# Environment and Natural Resources Trust Fund

M.L. 2021 Approved Work Plan

## General Information

**ID Number:** 2021-050

**Staff Lead:** Corrie Layfield

**Date this document submitted to LCCMR:** July 21, 2021

**Project Title:** Trout Stream Habitat Restoration Success

**Project Budget:** $319,000

## Project Manager Information

**Name:** Valerie Brady

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## Project Reporting

**Date Work Plan Approved by LCCMR:** July 20, 2021

**Reporting Schedule:** December 1 / June 1 of each year.

**Project Completion:** June 30, 2025

**Final Report Due Date:** August 14, 2025

## Legal Information

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 04a

**Appropriation Language:** $319,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute to evaluate the effectiveness and durability of previous trout stream habitat restoration projects to improve the success and cost effectiveness of future projects. This appropriation is available until June 30, 2025, by which time the project must be completed and final products delivered.

**Appropriation End Date:** June 30, 2025

## Narrative

**Project Summary:** Minnesota has spent millions on stream habitat improvement and restoration; we will evaluate effectiveness and durability of project designs. Results will inform success of future projects and improve cost effectiveness.

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

Are stream habitat improvement projects actually effective for improving the ecology and habitat of Minnesota's streams? Do the current methods used for stream improvements result in permanent solutions that can persist through increasingly challenging weather conditions?

As of December 2018 at least $19 million dollars has been spent by the Lessard-Sams Outdoor Heritage Fund alone to improve trout stream habitat or restore stream reaches in poor condition. These stream habitat projects have been implemented using a variety of engineering methods and designs. However, very few stream restorations or habitat improvements are evaluated rigorously or quantitatively. For example, in addition to achieving design goals (e.g., stop bank erosion), a successful restoration should both improve the physical structure (habitat) and result in healthier biological communities, (i.e., fish and fish food). Anglers, in particular, are not sure if habitat restorations actually provide the right kind and amount of habitat for fish and other aquatic organisms. There is also the continuing concern that some restorations cannot withstand flood events and need repair after just a few years. We will address the questions: How successful are different improvement designs? How well do different improvement projects withstand large storm events?

**What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.**

Sufficient numbers of habitat improvements and restorations have now been conducted across Minnesota to assess their long-term status and determine if projects resulted in appropriate and lasting improvements to these streams. We will select 5-7 realigned stream sites in the Arrowhead region of Minnesota (paired with 5-7 control [reference] sites) to assess outcomes and longevity of these projects. Our team has pre-restoration data for some stream reaches where this type of work has been completed. Having quantitative pre-restoration data will allow the “gold standard” assessment to be done: Before-After, Control-Impact (BACI) analysis. This statistical technique uses pre-restoration and post-restoration data at both control (reference) and restoration sites to assess how well restoration projects succeeded in improving fish habitat and restoring stream ecosystem function. Analysis will include how the permitting process influenced the restoration design.

We will leverage this activity with work by Dr. Doug Dieterman (MNDNR) to assess stream restoration projects in southeast Minnesota. We will align our study designs and share data for a broader analysis of which engineering and construction designs work best and how to improve this work in the future.

**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 greatly improve our understanding of the effectiveness and durability of stream realignment project designs; specifically, which hold up better over time, require less repair, result in increased fish habitat and food resources, and better restore stream ecosystem function, including connectivity with shallow groundwater. Fisheries managers, restoration practitioners, and funding and permitting agencies will have more information available to evaluate design success and cost-effectiveness. In the long term, our results will inform the development of better and more reliable stream realignment projects.

## Project Location

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

Region(s): NE

**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

## Activities and Milestones

### Activity 1: Characterize fish populations, food resources and habitat at realigned and reference sites to quantify results of stream realignment projects

**Activity Budget:** $136,178

**Activity Description:**
Five to seven stream channel realignment sites will be selected to represent: 1) different realignment designs, and 2) time since activity was completed. An equivalent number of reference sites will be compared to completed project sites to assess outcomes of restoration activities. Each reach will be characterized with respect to: 1) fish populations, 2) stream macroinvertebrates (fish food), and 3) habitat structure with the goal of assessing the extent of improvement. We will assess fish populations with catch-and-release electrofishing. We will collect macroinvertebrate samples throughout the stream for identification in the laboratory. We will assess stream habitat following protocols and metrics used by MN and WI DNRs.

We will analyze data using the rigorous Before-After, Control-Impact (BACI) method in reaches where pre-restoration data exists for a realigned site and its paired reference site. We will compare other realigned sites to their matched reference sites for post-restoration data only and assess statistically.

