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

Project Title: **ENRTF ID: 184-E**

Harvesting Hidden Clean Energy from Wastewater Systems

Category: E. Air Quality, Climate Change, and Renewable Energy

Sub-Category:

Total Project Budget: $ 408,694

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

Summary:

Existing technologies capable of harvesting hidden clean energy from wastewater streams will be studied to determine their effectiveness in moving the state toward an increasingly clean energy future.

Name: Troy Goodnough

Sponsoring Organization: U of MN - Morris

Title: Director of the Office of Sustainability

Department: University of Minnesota, Morris

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Location

Region: Central, Northeast

County Name: Stevens

City / Township: Morris, Northeast MN City TBD

Alternate Text for Visual:

Map of City of Morris sewer and water systems to illustrate potential points of harvesting hidden clean energy from wastewater streams.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Harvesting Hidden Clean Energy from Wastewater Systems

I. PROJECT STATEMENT

Given the need for diversified energy resources in the U.S., existing technologies capable of transferring heat energy to and from waste streams are growing in interest and demand. Only with an understanding of the heating and cooling potential unique to each community's wastewater system will the effectiveness of implementing this technology be fully realized. The first-phase involves identifying, quantifying, and mapping the heating and cooling potential within a community's system. The goal of this research proposal is to develop a systematic process of investigation, data collection, and mapping of the BTUs available within the various sewer-sheds of the site communities. The study will identify pathways to effectively plan and implement heating and cooling systems using these resources. The benefits of this endeavor include creating professional job opportunities in engineering, economics, and geographic information science, stimulating community growth, diversifying available energy resources, encouraging the implementation of available heat-transfer technology, and ultimately fortifying our nation's strength and independence among an ever-growing demand for energy.

The University of Minnesota, Morris (UMM) and University of Minnesota, Duluth (UMD), and engineering firm of Widseth Smith Nolting and Associates (Hidden Fuels), has reviewed a strategy to complete a study of the Morris community's existing wastewater system. The data will be used to define locations where it may be economically advantageous to harvest heat energy, or to utilize existing wastewater flow signature for cooling of facilities within the community. The project will involve monitoring and data collection of wastewater flows and temperatures at various locations to determine where and when potential energy may be available from the wastewater flows over the course of 12-14 months. After the first phase, the team will select a town in Northern Minnesota to analyze to compare and contrast the results to develop a repeatable approach to mapping the energy resources.

The process will involve installing data collection sensors and hardware; data logging, monitoring, analysis of energy potential at various wastewater sheds within the study area; GIS-based mapping; identification of potential capture locations; and evaluation of cost feasibility of an implementation phase.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Project Planning, Equipment Installation, and Data Collection **Budget: $254,854**

In partnership with UMM, UMD, and city staff a plan will be developed to locate and map the primary data collection points within the wastewater sheds; evaluate existing lift station control systems for flow measurement capability and data retrieval; determine if additional flow measurement equipment is needed; install flow and thermal measurement equipment; and collect data over the course of one year. After the first city has been analyzed and evaluated, a second city will be identified and the process repeated to verify data and increase the knowledge base of results. Geographic Information Systems (GIS) and Supervisory Control and Data Acquisition (SCADA) systems will be used, as available, to collect data and provide detailed mapping.

Outcome	Completion Date
1. Project Planning	August 1, 2019
2. Equipment Installation	Sept. 1, 2019
3. Data Collection	Sept. 1, 2020

Activity 2: Data Analysis and Compilation, Preparation of Mapping and Report **Budget: $153,840**

Evaluation of data collected for each wastewater shed for the potential thermal energy available; matching of the process between thermal sources and suitability of building facilities that may benefit; and identification and quantification of significant energy sources for future infrastructure planning and implementation.

Outcome	Completion Date
1. Data Calculations and Energy Estimates	February 1, 2021

2. Evaluation of Users of Captured Energy and Estimated Cost of Energy Extraction	April 1, 2021
3. Complete Feasibility Study to Extract Heat Energy from the UMM and City of Morris wastewater systems	July 1, 2021

III. PROJECT STRATEGY

A. Partners receiving ENRTF funding

All four partners will be involved in the planning phase, and to varying degrees with implementation. The Principal Investigators at UMM and UMD will assist with data collection with a full-time graduate student over the course of the two year project, with faculty and undergraduate students collaborating on data logging, data evaluation and reporting. WSN (Hidden Fuels) will provide project management, lead hardware installation and coordination of data collection. The City of Morris will be subject matter experts on local wastewater systems.

