

**Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 043-AH

Assessing the Legacy of Minnesotan Urban Ecosystem Services

Category: H. Proposals seeking \$200,000 or less in funding

Sub-Category: A. Foundational Natural Resource Data and Information

Total Project Budget: \$ 72,675

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

We are proposing a complete assessment of urban green space legacies on their soil-related ecosystem services and bacterial communities using soil extraction techniques, molecular and metagenomic analysis

Name: Florence Sessoms

Sponsoring Organization: U of MN

Title: Dr.

Department: Department of Horticultural Science

Address: 362 Alderman Hall
St. Paul MN 55108

Telephone Number: (607) 793-0245

Email fsessoms@umn.edu

Web Address

Location

Region: Metro

County Name: Ramsey

City / Township: Twin Cities

Alternate Text for Visual:

Pictures of the chosen urban green spaces are displayed. These sites will be assessed for their ecosystems services provided in relation to their soil microbe diversity and soil legacy.

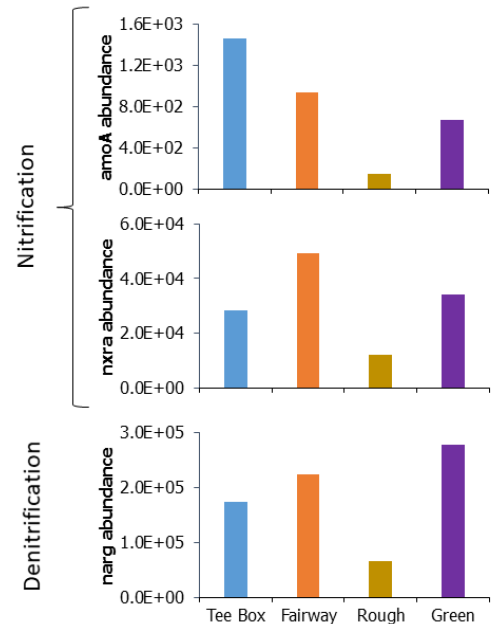
<input type="checkbox"/>	Funding Priorities	<input type="checkbox"/>	Multiple Benefits	<input type="checkbox"/>	Outcomes	<input type="checkbox"/>	Knowledge Base
<input type="checkbox"/>	Extent of Impact	<input type="checkbox"/>	Innovation	<input type="checkbox"/>	Scientific/Tech Basis	<input type="checkbox"/>	Urgency
<input type="checkbox"/>	Capacity Readiness	<input type="checkbox"/>	Leverage	<input type="checkbox"/>		TOTAL	<input type="checkbox"/> %
<input type="checkbox"/> If under \$200,000, waive presentation?							



PROJECT TITLE: Assessing the Legacy of Minnesotan Urban Ecosystem Services.

I. PROJECT STATEMENT

Why: We are proposing to use the University of Minnesota Les Bolstad Golf Course as a living lab to examine the legacy of urban green space ecosystem services (ES) in the Twin Cities. Numerous researchers have demonstrated that urban green spaces such as roadsides, parks, cemeteries, home lawns, and golf courses provide significant value to society through their ES contributions: urban green space can sequester carbon (C) into the soil, capture stormwater runoff, reduce phosphate and nitrate leaching, reduce the heat-island effect, and provide habitat for pollinators and wildlife. However, urban green spaces can be very heterogeneous with distinct legacy resulting from their land cover types (plant biodiversity), land-use history before urban development and management practices. As a result, the value of ES can differ greatly between the different urban land-use types. Studying ES at the metropolitan area or city scale would be tedious and expensive, requiring the selection of numerous urban green sites distributed geographically within the city. Fortunately, the University of Minnesota Les Bolstad Golf Course can serve as an urban green space laboratory. This public golf course has various soil types, provides over 90 years of documented management practices (mowing, fertilization, etc.), contains diverse vegetation (fairway, rough, trees, wetlands), and has variable topology that can alter water run-off. This incredible green space diversity makes Les Bolstad golf course an ideal proxy for studying ecosystem services in the Twin Cities. The main goal of this project is to collect and examine soil data of several diverse locations within and around Les Bolstad to assess nitrogen (N) mineralization, nitrification and denitrification and their connection to the soil microbiome diversity. Golf course sites will be compared to several adjacent home lawns and community parks. Preliminary results from golf hole #1 (Figure 1) showed that microbe gene abundance associated with nitrification and denitrification differed based on golf course maintenance practices (green were different than fairways, etc.). We are presented with a unique opportunity to better understand the impact of urban green space legacy (plant diversity, management practices, land-use history) on the N cycle and microbiome diversity after 90 years of recorded urban management. This 90-yr-old golf course will undergo future renovation, including surface re-grading that will result in significant disturbances of the soil's physical and chemical properties; this will create an ideal scenario, in later iterations of this project, to compare how soil disturbances and land-use legacy affect ecosystem services.



