Freeman, executive director of the Public Facilities Authority — held meetings in Detroit Lakes, Willmar, Worthington, Hibbing, Rochester, Pine City, Golden Valley, and Hastings to find out the specific concerns of more than 80 communities.

Community concerns

Many communities share the same concerns, which can be grouped into four main categories.

Cost-related problems

1. Debt service and tax base issue make grants, not loans, the best option for many communities.

   Debt service can be 25% to 44% of a community's annual water departmental budget. Even low-interest loans are not always helpful, especially for smaller towns. Provide more grants, and make them easier to obtain.

2. The local tax base is limited or declining.

   In some areas the population is declining. For example, the town of Gilbert lost 12 homes in last 5 years. In other areas, a substantial portion of the population are senior citizens on fixed incomes or people living below the federal poverty level. Even a $10 per month increase is significant for them.

3. Operations and maintenance of existing systems is expensive.

   Calumet: Even with using a neighboring town's WWTF (Marble, MN), we cannot sustain operating expenses. Wakefield Township: Mechanical plant costs are >$200,000 for town of 1,700 people.

Workforce issues

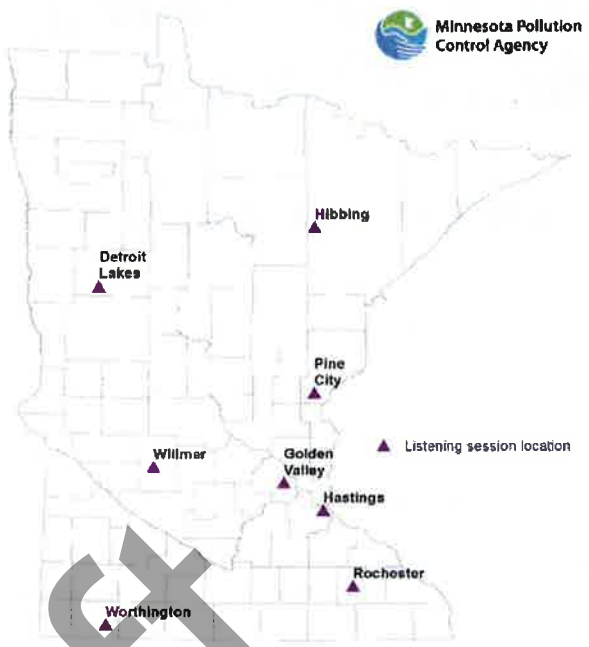
1. Many communities can't recruit or retain qualified water professionals.

   Willmar: Difficult to find enough Class A operators in rural communities.

2. Older water professionals are retiring.

   Owatonna: 65% of city water professionals will retire over the next 4 years. We will find replacements by turning to surrounding smaller communities' water utilities.

3. The job of operating these facilities has become highly technical.
   Sauk Center/Cold Spring: These plants are becoming more complicated.



Creativity/flexibility needed

1. Communities want to add trading to their toolbox of options.

   For example, Redwood Falls wants to buy credits, but can't find partners with credits to sell. Northfield has phosphorous credits to trade but doesn't have partners who want to buy.

2. Cities need help creating asset management plans for future work.

   Pelican Rapids: "It's just me and my Excel spreadsheet."
   Central Iron Range SS District: Asset management is costly – GIS, modeling, inspections, etc.

3. Comprehensive approach to include drinking water, wastewater, and stormwater.

   Faribault: The state needs to address all three at once.
   Little Falls, Madison, Hibbing: Think comprehensively to connect projects. It's all linked.

Policy changes

1. Look at nonpoint sources.

   Olivia: Point sources have been picked on for 30 years. Now that everyone has invested and upgraded, it's time to look at the agriculture industry.

2. Reconsider the reuse of wastewater.

   Hutchinson: Interested in water reuse, and have to convince people that it's good, healthy, safe.

3. Ban "flushable" personal care wipes in Minnesota.

   Sauk Center/Cold Spring: Suing the flushable wipes companies, in class-action lawsuit along with 10 other Minnesota cities, because when flushed these wipes cause big, costly problems at wastewater facilities.

4. Public education is needed about the relationship between water bills and water service, water supply, water conservation, etc.

   Hutchinson: Environmental education is a key component.

5. Allow municipalities to raise rates slowly, in ongoing incremental basis.

   Hibbing: Maybe we just need a kickstart. Couple it with education for ratepayers, rachet up rates slowly on incremental basis.

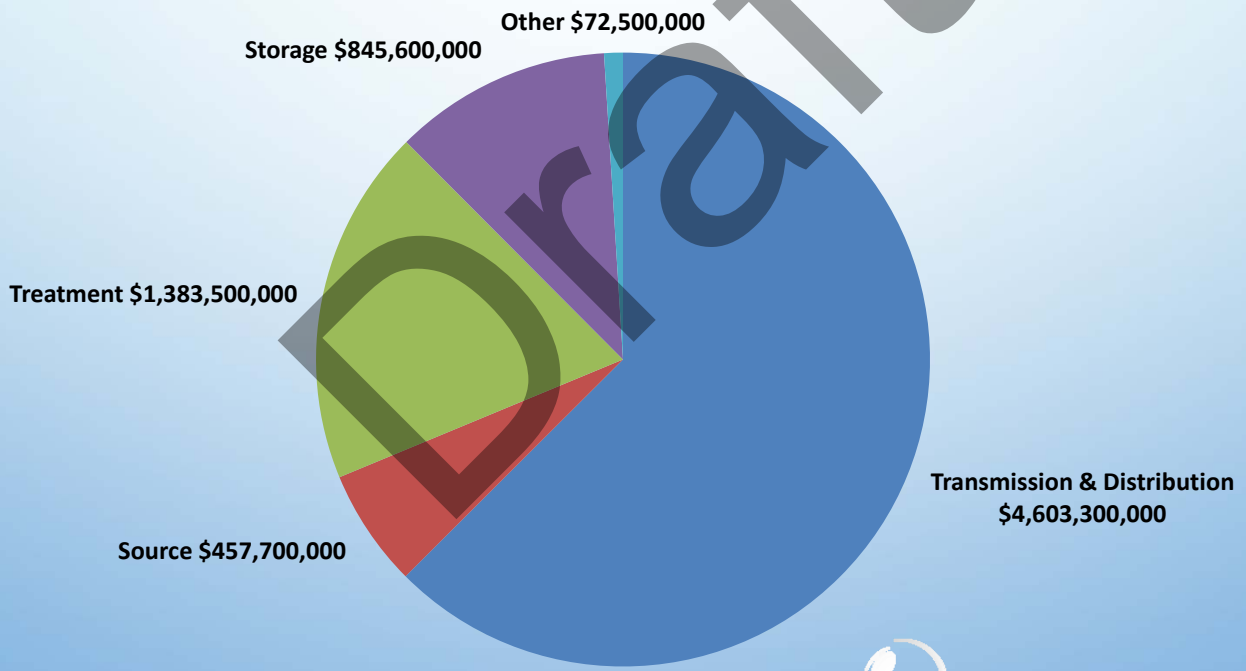
WATER & WASTEWATER INFRASTRUCTURE BREAKOUT SESSION

FEBRUARY 27, 2016

JEFF FREEMAN, MINNESOTA PUBLIC FACILITIES AUTHORITY

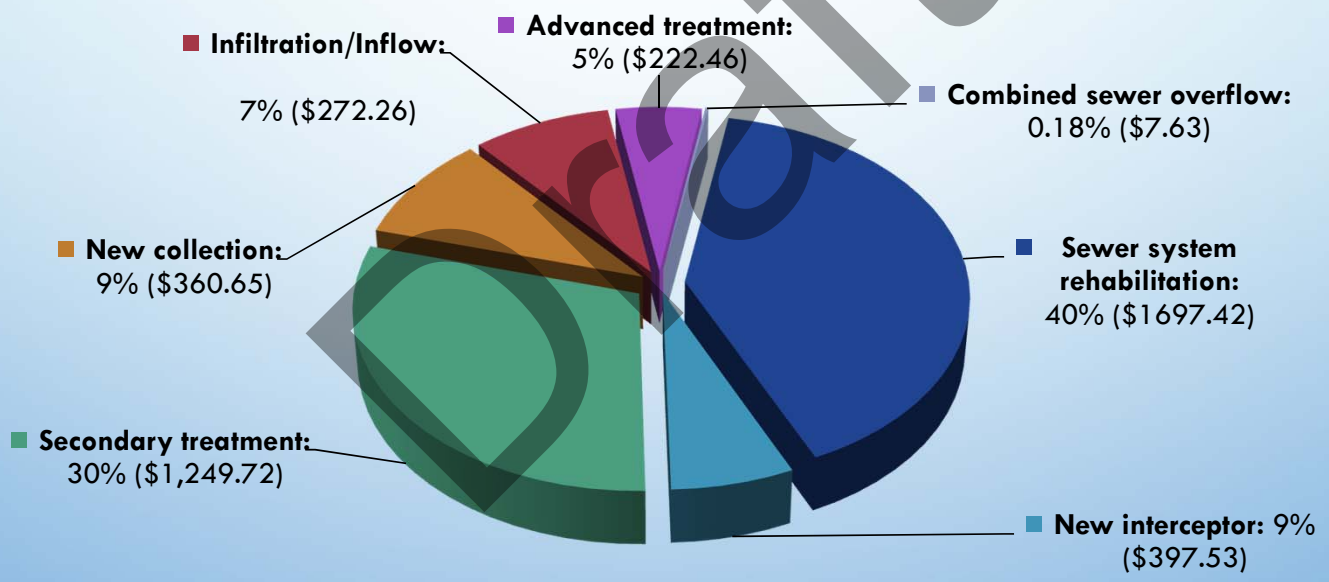
CURRENT DRINKING WATER INFRASTRUCTURE NEEDS

20 Year Drinking Water Infrastructure Needs for Minnesota by Project Type
Total Need - $7,362,600,000
(Based on 2011 Drinking Water Infrastructure Needs Survey and Assessment)