Outcome 1: Paired data from each realigned site and its reference site for fish, fish food and habitat.
Outcome 2: Determination of effectiveness and durability of stream realignment designs for fish, fish food and habitat.

**Activity Milestones:**

| Description | Completion Date |
|---|---|
| 1. Five to seven stream realignment projects selected for study, paired with reference sites. | August 31, 2021 |
| 2. Fish, macroinvertebrate, and habitat data collected for 5-7 paired realigned and reference sites (10-14) | September 30, 2024 |
| 4. Data from #1 compared between realigned and reference sites without pre-restoration data using ordinations | April 30, 2025 |
| 3. Data from #1 compared between realigned and reference sites with pre-restoration data using BACI. | April 30, 2025 |

### Activity 2: Assess stream realignment project status and longevity; assess stream ecosystem function relative to reference reaches

**Activity Budget:** $160,154

**Activity Description:**
Task 1. At 5-7 stream habitat improvement or restoration sites, assess each project's effectiveness at meeting its objectives and assess its longevity.
Methods: At each site we will assess whether the project's objectives were well-defined and quantifiable. We will compare current stream conditions with surveys done at each project's completion to determine how much change (erosion, deposition, or lateral migration) has occurred. We will also assess vegetation growth and bank stability.
Outcome: Assessment of how well each project met its own objectives, survived, and the characteristics that caused projects to fare better or worse.

Task 2. At four realigned sites, assess stream ecosystem function compared to matched reference (control) sites.
Methods: We will quantify ecosystem function by measuring 1) stream productivity (gross primary production and respiration); 2) the connectivity between stream surface water and groundwater using a unique water tracer test; and 3)

nutrient uptake by in-stream biota.
Outcome 1: Comparison between realigned and control stream reaches to assess if there are significant differences in ecosystem health.
Outcome 2: Determination of which types of work alter any of these three major components of stream ecosystem function.

**Activity Milestones:**

| Description | Completion Date |
|---|---|
| 1. Stream ecosystem measurements made in 5-7 paired restoration and reference sites (10-14 sites total). | September 30, 2024 |
| 2. Water quality, productivity, and nutrient cycling analyses completed at 4 sites. | February 28, 2025 |
| 3. Data compared between realigned and reference sites. | April 30, 2025 |

## Activity 3: Outreach and knowledge/technology transfer

**Activity Budget:** $22,668

**Activity Description:**
Task 1. Derive summary of efficiency and longevity by realignment design.
Task 2. Provide results of stream realignment assessments to those involved in stream restoration work or permitting.

Methods: We will provide project results to MNDNR fisheries managers, stream managers, MPCA staff, soil and water conservation district staff, Board of Water and Soil Resources staff, and non-profit staff using webinars, outreach at state meetings (e.g., the Water Resources Conference), reports and other venues or media.We know that much of this stream work is being done by soil and water conservation districts and angler enthusiast groups, with oversight and permitting through MNDNR and MPCA. Thus, we believe it is important to target these groups with our findings to ensure that the lessons learned about previous stream work are used to improve future activities.

Outcome 1. Ensure entities engaged in stream realignment, or in the permitting of those activities, are engaged in a discussion about the results of our assessment and their implications.
Outcome 2. Our results can be used to improve future stream realignment projects.

**Activity Milestones:**

| Description | Completion Date |
|---|---|
| Results presented at a state conference, such as the Water Resources Conference. | November 30, 2024 |
| Results presented to staff of entities engaged in stream realignment or restoration. | June 30, 2025 |
| Discussions with entities engaged in stream work to improve future restoration or realignment designs | June 30, 2025 |

## Project Partners and Collaborators

| Name | Organization | Role | Receiving Funds |
|---|---|---|---|
| Dr. Doug Dieterman | Minnesota Department of Natural Resources | Dr. Dieterman has proposed a companion project in southeastern MN. He will train our project team to collect stream data comparable to his team's data. | No |
| Dr. Karl Koller | Minnesota Department of Natural Resources | Dr. Karl Koller will assist with site selection and consult with the team on stream hydrologic and hydrogeomorphic assessment methods. | No |
| Dr. Ricardo Gonzalez-Pinzon | University of New Mexico | Dr. Gonzalez-Pinzon developed a tracer test that measures surface water-groundwater exchange within a stream bed. He will travel to Minnesota to teach our team his technique and assist with data analysis and report writing. | Yes |
| Ann Thompson | South St. Louis Soil and Water Conservation District | Ann Thompson will provide geomorphic surveys of reference reaches that are paired to realigned reaches that SSL SWCD is re-surveying in 2020 to assess how well they have survived. Surveys include Rosgen Level II including longitudinal profile, cross section, and substrate data. | Yes |
| Dr. Jeff Tillma | Minnesota Department of Natural Resources | Dr. Tillma will assist with selection of realigned sites to be assessed and consult on field methods. | No |