Goal: Our research goal will be to study of how urban landscape management practices, land cover types, land-use history and microbiome are connected to beneficial soil ES in an urban landscape.

II. PROJECT ACTIVITIES AND OUTCOMES

Activities: This research project will be divided into two activities

Activity 1: Soil profile and ES comparison of various St Paul urban green space areas.

Soil profiles of the University of Minnesota Les Bolstad Golf Course (3 fairways, 3 rough, and 3 wooded areas); a nearby community park (3 perennial grass areas and 3 wooded areas); and three home lawns will be compared. A total of 54 soil core samples (3 biological replicates for each of the 18 locations) will be collected and assessed for soil C, organic matter, bulk density, pH, and mineral nutrient composition (in particular P content). Total N, gross N mineralization (arginine ammonification assay), and potential nitrification rates will be evaluated for each soil sample. Finally, denitrification will be estimated with quantitative amplification (qPCR) of genes associated with the denitrification pathway (qPCR allows us to estimate microbial population size based on the quantity of genes that we detect in a sample)

ENRTF BUDGET: \$49,044



**Environment and Natural Resources Trust Fund (ENRTF)
2019 Main Proposal**

Outcome	Completion Date
1. <i>Soil sampling and analysis of chemical and physical properties</i>	<i>December 2019</i>
2. <i>Potential nitrification</i>	<i>January 2020</i>
3. <i>Denitrification estimation</i>	<i>March 2020</i>
4. <i>Gross N mineralization</i>	<i>June 2020</i>
5. <i>Data analysis</i>	<i>September 2020</i>

Activity 2: Soil microbiomes examination of St. Paul urban green spaces and data analysis.

Bacterial RNA sequencing will be processed for different sample areas (Soil DNA extraction with the DNeasy PowerSoil Kit, Qiagen; 16S V4 amplification and sequencing at The University of Minnesota Genomic Center <http://genomics.umn.edu>, the HiSeq 2500 rapid Run methodology, 250-bp Paired-end). Bioinformatic tools will be used to study the diversity of the microbial community and putative functional content of the bacterial community will be done using PICRUSt bioinformatic software (<http://picrust.github.io/picrust/>). Data will be used to correlate bacterial community to measured soil parameters and ES.

ENRTF BUDGET: \$23,631

Outcome	Completion Date
1. <i>Preliminary data presentation to public (UMN field days)</i>	<i>August 2020</i>
2. <i>Amplicon sequencing and microbiome analysis</i>	<i>September, 2020</i>
3. <i>Scientific publication</i>	<i>July, 2021</i>

Outcomes:

Altogether, this project will lead to a complete assessment of land management and green space legacies, evaluate soil ES (N retention, C storage and P runoff), increase our comprehension of the relationship between soil management and ecosystem legacy on the bacterial community. We will communicate our results to stakeholders through public field days, presentations, and research publications.

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Florence Sessoms	Dr.	Department of Horticultural Science	P.I

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Brian Horgan	Professor	Department of Horticultural Science	Co-P.I.
Eric Watkins	Professor	Department of Horticultural Science	Co-P.I.

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

Urban green spaces are critical for providing ES in a constant growing urban population. This project will fill major gaps in the scientific literature on the importance of established urban managed green space areas for the soil bacterial community, and its relationship with soil nitrogen dynamics and ecosystems services provided. In addition we will evaluate the impact of management practice, land-use history and vegetation on soil community and soil based ES. Because of the proposed renovation of the Les Bolstad Golf Course, this research project will be the foundation for our long-term strategy focused on determining how much time is necessary for a remodeled urban green space to reach its full potential as an environmental asset.

V. TIME LINE REQUIREMENTS:

Activity 1 is expected to start in July 2019, and finish in September 2020. Activity 2 will begin January 2020, and will finish June 2021. Preliminary results will be presented to the public at the University of Minnesota Turfgrass Science Field Day in August 2020; we will also share our results with the scientific community through peer-reviewed publications by June 2021.

2019 Proposal Budget Spreadsheet

Project Title: Assessing the Legacy of Minnesotan Urban Ecosystem Services.

