Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-435

Proposal Title: TickWise Minnesota: A First-Of-Its-Kind Minnesota Lyme Disease Forecast

Project Manager Information

Name: Ryan Harp

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: TickWise Minnesota will develop a first-of-its-kind Lyme disease forecast informed by participatory science and an Extension education program to help foster safe use and enjoyment of Minnesota's natural environment.

ENRTF Funds Requested: $541,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Resiliency (A)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Lyme disease is the most common vector-borne disease in Minnesota with over 2,000 cases annually—a number that has been rising dramatically over recent decades. The threat of Lyme disease is acute for those who frequently engage in outdoor recreation and management activities, and the threat of tickborne illness can lead to reduced enjoyment of, and time spent in, Minnesota's natural environment. Despite strong awareness of Lyme disease, many who participate in outdoor activities only take some preventative measures. Increasing Minnesotan's awareness of potential tick exposure, protective measures, and when to seek medical attention can reduce negative outcomes of Lyme disease. While Lyme disease is easily treated if caught early, it can become chronic with delayed treatment and many doctors rely on patient knowledge of tick exposure to diagnose and treat the disease. Further, there is currently no publicly-available forecast of Lyme disease risk or map of high-risk areas that can inform and motivate preventative measures. The development of the TickWise Lyme disease forecast and associated Extension education and participatory science programs will help all Minnesotans safely recreate across Minnesota's many landscapes from the Prairie Pothole Region to the Northwoods and beyond.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

TickWise Minnesota will develop a first-of-its-kind Lyme disease forecast integrated with Extension education and participatory science to mitigate risks of a growing environmental issue—Lyme disease—while strengthening public confidence in the safe use and enjoyment of Minnesota's natural environment. At its core is a statewide TickWise Forecast, which translates environmental information like humidity and overwintering temperatures into county-specific Lyme disease risk. This forecast will be refined by results from a participatory science program that will train outdoor visitors to collect and send ticks for disease testing.

We will empower natural resource managers and environmental educators across Minnesota to share the forecast and research-based information on tick identification, risk recognition, and bite prevention with their communities. Guidance from an advisory group, community surveys, and focus groups will be used to refine information before launching a sustainable, open-access online education platform. By partnering with organizations like the Minnesota Deer Hunters Association and Wood Lake Nature Center, the TickWise program will establish a scalable model that can reach nature centers, parks, and wildlife areas statewide to highlight seasonal Lyme disease risk and prevention. TickWise Minnesota seeks to transform public perception of Lyme disease from an unpredictable threat into a manageable risk.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

This project will help enable Minnesotans to safely enjoy Minnesota's abundant natural resources. The creation of the state's first-of-its-kind publicly-accessible Lyme disease forecast will clearly show the relative risk of Lyme disease at the local level and enable informed decision-making by outdoor visitors. Paired with an online training platform and dedicated Lyme disease education program targeted at outdoor and environmental educators and recreation sites, this project will promote public disease prevention measures and safe use of the outdoors Together, these outcomes will empower Minnesotans to take proactive measures to minimize the impacts of an emerging threat within our natural environment.

Activities and Milestones

Activity 1: Develop the TickWise Minnesota Lyme Disease Forecast and Associated Dashboard

Activity Budget: $223,600

Activity Description:
We will create a first-of-its-kind Lyme disease forecast for the state of Minnesota. This forecast will draw on known links between environmental conditions and the tick populations that carry Lyme disease. For example, wintertime temperatures affect tick survival rates and the overall abundance of Lyme disease-carrying ticks the following year. We will begin development of the TickWise forecast by gathering Lyme disease data from the Minnesota Department of Health (see attached letter of support) and analyzing it against historical weather and land use data to assess how weather affects Lyme disease caseload in Minnesota. We will then incorporate the environmental conditions-Lyme disease relationships uncovered in the previous step into the TickWise forecast model to project the relative risk of Lyme disease for each county in Minnesota for the upcoming year based on observed weather and environmental conditions. Finally, we will evaluate the effectiveness of this forecast based on both historical data and tick submissions and disease testing from the project's participatory science program (Activity 2). The forecast will be publicly available and updated on an online dashboard hosted by UMN Extension and available for integration into other websites like those for nature and outdoor education centers, state agencies, and others.