Name	Title	Affiliation	Role
Troy Goodnough	Sustainability Director	UMM	Principal Investigator
Dr. Alison Hoxie	Associate Professor M.E.	UMD	Co-Investigator
David Reese	VP/Civil Engineer	WSN (Hidden Fuels)	Project Manager
Mark Reineke	GIS Specialist	WSN (Hidden Fuels)	GIS
Peter Nelson	Principal Consultant	WSN (Hidden Fuels)	Principal Consultant
TBD	Morris Water/Sewer Staff	City of Morris	Water/Sewer Expert
TBD	City TBD Water/Sewer Staff	City TBD	Water/Sewer Expert
TBD	Grad or Undergrad Rsrch Asst	UMM, UMD	Research Assistants

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Bryan Herrmann	Vice Chancellor	UMM	UMM Personnel Coord.
Blaine Hill	Morris City Manager	City of Morris	Morris Personnel Coord.
Jeff Kuhn	VP/Civil Engineer	WSN (Hidden Fuels)	Morris City Engineer
James Dittbenner	Morris Public Works Director	City of Morris	Subject Matter Expert

IV. Project Impact and Long-Term Strategy

The long-term strategy is to provide a resource document that will quantify the available energy in operating wastewater collection systems, and predict the amount of energy that could be captured from this renewable source. The knowledge gained through engineering design criteria and formulating future facility infrastructure plans resulting from this research project can be implemented and replicated nationwide. Stakeholders within communities include a wide range of public, private, and institutional facility managers such as schools, campuses, hospitals, industrial and manufacturing facilities. Future investments by these stakeholders in the extraction of thermal energy from waste streams via existing heat exchange technology and equipment to reduce or eliminate fuel costs for heating and cooling systems.

This proposal does not include future implementation by stakeholders, but provides the necessary resources to identify the renewable energy that is available to them. The broad range impacts and benefits include sustainability of environmental resources, economic development, and skilled job growth.

V. Timeline Requirements

Data collection requires a minimum of one year to understand the wastewater characteristics associated with the community's wastewater flows, thermal energy fluctuations, mass and intensity, and availability. These factors will vary based on water usage, diurnal and seasonal variations, and condition of the wastewater collection systems. Expansion to an additional city, data compilation and analysis, mapping, and community facility evaluations will require approximately one additional year to complete the final report with follow-up to project partners and publishing.

