

**Environment and Natural Resources Trust Fund**

# 2021 Request for Proposal

## **General Information**

**Proposal ID:** 2021-160

**Proposal Title:** Establishment of Safe Water Reuse

## **Project Manager Information**

**Name:** Satoshi Ishii

**Organization:** U of MN, College of Food, Agricultural and Natural Resource Sciences

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## **Project Basic Information**

**Project Summary:** The goal of this project is to contribute to the establishment of safe water reuse in Minnesota by clarifying the potential health risks associated with water reuse.

**Funds Requested:** $362,000

**Proposed Project Completion:** 2024-06-30

**LCCMR Funding Category:** Water Resources (B)

## **Project Location**

**What is the best scale for describing where your work will take place?** Region(s): Metro

**What is the best scale to describe the area impacted by your work?** Statewide

**When will the work impact occur?** During the Project and In the Future

## **Narrative**

**Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

Stormwater has potential to be a useful resource in the State of Minnesota. Water reuse can provide many benefits, such as reduced use of highly treated drinking water for watering the lawn or toilet flushing, reduced pressure on groundwater aquifers and surface waters, better control of pollutants in stormwater, and long-term savings for irrigation. But the risks of water reuse to public health are not fully understood, limiting its implementation. Even if the water is not consumed, water reuse applications likely pose some risk to public health, which needs to be understood so that water reuse applications can proliferate without compromising public health. Our previous studies have detected genes (DNA) for potential pathogens (i.e., microbes capable of making people sick) as well as antibiotic resistance genes (ARGs) in water reuse systems. But dead pathogens can be also detected by DNA-based assays, so detection of genes does not necessarily reflect a genuine risk. In addition, non-pathogenic bacteria may also carry ARGs. Additional research is therefore needed to determine the risk posed by live pathogenic and antibiotic resistant microorganisms in the water being reused.

**What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.**

The proposed project will (1) quantify various live infectious pathogens in Minnesota’s water reuse systems, (2) analyze antibiotic resistance of the isolated bacteria, and (3) assess potential human health risks associated with the water reuse systems.

We will use culture (growth)-based analysis to detect infectious pathogens and clarify whether pathogenic bacteria are carrying the ARGs. By quantifying the levels of infectious pathogens with culture-based analysis and identifying the host of ARGs, it becomes possible to assess potential health risks associated with water reuse for various applications such as toilet flushing and irrigation.

**What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state’s natural resources?**

The overall goal of this project is to contribute to the establishment of safe water reuse by clarifying the
potential health risks associated with water reuse. The final outcome of this project, information needed to develop water quality recommendations for safe water reuse, can be used by agencies working to develop regulatory and non-regulatory guidance for safe and sustainable reuse in Minnesota and help to increase water reuse in Minnesota. In turn, increased water reuse will conserve our drinking water supplies in groundwater aquifers and improve surface water quality.

## **Activities and Milestones**

### **Activity 1: Quantify various infectious pathogens in Minnesota’s water reuse systems**

**Activity Budget:** $232,000

**Activity Description:**We will collect samples from water reuse facilities in Minnesota every two to three weeks during the reuse seasons (May-November) for two years (2021-2022). If water is treated (filtration, disinfection, etc.) or stored (stormwater pond) before reuse, both source water and treated water samples will be collected. Environmental parameters such as temperature and precipitation will be recorded for each site. General water quality parameters such as the nutrient concentrations and the levels of fecal indicator bacteria will be also measured. Pathogens previously frequently detected by DNA-based analysis as well as antibiotic-resistant bacteria will be isolated from the water samples using culture-based methods. In addition to culture-based analysis, DNA-based pathogen and ARG quantification will be also performed. By comparing the results obtained by culture-based and DNA-based methods, the proportion of infectious pathogens out of total pathogens will be calculated.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Water sample collection and characterization (from 3-4 facilities over 2 years) | 2022-12-31 |
| Isolation and quantification of pathogens and antibiotic resistant bacteria in water samples | 2023-06-30 |

### **Activity 2: Analyze antibiotic resistance of the isolated bacteria**

**Activity Budget:** $67,000

**Activity Description:**Bacteria isolated in Activity 1 will be analyzed for their levels of antibiotic resistance and the possession of ARGs. Bacterial species will be identified by gene sequencing analysis. Genomes of the representative strains will be also sequenced to analyze the possibility of ARGs being horizontally transferred between different bacteria (e.g., from non-pathogens to pathogens).

