

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

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**Project Title:**

**ENRTF ID: 170-DH**

Using Artificial Intelligence for Noxious Weed Detection

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

**Sub-Category:** D. Aquatic and Terrestrial Invasive Species

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**Total Project Budget: \$** 89,005

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

**Summary:**

Modify and automate an existing mobile plant identification application to allow for early detection and rapid response to noxious weed invasions (Palmer amaranth) for local weed inspectors, producers and public.

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**Name:** Robert Dunning

**Sponsoring Organization:** Stearns County

**Title:** Agricultural Inspector

**Department:** \_\_\_\_\_

**Address:** PO Box 246

St. Cloud MN 56302

**Telephone Number:** (320) 656-6578

**Email** Robert.Dunning@co.stearns.mn.us

**Web Address**

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**Location**

**Region:** Central

**County Name:** Stearns

**City / Township:**

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**Alternate Text for Visual:**

Flow chart sequence starting with unknown plant picture from cell phone or vehicle attached camera. Image processed to identify plant and produce plant location map and builds a smarter application.

|   |                         |                             |                      |
|---|-------------------------|-----------------------------|----------------------|
| _____ 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:** Using Artificial Intelligence for Noxious Weed Detection

## I. PROJECT STATEMENT

Noxious weeds are spreading across Minnesota like wildfire because there are not enough trained people and resources available to combat the problem. What if Local Weed Inspectors (LWI's), agricultural producers and the public had an automated process to help them identify and locate noxious weeds like Palmer Amaranth, Wild Parsnip, Common Tansy, etc. by just taking a picture or mounting a camera and taking pictures from a vehicle or drone? We look to create such a process. Our plan is to modify existing mobile plant identification application technology and tailor it towards automated noxious weed identification and detection. This system will enable LWI's, producers and the public to be earlier in detection and thus provide a faster management response. This will help minimize the spread of noxious weeds that are taking over our roadsides, agricultural fields and natural areas.

The plant ID apps work by taking a picture of an unknown plant and comparing it to an existing plant picture database. The app picks the best match from its database and identifies the plant for you. If you agree that the app provided a correct match, the picture you just analyzed gets added to the apps master database. This trains the app to be smarter over time.

The process of acquiring plant pictures can be speeded up by using a GPS enabled camera mounted to a motor vehicle (like one used to create Google Street View) or a drone. The picture upload and evaluation (virtual inspection) process can be automated with each positive ID to have its GPS coordinates exported to a mapping application.

## II. PROJECT ACTIVITIES AND OUTCOMES

**Activity 1:** Create the decision support tool and build noxious plant photo database. **Budget: \$31,335**

**Description:** St. Cloud State University will build the decision support tool. Stearns County along with SCSU students will build the noxious weed identification databases. The initial focus will be to train the computer to identify 3 noxious weed species. The system will be fine-tuned and validated to ensure that image quality is adequate for virtual inspections.

| Outcome   | Completion Date  |
|---|------------------|
| 1. Acquire equipment, build the decision support tool and build noxious weed photo database for 3 species | October 31, 2019 |
| 2. Testing and fine-tuning the system for data collection   | March 1, 2020    |

**Activity 2:** Assessing the system and continue modifying it for increased accuracy. **Budget: \$26,335**

**Description:** Create a database server which allows for remote public access to upload imagery and that automatically creates a digital map of targeted species location. Initial tests of the system will be carried out in a familiar environment, i.e., locations where noxious weeds already exist. We will test the effectiveness of database updates and accuracy of virtual inspections. Another two noxious weed species will be added to the process.

| Outcome | Completion Date |
|---------|-----------------|
|---------|-----------------|



## Environment and Natural Resources Trust Fund (ENRTF)

### 2019 Main Proposal

**Project Title:** Using Artificial Intelligence for Noxious Weed Detection

|  |                    |
|--|--------------------|
| 1. Setting up a database server for remote access              | May 1, 2020        |
| 2. Collection of data from a familiar environment              | September 30, 2020 |
| 3. Engaging LWI's and assessing effectiveness of participation | October 31, 2020   |

**Activity 3:** Deploy system, create instructional video and continue to test accuracy. **Budget: \$31,335**

Stearns County will partner with LWI's to use the system to collect data, utilize a survey grade GPS enable camera (rental) attached to a vehicle to it to collect photos from unfamiliar environments (e.g. locations where no prior information is available), evaluate system results and how those results can aid in future management decisions. LWI's will be trained to utilize the system results and this technology will be presented at the Annual Spring Meeting for Township and City LWI's and the County Inspectors Annual Short Course.

| Outcome  | Completion Date   |
|--|-------------------|
| 1. Carrying out data collection in LWI's areas | July 31, 2020     |
| 2. Create the instructional video              | December 31, 2020 |
| 3. Make the system available to the public     | June 30, 2021     |

