

**Environment and Natural Resources Trust Fund  
2014 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 001-A**

Mapping Landscapes for Better Land and Water Management

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**Category:** A. Foundational Natural Resource Data and Information

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**Total Project Budget: \$** 378,718

**Proposed Project Time Period for the Funding Requested:** 2 Years, July 2014 - June 2016

**Summary:**

Critically important land cover information for Minnesota is outdated. We propose to update the states land cover data at moderate spatial resolution statewide and high resolution for selected areas.

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**Sponsoring Organization:** U of MN

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**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

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



## Environment and Natural Resources Trust Fund (ENRTF)

### 2014 Main Proposal

#### Project Title: Mapping Landscapes for Better Land and Water Management

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##### I. PROJECT STATEMENT

Conservation and management of Minnesota's natural resources require significant investments of time and money by many state/local agencies and stakeholder groups. For example, in FY 2013, Clean Water Funding for restoration and protection watershed projects is over \$95 million. The three components of success in such projects (define problem sources, target and track changes) begin with accurate quantification of land cover/use via Geographic Information System (GIS) or geospatial data. This project will update the statewide geospatial data and freely distribute it to all land and water conservation entities. *This project is driven directly by the needs of local, county, state agencies and other stakeholders.*

##### *Why is updating land cover important?*

- Urban and agricultural lands (the most intensive land uses) shed the most water, sediments, and nutrients in contrast to forests and prairies that retain the most water, sediments and nutrients.
- The existing statewide land cover data (2000) does not include the effects of the boom growth period, changes in agricultural production, nor changing forests. Alternative datasets (e.g. the National Land Cover Data) are inadequate for many of Minnesota's needs.
- Wetlands, prairies, and forests are elements of critical conservations goals (e.g. LSOHC). *Effective conservation requires up-to-date land cover information.*

***How would the updated land cover be used?*** Project products will be used by county SWCDs, watershed district/management organizations, city, basin, and state agencies involved in water and land conservation. Land cover is a foundational dataset for watershed predictive computer modeling and planning used in land and water conservation efforts including:

- Effective targeting of \$100's M agricultural best management practices. Changing commodity prices have increased the amount of land in cultivation. This project will help track changes in cultivation coverage due to crop types and other land use practices.
- Effective management of urban areas, including impervious surfaces (roads, roofs and alleys), storm water and flood planning, and urban tree cover assessment.
- Effective tracking and quantification of recent changes to Minnesota's prairie and wetland areas;
- Effective monitoring of changes to our deciduous and conifer forests.

We propose to integrate the existing LiDAR elevation data collected for Minnesota with state-of-the-art remote sensing data and methods to develop the 'next generation' of Minnesota-specific land cover datasets that are needed statewide. Selected areas will be mapped at much higher spatial resolution.

The results of this project will *substantially* improve the land cover data available to Minnesota's resource managers. This project will result in statewide geospatial data for 2013-2014, with higher resolution data for selected parts of the state. Statewide 1/4-acre (30-meter) spatial resolution products will allow us to identify current land uses as well as track changes from 2000 to today that are applicable to diverse conservation goals. Higher resolution 1-2 meter geospatial data products will be developed for selected urban areas (e.g., the TCMA, Duluth, Rochester, St. Cloud, Alexandria and Detroit Lakes) as well as additional areas of the state deemed especially sensitive that would benefit from higher resolution data (e.g., sensitive lake districts such as the Whitefish, Gull and forested areas being converted to development/agriculture uses). The University of Minnesota will distribute all of the data and statistics in easily displayed GIS-compatible format through existing information websites including the DNR's Data Deli and MnGeo and the UMN Remote Sensing website ([www.land.umn.edu](http://www.land.umn.edu)) as well as provide website tutorials. Three data use workshops will be conducted for project stakeholders at appropriate locations.

## II. DESCRIPTION OF PROJECT ACTIVITIES

### Activity 1: Update the statewide land cover map for 2013/2014.

**Budget:** \$160,000

The State's land cover data will be updated consistent with existing classifications: cropland, forests, wetlands, grasslands, shrublands, wetlands, water and urban/developed + impervious surfaces) for 2013/2014.