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Species name of the antibiotic resistant bacteria isolated from water samples | 2023-06-30 |
| Genome of the antibiotic resistant bacteria strains | 2023-12-31 |

### **Activity 3: Assess potential health risks associated with the reuse water systems**

**Activity Budget:** $63,000

**Activity Description:**Quantity of potentially infectious pathogens obtained in Activity 1 will be used to assess potential human health risks associated with the water samples. Results of these analyses could then be used to develop water quality recommendations for best public health practices in Minnesota. In addition to written reports, we will discuss outcomes with managers of local water reuse facilities in various venues, such as conferences, training sessions, workshops or stakeholder meetings. Through these activities, we will contribute to the establishment of safe water reuse in Minnesota.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Events to disseminate the results | 2024-06-30 |
| Assessment of potential health risks associated with the reuse water systems | 2024-06-30 |

## **Project Partners and Collaborators**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Organization** | **Role** | **Receiving Funds** |
| Nancy Rice | Minnesota Department of Health | Data analysis | No |
| Anita Anderson | Minnesota Department of Health | Technical support | No |
| Timothy LaPara | University of Minnesota | Co-supervision of a post-doctoral researcher. | Yes |

## **Long-Term Implementation and Funding**

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?**This project will maximize the potential of water reuse to conserve Minnesota’s groundwater and improve surface water quality by providing the pathogen/ARB data needed to eliminate barriers to water reuse. This research will help provide assurances to the public, regulators and system owners that water reuse can become common practice without negative effects on public health and safety.

## **Other ENRTF Appropriations Awarded in the Last Six Years**

|  |  |  |
| --- | --- | --- |
| **Name** | **Appropriation** | **Amount Awarded** |
| Assessment of Water Quality for Reuse | M.L. 2017, Chp. 96, Sec. 2, Subd. 04f | $148,000 |

## **Project Manager and Organization Qualifications**

**Project Manager Name:** Satoshi Ishii

**Job Title:** Associate Professor

**Provide description of the project manager’s qualifications to manage the proposed project.**Satoshi Ishii is Associate Professor in the BioTechnology Institute (BTI) and the Department of Soil, Water, and Climate (SWC) at the University of Minnesota. Dr. Ishii’s research focuses on environmental microbiology and biotechnology, including water quality and public health microbiology. He has led several projects related to water quality and reuse, funded by LCCMR and Minnesota Stormwater Research Council (MSRC).

**Organization:** U of MN - Twin Cities

**Organization Description:**The University of Minnesota is the main research and graduate teaching institution in the state of Minnesota. The BioTechnology Institute provides advanced research, training, and university-industry interaction in biological process technology. In the Department of Soil, Water, and Climate, we seek to improve and protect the quality of soil, air, and water resources in natural and managed ecosystems, through research, reaching, and extension.