## 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.**
Data will be shared with the MNDNR Fisheries Research Division through Dr. Doug Dieterman, a collaborator on this project who does similar work in southeastern Minnesota. Data will also be provided to MPCA and SWCD's upon request or if we become aware of agency personnel interested in our dataset. The South St. Louis SWCD is a collaborator on this project.
We will provide project results to MNDNR fisheries managers, stream managers, MPCA staff, soil and water conservation district staff, Board of Water and Soil Resources staff, and non-profit staff using webinars, outreach at state conferences (e.g., the Water Resources Conference), reports and other venues or media. We know that much of the stream realignment work is being done by soil and water conservation districts with oversight and permitting through MNDNR and MPCA. Thus, we believe it is important to target these groups with our findings to ensure that the lessons learned about previous stream work are used to improve future activities. Because this outreach is so important, we have made it one of our activities, Activity 3, with formal outcomes and milestones.

All presentations, seminars, outreach meetings, etc., will acknowledge ENTRF funding using the logos and wording provided by LCCMR staff.
Data will be preserved through the University of Minnesota's Data Repository system (DRUM), a library system designed to archive data from UM researchers and projects.

## 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 be funded?**

We will provide our data, analyses, and reports to Dr. Doug Dieterman (MNDNR) to be combined with the results from his partner project in southeastern MN. He will continue working with DNR fisheries researchers and managers to implement these results in stream project selection and permitting so that future designs selected for stream habitat improvement and restoration projects are those that are most likely to provide the best outcomes for stream fish and ecosystems. It is our hope that these results will also inform future Lessard-Sams Outdoor Heritage project funding.

## Other ENRTF Appropriations Awarded in the Last Six Years

| Name | Appropriation | Amount Awarded |
|---|---|---|
| MAISRC Subproject 15: Determining Highest Risk Vectors of Spiny WaterFlea Spread | M.L. 2017, Chp. 96, Sec. 2, Subd. 06a | $0 |

## Budget Summary

| Category / Name | Subcategory or Type | Description | Purpose | Gen. Ineligible | % Benefits | # FTE | Classified Staff? | $ Amount |
|---|---|---|---|---|---|---|---|---|
| **Personnel** | | | | | | | | |
| Crew chief Josh Dumke | | Leads fish, invertebrate and habitat sampling; assist with reporting and data analysis. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF. | | | 26.7% | 0.39 | | $33,348 |
| Principle Investigator Valerie Brady | | Overall project management and coordination; invertebrate data analysis; lead reporting and outreach. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF. | | | 26.7% | 0.15 | | $19,553 |
| Undergraduate student technician | | The undergraduate summer technician will assist with all field sampling, particularly assisting the graduate student. | | | 0% | 0.7 | | $21,309 |
| Co-investigators (Lucinda Johnson & Karen Gran) | | Lead nutrient cycling and hydrology/geology aspects of project; co-advise graduate student | | | 26.7% | 0.12 | | $23,311 |
| Graduate student | | Conduct nutrient cycling and surface water-groundwater connectivity studies | | | 43.7% | 1 | | $63,028 |
| Summer technician | | Summer technician will assist with all field sampling, especially assisting the graduate student | | | 7.3% | 0.7 | | $24,657 |
| Taxonomists (2) and technician (1) | | Fish and invertebrate identification and sampling; data entry and checking. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF. | | | 24.1% | 1.2 | | $73,514 |
| | | | | | | | **Sub Total** | **$258,720** |
| **Contracts and Services** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UMD NRRI Analytical Lab | Internal services or fees (uncommon) | Water quality analyses for multiple water chemistry parameters for up to 14 sites assessed for this project. | | | | 0.18 | | $8,791 |
| South St. Louis Soil and Water Conservation District | Sub award | Team will provide geomorphic surveys of reference reaches that are paired to realigned reaches that SSL SWCD is re-surveying in 2020 to assess how well they have survived. Surveys include Rosgen Level II including longitudinal profile, cross section, and substrate data. | | | | 0.12 | | $14,080 |
| University of New Mexico | Sub award | This collaborator developed a tracer test that can be used to measure surface water-groundwater exchange within a stream bed. He will travel to Minnesota to teach our team his technique and assist with data analysis and report writing. | | X | | 0.05 | | $9,275 |
| | | | | | | | **Sub Total** | **$32,146** |
| **Equipment, Tools, and Supplies** | | | | | | | | |
| | Tools and Supplies | Fish and invertebrate sampling and lab supplies | Batteries for electrofishing equipment; preservative, vials, and labels for 200 stream invertebrate samples. Survey equipment (meter sticks, flagging, survey tape). | | | | | $1,840 |
| | Tools and Supplies | Stream nutrient and hydrology sampling meters and field and lab supplies | Eight temperature loggers ($160), 4 dissolved oxygen loggers ($1600), 4 conductivity loggers and meters ($8,400), a logging light sensor ($3800). Test chemicals and sample bottles ($3166) | | | | | $17,126 |
| | Tools and Supplies | General field supplies | Waders and nonskid boot studs for 3 people, waterproof paper & labels, gloves, batteries for GPS units and cameras | | | | | $800 |
| | | | | | | | **Sub Total** | **$19,766** |
| **Capital Expenditures** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Acquisitions and Stewardship** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Travel In Minnesota** | | | | | | | | |
| | Miles/ Meals/ Lodging | Mileage to travel to 14 sites over three years with each site requiring several days for two field crews to sample it completely. | Travel to stream sites 128.5 miles/site x 0.575/mile x 14 sites x 7 visits/site | | | | | $7,245 |
| | Conference Registration Miles/ Meals/ Lodging | Two people attend Water Resources Conference in St. Paul. | Attend Water Resources conference to present results of project to managers. Costs include GSA approved rates for per diem, mileage, and hotel. Conference registration estimated at $240 per person. | | | | | $1,123 |
| | | | | | | | **Sub Total** | **$8,368** |
| **Travel Outside Minnesota** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Printing and Publication** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Other Expenses** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| | | | | | | | **Grand Total** | **$319,000** |