Outcome	Completion Date
1. Acquire satellite data and process for 54 million acres.	January, 2015
2. Generate land cover classification datasets for Minnesota	June, 2015
3. Map municipality/MCD impervious surface area for 2,367 MCDs.	December, 2015

### Activity 2: Generate high resolution land cover/use products for selected Greater Minnesota areas and TCMA.

**Budget:** \$ 155,000

Acquire, process and combine high resolution satellite data with existing LiDAR data for improved land cover classification (1-2 meters). Land cover and impervious surfaces will be determined for selected Greater Minnesota urban areas (St. Cloud, Rochester, Duluth, and others) and the seven-county Twin Cities Metro Area.

Outcome	Completion Date
1. Acquire state-of-the-art satellite data and integrate with existing LiDAR data covering ~1.9 million acres of TCMA + ~100,000 acres Greater MN areas.	November, 2014
2. Generate land cover products (GIS) for 2.0 million acres	August, 2015
3. Define impervious surfaces (GIS) for ~350 cities/townships	December, 2015

### Activity 3: Distribute updated land cover and train users.

**Budget:** \$63,718

The project will freely distribute data and statistics of seven standard land covers and percent impervious surface area, in an ArcGIS database and MapServer application for both metro and statewide areas for updating of watershed computer modeling efforts. MapServer enables display and analysis of spatial data over the Internet. Products and statistics summarizing the classifications by city, township, county, ecoregion, watershed and catchment will be generated and added to the online database available at [land.umn.edu](http://land.umn.edu) at no cost. Three training sessions will be conducted by the University of Minnesota using existing BWSR, MAWD, and SWCD venues for cities, counties and professional engineering services.

Outcome	Completion Date
1. Convert into GIS datasets and web-based maps, along with area statistics by county, city/township, ecoregion, watershed and catchment for 54 million acres.	December, 2015
2. User training and distribution of map and GIS products on UM website	June, 2016

## III. PROJECT STRATEGY

### A. Project Team/Partners

- Joseph Knight and Marvin Bauer, University of Minnesota.
- Metropolitan Council, MPCA, DNR, MnGeo, SWCD, BWSR, MAWD

**B. Timeline Requirements.** The Project will be completed in two years.

**C. Long-Term Strategy and Future Funding Needs.** This project directly addresses LCCMR funding priority A. *Foundational Natural Resource Data and Information*. The proposed project's state-of-the-art data will be used by most land and water management entities. Minnesota Geospatial Information Office and other agencies will need to assign responsibility for future updating of land cover as it has been an orphan effort for 20 + years.

## 2014 Detailed Project Budget

**Project Title: Mapping Landscapes for Better Land and Water Management**

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

<b>BUDGET ITEM</b> (See "Guidance on Allowable Expenses", p. 13)	<b>AMOUNT</b>	
<b>Personnel:</b>	\$	329,321
Research Associate. 2 years @ 100%	152,574	
Research Fellow. 2 years @ 100%	125,216	
Information Technology Specialist. 1 year @ 10% + 1 year 30%	21,467	
Faculty (Knight), 2 years, 1 month salary per year	17,176	
Undergraduate Research Assistant, 1,200 hours	12,888	
<b>Training:</b> Training Workshops, three workshops in Metro and Greater MN @ \$5,000 ea.	\$	15,000
<b>Equipment/Tools/Supplies:</b> RapidEye satellite data, 11,869 sq. miles @2.46	\$	25,197
<b>Acquisition (Fee Title or Permanent Easements):</b>	\$	-
<b>Travel:</b> Field/reference data collection. 3,000 miles @ \$0.565 = \$1,695; plus 27 days per diem @ \$123 = \$3,305per diem @ \$123 = \$3,075	\$	5,000
<b>Additional Budget Items:</b> General operating supplies and services such as data storage, poster printing, UMN remote sensing lab user fees (2x\$1000/yr)	\$	4,200
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	\$	378,718

### V. OTHER FUNDS

<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>Other Non-State \$ Being Applied to Project During Project Period:</b>	\$ -	
<b>Other State \$ Being Applied to Project During Project Period:</b>	\$ -	
<b>In-kind Services During Project Period:</b> Salaries and Fringe benefits (\$28,380) for Marvin Bauer (10% effort) will be provided by the University. Computer and image processing facilities will be provided by the University (estimated value, \$65,000).	\$ 93,380	Secured
<b>In-kind Services During Project Period, continued:</b> High resolution (0.5 to 2.4 meter) commercial satellite imagery for most of Minnesota is expected to be available to this project at no cost. Negotiations are ongoing.	~2,500,000	Likely
<b>Remaining \$ from Current ENRTF Appropriation (if applicable):</b>	N/A	
<b>Funding History:</b> This project also will make heavy use of the state-funded lidar acquisition. It will also benefit from the NWI update that is funded by the ENRTF. Dr. Knight has led the methods research and development for the statewide NWI update Phases 1-3 via sub-contract with MNDNR. The results from the NWI update will be incorporated into the proposed updated land cover products, as available. Dr. Knight also has a long history of successful land cover related research projects funded by the U.S. Fish and Wildlife Service, the U.S. Dept. of Agriculture, and the National Science Foundation.		