CURRENT WASTEWATER INFRASTRUCTURE NEEDS

20 Year Wastewater Infrastructure Needs for Minnesota by Project Type
Total Need - $4,200,000,000
(Based on 2016 Wastewater Infrastructure Needs Survey)



In millions of dollars

CURRENT WATER & WASTEWATER DEMANDS

- Funding requests for projects over the next 5 years

- Drinking Water Revolving Fund Project Priority List
  - 271 projects totaling $393 million

- Clean Water Revolving Fund Project Priority List
  - 293 project totaling $1.4 billion

CURRENT FUNDING OPTIONS

- Federal
  - USDA Rural Development grants and loans
- State – Public Facilities Authority
  - Clean Water & Drinking Water State Revolving Funds
    - Low interest loans
  - Wastewater Infrastructure Fund (WIF)
    - Affordability Grants
  - Point Source Implementation Grants (PSIG)
    - Grants for treatment plant upgrades to meet new requirements
- Local
  - Pay as you go through system revenues
  - Market rate financing

CURRENT & PROPOSED REGULATIONS

- SAFE DRINKING WATER ACT & MINNESOTA HEALTH BASED GUIDELINES
  - PURPOSE - PROVIDE SAFE DRINKING WATER
    - LEAD & COPPER, MICROCYSTIN (ALGAL BLOOMS)
    - NITRATE, CONTAMINANTS OF EMERGING CONCERN
- CLEAN WATER ACT & WATER QUALITY STANDARDS
  - PURPOSE - PROTECT AND RESTORE WATERS OF THE STATE
    - PHOSPHORUS, CHLORIDE, NITROGEN

SUSTAINABLE UTILITIES

- Local responsibilities
  - Water and wastewater systems are owned, built, operated and maintained by local governments
  - What are the challenges that local governments face?
    - Operational Issues
    - Level of Service
    - Rate Setting
    - Equipment maintenance and replacement
    - Capital Improvements
  - Asset Management
    - What tools do utilities use to track the condition, useful life, criticality and replacement schedules of system components?
    - What can the state do to assist?

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan

Date of Report: February 8, 2017

Date of Next Status Update Report: July 1, 2017

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2019

Does this submission include an amendment request? No

PROJECT TITLE: Wastewater Treatment Process Improvements

Project Manager: Timothy M. LaPara

Organization: University of Minnesota

Mailing Address: 500 Pillsbury Drive SE

City/State/Zip Code: Minneapolis, MN 55455

Telephone Number: (612) 624-6028

Email Address: lapar001@umn.edu

Web Address:

Location: Statewide

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$398,000**
	Amount Spent:	**$53,869**
	Balance:	**$344,131**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04k

Appropriation Language:

$398,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to characterize and quantify the nutrient-removing microorganisms used for municipal wastewater treatment, in order to improve the process used to reduce total nitrogen discharge. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Wastewater treatment process control improvements

II. PROJECT STATEMENT:

In the near future (5-10 years), new regulations are expected on Minnesota's municipal wastewater discharges for total nitrogen (ammonia, nitrite, and nitrate), which is needed to prevent the eutrophication of the Gulf of Mexico. The goal of this project is to understand the composition of the microbial communities used for municipal wastewater treatment and to provide baseline information of the quantities of nutrient-removing microorganisms used for wastewater treatment in the State of Minnesota. The benefit of this research will be a useful set of tools that can be used to better control wastewater treatment operations.

All wastewater treatment facilities in Minnesota are currently regulated with respect to the release of biodegradable organic compounds (known as "BOD" – biochemical oxygen demand). These regulations ensure that the harmful impacts of wastewater are avoided, particularly the consumption of oxygen in the receiving water body (oxygen is needed for fish and other aquatic fauna and flora to thrive). Presently, many wastewater treatment facilities are also seasonally regulated for ammonia (due to fish toxicity) and continuously regulated for phosphorus, which contributes to the eutrophication (the excessive growth of algae) in lakes.

The most cost-effective way to treat municipal wastewater is to utilize microorganisms to metabolize pollutants of concern. Wastewater treatment facilities use microorganisms to remove the nutrients (BOD, phosphorus, nitrogen) of concern from the wastewater. From an engineering and operational perspective, it is relatively straight-forward to achieve either BOD and phosphorus removal or BOD and total nitrogen removal, but it is **much more difficult problem** to achieve BOD, total nitrogen, and phosphorus removal because all three processes occur only over a very narrow range of operating conditions. Future wastewater treatment operations, therefore, will likely require better process control; the research performed in this project will delineate the tools needed to provide this better process control.

Surprisingly, wastewater treatment bioreactors are currently operated with very little knowledge of the microorganisms that provide the treatment. The scientific reason for the lack of monitoring has been the inability of microbiologists to culture organisms from environmental samples. Over the past 5-10 years, however, microbiologists have developed next-generation DNA sequencing technology to generate 50,000+ sequences per sample to address the question of "*who is there*?" In addition, quantitative polymerase chain reaction (qPCR) can be used to determine the precise quantities of specific organisms, such as those responsible for phosphorus and nitrogen removal, allowing us to address "*how many of them are there*?"

Of particular importance, qPCR techniques are now relatively affordable (less than $30,000 for all of the needed instrumentation – on par with other lab techniques) and practical, requiring no special skills beyond those possessed by typical laboratory technicians. The final activity will be to disseminate the research results to Minnesota's wastewater treatment plant managers and operators (and providing training, if requested), with the goal of using these new technologies for better wastewater treatment process control.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of January 1, 2017:

The project has thus far focused on collecting wastewater bioreactor samples from wastewater treatment facilities throughout Minnesota. Genomic DNA has been extracted and purified from the majority of these samples and the quantities of nutrient-removing organisms have been quantified. Activated sludge bioreactors have thus far contained 10^9 bacteria per milliliter, of which 10^8 are capable of denitrification (i.e., contain a *nosZ* gene) and 10^6 are bacteria capable of ammonia-oxidization (i.e., contain a bacterial *amoA* gene). In addition,

about 10^6 ammonia-oxidizing archaea (i.e., contain an archaeal *amoA* gene) were detected at one facility, but were not detectable at other facilities.

Project Status as of July 1, 2017:

Project Status as of January 1, 2018:

Project Status as of July 1, 2018:

Project Status as of January 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Characterize Minnesota's wastewater treatment microbiome.

Description:

The goal of this activity is to provide a general characterization of microorganisms in Minnesota's biological wastewater treatment facilities. This information will be critically useful to corroborate the organism-specific quantifications performed in Activity 2. This work is needed because the organism-specific quantifications are based on well-described model organisms, but these organisms might not be the pertinent nutrient-removing organisms in Minnesota's wastewater treatment facilities. This Activity will also allow us to compare the bacterial community composition of wastewater bioreactors throughout the State, determining if there are correlations between bacterial community composition and treatment facility performance, size, design, and other factors.

Samples will be collected from the bioreactors treating wastewater and wastewater sludges at selected wastewater treatment facilities on a weekly basis. We will specifically collect samples from the wastewater treatment facilities both in St. Cloud and in Brainerd, because these two facilities were recently upgraded to perform simultaneous removal of BOD, nitrogen, and phosphorus. We will also collect samples from wastewater treatment facilities in Little Falls, Duluth, St. Peter, and Mankato; these facilities do not currently perform simultaneous BOD, nitrogen, and phosphorus removal. We also intend to get samples from as many as 50 wastewater treatment facilities throughout the State. Our intention is to collect samples weekly from each of their bioreactors (many facilities have a single bioreactor, others have multiple bioreactors). We anticipate collecting ~5,000 samples (50 facilities $\times$ 1 sample per week per bioreactor $\times$ 2 bioreactors per facility $\times$ 100 weeks = 5000) for this Activity.

Assessment of the bacterial community composition will be achieved by using next-generation DNA sequencing will be performed using an Illumina MiSeq analyzer at the University of Minnesota Genomics Center. We will then use software that is available at the Minnesota Supercomputing Institute to statistically analyze the data and correlate our data to process performance (which is routinely collected from each facility). The goal is to obtain 50,000-100,000 DNA sequences per sample, which should allow us to characterize the bacterial community composition of these bioreactors in considerable detail.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 194,000
Amount Spent: $ 43,095
Balance: $ 150,905

Outcome	Completion Date

1. *Sample collection and Genomic DNA extractions (5,000 samples)*	December 31, 2017
2. *Next-Generation DNA sequencing (20 Illumina MiSeq runs)*	December 31, 2018
3. *Data Analysis at the Minnesota Supercomputing Institute*	April 30, 2019

Activity Status as of January 1, 2017:

To date, relatively little progress has been made on this Activity. The accomplishments, so far, have included sample collection and DNA extraction/purification from numerous wastewater treatment facilities. These DNA samples have been stored and will be used for Illumina sequencing in subsequent project periods.

