III. Completed Research Projects

"a summary of any research project completed in the preceding biennium;"

This section includes summaries of all projects completed, including research projects.

- The following documents are summaries of accomplishments for each appropriation year and short abstracts for all projects completed since the previous biennial report of January 15, 2013.
- The abstracts describe the general accomplishments of each project for completed projects. See http://www.lccmr.leg.mn.
- Research projects have been marked as such in the description.
- Full final reports are available at the LCCMR, Room 65 - State Office Building. The abstracts are current as of 12/31/2014.
- 95 Projects were completed for a total of $59,562,000.
- Legal Citations
  1. M.L. 2013, Chapter 52, Section 2
  2. M.L. 2011, First Special Session, Chapter 2, Article 3, Section 2
  3. M.L. 2010, Chapter 362, Section 2
  4. M.L. 2009, Chapter 143, Section 2
  5. M.L. 2008, Chapter 367, Section 2
- Spreadsheet of all research projects completed between January 1, 2013 and December 31, 2014.

1. **M.L. 2013 Projects Completed**
   January 15, 2013 – January 15, 2015

   MN Laws 2013, Chapter 52, Section 2

M.L. 2013 Projects Completed in 2013-2014

M.L. 2013 Projects
MN Laws 2013, Chapter 52, Section 2 (beginning July 1, 2013)

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

When available, we have provided links to web sites related to the project. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 04 Land, Habitat, Restoration, and Recreation

04e Landscape Arboretum Acquisition Lake Tamarack

Landscape Arboretum Acquisition Lake Tamarack
Subd. 04e $2,000,000 TF

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Appropriation Language
$2,000,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to acquire land surrounding Lake Tamarack in Carver County as part of the acquisition of approximately 80 acres. This appropriation is available until June 30, 2016, by which time the project must be completed and final products delivered.

Project Overview
The University of Minnesota's Landscape Arboretum is the largest and most diverse horticultural site in Minnesota. It features gardens and natural areas representative of Minnesota and the upper-Midwest that can be explored using several miles of trails. Additionally it conducts fruit and plant breeding research to develop cultivars that have particular desired characteristics, such as cold hardiness or disease resistance. The arboretum has a long-term goal of protecting the entire watershed of which it is a part. This appropriation is being used by the arboretum to acquire approximately 80 acres of land surrounding Lake Tamarack in Carver County, which will protect a variety of habitat types and 1,300 feet of shoreline in an area threatened by development. This new portion of the arboretum will have free public access and provide additional land for future research that may pertain to restoration ecology, crop production, bio-energy, or wildlife habitat.

OVERALL PROJECT OUTCOME AND RESULTS
The University of Minnesota Landscape Arboretum purchased the property at 400 Arboretum Boulevard, Victoria, (previously known as the Kerber Farm or Lano Burau Property), effective Friday, November 1, 2013. The property consists of 78.13 acres in Carver County. This is the final property purchase identified in the Arboretum's 1995 Boundaries Plan. Over 300 acres have been added to the

Arboretum during the last 18 years.

The property is north of State Highway 5 and directly adjacent to the Horticultural Research Center. The property contains native forest, wetlands, tillable land, and 1,300 feet of lakeshore on Lake Tamarack. Current structures on the property will be evaluated for condition and safety and some will likely be retained for unheated storage while others may be demolished.

The property will be used in the future for research; protection of wildlife, wetlands and water quality; protection of big woods, oak savanna and upland meadow; and educational and public low impact recreational purposes. Research uses have not been determined and roads, fencing, and irrigation will be installed in the 10 acre area designated for research. Some of the current soybean fields could also be used for alternative crop, forage crop, or restoration research projects, and the Arboretum is considering partners from across the University of Minnesota or other conservation and natural resources groups.

Funding for this purchase was provided by the Environment and Natural Resources Trust Fund (ENRTF) - recommended by the Legislative Citizens Commission for Minnesota Resources (LCCMR), the Lessard Sams Outdoor Heritage Council (LSOHC) and the Minnesota Landscape Arboretum Foundation. Because we received LCCMR and LSOHC funding to purchase the property, the Arboretum will provide FREE public access. The University of Minnesota is charging the City of Victoria $1 for the 50 year Use License Agreement for the Trail that crosses the Lake Tamarack Property and $1 for the Use License Agreement for Temporary Construction Access for this trail. There are no fees beyond the $2 for the entire trail including the sections that do not cross the Lake Tamarack Property. Finally, the Arboretum will work over the next several months to develop public access policies and install signage.