2019 LCCMR Detailed Project Budget

Project Title: Energy Resource Mapping of Wastewater Systems

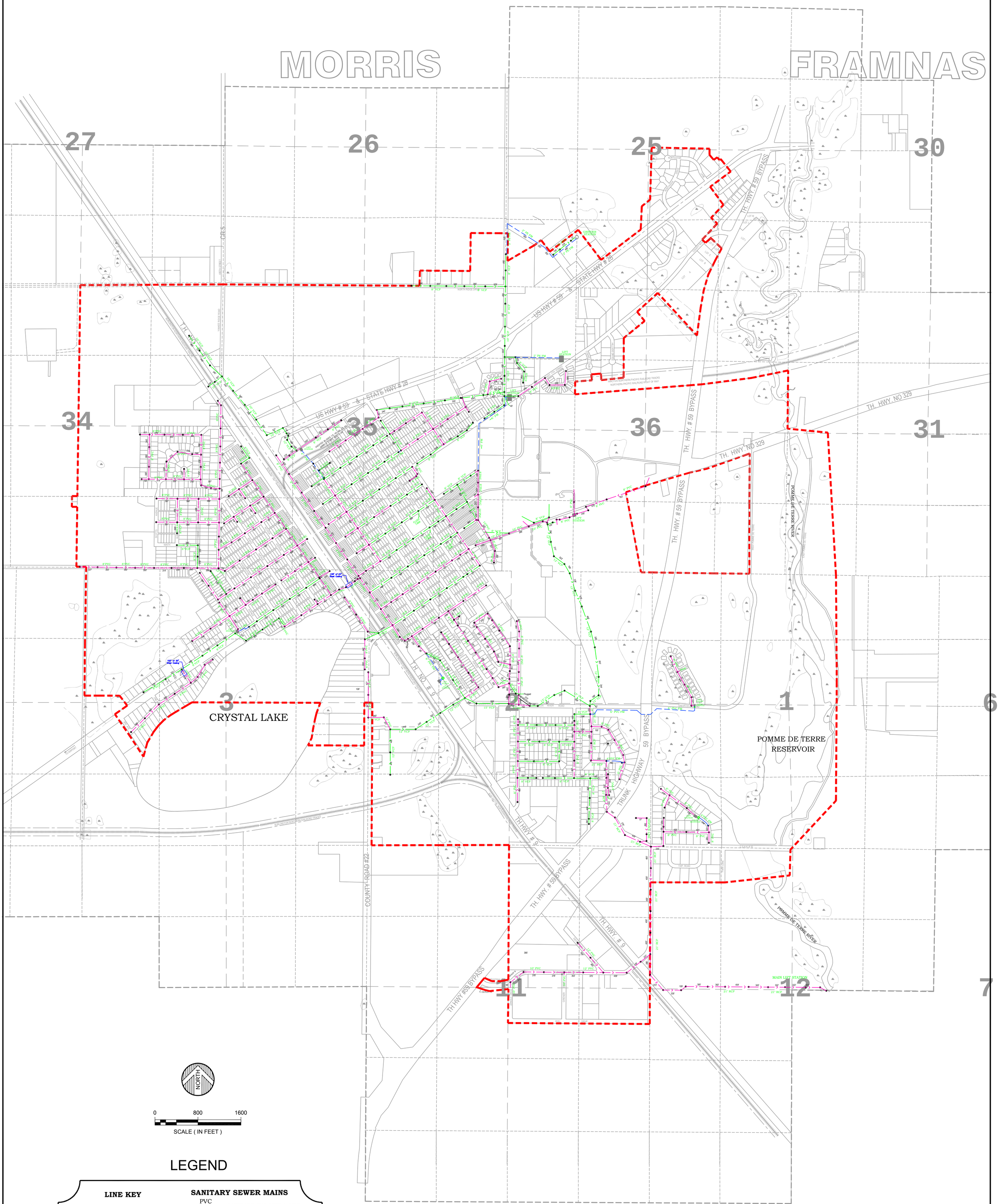
IV. TOTAL ENRTF REQUEST BUDGET: 2 years

BUDGET ITEM	AMOUNT
Personnel:	
Troy Goodnough, Sustainability Director, Co-Principal Investigator, 10% FTE 66.5% salary/33.5% fringe benefits	$ 19,667
Alison Hoxie, Associate Professor, Mechanical Engineering, Co-Principal Investigator, 11% FTE 66.5% salary/33.5% fringe benefits	$ 25,999
David Reese, Project Manager, 7.45% FTE, 28% fringe rate	$ 57,670
Peter Nelson, Principal Consultant, 8.77% FTE, 28% fringe rate	$ 48,980
Mark Reineke, GIS Geographer, 3% FTE, 28% fringe rate	$ 8,700
TBD WSN Administrative Assistant, 2% FTE, 28% fringe rate	$ 2,400
1 UMD Graduate Research Assistant, 2 years, 100% FTE, 17.7% fringe rate	$ 80,553
2 UMM Undergraduate Research Students for 2 semesters ea academic year at $11/hr, 5 hrs/wk, 30 wks; 2 students ea summer for $11/hr, 20hrs/wk, 15wks, no fringe	$ 20,000
Professional/Technical/Service Contracts: N/A	
City of Morris, water and sewer expert staff, 1	$ 8,000
Northern MN city TBD, water and sewer expert staff, 1	$ 8,000
Installation of Data Loggers and Sensors: 20 @ $1,000/each	$ 20,000
Equipment/Tools/Supplies:	
Remote Monitoring Station Data Logger and Sensors: 24 @ $3,000/each, and service contract	$ 80,400
Access tools, gloves, fasteners, miscellaneous hardware, data storage, and printing	$ 8,000
Acquisition (Fee Title or Permanent Easements): N/A	
Travel:	
UMM - Mileage @$.545/mi, lodging and per diem @$51/day for travel to and between data gathering sites and office	$ 6,000
UMD - Mileage @$.545/mi, lodging and per diem @$51/day for travel to and between data gathering sites and office	$ 8,325
WSN - Mileage @$.545/mi, lodging and per diem @$51/day for travel to and between gathering sites and office	$ 6,000
Additional Budget Items:	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 408,694