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 2: Quantify nutrient-removing microbial populations in wastewater bioreactors.

Description:

In this activity, we will quantify the presence of specific microbial populations that are known to perform nitrogen and phosphorus removal. These organisms will include all bacteria, ammonia-oxidizing bacteria, ammonia-oxidizing Archaea, nitrite-oxidizing bacteria, three different types of denitrifying bacteria, and phosphate-accumulating organisms. That is, we will quantify the presence of as many as 8 different 'types' of bacteria in each sample. These quantitative values will allow us to directly compare the 'treatment capacity' of each biological wastewater treatment process (i.e., the ability to treat wastewater is usually proportional to the quantity of organisms of each type). This research will also allow us to compare how different treatment processes are affected by seasonal variation in temperature, process design, etc.

A very similar process will be used for Activity 2 as for Activity 1. We will use the same samples as used in Activity 1. We will perform these assays using the 384-well real time PCR system at the University of Minnesota Genomics Center (approximately 40,000 quantifications). Data will then be correlated to the process performance data provided to us from the treatment facilities.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 194,000
Amount Spent: $ 10,774
Balance: $ 183,226

Outcome	Completion Date
1. *Sample collection and Genomic DNA extractions*	December 31, 2017
2. *qPCR targeting specific nutrient-removing microorganisms*	June 30, 2018
3. *Data Analysis at the Minnesota Supercomputing Institute*	April 30, 2019

Activity Status as of January 1, 2017:
As with Activity 1, the primary accomplishments Activity 2 have included sample collection and DNA extraction/purification from numerous wastewater treatment facilities. These DNA samples have been stored

and will be used for Illumina sequencing in subsequent project periods. Numerous samples have been used to quantify total bacteria (16S rRNA genes: 10^9/mL), ammonia-oxidizing bacteria (*amoA* genes: 10^6/mL), ammonia-oxidizing archaea (*amoA* genes: < 10^6/mL), denitrifying bacteria (*nosZ*: 10^7/mL; *nirS*: 10^7/mL;*nirK* genes: 10^5/mL), and polyphosphate accumulating organisms (16S rRNA genes specific to these organisms: 10^6/mL). In general, the quantities of these populations were stable over time.

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 3: Disseminate our results to Minnesota's wastewater treatment facilities.
Description:

The first two activities will demonstrate the value of tracking bacterial populations in Minnesota's wastewater treatment facilities. The final activity will be to disseminate these results at local conferences and then to work with Minnesota's wastewater treatment facilities to perform these assays in-house. The techniques used in this project are relatively new, but they are ready to be used at wastewater treatment laboratories throughout the State for process monitoring and control. The cost of these assays is similar to those used for other laboratory assays used by wastewater treatment operators and managers. The skills required are similar to those needed by laboratory technicians.

Ideally, we will convince some facilities to purchase the equipment to perform these assays; in this case, we would provide training at no cost to the participating utility.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 10,000
Amount Spent: $ 0
Balance: $ 10,000

Outcome	Completion Date
1. *Presentations at local wastewater treatment conferences*	December 31, 2018
2. *Train laboratory technicians at wastewater treatment facilities to use qPCR*	June 30, 2019

Activity Status as of January 1, 2017:

There has been no progress with this activity at this time.

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description:

Findings will be disseminated and archived via reports to LCCMR, peer-reviewed publications, and presentations at conferences. We will also, when appropriate, disseminate results via press releases to the media. The audience is not only the scientific community, but also the public, policymakers, and practitioners. The work will also be of interest to the wastewater treatment community and we will seek avenues to share the results with this community (such as the Minnesota Wastewater Operators Conference). We would also like to work one-on-one with individual wastewater utilities to start performing these assays; our hope is that we can get actual wastewater treatment plants performing the analyses that we explore herein.

Status as of January 1, 2017:

Status as of July 1, 2017:

Status as of January 1, 2018:

Status as of July 1, 2018:

Status as of January 1, 2019:

Status as of July 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 311,524	For Drs. LaPara ($77,844) and Behrens ($44,292) for directing the project, for a year of graduate student support at the University of Minnesota ($47,451), and for two years of post-doctoral research associate support ($114,704) at the University of Minnesota. Dr. LaPara will also effectively serve as a "post-doctoral" researcher during the first year of the project while he is on sabbatical from the University of Minnesota.
Equipment/Tools/Supplies:	$81,976	General lab supplies ($5,000), reagents for qPCR ($17,500), use of UMGC's facilities for qPCR and Illumina sequencing ($36,976), DNA extraction kits ($12,500), PCR purification kits ($10,000)
Travel Expenses in MN:	$4,500	Travel to wastewater treatment facilities in Minnesota to collect bioreactor samples; travel to MN wastewater conferences to present research; travel to wastewater treatment facilities to train lab personnel
TOTAL ENRTF BUDGET:	**$398,000**	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.75

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
National Science Foundation fellowship to Julie Johnston (informational only; not intended to represent committed cost share)	$121,225	$	NSF fellowship for graduate student working on this project
State			
	$197,064	$	In-kind contribution; indirect costs not charged to this project
TOTAL OTHER FUNDS:	**$318,289**	**$**	

VII. PROJECT STRATEGY:
A. Project Partners: N/A

B. Project Impact and Long-term Strategy:

The goal of the project is to get Minnesota's wastewater treatment plants to monitor their biomass for specific bacterial populations by qPCR. This will be achieved by demonstrating and verifying the technology and then presenting the results (including the costs for the analyses) to Minnesota's wastewater treatment facilities. If needed (or requested), we will even visit treatment facilities to train their personnel to perform the assays.

C. Funding History: N/A

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: N/A

IX. VISUAL COMPONENT or MAP(S): See attached visual

X. RESEARCH ADDENDUM: See attached

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than January 1, 2017, July 1, 2017, January 1, 2018, July 1, 2018, and January 1, 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan

Date of Report: May 1, 2017

Date of Next Status Update Report: December 1, 2017

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2018

Does this submission include an amendment request? No

PROJECT TITLE: Analyzing Alternative for Muncipal Wastewater Treatment

Project Manager: Scott Kyser

Organization: Minnesota Pollution Control Agency

Mailing Address: 520 Lafayette Rd

City/State/Zip Code: St. Paul, MN 55155

Telephone Number: (651) 895-9146

Email Address: Scott.Kyser@state.mn.us

Web Address: NA

Location: Statewide

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$180,000**
	Amount Spent:	**$27,690**
276	**Balance:**	**$152,310**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04m

Appropriation Language:

$180,000 the second year is from the trust fund to the commissioner of the Minnesota Pollution Control Agency to analyze alternatives for improved treatment of sulfate and salty parameters at municipal wastewater plants to inform the development and implementation of wild rice, sulfate, and other water quality standards. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Analyzing Alternative for Muncipal Wastewater Treatment

II. PROJECT STATEMENT:

The goal of this project is analyze alternatives for improved treatment of sulfate and salty parameters at municipal wastewater plants. This analysis will inform implementation of the wild rice, sulfate and other water quality standards.

The MPCA has begun the administrative process to revise the existing 10 mg/L wild rice sulfate standard to better reflect the complex biochemistry necessary to support wild rice. Currently there are few effluent limits in wastewater treatment plant (WWTP) permits derived from the existing wild rice sulfate standard. Although specifics about how a revised standard may be implemented are limited, more WWTPs are likely to have sulfate limits in the future.

Municipal WWTPs are not designed to remove sulfate or salty parameters from their wastewater. In order to remove sulfate or salty parameters, a treatment plant would need to upgrade or change their treatment processes. The proposed study will allow affected communities to better understand sulfate and salty parameter treatment alternatives and their costs before beginning pilot testing and design work.

A document that summarizes and critically evaluates potential sulfate and salty parameter treatment technologies would provide essential support to municipalities in Minnesota. If this information were made available municipalities they would not have to incur costs on hiring consultants to evaluate it on a project by project basis. It would also be useful to know how sulfate and the salty parameters (chloride, sulfate, salinity, dissolved materials, etc) could be effectively co-removed.

The treatment plant engineering design community has the best resources available to both critically evaluate sulfate and salty parameter treatment alternatives and their associated costs for municipal treatment plants. The design community possesses knowledge and costing experience that the MPCA does not have. MPCA would issue a competitive Request for Proposals (RFP) to solicit a sulfate and salty parameter treatment alternatives analysis that critically evaluates the applicability of sulfate treatment technologies and their costs for municipal utilities. At a minimum, the treatment alternatives in table 1 including source reduction will be evaluated for removal potential for both salty parameters and sulfate.

The MPCA believes there would be additional value in a more detailed "Case Analysis" exercise where the contractor would perform initial sulfate and salty parameter treatment plant design for a representative small, medium and large scale municipality. This approach would identify design concerns that could only come to light through the design process. Since a WWTP that simultaneously treats human waste and potentially removes sulfate and salty parameters to low levels has never been designed in Minnesota, this step would provide crucial implementation information. A "Case Analysis" exercise is common in federal EPA guidance documents for evaluating wastewater treatment technologies and provides critical insight.

III. OVERALL PROJECT STATUS UPDATES

Project Status as of December 1, 2016: Update #1 to LCCMR

The MPCA issued the RFP to select a contractor to perform the work in our 2016 Work Plan submitted to the LCCMR. We selected a contractor following MN contracting rules using a selection team of four MPCA engineers and two engineers from the city of Moorhead and the city of Duluth respectively.