PROJECT RESULTS USE AND DISSEMINATION

The acquisition was successfully publicized by the Arboretum with a press release issued on November 11, 2013 and was also covered in the Arboretum E-News with 10,000 subscribers. It was then covered in the local media:

- U to expand arboretum with 78-acre purchase, Minnesota Daily, January 28, 2013
- U Arboretum expands base in Chanhassen by 78 acres, Star Tribune, November 12, 2013
- Minnesota Landscape Arboretum grows by 78 acres, Finance & Commerce, November 13, 2013
- Minnesota Landscape Arboretum Grows By 78 Acres, WCCO-CBS News Online, November 13, 2013

Project completed: 6/30/2014

2. M.L. 2011 Projects Completed
January 15, 2013 – January 15, 2015

MN Laws 2011, First Special Session, Chapter 2, Article 3, Section 2

M.L. 2011 Projects Completed in 2013-2014

M.L. 2011-12 Projects
MN Laws 2011, 1st Special Session, Chapter 2, Article 3, Section 2 (beginning July 1, 2011)

NOTE: Below are shore abstracts for projects funding during the 2011 Legislative Session and ending during 2013-2014. The final date of completion for these projects is listed at the end of the abstract. Final Reports for all completed projects are available at http://www.lccmr.leg.mn/projects/2011-index.html or by contacting the LCCMR office.

Subd. 03 Natural Resource Data and Information

03a Minnesota County Biological Survey
03c Completion of Statewide Digital Soil Survey
03e Golden Eagle Survey
03g Prairie Management for Wildlife and Bioenergy - Phase II - RESEARCH
03h Evaluation of Biomass Harvesting Impacts on Minnesota's Forests - RESEARCH
03i Change and Resilience in Boreal Forests in Northern Minnesota - RESEARCH
03k Strengthening Natural Resource Management with LiDAR Training
03l Measuring Conservation Practice Outcomes
03m Conservation-Based Approach for Assessing Public Drainage Benefits
03n Mississippi River Central Minnesota Conservation Planning
03o Saint Croix Basin Conservation Planning and Protection
03p Species of Concern; Investigations

Subd. 04 Land, Habitat, and Recreation

04a State Park and Recreation Area Operations and Improvements
04c Metropolitan Regional Park System Acquisition
04e Scientific and Natural Areas Acquisition and Restoration
04f LaSalle Lake State Recreation Area Acquisition
04h Native Prairie Stewardship and Native Prairie Bank Acquisition
04i Metropolitan Conservation Corridors (MeCC) - Phase VI
04j Habitat Conservation Partnership (HCP) - Phase VII
04k Natural and Scenic Area Acquisition Grants
04l Acceleration of Minnesota Conservation Assistance
04m Conservation Easement Stewardship and Enforcement Program - Phase II
04n Recovery of At-Risk Native Prairie Species
04o Understanding Threats, Genetic Diversity, and Conservation Options for Wild Rice - RESEARCH
04r Northeast Minnesota White Cedar Plant Community Restoration
04s Land and Water Conservation Account (LAWCON) Federal Reimbursement

Subd. 05 Water Resources

05a Itasca County Sensitive Lakeshore Identification
05b Trout Stream Springshed Mapping in Southeast Minnesota - Phase III
05c Mississippi River Water Quality Assessment - RESEARCH
05d Zumbro River Watershed Restoration Prioritization
05e Assessment of Minnesota River Antibiotic Concentrations - RESEARCH

Subd. 06 Aquatic and Terrestrial Invasive Species

06b Emerald Ash Borer Biocontrol Research and Implementation - RESEARCH

Subd. 07 Renewable Energy and Air Quality

07 Supporting Community-Driven Sustainable Bioenergy Projects

Subd. 08 Environmental Education

08a Youth-Led Renewable Energy and Energy Conservation in West and Southwest Minnesota

08c Experiential Environmental Education for Urban Youth

Subd. 09 Emerging Issues

09b Chronic Wasting Disease and Animal Health

09c Aquatic Invasive Species

09d Reinvest in Minnesota Wetlands Reserve Acquisition and Restoration Program Partnership

Subd. 10 Administration and Contract Management

10a Legislative-Citizen Commission on Minnesota Resources (LCCMR)

10b Contract Administration

10c LCC Web Site

Subd. 03 Natural Resource Data and Information

Minnesota County Biological Survey

Subd. 03a $2,250,000 TF

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Appropriation Language

$1,125,000 the first year and $1,125,000 the second year are from the trust fund to the commissioner of natural resources for continuation of the Minnesota county biological survey to provide a foundation for conserving biological diversity by systematically collecting, interpreting, and delivering data on plant and animal distribution and ecology, native plant communities, and functional landscapes.