Activity Milestones:

Description	Approximate Completion Date
Establish TickWise Advisory Group including public health and conservation experts.	September 30, 2027
Procure data needed for forecast development, including climate, land use, Lyme disease, and other data.	September 30, 2027
Determine the statistical relationships between climate variability and Lyme disease incidence.	January 31, 2028
Analyze local tick habitat suitability across Minnesota to guide county Lyme risk assessment.	April 30, 2028
Develop county level forecast of Lyme disease for Minnesota using climate and other inputs.	April 30, 2028
Examine county level forecast accuracy for historical conditions.	November 30, 2028
Develop and publicize an online interactive dashboard to widely disseminate the TickWise forecast to Minnesotans.	March 31, 2029

Activity 2: The Ixodes Outreach Program (IOP) Will Build a Statewide Participatory Science Program for Public Participation in TickWise Minnesota

Activity Budget: $177,735

Activity Description:
The Ixodes Outreach Program (IOP) will build upon an existing participatory science framework through a statewide expansion of volunteer tick collection and additional student-led analyses. Currently, the IOP trains community scientists to submit ticks they encounter in order to build a database on Lyme distribution in Northern Minnesota. Collected ticks are mailed to the University of Minnesota - Duluth where student volunteers complete DNA analyses to detect Lyme disease-causing bacteria, generate Lyme disease presence data, and gain valuable STEM research experience. TickWise Minnesota will expand this participatory science program statewide. This will include training project team members, including Extension educators, to train community scientists on tick identification and biology, and tick collection for Lyme screening. To support this statewide participatory science program, tick-collection kits with a Tick Removal Key, information cards, and instructions for tick submission will be provided to all volunteers. Participant-submitted tick results will then be tested for Lyme presence and the data will be integrated into the TickWise Minnesota forecast. This community science program will enable a comprehensive survey of Lyme prevalence in Minnesota and help to identify environmental conditions associated with infected ticks.

Activity Milestones:

Description	Approximate Completion Date
Recruit community scientists using news articles, social media, and workshops for schools and outdoor clubs.	September 30, 2027
Refine participatory science recruitment and volunteer training approach including tick identification for statewide audiences.	October 31, 2027
Train undergraduate student volunteers in Lyme screening DNA analysis of community submitted ticks.	May 31, 2028
Use submitted tick results to create an online database of Lyme disease presence in Minnesota.	June 30, 2029
Integrate tick and Lyme disease presence database into TickWise Minnesota forecast.	January 31, 2030

Activity 3: TickWise Minnesota Public Engagement and Education to Inform Outdoor Recreation, Environmental Education, and Resource Management

Activity Budget: $139,665

Activity Description:

We will create an open-access online education platform and scalable Lyme disease education model for outdoor resource managers, educators, hunters, parks and trails users, recreational visitors, and the general public. Educational resources will include how to identify ticks, recognize the signs of Lyme Disease, prepare to avoid and treat tick bites, and interpret and use the TickWise Minnesota Lyme disease forecast. To support program accessibility and effectiveness in helping Minnesotans prepare for tick season, we will test and refine the resources and public messaging in collaboration with a dedicated TickWise Advisory Group throughout the project, including partners from outdoor organizations like the MN Deer Hunters Association and the Wood Lake and Wolf Ridge nature centers. Advisory group organizations will also help host pilot training sessions for staff on the use of the TickWise Minnesota Lyme Disease Forecast, and educational information resources to help their visitors and students be prepared, safe, and comfortable outdoors, even when Lyme prevalence is high. Building on these pilot trainings, the team will then refine and deploy a statewide, open-access online training for other schools, nature centers, parks, camps, parks and trails organizations, and other outdoor recreation centers to use in staff and visitor education.

Activity Milestones:

Description	Approximate Completion Date
Engage with TickWise Advisory Group to develop public messaging about tick awareness, prevention, and treatment.	December 31, 2027
Curate and develop online Extension information about tick identification, prevention measures, disease symptoms, and treatment.	January 31, 2028
Promote public messaging and information through news media, nature center, park, and other websites.	February 28, 2028
Create a training platform for nature centers and outdoor groups to use with staff/visitors.	April 30, 2028
Host six or more training sessions for staff from nature centers, parks, and outdoor spaces.	March 31, 2030
Finalize online education platform for ongoing nature center and outdoor group use with staff/visitors.	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Ryan Harp	University of Minnesota Climate Adaptation Partnership	Co-Principal Investigator. Oversee project, oversee and conduct scientific analysis and development of TickWise Lyme disease forecast, serve as the primary point of contact for the project.	Yes
Heidi Roop	University of Minnesota Extension	Co-Principal Investigator & Extension Specialist. Oversee project and provide supervision to UMN staff and researchers, provide guidance on research and Extension activities including forecast development and participatory science program.	Yes
Nathan Meyer	University of Minnesota Extension	Extension Program Leader. Oversee Extension program development and advisory board, lead program evaluation and support participatory science program.	No
Alexandra Zachwieja	University Medical School - University of Minnesota Duluth	Co-Investigator. Oversee aspects of participatory science program development and supervise UMN Medical School staff, conduct scientific analysis toward mapping of Lyme disease habitat suitability, provide project project management and leadership.	Yes
Clara Smoniewski	University Medical School - University of Minnesota Duluth	Participatory Science Bioinformatics Lead. Oversee aspects of participatory science program with a focus on testing collected ticks for Lyme disease, conduct scientific analysis.	Yes
Benjamin Clarke	University Medical School - University of Minnesota Duluth	Participatory Science Tick Collection Lead. Oversee aspects of participatory science program, conduct scientific analysis.	Yes
Jesse Berman	University of Minnesota School of Public Health	Technical Advisor. Provide technical advising on epidemiological modeling toward the development of the TickWise Lyme disease forecast.	Yes
Jonathan Oliver	University of Minnesota School of Public Health	Technical Advisor. Provide technical advising and subject matter expertise on tick and Lyme disease toward the development of the TickWise Lyme disease forecast.	Yes
Kent Boyd	University of Minnesota Climate Adaptation Partnership	Extension Educator. Extension education and the development of online information resources regarding Lyme disease safety measures.	Yes
Britta Greene	University of Minnesota Climate Adaptation Partnership	Communications Specialist. Support communication and extension material development and design.	Yes
Christy Marsden	University of Minnesota Climate Adaptation Partnership	Curriculum Manager. Develop online information resources and training modules to encourage proactive measures for Lyme disease safety.	Yes

Maria Tomczik	University of Minnesota Climate Adaptation Partnership	Senior Program Manager. Project management support, including overseeing contracts, services, and financial tasks to ensure timely delivery of project tasks and milestones.	Yes
Dena Coffman	University of Minnesota Climate Adaptation Partnership	GIS Specialist. Develop a publicly-available interactive dashboard for the TickWise Lyme disease forecast.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
Ensuring the TickWise Minnesota Lyme disease forecast and Lyme disease prevention information is readily accessible is a critical component of the TickWise Minnesota project. A dashboard of the TickWise Minnesota Lyme disease forecast will be hosted on the University of Minnesota Climate Adaptation Partnership website (climate.umn.edu) and will be updated annually, at a minimum. This will allow outdoor organizations and the general public to easily access local estimates of Lyme disease risk. Additionally, to follow best scientific practices and allow for future developments and collaborations on the forecast, the methods and detailed validation of the forecast will be published in a peer reviewed academic journal at the earliest appropriate time. The code and other technical underpinnings of the forecast will be similarly shared in an open source repository (e.g., GitHub).

The Lyme disease awareness and prevention educational products created through the project will be incorporated into an interactive online education platform and will be accessible beyond the length of the grant on the Climate Adaptation Partnership website (climate.umn.edu). This platform will also be shared directly with partners who will disseminate the materials to the communities they serve or represent to facilitate safe use of Minnesota's great outdoors. These products we develop will also be integrated into sustained Extension programs (e.g., Community Climate Leaders, climate change and health programs, Master Naturalists, Woodland Steward, and Master Gardener).

Finally, the data on Lyme disease presence in tick populations collected as a result of the participatory science component of our project will be compiled in a publicly available online database of Lyme disease prevalence in Minnesota that will be hosted through the Climate Adaptation Partnership website. Providing these data will allow Minnesota-specific tick and Lyme disease presence data to be utilized by public health professionals and other Lyme disease researchers.
Environment and Natural Resources Trust Fund will be acknowledged as appropriate through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENTRF Acknowledgement Guidelines.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?
Once developed, the TickWise Minnesota Lyme disease forecast will be accessible online and will be updated annually, at a minimum, to provide seasonal forecasts of Lyme disease risk across the state. The Extension resources and participatory science program developed through TickWise Minnesota will be integrated into ongoing Extension training and educational programming for outdoor resource managers, educators, hunters and anglers, and recreational visitors. The interactive online training platform will also be accessible in an ongoing manner through Extension's Climate Adaptation Partnership (climate.umn.edu).