The selected contractor was a combined proposal from the consulting firms of Bolton and Menk and Barr Engineering. Their submitted proposal is attached to the e-mail this document was sent with. The final bid came to $179,940. They will sign the finalized contract with the MPCA on Dec 5th, 2016 and begin work on that date. There have been no expenditures to date. We expect preliminary results to be included in our next update.

Project Status as of May 1, 2017: Update #2 to LCCMR

Work tasks completed to-date include:

- Reviewed and revised treatment technology categories
- Identified treatment technologies and conducted review of available literature for primary treatment technologies and concentrate management technologies
- Developed technology screening approach including screening for sulfate removal and other parameters (N, P, Hg, TDS, Cl)
- Participated in kick-off meeting with MPCA to review proposed approach and receive review comments (3/30/17)
- Conducted preliminary technology screening

Deliverables provided:

- Revised technology categories
- List of sulfate removal technologies identified up through date of MPCA meeting on 3/30/17
- Draft concepts for screening of the other parameters and visualization of influent-effluent sulfate condition scenarios
- Preliminary screening results (internal draft to BMI, See table below)

DRAFT Treatment Technology Descriptions		
Primary Sulfate Removal Categories	**Technology**	**Technology description**
Influent source sulfate reduction	Change Drinking Water Source (if groundwater source)	Change drinking water to a surface water source with lower chloride concentrations.
	Change Drinking Water Coagulant (if alum and surface water source)	Change drinking water treatment process to use ferric chloride instead of aluminum sulfate as the primary coagulant.
	Restrict Industrial Discharges	Implement tighter pretreatment requirements to reduce sulfate concentration in discharges.
Chemical precipitation	Gypsum Precipitation	Calcium is added in the form of lime, and combines with sulfate to form gypsum solids, which can be removed from the water in a clarifier. Final concentration is limited by solubility of gypsum to >1,500 mg/L.
	Ettringite Precipitation (CESR or SAVMIN)	Lime and Gibbsite are added to form ettringite, which can be removed in a clarifier. Gibbsite can be recovered from ettringite and reused.
	Ettringite Precipitation with Aluminum Recovery (LoSO4)	Lime and aluminum reagent are added to form ettringite, which can be removed in a clarifier. Sludge is then processes to recover aluminum reagent for reuse. Designed for mine water treatment of nanofiltration (NF) reject.
	Barite Precipitation	Barium chloride or barium hydroxide is added, then barium combines with sulfate to form barium sulfate, which is removed in a clarifier.
	Co-Precipitation with Aluminum	Sulfate ions can form complexes with aluminum precipitates and be removed from solution at pH 4-5.
Ion exchange	Conventional Ion Exchange	A strong base anion exchange resin can be used to remove all anions along with sulfate and sulfite.
	Sulf-IX	Sulfate removal is completed in a two-stage process. Feed water passed through a series of contactors containing cation exchange resin to remove calcium and magnesium, then passed through a second set of contactors containing anion exchange resins to remove sulfate.
Membranes	Closed-circuit Desalination Reverse Osmosis (CCD RO)	Uses conventional RO membranes. Permeate is produced at a rate equal to the incoming flow rate, and when a desired (high) recovery percentage is reached, brine is throttled out of the system, displaced by feedwater in a single "plug flow" sweep.
	Electrodialysis Reversal (EDR)	An electric current is used to move dissolved salt ions through layers of charged membranes.
	Zero Discharge Desalination (ZDD)	Combines conventional reverse osmosis with electrodialysis metathesis on the concentrate management side.
	Membrane distillation	A separation process that is thermally-driven, in which only vapor molecules transfer through a microporous hydrophobic membrane. Membrane distillation is driven by the vapor pressure difference that results from the temperature difference across the hydrophobic membrane.
	Nanofiltration (NF)	Pressure is applied to force a solution through the membrane. The membrane allows the water to pass through but restricts some salts and other compounds. NF membranes have a larger pore size than conventional RO; monovalent ions can pass through the membrane.
	Conventional Reverse Osmosis (RO)	Pressure is applied to force a solution through a spiral-wound membrane. The membrane allows the water to pass through but restricts some salts and other compounds. Membranes have a smaller pore size than NF; monovalent ions are rejected by the membrane/cannot pass through.
	Vibratory Shear Enhanced Processing (VSEP)	High-pressure membrane treatment. In contrast to traditional spiral-wound membranes, VSEP uses flat-sheet membranes in a cross-flow configuration, which reduces the boundary layer at the membrane surface, which in combination with applied vibratory shear, reduces the boundary layer at the membrane surface.
	Forward osmosis	Uses natural osmotic process to separate water from dissolved solids. Driving force for this separation is a "draw" solution of higher concentration than the feed water. The osmotic gradient between the two streams creates a flow of water through the membrane, allowing clean water to mix with the draw solution separating it from salt and other contaminants.
Electrochemical treatment	Electrocoagulation	Metal ions formed in an electrochemical cell are used to precipitate metal hydroxides, which can remove anions such as sulfate from solution through adsorption.
	Electrochemical Reduction	Sulfate is reduced to sulfide on graphite electrode at temperature of 120 degrees Celsius.
Biological treatment	Constructed Wetlands	Bacteria present in wetland sediments reduce sulfate to sulfide, which then removes metals from industrial wastewaters. Needs carbon source. Limited sulfate removal capacity.
	Floating Wetlands	Islands consisting of floating media and wetland plants can remove sulfate from a larger body of water. Floating wetlands are most practical in existing water bodies. Needs carbon addition. Limited sulfate removal capacity.
	Pit Lake or In-Pit Treatment	Mining application. Naturally-occurring microbiological communities in pit lakes remove sulfate to sulfide with addition of carbon amendment. Needs carbon source. Limited sulfate removal capacity.
	Constructed Trench Bioreactors/ Permeable Reactive Barriers	Water is routed through a soil bed trench packed with carbon substrate, which grows a biofilm to reduce sulfate to sulfide. Needs carbon source. Limited sulfate removal capacity.
	Suspended-Growth Reactor (Activated Sludge Modification)	Anaerobic suspended-growth treatment, similar to an activated sludge process, could be used upstream of traditional activated sludge treatment systems, but would require a long solids retention time. A sequencing batch reactor (SBR) allows for more efficient biological removal in the liquid phase and lower tank volume, but requires more sophisticated operations and control. This can be implemented upstream of traditional activated sludge systems. Fluidized bed reactors can maintain about 5x the bacteria concentration as mixed reactors, and the reactor size can be smaller.
	UASB Reactor with Sulfide Treatment	A UASB reactor provides sufficient SRT to grow sulfate-reducers and reduce sulfate to sulfide. A second reactor can then be optimized to oxidize sulfide to elemental sulfur, which can be recovered.
	Packed Bed Bioreactor	Sulfate reducing bacteria retained on synthetic or natural media in a tank, where sulfate is reduced to sulfide
	Packed Bed Sulfide Reactor (BioSulphide)	Commercial process to produce sulfide from sulfate reduction primarily designed to precipitate and recover metals from industrial wastewaters.
	Bioelectrochemical	Bioreactors with electrodes can reduce sulfate to recover sulfur as elemental sulfur or iron sulfide using electrons (Chanlun Chun's lab at U of M Duluth).
	Sulfate reduction deammonification	Using a biological metabolism similar to ANAMMOX, sulfate can be used to remove ammonia.
	Liquid-phase biofilters	Biofilms growing on GAC or biochar can reduce sulfate to sulfide, which can be precipitated with metal as metal sulfides (Sebastian Behren's lab at U of M).
	Sulfate reduction denitrification and nitrification integrated process (SANI)	SANI includes removal of ammonia, nitrate, and sulfate in three separate reactors. Sulfate is reduced to sulfide, which feeds dinitrifiers in a second reactor. Ammonia is then removed in a third, aerated reactor. This system would replace activated sludge treatment and decrease sludge production.
Evaporative treatment	LM-HT Concentrator	The system involves the direct contact of hot gases and water/brine to evaporate water and produce a more concentrated brine or salt slurry, which is then stabilized and disposed. No heat exchangers are used, less fouling, but requires a source of hot gas for the process.
	Mechanical evaporation / Zero Liquid Discharge (ZLD)	ZLD includes brine concentration, where brine is heated and recirculated until about 95% is converted to high purity distillate, followed by crystallization which uses heat to reduce brine concentrate to a dry solid. Overall water recovery up to 99%. High-purity distillate suitable for reuse, discharge, or aquifer reinjection. Produces solid salt cake suitable for landfill disposal.

Project Status as of December 1, 2017: Update #3 to LCCMR

Project Status as of May 1, 2018: Update #4 to LCCMR

Project Status as of June 30, 2018: Final written report due to LCCMR.

