



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-274

Proposal Title: Removal of Dioxin and PCBs from Native Land

Project Manager Information

Name: Jana Danker

Organization: Akiing 8th Fire

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Project Basic Information

Project Summary: Demonstrate a suite of technologies to remove toxins from the soil on Minnesota superfund sites.

Funds Requested: \$987,000

Proposed Project Completion: June 30, 2027

LCCMR Funding Category: Methods to Protect, Restore, and Enhance Land, Water, and Habitat (F)

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.

Soil and water contamination caused by extremely toxic chemicals like dioxin, or dioxin-like polychlorinated biphenyls (PCBs), has been on the national spotlight for better treatment options, especially after recent train derailment accidents. The St. Regis superfund site is a 163-acre site located within the Leech Lake Reservation boundary. The St. Regis wood treatment facility operated there from the 1950s to the 1980s. The facility's operations contaminated soil and groundwater with hazardous chemicals. This site was placed on the national priorities list in 1984, and 39 years later this site is still contaminated above safe levels. The site is contaminated with dioxin, polycyclic aromatic hydrocarbons, and pentachlorophenol. There are residential units located within the superfund site. All these contaminants are known to be dangerous to human health. This research is needed to establish a process that would truly begin to clean the site and protect the health of our people and homeland. Right now the current plan from the EPA is to move contaminated soil from one place to another. These contaminant chemicals are very stable chemically and need extremely high temperatures to destroy. We wish to establish a process that could truly clean the contaminants from this site.

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.

This project will study the potential of native plant species for the phytoremediation to remove dioxins, PCP and other polycyclic aromatic hydrocarbons from the contaminated soil at the superfund site near Cass Lake, and then treatment of plant biomass via composting or thermochemical methods with minimum pollutant emissions. Phytoremediation is an emerging method to extract environmental pollutants from the soil by utilizing the growth of certain plants and remove toxins by harvesting the plant biomass. Composting has been approved to be an effective method for the dioxin and PCP degradation. Recent research by mixing contaminated soil with animal manure showed that the disappearance of PCP was rapid and virtually complete within 6 days, prior to the onset of thermophilic conditions. Dioxin degradation in the composting typically occurs during the thermophilic conditions where one study showed a removal efficiency of 81% after 35 days from the dioxin contaminated soil. Pyrolysis is another promising and economically viable approach to the complete destruction of complicated organic contaminants, where contaminants are converted to carbon dioxide and water at medium to high temperatures. This project is designed to develop a continuous microwave-assisted pyrolysis system for contaminated soil remediation and treatment of harvested contaminants-rich biomass.

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?

We will establish a process to remove the contaminants from the soil, and then two different follow-up methods to completely destroy these contaminants. Phytoremediation and composting are low-risk processes and they can be readily implemented in the native community; while pyrolysis is an industrial process and coordinated efforts are needed for its commercial application. We will share these different methods with concerned parties and the scientific community to help countless others. If we can prove that these contaminants can be removed from the soil, we could help Leech Lake Reservation seek environmental justice by setting up these treatment processes.

Activities and Milestones

Activity 1: Screening of native Minnesota plants for toxin removal

Activity Budget: \$168,475

Activity Description:

We first want to study our plant inventory and screen more native species via lab growth tests for phytoremediation purpose. Bo Hu's research group has been funded to work on the phytoremediation of salt from roadside soil and we have been working with around 30 native plant species. We will select species based on native plant database published at MNDNR and also based on their phytoremediation potential to remove dioxin and PCB contaminants. For instance, Reed Canarygrass and switchgrass has shown to be very effective in degrading PCBs. Other plants also showed potential in extracting from soil and accumulating chlorinated organic compounds into their biomass, including: ryegrass, bermuda grass, bent grass, white clover, pumpkin, zucchini, maize, vetiver, physic nut, hemp etc. Maize is shown to accumulate dioxins mostly in their roots, while vetiver mostly in their shoots. We will grow some plants in greenhouse to evaluate their phytoremediation potential. A decision matrix will be established considering all factors affecting their real applications and two to three best plan species will be selected for the onsite plantation. Toxin content of the biomass will be measured after one full growth cycle year in order to collect plant biomass for the subsequent treatments.

