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

Project Title: **ENRTF ID: 234-FH**

Cost-Effective Environmental Protection by Predicting Land Use Change

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

Sub-Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: $ 199,420

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

Summary:

Cost-effective environmental protection requires reliable predictions of which natural land will be lost without protection. We will produce statewide maps that quantify the likelihood of future conversion for every parcel.

Name: Ryan Noe

Sponsoring Organization: U of MN

Title: Scientist

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Maps produced in this research would allow a practitioner to identify natural vegetation parcels most likely to convert to a different land cover in the future.

_____ 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: Cost-effective environmental protection by predicting land conversion

I. PROJECT STATEMENT

The cost-effectiveness of protecting land for conservation depends on whether or not that land is likely to convert from its natural state in the future. However, current assessments of the risk of conversion are not quantitative, well-documented, or readily available to practitioners. We will produce statewide maps that quantify the likelihood of future conversion for every parcel. This work will benefit conservation practitioners by integrating the best methods and data into ready-to-use maps that will help them avoid acquiring land that is not likely to be converted, and instead focus resources on the parcels most at risk.

Previous LCCMR-funded research (Noe et al. 2017, figure 1) identified that state agencies and NGOs typically do not consider the likelihood of future land cover changes in conservation acquisition decisions. For example, Minnesota has made significant investments protecting the social and economic benefits of lakes through the Watershed Restoration and Protection Strategy (WRAPS). However, this framework identifies lakes most in need of protection today, but does not consider the likelihood of future expansion of agriculture, urban development, or the location of those changes. Practitioners want to prioritize protection of land providing the benefits most at risk of being lost, however, these predictions are too time consuming and technically challenging to be practical for individual organizations to perform. Our work will amplify the effectiveness of existing programs and reduce duplication of prediction efforts by making parcel-by-parcel predictions of land cover change available to all state agency programs and NGOs that must select which lands to protect with limited resources.

The existing approaches to considering future land cover change used by state agencies and NGOs often rely on expert opinion, which is difficult to transparently quantify and replicate. Simple quantitative methods tend to look for patterns in past changes at the local level, but ignore the influence of broader economic and demographic trends. Our work improves on these approaches by considering both the global (e.g., commodity prices, population/demographics), and local (e.g., distance to roads, slope of the land) factors that influence the likelihood land will be converted without protection. Furthermore, our work starts and ends by working directly with practitioners. By engaging with both our formal practitioner partners and others in their network, we ensure we are addressing threats and questions that are real-world barriers to making cost-effective conservation decisions.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Generate maps of predictions, synthesize findings.

Description: Our work will be guided by the barriers identified by our practitioner advisory committee and others in their professional networks. To ensure our work serves their needs, we will engage with practitioners to identify specific threats to model, and what maps are needed to inform acquisition decisions. For example, would predictions 10 or 50 years in the future be most useful for planning, and what resolution is needed to be relevant for their decisions?

Our modeling approach occurs at two levels; 1) global/national changes in the economy, environment, and demographics, and 2) local changes in the spatial arrangement of parcel land covers. We use global/national projections of changes in social and economic factors to estimate the amount of change of each land cover at the regional (e.g., county) level. Next, we use local models based on the patterns of past changes to make parcel-by-parcel predictions that match the amount of change predicted at the regional level. To reduce uncertainty, we will produce a range of plausible predictions and synthesize the results by identifying the parcels that frequently convert across a multiple predictions. We will overlay these predictions with our past research creating metrics of environmental benefits in Minnesota to identify specific benefits most at risk.

ENRTF BUDGET: $165,000

Outcome	Completion Date
1. Engage with advisory committee and other practitioners to identify the most useful predictions for conservation decision making.	*December 2019*
2. Generate maps of a suite of predictions of future land cover in Minnesota.	*December 2020*
3. Synthesize findings from predictions, highlighting benefits that would be lost under the most likely changes in a report.	*March 2021*

Activity 2: Engage practitioners and make results and methods accessible.
Description: We will work with our practitioner advisory committee to identify and train individuals who want to fully understand our methods and results in order to incorporate them into their research or decision making processes. Our outreach will also have a non-technical component aimed at making our predictions accessible to a broad audience.