Overall Project Outcomes and Results: A document that summarizes and critically evaluates potential municipal sulfate and salty parameter treatment technologies and their associated costs and implementation concerns for representative wastewater treatment plants.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Administration of Sulfate and Salty Parameter Treatment Alternative RFP
Description: The RFP will encourage the state and national design community to apply for funds to complete an analysis of sulfate and salty parameter treatment options. The RFP contracting process will be managed by the MPCA contract staff, reviewed by MPCA engineers and out-state municipal wastewater engineers and will comply with all state and federal regulations. The final candidate will be selected by a committee of MPCA engineering staff and out-state municipal wastewater engineers under the guidance of the MPCA contract unit. Once the best candidate is selected, funds and necessary design information will be delivered to the contractor by the MPCA. The grantee will have ten months to complete the deliverable for activity 1. A presentation of likely feasible treatment alternatives to a panel of engineering experts will be required before activity 1 will be completed. The panel of experts will include UMN engineering and scientific faculty, MPCA staff and engineering experts from outside the MPCA. A written summary evaluating each alternative with the selection of a most feasible alternative for a municipal WWTP will be the deliverable for activity 1.

The selected party, will at a minimum, review the feasibility of the nine selected technology categories below in Table 1. The goal is to understand all preliminary advantages and disadvantages of each selected sulfate treatment approach in order to rank them and find the most feasible treatment technology. Feasibility will be defined as a holistic evaluation of the technology considering relative costs, design, operational, waste stream handling and other life-cycle analysis concerns. Eliminating a technology as being feasible is just as important as finding an alternative that is feasible. Each treatment alternative must also be evaluated as to whether it will additionally remove other 'salty parameters', but removing sulfate will be considered the primary goal of each alternative.

The selected party will be provided with four representative effluent sulfate treatment goals and four representative sulfate influent conditions to evaluate each alternative against. A given treatment technology might work well for certain scenarios (low influent sulfate, high effluent target) but not for others (high influent sulfate, low effluent target). The selected party will, to the extent possible, determine how each treatment technology would work across the range of provided treatment goals.

The MPCA has selected the treatment alternatives listed below but does not consider this list to be complete. The selected party will demonstrate having evaluated whether other treatment alternatives not listed might be feasible or whether linking several treatment alternatives in new ways might generate a new feasible alternative. The selected party must understand that the list below represents categories and that the specifics of the technologies within each category must be illuminated in the alternative analysis. This project should not involve collecting any water samples or physically evaluating treatment technologies at the bench or pilot scale; the goal is a white paper level analysis of feasibility.

Table 1. The minimum nine categories of sulfate treatment technologies required for review in activity 1

Sulfate Influent Source Reduction
Chemical Precipitation with Lime, Barium, Ettringite
Sulfate Ion Exchange
Nanofiltration, Reverse Osmosis and Associated Membrane Technologies
Electrodialysis
Activated Sludge Retrofit
Anaerobic Treatment Processes (Sulfate Digestion, Anammox & other Sidestream Unit Operations)

Constructed Wetlands
Permeable Reactive Barriers

Summary Budget Information for Activity 1:

ENRTF Budget: $ 100,000
Amount Spent: $ 27,690
Balance: $ 72,310

Outcome	Completion Date
1. MPCA publically issues RFP	July 1, 2016
2. MPCA finalizes candidate selection and initiates project kickoff	November 1, 2016
3. Update #1 to LCCMR	December 1, 2016
4. Update #2 to LCCMR	May 1, 2017
5. Final alternative analysis and most feasible alternative due to MPCA allowing for changes based on panel input	September 1, 2017

Project Status as of December 1, 2016: Update #1 to LCCMR

The selected contractor has not begun work on activity 1. They will begin work on this once the final contract has been signed on Dec 6th, 2016.

Project Status as of May 1, 2017: Update #2 to LCCMR
The contractor has developed a list of technologies that could remove sulfate and developed a screening technology to rank and score those technologies. There have been good interactions with MPCA staff in developing the screening technology and results of the project are preliminary good. The preliminary best technology to remove sulfate for a municipal wastewater treatment plant is reverse osmosis with evaporation and crystallization (highest score of 90/100; see ranking below).

DRAFT Technology Screening Summary

Group 1: > 90
Reverse osmosis
Nanofiltration
Group 2 : 75 - 90
Barite precipitation
Ettringite precipitation
Sulf-IX
EDR
VSEP
CCD RO
Group 3: < 74
Conventional ion exchange
UASB
LM-HT concentrator
Packed bed bioreactor
ZLD with mechanical evaporator/crystallizer

Budget status:

- Spent through 4/13/17: $27,690

ACTIVITY 2: Sulfate and Salty Parameter Treatment Case Analysis

Description: The candidate will select the most promising sulfate and salty parameter treatment technologies from Activity 1 and begin a preliminary design for three representative municipalities using the average wet weather flows described in the table below. The goal of design would be to unearth implementation concerns only discoverable through initial design and to get a better sense of costs and relevant implementation concerns. The information found in this preliminary design would be used to inform the final deliverable with respect to costs and design considerations.

Facility Size	Average Wet Weather Flow (MGD)	Sulfate Treatment Target
Small	0.5	Most Restrictive
Medium	2.5	Most Restrictive
Large	10	Most Restrictive

A facility plan level analysis as defined in the ten state standards (section 11; http://www.10statesstandards.com/wastewaterstandards.pdf) will be used as a guide to the level of analysis required for each facility size. Detailed design (sewering, electrical, structural, pumping, etc…), financing methods, construction schedules, population projections and environmental review will not be required. Unit operation train diagrams and general flow diagrams will be required. A conceptual understanding of the proposed WWTP design, operation and maintenance should be the goal of activity 2.

The contractor should also generally comment on whether new WWTP construction would be required for each scenario or whether a conventional activated sludge WWTP or pond could be retrofitted to treat sulfate. The MPCA will provide theoretical WWTPs specifications for retrofit considerations. The facility plan documents do not need to go into specific design of retrofitted plants; a general comment on the feasibility of retrofitting the representative WWTPs for treating sulfate is all that will be required.

It is not reasonable to expect the contractor to develop a facility plan for each of the various influent sulfate concentrations and treatment targets in activity 1 using the given budget. The facility plans will use the most restrictive treatment scenario (highest influent sulfate, lowest effluent target from activity 1) but the contractor will be required to generally comment on how well the treatment would scale in response to the other treatment scenarios. The facility plan will also consider whether this treatment will remove other salty parameters as a secondary goal. The same panel of experts from Activity 1 will review this project activity and provide recommendations for improvement as needed before final deliverable.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 80,000
Amount Spent: $ 0
Balance: $ 80,000

Outcome (must match up)	Completion Date
1. Selected contractor begins case analysis	September 1, 2017
2. Contractor presents final results to panel of review experts (See Partners, Page 6)	By May 1, 2018
3. Final report due to MPCA allowing for changes based on panel input	May 31, 2018
4. Final report deliverable to LCCMR	June 20, 2018

Project Status as of December 1, 2017: Update #3 to LCCMR

Project Status as of May 1, 2018: Update #4 to LCCMR

Project Status as of June 30, 2018: Final written report due to LCCMR.

Final Report Summary:

The final report will be a written document describing all of the results from activity 1 and activity 2. It will explain why each sulfate treatment alternative was eliminated as being feasible, why the most feasible treatment alternative was chosen and all associated costs and implementation concerns of that chosen treatment alternative.

V. DISSEMINATION:
Description: The final deliverable will be available on the MPCA webpage and will be disseminated electronically to the MPCA wastewater listserv and MPCA twitter page. The draft report after activity 1 will not be disseminated electronically.

MPCA webpage:
http://www.pca.state.mn.us/index.php/water/water-types-and-programs/wastewater/index.html

Twitter Site:
http://twitter.com/MnPCA?ref_src=twsrc^google|twcamp^serp|twgr^author

The selected contractor will be required to present the results of the report after completion of both activity 1 and activity 2 at MN conferences for wastewater engineers and environmental professionals. A list of recommended conferences to be presented at will be provided in the RFP.

Project Status as of December 1, 2016: Update #1 to LCCMR

The project has not officially begun yet. Nothing to report in this section.

Project Status as of May 1, 2017:

The contractor has begun the process of submitting research abstracts to MN wastewater conferences. They are targeting a November 2017 conference for presentation of initial research results.

Project Status as of December 1, 2017:

Project Status as of May 1, 2018:

Project Status as of June 30, 2018:

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Professional/Technical/Service Contracts:	$180,000	Determining reasonable sulfate treatment alternatives and their associated costs
TOTAL ENRTF BUDGET:	**$180,000**	

Explanation of Use of Classified Staff: MPCA will donate in-kind time to develop the RFP, select the contractor and monitor the progress of the project. No funds from the ENRTF will be used for MPCA staff funding.

Explanation of Capital Expenditures Greater Than $5,000: None

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: None

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 1.5 FTE for a registered professional engineer

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state	None		
State	$38,248	$0	In-Kind FTE dollar equivalent for contracts unit and Engineering Review
TOTAL OTHER FUNDS:	**$38,248**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners: Review committee including engineers and scientists from the University of Minnesota, Met Council, Moorehead and Western Lake Superior Sanitary District.

B. Project Impact and Long-term Strategy:

In 2015, the MPCA began the administrative process to revise the existing 10 mg/L wild rice sulfate standard to better reflect the complex biochemistry necessary to support wild rice. Currently there are few effluent limits in wastewater permits derived from the existing wild rice sulfate standard. Although specifics about how a revised standard may be implemented are still in development, more municipal WWTPs are likely to have sulfate limits in the future.

This work will aid and inform the implementation of the wild rice sulfate standard. The project will provide accurate costs and implementation concerns for municipal WWTPs with regards to sulfate treatment. These costs and implementation concerns are absolutely essential for permitting WWTPs to comply with the wild rice sulfate standard.