Activity Milestones:

Description	Approximate Completion Date
Select native plants with the ability to assimilate toxins	January 31, 2025
Screen these plants with lab growth for phytoremediation capability	May 31, 2025
Decision matrix for plant recommendations	October 31, 2025

Activity 2: Composting of plant biomass for toxin degradation

Activity Budget: \$168,485

Activity Description:

The species selected from activity 1 will be planted at the St. Regis superfund in collaboration with local residents. Soil samples will be taken monthly to monitor the contamination levels during the growth experiments. The plant biomass generated from the growth study will serve as raw materials for the composting treatment. Co-PI Bo Hu's research group has been working on the anaerobic composting/digestion treatment of food waste under the aerobic and anaerobic conditions. Composting of organic solid wastes recycles the nutrients by converting the waste into organic fertilizer ready for land application, and it has gained popularity in many states. We will first evaluate the effectiveness of toxin degradation removal through aerobic composting under different lab conditions. These conditions will include optimizing lab-scale aerobic composting system treating harvest biomass mixed with co-substrate (livestock manure and/or bulking agents) at different temperatures, including three temperatures 25°C (psychrophilic), 35°C (mesophilic), and 55°C (thermophilic). Statistical analyses will be conducted to obtain optimized operational conditions, including co-substrate ratio, temperature, and retention time. A pilot-scale on-farm composting system will be established to demonstrate the system under the optimized conditions and samples will be analyzed for their effectiveness.

Activity Milestones:

Description	Approximate Completion Date
Lab scale composting optimization	March 31, 2026
Pilot scale composting pile	March 31, 2026
On-site plantation and monitoring of these plants for toxin removal	June 30, 2026

Activity 3: Develop and evaluate thermochemical treatment of contaminated harvested plant biomass and soil

Activity Budget: \$401,365

Activity Description:

Co-PI Roger Ruan's group has been working on pyrolysis of solid feedstock including biomass for many years. In this project, they will design and develop a continuous microwave-assisted pyrolysis process for degrading dioxins and hydrocarbon contaminants in the harvested biomass and soil samples that contain the aforementioned toxins. The effectiveness will be investigated under different process conditions including microwave power input, temperature, residence time, sample load rate, sample to silicon carbide ratio, and catalyst type and load. Injection of moisture (steam) and gasses will be tested to determine if they enhance the degradation performance. It is known that degradation products from thermochemical reactions may still be toxic and persistent. Therefore, how the proposed method behaves in terms of complete removal of organic contaminants and the generation of toxic byproducts needs to be studied in detail. To understand this, we will analyze some key intermediates and flue gas of organic contaminants breakdown during the microwave-assisted pyrolysis. Using this information, we will improve and optimize the microwave-assisted pyrolysis processes to prevent the generation of potential toxic byproducts. The secondary ex-situ catalytic reactor will be designed to destruct any hazardous volatiles generated during the microwave-assisted pyrolysis treatment, further eliminating any potential risk.

Activity Milestones:

Description	Approximate Completion Date
Initial test of continuous microwave assisted pyrolysis of harvested biomass and soil samples	June 30, 2026
Evaluation and optimization of the pyrolysis process	December 31, 2026
Evaluation of the potential generation of secondary toxic byproducts	December 31, 2026
Mitigation of secondary hazardous compounds using ex situ catalytic reactor	December 31, 2026

Activity 4: Plant hemp on the superfund site to test phytoremediation of dioxins, Polycyclic aromatic Hydrocarbons, and Pentachlorophenol

Activity Budget: \$248,675

Activity Description:

Hemp is a plant known for its phytoremediation qualities; it grows quickly and has deep roots, it is able to pull contaminants from the ground as it grows. It has been documented in scientific studies for its ability to pull heavy metals from the ground. We will first test the soil for contaminants, and then plant hemp on a 3x3 foot test plot located on a residential property on the superfund site. After the plants have grown we would remove the plants and then we would test the soil again to see how contaminants have been lowered in the soil. After the plants have been harvested we would send the plants to the University of Minnesota to be turned into Biochar which would rid the plants of contaminants and then the biochar could be safely returned to the soil. Honor the Earth will be planting the hemp plants and would need funding to cover the testing of the soil and to cover the cost of turning the plants into biochar. Also included in this budget is the cost of protective equipment to begin planting hemp safely. Also included are two community outreach events that will take place before and after

Activity Milestones:

Description	Approximate Completion Date
Plant hemp on the superfund site to test phytoremediation capability to lower contamination levels in	September 30, 2025

Test of contaminated soil treatment by microwave-assisted pyrolysis process	June 30, 2026
Continue this process of phytoremediation of contaminants using hemp	September 30, 2026
Process optimization	December 31, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Bo Hu and Roger Ruan's Research Groups	University of Minnesota	Research partners	Yes

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?