ENRTF BUDGET: $34,420

Outcome	Completion Date
1. Hold meetings/webinars training practitioners on interpretation and use of predictions.	*June 2021*
2. Produce documentation enabling practitioners to develop predictions.	*June 2021*

III. PROJECT PARTNERS:

Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Peter C. Jacobson	Habitat Research Group Leader	MN DNR, St. Paul	Practitioner advisory committee
Gretchen Hansen	Fisheries Research Scientist	MN DNR, St. Paul	Practitioner advisory committee
Paul J. Radomski	Lake Habitat Research Scientist	MN DNR, Brainerd	Practitioner advisory committee
Kristin M. Carlson	Specialist in Ecosystem Services	MN DNR, Brainerd	Practitioner advisory committee
Kristen Blann	Freshwater Ecologist	TNC	Practitioner advisory committee

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:
All of the data and code used to generate our predictions will be made publicly available online. Any conservation practitioner will be able to download our maps of land conversion risk to assess how likely a parcel they are considering is convert, and compare this to other parcels. Since our predictions will be for decades in the future, short term updates and maintenance are not required. Furthermore, we will produce documentation that will allow practitioners and researchers to replicate and build on our methods. Before the end of the project we will also make team members available to interested practitioners for more in-depth training.

V. TIME LINE REQUIREMENTS:
Start July 2019, end June 2021, duration: 2 years.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:
A. Proposal Budget Spreadsheet
B. Visual Component or Map
C. Project Manager Qualifications and Organization Description

2019 Proposal Budget Spreadsheet

Project Title: Cost-effective environmental protection by predicting land use change

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM (See "Guidance on Allowable Expenses")	**AMOUNT**
Personnel: Ryan Noe, Project Manager and Scientist, (75% salary, 25% benefits), 50% FTE for 2 years	$ 86,251
Justin Johnson, Scientist, (75% salary, 25% benefits), 50% FTE for 2 years	$ 112,169
Travel: Travel within Minnesota. These funds will be used to pay mileage (75%) and per diem costs (25%) for practitioner engagement within Minnesota.	$ 1,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 199,420