The greatest benefit to this project is that it will provide a generalized sulfate preliminary design document for municipal WWTPs. This document will eliminate the need for municipal WWTPs to individually perform a sulfate treatment study, collectively saving municipal WWTPs hundreds of thousands of dollars in implementation costs!

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
No previous funding for this project.		$0

IX. VISUAL COMPONENT or MAP(S): See attached

X. RESEARCH ADDENDUM: None

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than Dec 1 2016, May 1 2017, December 1 2017 and May 1 2018. A final report and associated products will be submitted by June 30th, 2018.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2017 LCCMR Work Plan

Date of Submission: October 7, 2016

Date of Next Status Update Report: January 1, 2018

Date of Work Plan Approval: 06/07/2017

Project Completion Date: June 30, 2019

Does this submission include an amendment request? __

PROJECT TITLE: Assessment of Water Quality for Reuse

Project Manager: Satoshi Ishii

Organization: University of Minnesota

Mailing Address: 1479 Gortner Avenue

City/State/Zip Code: St. Paul, MN 55108

Telephone Number: (612) 624-7902

Email Address: ishi0040@umn.edu

Web Address: https://ishii-lab.dl.umn.edu/

Location: Statewide

Total ENRTF Project Budget:	
ENRTF Appropriation:	**$148,000**
Amount Spent:	**$0**
Balance:	**$148,000**

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 04f

Appropriation Language:
$148,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to collect and analyze pathogen data for evaluation of water reuse in order to maximize water reuse and protect groundwater and surface water quality.

I. PROJECT TITLE: Maximizing the Benefits of Water Reuse

II. PROJECT STATEMENT:

The goal of this project is to maximize the potential of water reuse in Minnesota by eliminating barriers to water reuse implementation. Reusing water will improve water quality through better stormwater management and reduce demands on groundwater aquifers. Quality of reclaimed water (i.e., treated wastewater/stormwater for reuse purposes) needs to be maintained to assure safe water reuse. However, there is no water quality standard for water reuse for various purposes such as toilet flushing, vehicle washing, irrigation and final product rinse. On some occasions, sophisticated and expensive treatment is used to create reclaimed water with quality possibly higher than necessary for flushing a toilet. The cost of water reuse systems may be reduced by utilizing design components that minimize pathogens. By quantitatively detecting multiple human pathogens in Minnesota water reuse systems, we will have data for use in setting water quality standards and making design recommendations.

The specific goals of this work are to:

1. System Design: Collect information on design elements (including water source, storage, and treatment devices) for the 24 water reuse systems within the state (see Activity 1 for detail).
2. Pathogens: Quantitatively detect multiple human pathogens in the 24 water reuse systems. Compare pathogen data among the reuse systems.
3. Risk Assessment: Relate the pathogen data to health risk through quantitative microbial risk assessment (QMRA) in order to ensure the health and safety of the public is protected.
4. Recommendations: Make recommendations about water quality standards and treatment design to set a clear path for water reuse in Minnesota.

This project will be done with a team of scientists/engineers from the University of Minnesota (U of M) and the Minnesota Department of Health (MDH). The U of M previously developed innovative tools to quantify multiple pathogens (both bacteria and viruses) in many water samples. By taking advantage of these tools, the team can comprehensively analyze the safety of water reuse and relate system design to pathogen occurrence. Based on these results, the MDH can set a standard for water reuse and make system design recommendations.

The need for this work is supported by national reports that conclude understanding the occurrence and fate of human pathogens in graywater and stormwater is a primary research need. Thus, we have a unique opportunity in Minnesota to contribute to advancing water reuse both in Minnesota and across the country.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of Status as of January 1, 2018:

Project Status as of Status as of July 1, 2018:

Project Status as of Status as of January 1, 2019:

Project Status as of Status as of July 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Water sample collections

Description:

The goal of this activity is to collect various recycled water samples. Samples collected in this activity will be used to quantify pathogen concentrations in Activity 2.

Water samples will be collected from 24 water reuse systems around the state. Final site selection will depend on the owner's agreement to participate in the study. Most of the water reuse systems are located in the metro area (18 research sites), but there are examples in Northeast (3 sites), Central (2 sites), and Southern MN (1 site). The reused water at these systems is used for various purposes such as toilet flushing (4 sites), vehicle washing (2 sites), irrigation (11 sites), and other industry usages (7 sites).

The preferred sample sites include a mixture of public and privately owned locations with various designs, treatment techniques, and end uses. For example, one potential site is located on the University of Minnesota campus in the Twin Cities. At this site, precipitation is collected from the 17th Avenue Residence Hall roof and surrounding sidewalk for use primarily in flushing toilets, but also for irrigation. Taking samples from this site under different weather conditions will help expand our understanding of microbial dynamics at this site.

Other potential systems to include are locations where precipitation is collected for various purposes, such as flushing toilets, turf irrigation, washing vehicles or washing stadiums. For example, the St. Paul Saints stadium in St. Paul, MN and Twins stadium in Minneapolis, MN could provide examples of systems located at similar venues but with differing collection systems, treatment trains, and end uses. Additional examples of water reuse systems that could be studied include several municipally-owned systems that collect stormwater for irrigating city properties or park areas. Possible examples include irrigation systems in the cities of Centerville, Cottage Grove, St. Anthony Village, or Woodbury, MN. A vehicle washing facility at St. Louis County, MN, that uses rainwater in the washing process could provide data about this additional type of end use. Further, a new graywater system at Lake Vermillion State Park would provide an excellent opportunity to learn more about microbial populations in a graywater system in Minnesota. The diversity of the systems' designs and treatment techniques will help to broaden understanding of microbial populations in water reuse systems in Minnesota's diverse settings and variable weather conditions.

We anticipate collecting samples from each reuse system on two different occasions, sampling at the source, after treatment and distributed water as appropriate for the site (24 locations x 2 time points x 3 types = 144 samples). Tap water collected from several drinking water treatment facilities will be used as negative control samples.

Physical and chemical properties of the water samples (temperature, pH, turbidity, odor, biomass and chlorine concentration, etc.) will be recorded. We will also inventory and record the types of water reuse design components such as source of reuse water, storage and treatment devices used in each water system. Sources will include rainwater (from roofs), stormwater, graywater and industrial process water. Storage includes cisterns, stormwater ponds and underground storage. Treatment devices include first flush devices, disinfection such as chlorine or ozone, or filters. These components can affect water quality by affecting the ability of pathogens to collect, survive, and multiply.

Water samples (10-1,000 L depending on water quality) will be filtered on site through membrane filters to capture bacteria and viruses, and brought back to the lab in the University of Minnesota. Bacterial cells and viral particles will be detached from the membranes and pelleted by centrifugation. These pellets will be frozen and stored until used for Activity 2.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 47,000
Amount Spent: $ 0
Balance: $ 47,000

Outcome	Completion Date
1. *Sample collection and bacteria/virus concentration (144 samples)*	September 30, 2018
2. *Physical and chemical properties of the water samples*	September 30, 2018
3. *Documentation of water reuse system design*	September 30, 2018

Activity 1 Status as of January 1, 2018:

Activity 1 Status as of July 1, 2018:

Activity 1 Status as of January 1, 2019:

Activity 1 Status as of July 1, 2019:

Final Report Summary:

ACTIVITY 2: Quantitatively detect multiple human pathogens in reuse systems

Description:

In this activity, we will quantitatively detect multiple human pathogens (both bacteria and viruses) in the 144 water samples collected in Activity 1. We will target all major waterborne pathogens including *E. coli* O157, *Salmonella*, *Campylobacter*, *Shigella*, *Clostridium perfringens*, *Legionella pneumophila*, *Listeria monocytogenes*, human adenovirus, Astrovirus, Enterovirus, human Norovirus (GI, GII, and GIV genotypes), Hepatitis A virus, Hepatitis E virus, Rotavirus A, and Sapovirus. The project manager (Dr. Ishii at the U of M) has developed and optimized the microfluidics quantitative PCR chip system to simultaneously quantify these pathogens in water samples. All necessary equipment is present in the U of M, and will be used in this project.

DNA and RNA will be extracted from the cell pellets prepared from the 144 water samples in Activity 1. Pathogen-specific genes will be amplified and quantified in the microfluidic quantitative PCR chip. Based on these results, we will calculate the concentrations of pathogens per liter water. These concentration data will be used for the risk assessment in Activity 3.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 72,000
Amount Spent: $ 0
Balance: $ 72,000

Outcome	Completion Date
1. *DNA and RNA samples (144 samples)*	December 31, 2018
2. *Concentrations of multiple pathogens in water samples*	December 31, 2018

Activity 2 Status as of January 1, 2018:

Activity 2 Status as of July 1, 2018:

Activity 2 Status as of January 1, 2019:

Activity 2 Status as of July 1, 2019:

Final Report Summary:

ACTIVITY 3: Quantitative microbial risk assessment

Description:

In this activity, we will assess the potential health risks associated with the water samples through quantitative microbial risk assessment (QMRA). Risk of pathogen infection is a function of pathogen concentration in water, infectious dose of the pathogen, and a probability of pathogen exposure. We will use the pathogen concentration data obtained in Activity 2. Infectious dose is the concentration of pathogens that cause pathogen infection to 50% of human population. The infectious dose differs by pathogen and is available in the literature. The probability of pathogen exposure differs by water reuse purpose. For example, when reclaimed water is used to for irrigation to golf green, people may ingest mist generated by sprinklers. We will calculate the volume of mist people may ingest and then calculate the probability of pathogen exposure by taking pathogen concentration in the mist into account.