The project will have a broad impact on both academia and industry. The results will provide fundamental knowledge on how these native plants mobilize and excrete dioxins and PCP in the soil. The possible applications will lead to new ways to treat these environmental toxins from the contaminated soil. It will have broad impacts to other superfund sites cross the state and the nation.

Project Manager and Organization Qualifications

Project Manager Name: Jana Danker

Job Title: Remove pollutants from well water on superfund sites

Provide description of the project manager's qualifications to manage the proposed project.

Esther Ames will be the project manager for this project and have a total of 19 & 1/2 years of work experience in Tribal Government, most of which directly relate to building, managing, and evaluating programs. Esther brings extensive experience in project management, planning, grant and financial reporting, budget management, statistics, research and data collection, partnership development and staff supervision.

Organization: Akiing 8th Fire

Organization Description:

Akiing 8th Fire will be the lead for this innovation. Akiing, the Anishinaabe word for "the land to which the people belong", is a regional integrated community development initiative aimed at restoring a culturally based Anishinaabe economy focused on regional food production, renewable energy, hemp, traditional arts, and youth leadership. The organization was founded in 2017 after over 30 years of integrated environmental and economic justice work in the village of Pine Point, located in the White Earth reservation. For the past seven years, Akiing has been growing hemp fiber and providing education on all aspects of hemp production to developing a hemp farming industry in the region.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Akiing Reasearcher		Work with partners to on water research			25%	0.3		\$45,000
Project Manager		Work with partners to coordinate project, reporting and milestones.			25%	0.3		\$15,000
							Sub Total	\$60,000
Contracts and Services								
University of MInnesota	Sub award	research partners through the University of Minnesota				0		\$738,335
Independant Contractor	Sub award	contracted services for land use @ \$5,000 per year x 3 years				-		\$15,000
Independant Contract	Sub award	contracted hemp growers @ \$5000 a months x3 months x 2 growers				-		\$90,000
							Sub Total	\$843,335
Equipment, Tools, and Supplies								
	Tools and Supplies	x2 hemp licenses, testing and protective equipment,Costs to create a scientific article ,seeds	general supplies to safely collect samples and test the samples					\$5,865
	Tools and Supplies	Community Engagement	Community engagement sessions					\$1,800
	Tools and Supplies	dioxin testing	Diox testing equipment \$1000 per text per sq ft x 3 years					\$54,000
	Tools and Supplies	Hemp and Plant Seeds	Seeds related to theory of change/hypothesis					\$9,000
							Sub Total	\$70,665
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								

							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	regional travel to and from the twin cities and regional travel to and from White Earth Nation to the superfund site	travel to site to site					\$6,000
							Sub Total	\$6,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	printing and publication costs for research results	Research dissemination					\$1,000
							Sub Total	\$1,000
Other Expenses								
		Hemp Licenses	x 2 licenses x 3 years @ \$1,000 per license					\$6,000
							Sub Total	\$6,000
							Grand Total	\$987,000

Classified Staff or Generally Ineligible Expenses

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

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
In-Kind	In kind	Administrative costs	Secured	\$406,073
			Non State Sub Total	\$406,073
			Funds Total	\$406,073

Attachments

Required Attachments

Visual Component

File: [42aef507-a91.pdf](#)

Alternate Text for Visual Component

This map shows where the contaminants are above cleanup levels that have been established for EPA cleanup. As you can see on the map there is more area that is above the cleanup level goals than there is below, meaning these responsible parties are not doing enough....

Board Resolution or Letter

Title	File
Letter from board	b6200063-b49.pdf

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
Partner support letter	1e78e9c4-f02.pdf
Support letter	8ff81c14-f61.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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 design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?

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?

No