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

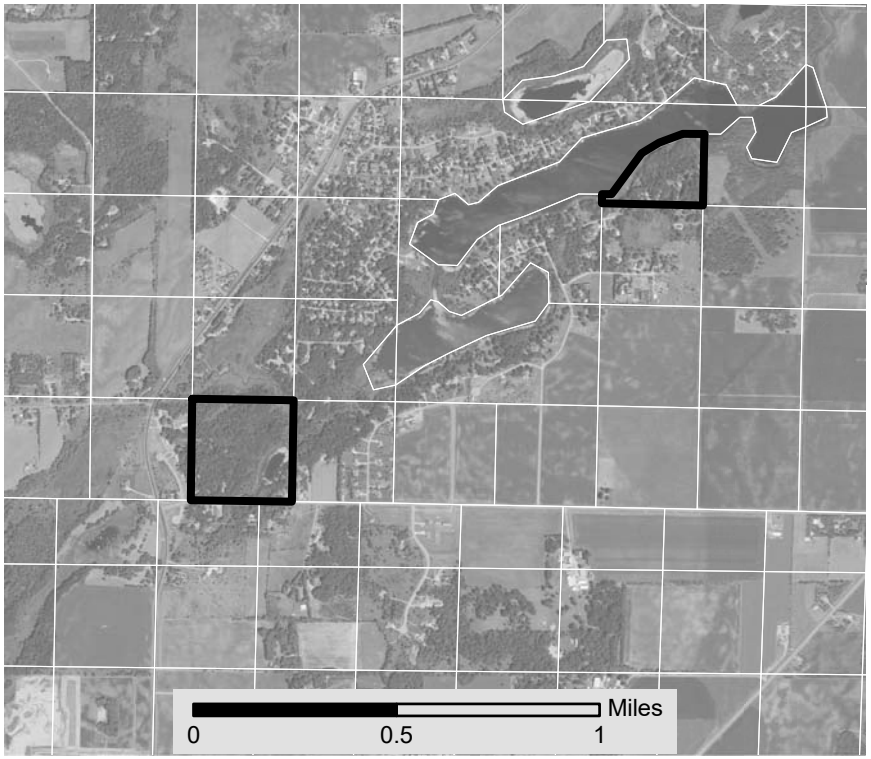
SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	$ -	*N/A*
Other State $ To Be Applied To Project During Project Period: The Natural Capital Project at the University of Minnesota's Institute on the Environment has agreed to provide a 25% match to support land change modeling research.	$ 50,000	*Secured*
In-kind Services To Be Applied To Project During Project Period: MN DNR Fisheries Reserach staff Peter Jacobson and Gretchen Hansen will provide 100 hours each of in-kind support for this project for each of two years, for a value $20,950. See letter of support for details.	$ 20,950	*Secured*
Past and Current ENRTF Appropriation: M.L. 2017, Chp. 96, Sec. 2, Subd. 02b Assessment of Public Benefits of Protecting Source Water $320,000	$ 264,120	*Unspent*
M.L. 2015, Chp. 76, Sec. 2, Subd. 09k Conservation Easement Assessment and Valuation System Development $250,000. This project ends June 30th 2018. The metrics produced would be used to assess threats to ecosystem services in our land change modeling research.	$ 34,201	*Unspent*
M.L. 2015, Chp. 76, Sec. 2, Subd. 04a Understanding Water Scarcity, Threats, and Values to Improve Management $234,000. This project ends June 30th 2018. The projections of water scarcity would be used to as a predictor in our land change modeling research.	$ 36,462	*Unspent*
Other Funding History:	$ -	*N/A*

Our research will enable practitioners to answer questions like these when making acquisition decisions:

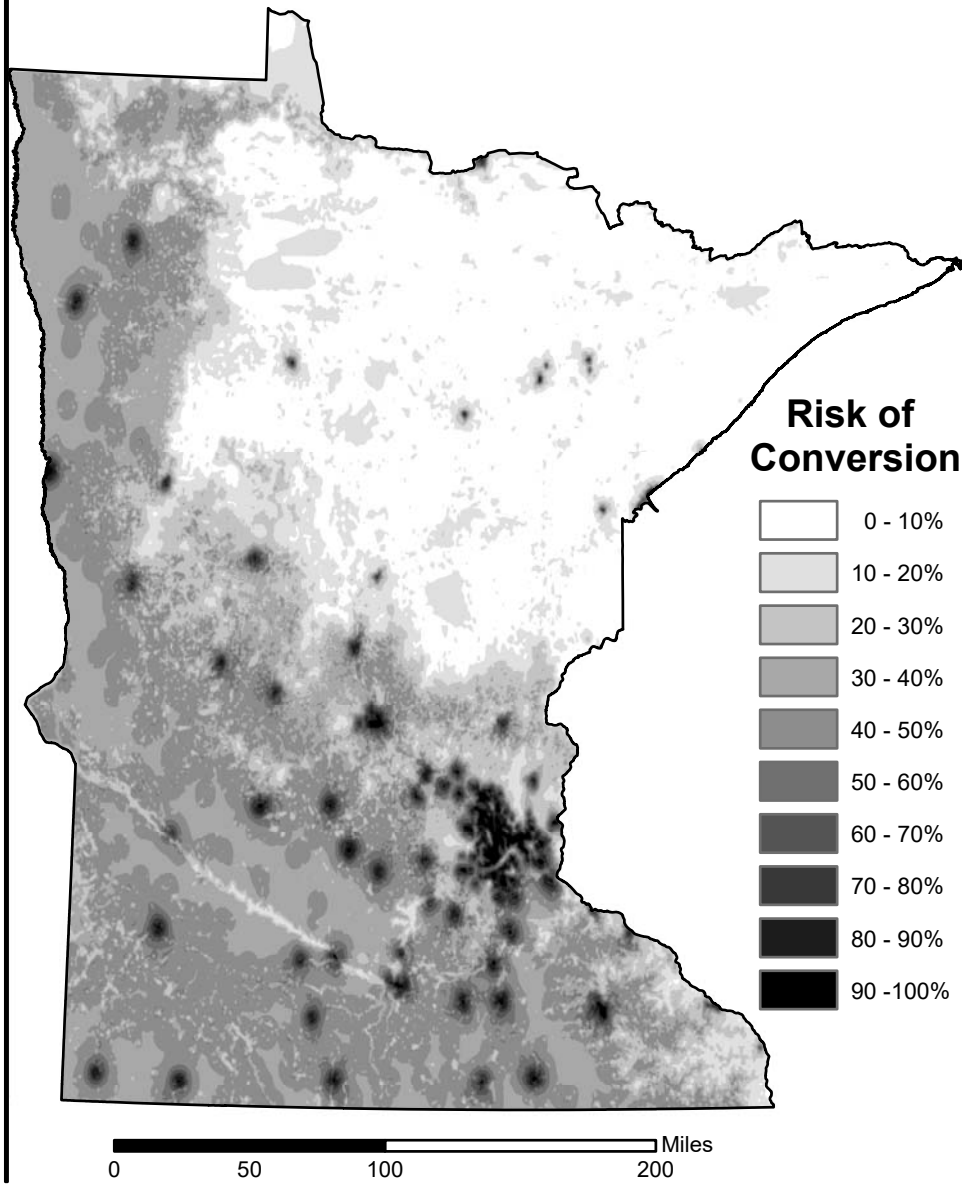
-Without protection, which of the natural parcels below is most likely to convert by 2030?