Based on the QMRA results (Activity 3) and water reuse system design assessment (Activity 1), we will analyze how system design components affect the microbial pathogen populations in the water. We will then recommend water quality standards and make system design recommendations using best public health and engineering practices. Benefits of water reuse will be maximized due to elimination of barriers.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 29,000
Amount Spent: $ 0
Balance: $ 29,000

Outcome	Completion Date
1. *Potential health risks of water samples*	March 31, 2019
2. *Analysis of microbial data in relation to system design*	March 31, 2019
3. *Recommend water quality and design standards for water reuse systems*	June 30, 2019

Activity 3 Status as of January 1, 2018:

Activity 3 Status as of July 1, 2018:

Activity 3 Status as of January 1, 2019:

Activity 3 Status as of July 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description:

Findings will be disseminated and archived via reports to LCCMR, peer-reviewed publications, and presentations at conferences. We will also publish recommended water quality and design standards for water reuse purposes on the Minnesota Department of Health's website or other locations as appropriate.

Status as of January 1, 2018:

Status as of July 1, 2018:

Status as of January 1, 2019:

Status as of July 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview:

***This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report.**

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 123,000	1 project manager at 8% FTE for two years; one graduate research assistant at 50% FTE for two years; 1 undergraduate research assistant at 100% FTE for 5 months.
Equipment/Tools/Supplies:	$20,000	General lab supplies ($3,000), membrane filters ($3,000), water sample analysis ($2,000), DNA/RNA extraction kits ($2,000), reagents for qPCR ($4,000), use of UMGC's facilities for microfluidic qPCR ($6,000)
Travel Expenses in MN:	$5,000	In-state travel to collect water samples: Mileage $4000; meals $1,000
TOTAL ENRTF BUDGET:	**$148,000**	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.5

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
N/A		$	
State			
University of Minnesota	$56,000	$0	In-kind contribution of indirect costs not charged to this project
Minnesota Department of Health	$32,000	$0	In-kind salary for Anita Anderson and Nancy Rice
TOTAL OTHER FUNDS:	**$88,000**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners:

Partners receiving ENRTF funding: N/A

Partners NOT receiving ENRTF funding

- Timothy LaPara (Professor at the Department of Civil, Environmental, and Geo- Engineering, the University of Minnesota): Providing technical support (Activities 1, 2, and 3)
- Anita Anderson (Principal Engineering Supervisor at the Drinking Water Protection Unit, Minnesota Department of Health): Providing advice on water sample collection (Activity 1) and recommending water quality and design standards for water reuse systems (Activity 3)
- Nancy Rice (Research Scientist at the Health Risk Assessment Unit, Minnesota Department of Health): Providing advice on QMRA (Activity 3)

B. Project Impact and Long-term Strategy:

This project will maximize the potential of water reuse to conserve Minnesota's groundwater and improve surface water quality by providing the pathogen data needed to eliminate barriers to water reuse. This project will provide assurances to the public, regulators and system owners that water reuse can become common practice without negative effects on public health and safety and provide design information to reduce cost.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
Clean water fund	September 1, 2014 to December 31, 2016 (no-cost extension being requested to June 30, 2017)	$200,000
Total		$200,000

VIII. REPORTING REQUIREMENTS:

- **The project is for 2 years, will begin on July 1, 2017, and end on June 30, 2019.**
- **Periodic project status update reports will be submitted January 1 and July 1 of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2019**.

IX. VISUAL COMPONENT or MAP(S): See attached visual

Environment and Natural Resources Trust Fund
M.L. 2017 Project Budget

Project Title: Assessment of Water Quality for Reuse
Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 04f
Project Manager: Satoshi Ishii
Organization: University of Minnesota
M.L. 2017 ENRTF Appropriation: $148,000
Project Length and Completion Date: 2 Years, June 30, 2019
Date of Report: 9/14/2016

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Water sample collections***			***Quantitatively detect multiple human***			***Quantitative microbial risk assessment***				
Personnel (Wages and Benefits)	$37,000	$0	$37,000	$57,000	$0	$57,000	$29,000	$0	$29,000	$123,000	$123,000
Satoshi Ishii, Project Manager: $27,000 (75% salary, 25% benefits) 8% FTE each year for 2 years											
Graduate research assistant: $87,000 (55% salary, 45% benef 50% FTE for 2 years											
Undergraduate research assistant: $9,000 (100% salary, 0% benefits); 100% FTE in summer for 5 months											
Equipment/Tools/Supplies											
General lab supplies ($3,000), membrane filters ($3,000), water sample analysis ($2,000), DNA/RNA extraction kits ($2,000), reagents for qPCR ($4,000), use of UMGC's facilities for microfluidic qPCR ($6,000)	$5,000	$0	$5,000	$15,000	$0	$15,000				$20,000	$20,000
Travel expenses in Minnesota											
In-state travel to collect water samples: Mileage $4000; meals $1,000	$5,000	$0	$5,000							$5,000	$5,000
COLUMN TOTAL	**$47,000**	**$0**	**$47,000**	**$72,000**	**$0**	**$72,000**	**$29,000**	**$0**	**$29,000**	**$148,000**	**$148,000**

Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: Wastewater Treatment Plant Optimization Pilot Program

ENRTF ID: 035-B

Category: B. Water Resources

Total Project Budget: $ 236,360

Proposed Project Time Period for the Funding Requested: 1.5 years, July 2017 to December 2018

Summary:

A pilot program of wastewater treatment optimization without costly facility upgrades. This will lead to cleaner lakes and rivers without needless costs, and achieve significantly better treatment results.

Name: Joel Peck

Sponsoring Organization: Minnesota Pollution Control Agency

Address: 520 Lafayette Rd. N.
St. Paul MN 55155

Telephone Number: (651) 7572202

Email joel.peck@state.mn.us

Web Address pca.state.mn.us

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Map of Minnesota showing Phosphorous trends by watershed.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Wastewater Treatment Plant Optimization Pilot Program

I. PROJECT STATEMENT

This proposal, if successful, will fund a pilot project to determine how, and by what means, wastewater treatment plants can be optimized, and the new effluent limitations met, without adding costly new infrastructure upgrades. Infrastructure upgrades should be the last resort when more restrictive effluent limitations are required to meet water quality standards. MPCA should support communities' efforts to optimize existing treatment processes where treatment can be modified or optimized to improve nutrient removal.

As the MPCA reviews municipal NPDES permits and completes watershed assessments, sometimes these actions result in more restrictive effluent limits for WWTPs. Municipal engineering cunsultants usually recommend adding new infrastructure, at significant cost to the municipality. This should always be the last resort. If WWTP optimization was a demonstrable success in Minnesota as a means to achieve new effluent limitations, then fewer cities may be required to take on the expense of adding infrastucture to their treatment process.

Wastewater Treatment Plant Optimization can:

- adjust or modify certain treatment processes and controls, detention times, aeration rates which makes the microorganisms (bugs) work harder and achieving significantly better treatment;
- demonstrate that infrastructure projects are often not needed to meet new phosphorous limits;
- improve operator knowledge of treatment process to allow more nimble response to existing effluent conditions;
- achieve cleaner Mississippi, Red River, Shellrock and Minnesota River watersheds at lower economic burden to municipalities.

II. PROJECT ACTIVITIES AND OUTCOMES

The outcome of this proposal will transfer knowledge through a final report that describes what wastewater treatment plant optimization is capable of achieving in a pilot project scenario. This will inform future programmatic decisions to place greater emphasis on operator technical support and also serve to transfer knowledge to municipal organizations that want to explore this means of achieving compliance.

Activities will include design and promotion of a kick-off seminar that will inform municipal wastewater operators and administrative officials about the concept of plant optimization, how it has worked in other situations and what it is capable of doing in Minnesota's climate. The kickoff seminar will establish a pool of interested facilities and operators from which the pilot program partners can select three to five participating facilities. These participating facilities will enter into an agreement under which program partners will conduct technical assistance and conduct optimization techniques to increase treatment without adding infrastructure..

Knowledge transfer begins when program partners will evaluate each plant's existing treatment process and make adjustments, through process control, operator training, and increasing or decreasing wastewater detention time, to achieve better treatment result. This is what optimization is, simply getting better treatment through existing infrastructure. The results of this data will be analyzed by a University of Minnesota Grad student and published. It will be shared with wastewater operators throughout the state as a resource.

Activity 1: *Pilot Facility Selection* **Budget: $ 2,000**

Advertise for and conduct a seminar on what WWTP Optimization is, and why it may be a viable alternative to infrastructure improvements to meet nutrient effluent limitations. Select three to five candidate-WWTP's from seminar attendees to participate in pilot program.

Outcome	Completion Date
1. Provide a transfer of knowledge from experts to interested parties about optimization	*07/15/2017*
2. Generate interest of 3-5 possible pilot program candidates	*07/15-20/2017*

Activity 2: *Transfer of knowledge* **Budget: $ 234,360**

Once the pool of participants from WWTP optimization seminar have been identified, they will need to enter into a memorandum of understanding that offers the program partners indemnification and clearly defines what is expected of each party. Technical assistance will commence with a site visit to the participating WWTP to understand the plants process, existing components, and general capability of both the facility and the operator. Additional instruction will likely occur at program partner facilities.