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM (See "Guidance on Allowable Expenses")	AMOUNT
Personnel: Partial salary support for F. Sessoms (Project investigator, Researcher 5), who will be conducting research and analysis for Activities 1 and 2 : 50% year 1 w/ fringe rate of 33.5% (\$26,523 salary + \$8,885 fringe), and 25% year 2 (\$13,659 salary plus \$4,576 fringe).	\$ 53,643
Personnel: One part-time undergraduate to assist with soil sampling and laboratory work in Activity 1 and 2 (\$12/hr, 10 hrs/wk, 26.5 wks/yr, during year 1; equivalent to ~12.7% FTE). Dr. Sessoms will be in charge of the training and mentoring of the undergraduate student. (\$3,180).	\$ 3,180
Professional/Technical/Service Contracts:	\$ -
Equipment/Tools/Supplies: General lab supplies (various tips, diverse autoclavable plastic tubes, paper towels, gloves, MoBio Kit for DNA extraction, dnase free water).	\$ 3,578
Equipment/Tools/Supplies: Specific lab supplies (tubes ,96-wells plates, cuvettes), chemicals (EtOH, sodium hypochlorite, isopropanol), & salt (various) needed for the arginine amminification assay and net nitrification assay.	\$ 1,664
Equipment/Tools/Supplies: Sybr-green, primers, gBlock Gene Fragments, qPCR plates, seals needed for the denitrification.	\$ 2,500
Acquisition (Fee Title or Permanent Easements): This is not a acquisition/restoration proposal.	\$ -
Travel:	\$ -
Additional Budget Items: Research analytic lab for 54 soil profiles (18 sites, 3 replicates per site) evaluation and total NO2-NO3 content (54 soil samples) for the nitrification slurry experiment.	\$ 2,714
Additional Budget Items: Amplicon sequencing of the 54 soil-DNA samples at the UMN genomic center.	\$ 4,396
Additional Budget Items: Publication costs	\$ 1,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 72,675

V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	N/A
Other State \$ To Be Applied To Project During Project Period:	N/A	N/A
In-kind Services To Be Applied To Project During Project Period:	N/A	N/A
Past and Current ENRTF Appropriation:	N/A	N/A
Other Funding History:	N/A	N/A

Assessing the Legacy of Minnesotan Urban Ecosystem Services

Golf Course Laboratory

Wooded Area



Home Lawns



Community Park





**Environment and Natural Resources Trust Fund (ENRTF). Project Manager
Qualifications and Organization Description**

Dr. Florence Sessoms
Researcher
Department of Horticulture
University of Minnesota
362 Alderman Hall
1970 Folwell Ave.
St. Paul, MN. 55108
fsessoms@umn.edu
607 793 0245

Project title: Assessing the Legacy of Minnesotan Urban Ecosystem Services.

Dr. Florence Sessoms is currently serving as a Researcher at the University of Minnesota in the Department of Horticultural Science. Dr. Sessoms possess over 10 years of research experience working with plant-soil microbe interaction (beneficial and pathogenic). Dr. Sessoms focus is to understand how the presence of soil microbe, bacterial or fungal, could be beneficial for plants (improve nutrient uptake, yield and resistance to abiotic stresses) and lead to the reduction of fertilization application, in particular nitrogen. Altogether, Dr. Sessoms is particularly interested in studying the interaction between soil biodiversity and soil-based ecosystem services.

As a young member of the Turfgrass Science Research Lab at the University of Minnesota, Dr. Sessoms is committed to pursuing research efforts that reduce inputs to urban perennial systems. Dr. Sessoms is currently working on screening several perennial grass consumer mixtures for their resistance to drought stress. Additionally, Dr. Sessoms is initiating a promising and exciting research on nitrification inhibition by perennial grass root exudates. Dr. Sessoms main goal is to improve the comprehension of the soil community and its function to maximize soil management practices.

Dr. Sessoms possesses numerous peer-reviewed publications in international journals demonstrating her ability to conduct research successfully. Dr. Sessoms has always presented her research results through seminar or by poster presentation in various international conferences. Dr. Sessoms is very keen to interact with the public as she already has participated to different outreach events involving various types of public audience.

Turfgrass Science Research Lab and Department of Horticultural Science, University of Minnesota

The Turfgrass Science Research Lab consists of seven faculty and extension positions, full-time research staff, and graduate students. The University of Minnesota's Turfgrass Science Program conducts field-based research and offers education and consultation to both turfgrass professionals and homeowners. Over forty peer-reviewed journal articles have been published in the last 10 years. The Turfgrass Science Research Lab and the department of horticultural science possess all the necessary equipment and personal (diverse faculty and staff) to assist Dr. Sessoms for successful progress and execution of the research.