## Classified Staff or Generally Ineligible Expenses

| Category/Name | Subcategory or Type | Description | Justification Ineligible Expense or Classified Staff Request |
|---|---|---|---|
| **Contracts and Services** - University of New Mexico | Sub award | This collaborator developed a tracer test that can be used to measure surface water-groundwater exchange within a stream bed. He will travel to Minnesota to teach our team his technique and assist with data analysis and report writing. | This researcher developed this relatively new technique that we plan to use for our project. His expertise is not available in MN. He will travel to MN and train us so we can become the regional experts in this technique in MN and the Midwest/Great Lakes. |

## Non ENRTF Funds

| Category | Specific Source | Use | Status | Amount |
|---|---|---|---|---|
| **State** | | | | |
| In-Kind | MNDNR staff contributed effort. | MNDNR staff will work with us to select appropriate sites for assessment, provide in-field cross-training on sampling methods to ensure comparability of data collection between this project and the companion Dieterman MNDNR proposal, and integrate our data into their data for additional analysis. D. Dieterman ($9000) and J. Tillma ($6000) in effort match. | Pending | $15,000 |
| | | | **State Sub Total** | **$15,000** |
| **Non-State** | | | | |
| In-Kind | UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% modified total direct costs. | Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs) | Secured | $166,415 |
| | | | **Non State Sub Total** | **$166,415** |
| | | | **Funds Total** | **$181,415** |

## Attachments

### Required Attachments

*Visual Component*

File: dbfa85df-608.pdf

*Alternate Text for Visual Component*

Our graphic shows a time series of photos of a trout stream bank restoration, from pre-restoration to post-restoration to the restoration's damage after flood events. We also depict our how our study sites are selected to meet the requirements of the Before-After, Control-Impact (BACI) study design: control (reference) sites are similar stream segments often located upstream of the stream segment being restored. Both stream segments are sampled both before and after the restoration work and t...

### Optional Attachments

*Support Letter or Other*

| Title | File |
|---|---|
| Minnesota DNR Letter of Support | c84bbe77-03a.pdf |
| Sponsored Projects Transmittal Letter | 3516524d-d03.pdf |
| BradyResearchAddendum2021-050_revised | 838506cc-519.docx |
| Background check form | 081a8ea5-377.pdf |

## Difference between Proposal and Work Plan

*Describe changes from Proposal to Work Plan Stage*

We achieved our required 15% budget reduction ($56,000) and response to reviewer comments for statistical rigor by reducing the number of stream reach (site) pairs that we will sample from 10 to 5-7, including dropping one intensive-sampling reach pair (from 5 to 4 reaches).