-How much natural land will be left by 2080?

-Which of the two parcels highlighted below will be more likely to convert with future changes in population and crop prices?



Potential output: map of risk of conversion from agricultural or urban expansion



Project Manager Qualifications:

I am a researcher with six years of experience studying topics at the intersection of land use change and ecosystem services. Past projects particularly relevant to creating improved land use change predictions in Minnesota include quantifying the high degree of uncertainty of estimates of recent corn and soy expansion in the Corn Belt (Noe, 2015), and producing a model of land conversion as part of the life cycle assessment used in Unilever's commodity sourcing research (Chaplin-Kramer et al., 2017). Furthermore, I have developed insight into the conservation acquisition decision making processes across state agency programs and NGOs through previous LCCMR-funded work (Noe et al., 2017). This research in particular helped identify the difficulty the practitioners in Minnesota face in predicting future land conversion.

I work with the Natural Capital Project (www.naturalcapitalproject.org) within the Institute on the Environment at the University of Minnesota. Our team has extensive experience with engaging with practitioners and stakeholders to identify the research questions that create research products useful to the community. We use spatial analysis and modeling techniques to quantify and communicate the benefits that nature provides to people.

Chaplin-Kramer, R., Sim, S., Hamel, P., Bryant, B., Noe, R., Mueller, C., Rigarlsford, G., Kulak, M., Kowal, V., Sharp, R., Clavreul, J., Price, E., Polasky, S., Ruckelshaus, M., Daily, G., 2017. Life cycle assessment needs predictive spatial modelling for biodiversity and ecosystem services. Nat. Commun. 8, 15065. https://doi.org/10.1038/ncomms15065

Noe, R.R., 2015. Uncertainty in Cropland Data Layer derived land-use change estimates: putting corn and soy expansion estimates in context. https://conservancy.umn.edu/handle/11299/178921

Noe, R.R., Keeler, B.L., Kilgore, M.A., Taff, S.J., Polasky, S., 2017. Mainstreaming ecosystem services in state-level conservation planning: progress and future needs. Ecol. Soc. 22, art4. https://doi.org/10.5751/ES-09581-220404