## **Budget Summary**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category / Name** | **Subcategory or Type** | **Description** | **Purpose** | **Gen. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified Staff?** | **$ Amount** |
| **Personnel** |  |  |  |  |  |  |  |  |
| 2 Professors |  | Project supervision, supervision of a post-doctoral researcher, project reporting. |  |  | 27% | 0.48 |  | $76,000 |
| Postdoctoral research associate |  | Collect samples, peform lab experiments, and analyze data for Activities 1, 2, and 3; write reports |  |  | 20% | 3 |  | $186,000 |
| 2 Undergraduate research technicians |  | Sample collection and processing, water quality analysis for Activity 1 |  |  | 0% | 0.54 |  | $13,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$275,000** |
| **Contracts and Services** |  |  |  |  |  |  |  |  |
| University of Minnesota Genomics Center | Internal services or fees (uncommon) | Microfluidic qPCRuser fee (Approx $300/run x 12 runs); Complete genome sequencing (Approx. $5,000 for 8 genomes) |  |  |  | 0 |  | $9,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$9,000** |
| **Equipment, Tools, and Supplies** |  |  |  |  |  |  |  |  |
|  | Equipment | CO2 incubator | Necessary to grow enteric viruses |  |  |  |  | $6,000 |
|  | Tools and Supplies | Field supplies (a high-performance vacuum pump: $1,800; tubings: $1,000; other supplies: $400) | Necessary to collect water samples from water reuse facilities |  |  |  |  | $3,000 |
|  | Tools and Supplies | Lab supplies (Membrane filters: 400 samples at $20/sample; DNA/RNA extraction kits: 400 samples at $10/sample; Reagents for microfluidic qPCR pathogen and ARG detections: 400 samples at $60/sample; general water quality analysis: 400 samples at $20/sample; Culture media for pathogen isolation $4,000; Quanti-Tray kits for fecal indicator bacteria testing: $4,800; Glassware and plastic consumables: $4,000) | Necessary to grow and detect pathogens and antibiotic resistant bacteria in water samples |  |  |  |  | $57,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$66,000** |
| **Capital Expenditures** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Acquisitions and Stewardship** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Travel In Minnesota** |  |  |  |  |  |  |  |  |
|  | Miles/ Meals/ Lodging | In-state travel to collect samples (Approximately 8,700 miles at $0.575/mile per U of M travel policy) | Necessary to collect water samples from several water reuse facilities in Minnesota |  |  |  |  | $5,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$5,000** |
| **Travel Outside Minnesota** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Printing and Publication** |  |  |  |  |  |  |  |  |
|  | Publication | Open access publication fee ($2,500/publication x 2 publications) | Necessary to make the results publicly available |  |  |  |  | $5,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$5,000** |
| **Other Expenses** |  |  |  |  |  |  |  |  |
|  |  | Equipment repair and maintenance | Necessary for maintaining existing incubators, biosafety cabinet, etc. |  |  |  |  | $2,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$2,000** |
|  |  |  |  |  |  |  | **Grand Total** | **$362,000** |

### **Classified Staff or Generally Ineligible Expenses**

|  |  |  |  |
| --- | --- | --- | --- |
| **Category/Name** | **Subcategory or Type** | **Description** | **Justification Ineligible Expense or Classified Staff Request** |

### **Non ENRTF Funds**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Specific Source** | **Use** | **Status** | **Amount** |
| **State** |  |  |  |  |
| Cash | Minnesota Stormwater Research Council (5/1/2020-11/31/2021) | Stormwater samples will be collected from several reuse facilities in the Twin Cities Metro area, for the quantification of pathogens and antibiotic resistance genes. This MSRC-funded research does not grow pathogens and antibiotic resistant bacteria by culture-based methods, and therefore, there is a minimum overlap between the MSRC-funded research and the proposed LCCMR research. | Secured | $59,756 |
| In-Kind | Minnesota Department of Health | Minnesota Department of Health provides salary + benefits to its members for this project. | Secured | $10,000 |
| In-Kind | University of Minnesota | The University of Minnesota is not allowed to charge the State of Minnesota its typical overhead rate of 55% of the total modified direct costs. We are listing our unrecoverable indirect cost as in-kind contribution. | Secured | $195,800 |
|  |  |  | **State Sub Total** | **$265,556** |
| **Non-State** |  |  |  |  |
|  |  |  | **Non State Sub Total** | **-** |
|  |  |  | **Funds Total** | **$265,556** |

## **Attachments**

### **Required Attachments**

#### **Visual Component**

File: [8d611653-a03.pdf](https://lccmrprojectmgmt.leg.mn/media/map/8d611653-a03.pdf)

#### **Alternate Text for Visual Component**

This graphic shows how this project contributes to maximizing the benefit of water reuse in improving surface water quality and reducing demand on groundwater aquifers in Minnesota.

### **Optional Attachments**

#### **Support Letter or Other**

|  |  |
| --- | --- |
| **Title** | **File** |
| Letter from MDH | [026f1f48-ee7.pdf](https://lccmrprojectmgmt.leg.mn/media/attachments/026f1f48-ee7.pdf) |

## **Administrative Use**

**Does your project include restoration or acquisition of land rights?**
 No

**Does your project have patent, royalties, or revenue potential?**
 No

**Does your project include research?**
 Yes

**Does the organization have a fiscal agent for this project?**
 Yes, Sponsored Projects Administration