PROJECT OVERVIEW

The Minnesota County Biological Survey (MCBS) is an ongoing effort begun in 1987 by the Minnesota Department of Natural Resources (DNR) that is systematically surveying, county-by-county, the state's natural habitats. The effort identifies significant natural areas and collects and interprets data on the status, distribution, and ecology of plants, animals, and native plant communities throughout the state. Through July 2011, surveys have been completed in 81 of Minnesota's 87 counties and have added nearly 17,000 new records of rare features to the DNR's information systems. MCBS data is used by all levels of government in natural resource planning and use decisions, including prioritization of protection of park lands and scientific and natural areas. This appropriation will permit continuation of the survey in Lake, St. Louis, Clearwater, and Beltrami counties and begin initial surveying in Koochiching and Lake of the Woods counties. Additionally one book will be published: a natural history guidebook of

the Aspen Parkland-Red River Valley region of MN.

OVERALL PROJECT OUTCOME AND RESULTS
The need to protect and manage functional ecological systems, including ecological processes and component organisms continues to accelerate with increased demands for water and energy, continued habitat fragmentation, loss of species and genetic diversity, invasive species expansion, and changing environmental conditions.

Since 1987 the Minnesota County Biological Survey (MCBS) has systematically collected, interpreted and delivered baseline data on the distribution and ecology of plants, animals, native plant communities, and functional landscapes. These data help prioritize actions to conserve and manage Minnesota's ecological systems and critical components of biological diversity.

During this project period baseline surveys continued, focused largely in northern Minnesota (see map). One highlight was data collection in remote areas of the patterned peatlands that included three helicopter-assisted field surveys coordinated with other researchers to increase the knowledge of this ecological system and to continue long-term collaborative monitoring.

Another goal was to begin monitoring to measure the effectiveness of management and policy activities. For example, prairie vegetation and small white lady's slipper monitoring began in western Minnesota sites in response to ecological measures identified in the Minnesota Prairie Conservation Plan 2010.

MCBS also provided data and interpretation related to the DNR's forest certification goals and began monitoring activities in selected sites in the Aspen Parkland and in southeastern Minnesota.

Since July 2011 new records of 929 rare features were added to the Rare Features Database. Since 1987, MCBS has added a total of 20,018 new rare feature records. Statewide 10,192 MCBS sites of Biodiversity Significance and 63,232 polygons of native plant communities are now publically available on the DNR's Data Deli. Since 1987, MCBS has contributed 4,972 of the 9,467 Minnesota vegetation plot records in the DNR's Releve (vegetation plot) Database. Since 1987 botanists documented 1,194 rare aquatic plants during targeted aquatic plant surveys of 1,872 lakes.

PROJECT RESULTS USE AND DISSEMINATION<
Results and interpretation of data included web-delivery, technical assistance and publications that are identified in more detail in the final report.

For example, in 2013 MCBS reports of vegetation observed in 1836 lakes were added as a link in the Lakefinder application Native Orchids of Minnesota was published that included substantial new distributional information from survey botanists. Substantial progress was made on a book related to natural history sites in NW Minnesota based in part on MCBS work in that region.

Project completed: 6/30/2013

Completion of Statewide Digital Soil Survey
Subd. 03c $500,000 TF

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Appropriation Language
$250,000 the first year and $250,000 the second year are from the trust fund to the Board of Water and Soil Resources to accelerate the completion of county soil survey mapping and Web-based data delivery. The soil surveys must be done on a cost-share basis with local and federal funds.

PROJECT OVERVIEW
The Minnesota Soil Survey is an ongoing effort by the Board of Water and Soil Resources (BWSR) in cooperation with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) that is systematically collecting and mapping data pertaining to soil types and other soil properties in each county of the state. To date, surveys for nearly all counties in the state have been completed. Soils data is used by governments, farmers, and other businesses for a number of purposes from protection and restoration of soil, water, wetlands, and habitats to agricultural productivity and soil management to building construction. This appropriation will complete the mapping and digitization of soil surveys for Crow Wing, Koochiching, Lake, Cook, and Saint Louis counties.