Project Manager and Organization Qualifications

Project Manager Name: Ryan Harp

Job Title: Applied Climate Scientist

Provide description of the project manager's qualifications to manage the proposed project.
Harp is an applied climate scientist with the University of Minnesota Climate Adaptation Partnership who specializes in linking weather and climate to human health outcomes and the development of disease early warning systems. He developed expertise in vector-borne disease modeling while serving in a unique cross-institutional research position jointly funded by the National Oceanic and Atmospheric Administration (NOAA) Global Systems Laboratory and the Centers for Disease Control (CDC) Division of Vector-Borne Diseases. As part of this position, Harp developed a climate-informed West Nile virus forecast which was the first to demonstrate nationwide forecast accuracy beyond a benchmark. He also led the diagnostic analysis of the 2022 CDC West Nile Virus Forecasting Challenge and facilitated the 2023 CDC West Nile Virus Forecasting Challenge by coordinating efforts from nine disease modeling teams across the country in both the academic and public health sectors. Earlier research from Harp linked over 80% of year-over-year malaria variability in Mozambique to locally relevant climate phenomena.

Harp is a leader in the climate and health space. He serves on the leadership team of the American Geophysical Union GeoHealth section and is an invited participant of the U.S. Climate Variability and Predictability Climate and Health Working Group. In recognition of his expertise, Harp has been invited to present his work to a wide array of epidemiological meetings and groups, including the 2024 and 2026 CSTE-CDC Vector-Borne Disease Modeling Workshops, the CDC Dengue Branch Epidemic Analytics team, and many others.

In past roles, Harp demonstrated success coordinating complex projects through his leadership of cross-disciplinary research teams, oversight of junior researchers, and through projects like the aforementioned CDC West Nile Virus Forecasting Challenges and the NOAA Southern California Drought Early Warning Pilot. Additionally, the Climate Adaptation Partnership and co-principal investigator Roop have ample experience effectively executing LCCMR funded grants.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:
The University of Minnesota Climate Adaptation Partnership offers critical research, resources, and Extension education to help communities respond to changing climate conditions and prepare for the years to come. Affiliated with both University of Minnesota Extension and the College of Food, Agricultural and Natural Resource Sciences, we perform foundational climate research relevant to Minnesota and offer place-based and community-centered Extension education and technical assistance with the aim to sustain and foster resilient communities, landscapes and economies across the state.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
co-Principal Investigator Harp		Co-Principal Investigator. Oversee project, oversee and conduct scientific analysis and development of TickWise Lyme disease forecast, serve as the primary point of contact for the project.			27%	1.5		$181,013
co-Principal Investigator Roop		Co-Principal Investigator & Extension Specialist. Oversee project and provide supervision to UMN staff and researchers, provide guidance on research and Extension activities including forecast development and participatory science program.			27%	0.24		$58,569
co-Investigator Alexandra Zachwieja		Co-Investigator. Oversee aspects of participatory science program development and supervise UMN Medical School staff, conduct scientific analysis toward mapping of Lyme disease habitat suitability, provide project project management and leadership.			27%	0.24		$50,824
Participatory Science Bioinformatics Lead (Smoniewski)		Participatory Science Bioinformatics Lead. Oversee aspects of participatory science program with a focus on testing collected ticks for Lyme disease, conduct scientific analysis.			37%	0.24		$35,478
Participatory Science Tick Collection Lead (Clarke)		Participatory Science Tick Collection Lead. Oversee aspects of participatory science program, conduct scientific analysis.			27%	0.03		$5,040
Epidemiological Technical Advisor (Berman)		Technical Advisor. Provide technical advising on epidemiological modeling toward the development of the TickWise Lyme disease forecast.			27%	0.06		$12,969
Tick and Lyme Disease Technical Advisor (Oliver)		Technical Advisor. Provide technical advising and subject matter expertise on tick and Lyme disease toward the development of the TickWise Lyme disease forecast.			27%	0.06		$12,852
Extension Educator (Boyd)		Extension Educator. Extension education and the development of online information resources regarding Lyme disease safety measures.			27%	0.24		$30,877