Outcome	Completion Date
1. MOU will be signed engaging the facility in pilot program. Expectations of each party are clearly understood.	*08/15/2017*
2. Site visits begin	*08/15/2017*
3. Program partners begin providing technical assistance to participating operators	*08/15/2017*
4. Evaluation of optimization activities. What worked and what did not. Why?	*06/28/2018*
5. Knowledge sharing	*12/31/2018*

III. PROJECT STRATEGY

A. Project Team/Partners

Partners with MPCA: We intend to engage organizations that have experience in treatment of biological nutrient removal facilities in municipal wastestreams. Ideally, municipal organizations, such as St. Cloud that have real world experience in optimization, and organizations that focus on research such as University of Minnesota, will provide the technical assistance required. Four partners, with MPCA, will initiate the pilot project with a seminar describing what WWTP optimization involves and how it is accomplished. These include Tim LaPara, from University of Minnesota; Karl DeWahl, from MnTAP; staff at MCES and staff at St. Cloud Wastewater Treatment Plant.

The University of Minnesota's Department of Civil, Environmental, and Geo- Engineering will be a key partner, as will the University's MnTAP program. We will engage a graduate-level student to analyze and compile the results in a final report. Additionally, staff from St. Cloud WWTP and MCES will also be available to provide optimization assistance.

B. Project Impact and Long-Term Strategy

The long-term strategy is to understand how plant optimization activities and techniques work in an upper Midwestern climate. The pilot program will inform future decisions about funding technical assistance programs that can be more cost effective than funding major infrastructure projects to meet new effluent limitations.

C. Timeline Requirements

The timeline proposed will be able to demonstrate the effectiveness of WWTP optimization actives within six months of program funding. Monitoring, data evaluation complete by December 2018.

2018 Detailed Project Budget

Project Title: *Wastewater Treatment Plant Optimization Pilot Program*

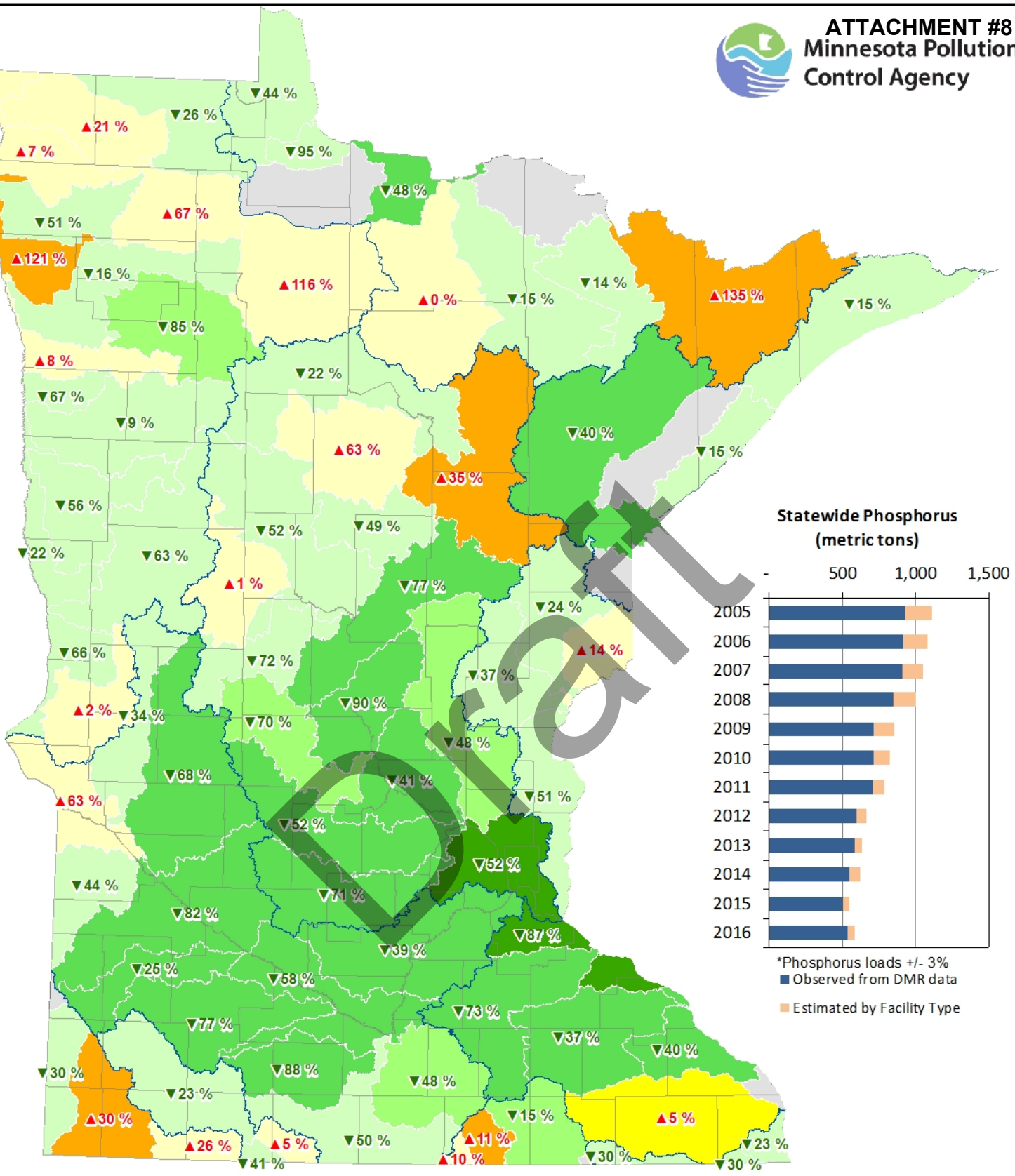
IV. TOTAL ENRTF REQUEST BUDGET Two years

BUDGET ITEM	AMOUNT
Personnel:	na
Professional/Technical/Service Contracts: The amount proposed for contract amounts with MCES, St. Cloud WWTP, and MnTAP, includes two wastewater engineers at 160 hours each at a rate of $185 per hour ($59,200) through sole-source contract.	$ 59,200
Professional/Technical/Service Contracts: Three experienced wastewater operators from MCES, St. Cloud WWTP, and MnTAP, at 320 hours each at a rate of $125 per hour ($60,000) through sole-source contract.	$ 120,000
Professional/Technical/Service Contracts: ;; and one graduate-level student at 25 percent apportionment for 940 hours at $20 per hour, plus tuition, and fringe benefits ($34,656).	$ 34,656
Equipment/Tools/Supplies: Materials and consumables $1,500; five Portable Spectrophotometers (5x$3,270)	$ 17,850
	na
Travel: Estimated 2000 miles at $.535 per mile	$ 1,070
Additional Budget Items: Expenses for an opening and closing seminar, estimated at $3,584	$ 3,584
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 236,360

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	na	*Indicate: Secured or*
Other State $ To Be Applied To Project During Project Period: Joel Peck, MPCA Municipal Liaison, project manangement and administration at 160 hours, or 8.3 percent of annual salary, and 8.3 percent of fringe benefits. The anticipated work requirement is 160 hours over the six-month periodindividual sum, list out the source of the funds, the amount, and indicate whether the funds are secured or pending approval.	$ 9,448	*Secured*
In-kind Services To Be Applied To Project During Project Period:	na	*Indicate: Secured or*
Past and Current ENRTF Appropriation:	na	Indicate: Unspent?
Other Funding History:	na	

Minnesota Pollution Control Agency



Statewide Phosphorus (metric tons)

*Phosphorus loads +/- 3%
Observed from DMR data
Estimated by Facility Type

Decrease from 2005 to 2014-16 avg.(kg)

- 0 - 5,000
- 5,000 - 10,000
- 10,000 - 50,000
- >50,000

Increase from 2005 to 2014-16 avg.(kg)

- 1 - 500
- 501 - 1,000
- 1,001 - 3,000
- No WWTP Loads

Statewide NPDES Permitted Wastewater Phosphorus Loading Change from 2005 to 2014-16 Average

Joel Peck, Municipal Liaison
Joel.peck@state.mn.us 651.757.2202
520 Lafayette Rd. N., St. Paul, MN 55155

Minnesota Pollution Control Agency

Municipal Liaison

This position exists to serve as the liaison for Municipal wastewater facilities that require interaction with the Minnesota Pollution Control Agency. This work includes building and fostering relationships with municipal administrators and wastewater professionals, providing outreach and education on the basis and need for new and proposed water quality regulations with potential to impact wastewater facilities, and specifically assisting municipal facilities to understand the impact of applicable rules and requirements of agency on financial and human resources. In particular, this position assists municipalities in implementing and participating in the water quality standards rulemaking process and navigating the NPDES/SDS permitting process. The position also provides direction on the public funding programs for water infrastructure projects.

Joel Peck's Professional History

Municipal Liaison
2015-present Minnesota Pollution Control Agency

City Administrator
2011-2015 St. Croix Falls, WI

City Administrator
2008-2011 Crosby, MN

Intern to Director of Member Service
2007-2008 League of Minnesota Cities

Administrative Assistant
2003-2007 Third Floor Documents Division, Office of the Chief Clerk of the Minnesota House of Representatives

Education

Masters of Science in Public Administration
2006 Hamline University

Bachelor of Arts in Journalism
2003 North Central University