This reduction in sampling effort allowed us to decrease our fieldwork travel, supplies, and water chemistry analyses. We reduced personnel costs by a small amount for most people, but achieved the largest part of the budget reduction by dropping 9 months of the graduate student salary from the budget. We will instead seek a teaching assistantship for the graduate student for two semesters instead of the student being paid for the whole two years on this project. Finally, Dr. Dieterman has offered to travel to Duluth to collaborate with our crew instead of us traveling to southeastern Minnesota to his location. He will pay for this travel as part of his collaboration with this project.

We added to the narrative the clarification that we will assess how the permitting process may have influenced the type or way that studied restorations were done.

## Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

**Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?**

N/A

**Do you agree travel expenses must 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 agree to the UMN Policy.

**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

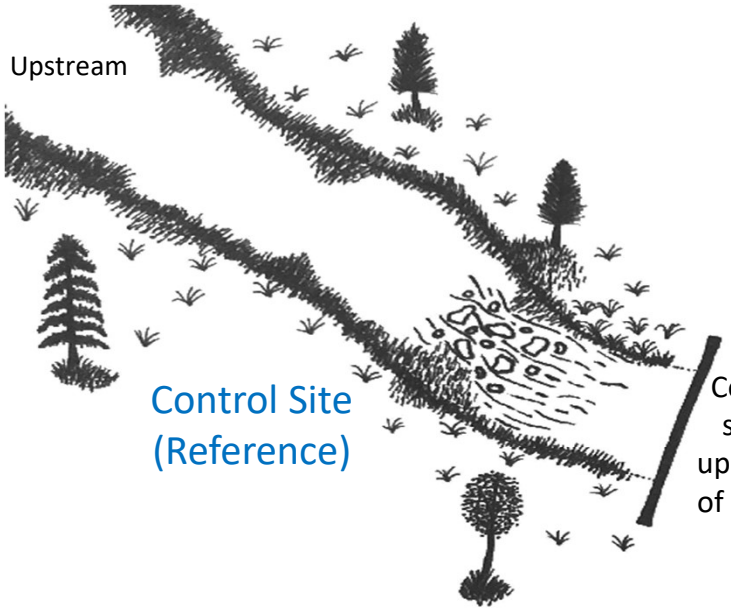
**Does the organization have a fiscal agent for this project?**

Yes,  Sponsored Projects Administration

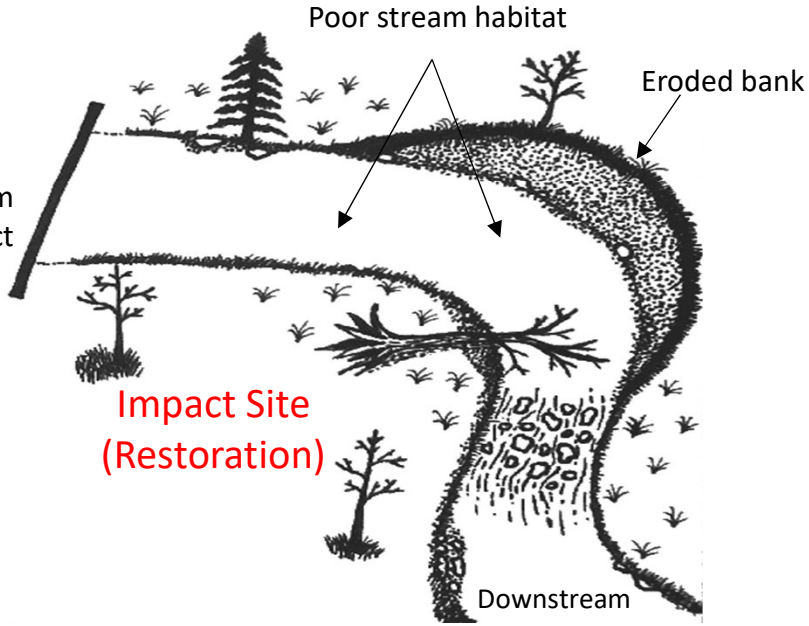
Northern Minnesota stream bank **before** restoration

Same stream bank **after** restoration

Same restored stream bank after flood damage




Control site is upstream of Impact site




## Gold Standard Study Design: Before-After, Control-Impact (BACI)

Data from before AND after restoration are compared for both reference and restoration sites

Photo Credit: NRRI
Artist Credit: Kari Hansen, NRRI