### III. PROJECT PARTNERS:

#### A. Partners Receiving Funds:

| Name                | Title                     | Affiliation                | Role                                       |
|---------------------|---------------------------|----------------------------|--|
| Mr. Mark Gill       | Visualization Engineer    | St. Cloud State University | Manage students and decision support tool. |
| Dr. Ramnath Sarnath | Professor                 | St. Cloud State University | Software design                            |
| Mr. Wayne Cymbaluk  | Water Resource Specialist | Stearns County SWCD        | Education and BMP's                        |

#### B. Project Partners Not Receiving Funds:

| Name            | Title               | Affiliation     | Role                |
|-----------------|---------------------|-----------------|---------------------|
| Jeff Westerlund | Township Supervisor | LeSauk Township | Testing site access |

### IV. LONG-TERM- IMPLEMENTATION AND FUNDING

Stearns County will continue to build partnerships to further develop the technology, add additional noxious weed species to the process and look for opportunities with other LWI's to expand the use of this technology across central Minnesota.

### V. Timeline Requirements

2 years.

## 2019 Proposal Budget Spreadsheet

**Project Title: Using Artificial Intelligence for Noxious Weed Detection**

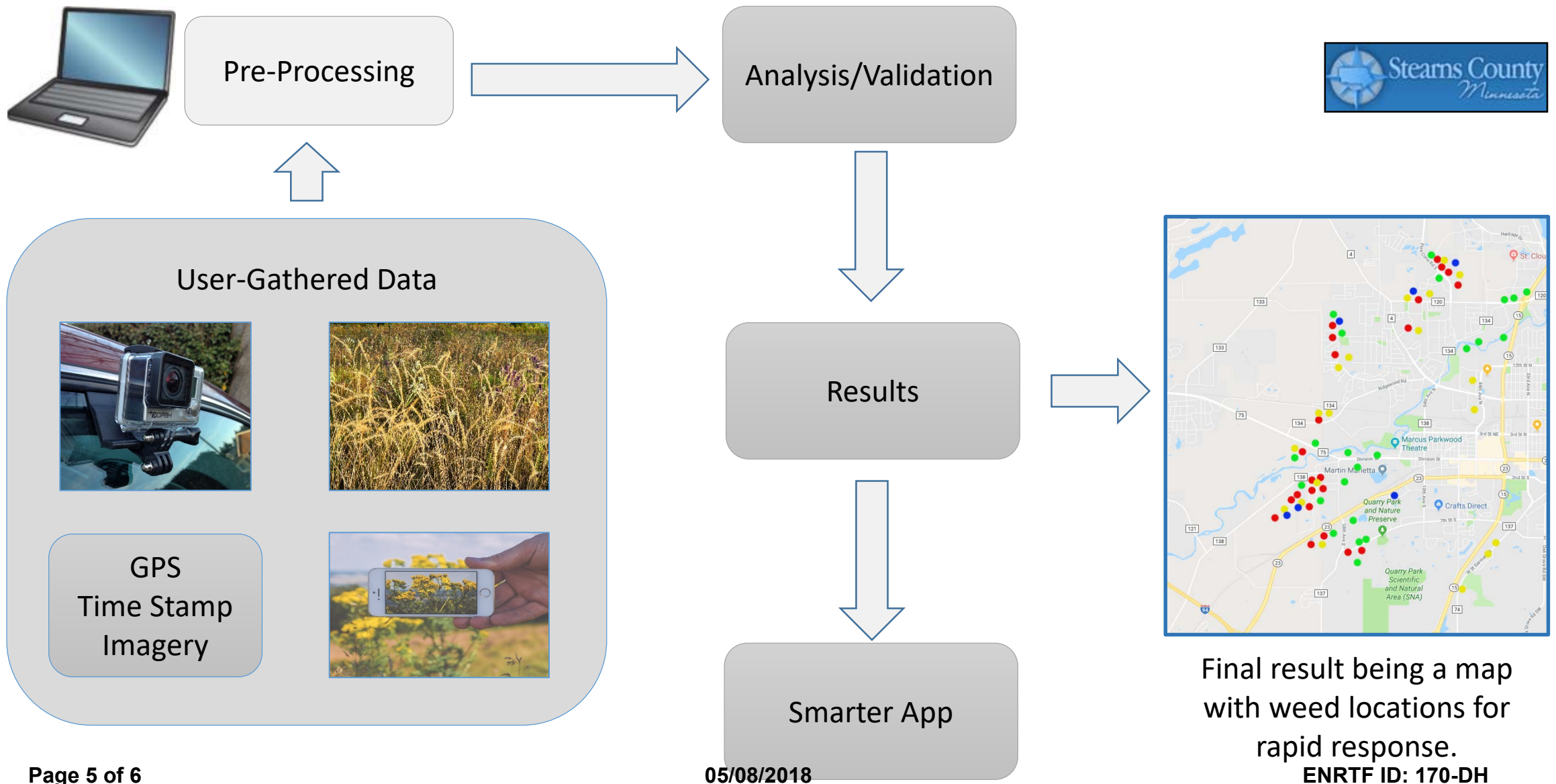
### IV. TOTAL ENRTF REQUEST BUDGET 2 years (24 months)