The data products developed in this project will be suitable for direct incorporation into resource Minnesota managers' decision making. These images show examples of the types of high resolution, high information content products that we will produce.

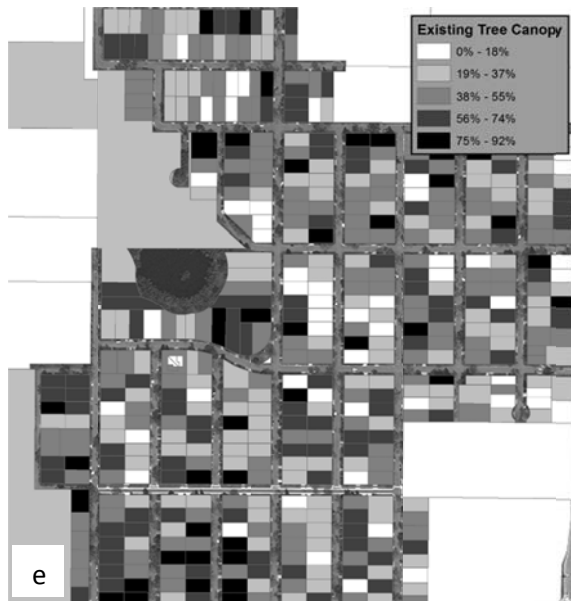


Figure 1: (a) LiDAR point cloud for Bloomington MN (image shows *LiDAR only*), (b) Worldview-2, 0.5-m image for Bloomington, (c) Land cover classification using LiDAR and Worldview-2, (d) Impervious surface percentages by parcel, (e) Tree canopy percentages by parcel.

## **Project Manager Qualifications/Organization Description**

**Project Manager:** Joseph Knight is an Assistant Professor of Remote Sensing in the Department of Forest Resources at the University of Minnesota, Twin Cities. Dr. Knight studies how changing land use affects both natural resources and humans. Human land use is a significant force shaping our planet. As land use intensifies due to increasing population and affluence, environmental effects also increase. Dr. Knight's research focuses on the use of geospatial science methods such as remote sensing, image analysis, geographic information systems (GIS), and statistics to understand and quantify the impacts of land use on our environment and natural resources. The improved understanding provided by this research of the dynamics of land use effects on Earth's ecosystems allows us to address more effectively current challenges such as climate change, deforestation, and loss of wetlands, and to develop sustainable land use practices to avoid or mitigate future environmental problems and the resulting impacts on humans. He can be contacted at jknight@umn.edu or 612-625-5354.

Dr. Marvin Bauer, professor of Remote Sensing at the University of Minnesota, who will be the co-investigator. His research and teaching focuses on applications of remote sensing to monitor land, vegetation, and water resources. Recent research projects have concentrated on monitoring lake water quality, impervious surface mapping, and land cover classification and change detection and analysis. He is a fellow of the American Society of Photogrammetry and Remote Sensing and has received the William T. Pecora Award from NASA and Department of Interior, NASA Distinguished Public Service Medal, ASPRS SAIC Estes Memorial Teaching Award, and Minnesota GIS/LIS Consortium Lifetime Achievement Award. He also serves as editor-in-chief of Remote Sensing of Environment.

Drs. Knight and Bauer will be assisted by two research staff supported by Environment and Natural Resources Trust Funds.

**Facilities:** The Remote Sensing and Geospatial Analysis Laboratory is a focal point of research, instruction, and outreach in applications of remote sensing and GIS at the University of Minnesota. The goal of the Laboratory is to research and develop approaches for applying geospatial imagery and analysis to inventory and monitor land and water resources. The Laboratory works closely with agencies such as the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, Metropolitan Council, U.S. Forest Service, and U.S. Fish and Wildlife Service. The Laboratory has state-of-the-art workstation-based facilities for digital image processing and analysis. Software systems include ERDAS Imagine, ArcGIS, S-Plus spatial statistics, eCognition, and MySQL.