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: *The federally negotiated 54% in unrecovered indirect costs constitutes the University of Minnesota's cost share of the project.*	$ 167,370	Secured
Other State $ To Be Applied To Project During Project Period: N/A	$ -	
In-kind Services To Be Applied To Project During Project Period:		
Funding History: N/A		
Remaining $ From Current ENRTF Appropriation: N/A		

CITY OF MORRIS-SANITARY SEWER



LEGEND

LINE KEY

- RIGHT OF WAY
- SECTION LINE
- QUARTER-SECTION
- QUARTER-QUARTER
- CORPORATE LIMITS

SANITARY SEWER MAINS

- PVC 400' — SANITARY PVC LINE & SIZE
- VCP OR RCP 400' — SANITARY VCP LINE & SIZE
- FM 400' — FORCE MAIN SIZE & TYPE
- LIFT STATION
- SANITARY MANHOLE
- VALVE MANHOLE

SCALE: 1" = 800'

February 2014

WIDSETH SMITH NOLTING
Engineering
Architecture
Surveying
Environmental

J:\0368A-City of Morris\0368A0000-City Engineering\0368A0000.000-Miscellaneous\City Maps\2014\CADD\Utilities

Project Manager Qualifications

Troy Goodnough has served as the director of the office of sustainability at the University of Minnesota, Morris (UMM) for the past decade. Goodnough received his B.S. in chemical engineering and in chemistry from the University of Minnesota, Twin Cities (UMTC). Troy spent a decade in semiconductor start-up companies leading crystal growth operations for laser development. He was the first sustainability coordinator hired in the University of Minnesota system in 2006, and has served in the Center for Small Towns. Troy works with students, faculty and staff to develop and implement sustainability initiatives, including educational programs, outreach initiatives, and renewable energy projects. Troy provides leadership with the Upper Midwest Association for Campus Sustainability, the West Central Clean Energy Resource Teams Steering Committee and other sustainability-focused groups. During his tenure as director, Morris has earned AASHE STARS Gold ratings, the Second Nature Climate Leadership Award, the Minnesota Climate Adaptation Award, and recognition by Sierra Club, Princeton Review, Minnesota Environmental Initiative and other organizations.

Dr. Alison Hoxie is an Associate Professor in the Department of Mechanical and Industrial Engineering at the University of Minnesota, Duluth. Her education includes a B.A. in Natural Science from the College of Saint Benedict, a B.S.ME. (2000), and a Ph.D. (2007) from the University of Minnesota, Twin Cities. She has held positions as a consulting engineering in power and energy sectors, and as an Instructor at the University of Utah. Her current research focuses on cost effective methods for efficient utilization of biomass-derived oils in combustion applications. In addition to lab-scale research, she focuses on renewable energy technologies, resiliency and energy efficiency at the community level. She led the effort to install small wind at UMD, developed student project teams to evaluate renewable energy and efficiency measures for local Duluth businesses and is currently working on solar plus energy storage demonstration projects in collaboration with UMM and the Energy Transition Lab at MNTC.

Organization Descriptions

The University of Minnesota, Morris's mission is to provide "a rigorous undergraduate liberal arts education, preparing its students to be global citizens who value and pursue intellectual growth, civic engagement, intercultural competence, and environmental stewardship. As a public land-grant institution, UMM is a center for education, culture, and research for the region, nation, and world. UMM is committed to outstanding teaching, dynamic learning, innovative faculty and student scholarship and creative activity, and public outreach. Our residential academic setting fosters collaboration, diversity, and a deep sense of community." UMM serves 1,500 students from MN, the U.S. and the globe.

The **University of Minnesota Duluth** integrates liberal education, research, creative activity, and public engagement and prepares students to thrive as lifelong learners and globally engaged citizens.

Widseth Smith Nolting is an engineering, architecture, land surveying and environmental services firm with eight offices in Minnesota and North Dakota and 190 employees. We design roads, bridges, water and wastewater systems, and buildings of all types. Our engineering practice includes civil, structural, mechanical and electrical engineers who work on a wide range of projects for public and private clients—from large-scale public works improvements to facility and site design for individual companies. Our land survey crews and environmental specialists work throughout the Midwest. Our architectural portfolio includes schools, clinics, senior living, retail, offices, factories, historic buildings and more. WSN was established in 1975.