| BUDGET ITEM   | AMOUNT           |
|---|------------------|
| <b>Personnel:</b>   |                  |
| <b>Professional/Technical/Service Contracts:</b>  |                  |
| Mr. Mark Gill: Oversee students in the development of the visualization platform and decision support tool using GIS; 24 days per year (equivalent to 13% FTE in 12 month contract) for each of the two years; total includes approx. 70% salary and 30% fringe             | \$ 20,698        |
| Dr. Sarnath Ramnath: Create and manage the photo database and technical support; 4 days a year (equivalent to 3% FTE per year in 9-month contract); daily rate \$678.82 plus fringe 82% salary and 18% fringe   | \$ 6,758         |
| Undergraduate Student Employees: Assist with the creation of the visualization platform and decision support tool. 2 students at 20 hours/week for the equivalent of 4 semesters (70 weeks total), \$12/hour  | \$ 35,363        |
| Mr. Wayne Cymbaluk Water Resource Specialist Stearns County Soil & Water Conservation District: Consult with team on LWI's needs and best practices; Education and deployment to other LWI's. 81 Hrs at \$61.40 Hr (4% FTE each year for 2 years) 52% salary and 48% fringe | \$ 9,946         |
| <b>Equipment/Tools/Supplies:</b>  | \$ -             |
| Survey Grade GPS-enabled Camera System Rental for data collection   | \$ 3,000         |
| Dell PowerEdge Server to allow public access to the plant photo database  | \$ 5,000         |
| 5 cellphones with service plan for taking pictures, building database and running the system.   | \$ 2,500         |
| Domain Name and hosting fees  | \$ 500           |
| <b>Acquisition (Fee Title or Permanent Easements):</b>  | NA               |
| <b>Mileage</b> - travel to and from data collection sites within Central MN; \$0.54/mile, 6,000 miles   | \$ 3,240         |
| Creation of a professionally done instructional video on how to install and run the system.   | \$ 2,000         |
| <b>Additional Budget Items:</b>   | NA               |
| <b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>  | <b>\$ 89,005</b> |

### 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  |
|---|-----------|---------|
| <b>Other Non-State \$ To Be Applied To Project During Project Period:</b>             | NA        |         |
| <b>Other State \$ To Be Applied To Project During Project Period: NA</b>              | NA        |         |
| <b>In-kind Services To Be Applied To Project During Project Period:</b>               | \$ -      |         |
| <b>Mr. Robert Dunning, Agricultural Inspector, Stearns County; Project Management</b> | \$ 25,318 | Secured |
| <b>Past and Current ENRTF Appropriation:</b>  | NA        |         |
| <b>Other Funding History:</b>   | NA        |         |

# Using Artificial Intelligence for Noxious Weed Detection



## **Project Manager Qualifications & Organization Description:**

The project team will be led by Bob Dunning who has lead the Stearns County noxious weed program for the past 6 years. He is in charge of the managing the Cooperative Weed Management Area grant which partners with state and local agencies to control the spread of noxious weeds. He trains local weed inspectors to identify noxious weeds and implement the Minnesota Noxious Weed Law. Stearns County's mission is to "Provide exceptional public services to assure a safe, healthy, vibrant county for all."

Professor Ramnath Sarnath. He holds a B.Tech degree in Civil Engineering and an M.Tech degree in Computer Science from the Indian Institute of Technology, New Delhi. He has a Ph.D. degree in Computer Science from the State University of New York at Buffalo. He has extensive administrative experience, expertise in software design and has worked with algorithm development for large data sets. SCSU's mission "We prepare our students for life, work and citizenship in the twenty-first century."

Mark Gill is the director of the SCSU Visualization Lab. He holds an M.S. in Software engineering and has 20 years of experience in the realm of 3D visualization, Virtual Reality, and high-performance data presentation. Over the course of his career, Mark has developed, or overseen the development of several 'big data' or time-sequenced visualization projects, which would fall in line with the goals and deliverables of this proposal. He also has experience with use of GIS. SCSU's mission "We prepare our students for life, work and citizenship in the twenty-first century."

Wayne Cymbaluk works as a Water Resources Specialist with the Stearns County Soil and Water Conservation District. He provides natural resource management and protection expertise to resource users within Stearns County. He holds a M.S. in Natural Resource Management from North Dakota State University. Stearns County SWCD's mission is "To provide local leadership in the conservation of soil, water, and related natural resources through programs and partnerships with individuals, businesses, organizations, and government."

SCSU has undergraduate programs in Computer Science and Software Engineering, and an MS program in Computer Science. The Integrated Science and Engineering Laboratory Facility (ISELF) building provides the facilities needed for this project. A high speed data link is available to campus, so that the server housing the proposed system can be easily accessed by all agencies.