Communications Specialist (Greene)		Communications Specialist. Support communication and extension material development and design.			27%	0.12		$14,358
Curriculum Manager (Marsden)		Curriculum Manager. Develop online information resources and training modules to encourage proactive measures for Lyme disease safety.			27%	0.08		$11,245
Senior Program Coordinator (Tomczik)		Senior Program Manager. Project management support, including overseeing contracts, services, and financial tasks to ensure timely delivery of project tasks and milestones.			24%	0.24		$24,490
GIS Specialist (Coffman)		GIS Specialist. Develop a publicly-available interactive dashboard for the TickWise Lyme disease forecast.			24%	0.34		$36,484
							Sub Total	**$474,199**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Extension training supplies (flipcharts, markers, convening supplies, etc.)	Supplies necessary for Extension training					$750
	Tools and Supplies	Materials for tick collection kits (1,690 kits at $2.20 each)	Tick collection kits will be distributed to participatory science volunteers to allow them to send collected ticks to University of Minnesota Duluth					$3,718
	Tools and Supplies	Supplies for genomic array analysis	Genomic array analysis materials are needed to test community-submitted ticks for the presence of Lyme disease-causing bacteria					$30,000
							Sub Total	**$34,468**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**

Travel In Minnesota								
	Miles/ Meals/ Lodging	13 day trips, 350 round-trip miles ($0.725/mile), 2 people	For project team members to engage in education and outreach with community partners and other targeted audiences.					$3,299
	Conference Registration Miles/ Meals/ Lodging	1 person, includes conference registration ($550), two nights of lodging ($159/night), per diem, and estimated mileage rates for 375 mile round-trip travel ($0.725/mile)	Project team member will present program results and host a workshop at the 2029 Midwest Resilience Conference anticipated to be held in Saint Paul, MN.					$1,348
	Miles/ Meals/ Lodging	3 trips for 5 people, including 2 nights of lodging ($159/night), 3 days of per diem ($86 full per diem; $64.50 for first and last day of travel), and mileage charges for 350 mile round-trip journey with 2 vehicles ($0.725/mile)	For annual project team meetings and coupled community engagement.					$9,517
	Miles/ Meals/ Lodging	6 trips total (2 trips annually) for 3 people, including 2 nights of lodging ($159/night), per diem ($86 full per diem; $64.50 for first and last day of travel), and mileage charges for 350 mile round-trip with 1 vehicle ($0.725/mile)	For project team members to train community members in participatory science tick collection methods.					$11,169
							Sub Total	**$25,333**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Large format maps, educational resources, program booklets, promotional materials, and signage.	To print the Extension resources needed to facilitate the delivery, recruitment, and documentation of the project.					$4,500
							Sub Total	**$4,500**
Other Expenses								
		Stipends for advisory group members (10 stipends at $250 each)	To incentivize partner participation in the advisory group which will guide the development of the TickWise Lyme disease forecast and educational materials.					$2,500

							Sub Total	**$2,500**
							Grand Total	**$541,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**-**

Total Project Cost: $541,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 2cb18824-8b5.pdf

Alternate Text for Visual Component

The graphic depicts how the three activities of TickWise Minnesota (Lyme disease risk forecast, Lyme disease prevention resources and online educational platform, participatory science tick collection) integrate to foster the safe use and enjoyment of Minnesota's natural environment and combat the risks of Lyme disease....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letter of Support: Minnesota Naturalists' Association	972ea13c-df2.pdf
University of Minnesota Sponsored Projects Administration Letter of Support	d5905a41-6e5.pdf
Letter of Support: 1854 Treaty Authority	7ff3d3ab-15d.pdf
Letter of Support: Wolf Ridge Environmental Learning Center	22781333-260.pdf
Letter of Support: Wood Lake Nature Center	013a8cc0-8ec.pdf
Letter of Support: Minnesota Department of Health	e0727892-8ac.pdf
Letter of Support: Minnesota Deer Hunters Association	88bb7ac4-174.pdf
Letter of Support: Superior Hiking Trail Association	77602a05-389.pdf
Letter of Support: Metropolitan Mosquito Control District	d7c6e97b-8d3.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing $10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

University of Minnesota Sponsored Projects Administration (see attached letter of support)

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A