OVERALL PROJECT OUTCOME AND RESULTS
This project, Completion of Statewide Digital Soil Survey, is the last in a series of projects to map and digitize all Minnesota soils. The Environment and Natural Resources Trust Fund (ENRTF) has supported the completion of a statewide soil survey since 1997. ENRTF's contribution of $3.5 million over 17 years leveraged $13.2 million from project partners including cooperating counties, the Natural Resource Conservation Service (NRCS), and the University of Minnesota.

Soil surveys contain information essential to the management of natural resources. Soil surveys provide a field-based scientific inventory of soil resources, including soil maps, data about the physical and chemical properties of soils, and information on the potentials and limitations of each soil. Farmers, landowners, builders, county assessors, and natural resource managers depend on soil survey information to conduct business and protect natural resources. This project extended soil maps and data to millions of acres previously lacking comprehensive soil surveys.

It is ideal to have 'seamless' soil data coverage regardless of land ownership (county, state, federal, or private). However, gaps exist in soil survey coverage due to these land ownership issues. This project focused on addressing portions of Minnesota with missing digital soils information; e.g., the Boundary Waters Canoe Area Wilderness, the Superior National Forest, and Crow Wing County. At the end of the final mapping phase (NRCS contributions extend to 2016) Pine County and the Grand Portage Reservation will be the only unmapped areas in Minnesota. NRCS intends to map Pine County in the future, funded entirely by the NRCS.

The mapping goal for the ENTRF funds was 400,000 acres. NRCS mapped over 2 million acres using ENTRF dollars and Federal funds. This included 207,546 acres in Crow Wing County; 470,000 in Lake and Cook Counties (outside Superior National Forest boundary); 793,725 acres in Lake, Cook, and St. Louis Counties (inside Superior National Forest boundary); and 600,000 in the Boundary Waters Canoe Area

Wilderness.

All the spatial and tabular data collected during this project will be available on Web Soil Survey: www.websoilsurvey.sc.egov.usda.gov.

PROJECT RESULTS USE AND DISSEMINATION<
The data collected during the soil survey field investigations is available to the public via the Web Soil Survey website: www.websoilsurvey.sc.egov.usda.gov. The Web Soil Survey is the single authoritative source of up-to-date soils information for selecting sites for development, road building, pipeline corridors, and waste disposal; for pollution control; for minimizing risks to human life and property; and for wildlife management, wetlands identification, and soil or water conservation. The data collected during this project will be posted to Web Soil Survey in January 2015.

Project completed: 6/30/2014

Golden Eagle Survey
Subd. 03e $60,000 TF

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Appropriation Language
$30,000 the first year and $30,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with the National Eagle Center to increase the understanding of golden eagles in Minnesota through surveys and education. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Not previously thought to be regular inhabitants of Minnesota, in recent years there have been reports of golden eagle sightings in most counties of the state, while recent surveys suggest there is now a regular wintering population in the blufflands of southeast Minnesota. This appropriation is being used to better understand the numbers, distribution, migration routes, and habitat needs of golden eagles in Minnesota. This information will inform natural resource management decisions and be used to educate landowners and the general public about golden eagles in the state.

OVERALL PROJECT OUTCOME AND RESULTS
The Golden Eagle Survey Project represents groundbreaking research on a bird that was previously not thought to be a regular inhabitant of Minnesota. Through field observations and telemetry, the Golden Eagle Survey Project is expanding the understanding of population, distribution, habitats, habitat use, migration routes, breeding areas, and management needs of the population of golden eagles that winter in Minnesota.

Annual surveys coordinated by the Golden Eagle Survey Project have documented a regular migratory population using the bluffland subsection of the Paleozoic Plateau in southeast Minnesota in winter. During annual winter surveys in 2012-2014, an average of 36 golden eagles have been observed in Minnesota's blufflands.

Using satellite telemetry to track golden eagles, the Project is expanding the world's knowledge of the range, location of breeding territories, and migration routes of this previously unstudied population. One golden eagle, #46, was released in January 2011 with a GPS satellite-linked transmitter. The Project tracked #46 for more than 950 days, from his release in Wabasha County and his migrations to Nunavut, Canada and back to wintering range in southeast Minnesota. Data collected on golden eagle habitat use, preferred prey, and range will be used to ensure appropriate management and conservation action to protect critical wintering habitat for golden eagles in Minnesota.

Thousands of people have learned about the presence of golden eagles in Minnesota through the Golden Eagle Survey Project's outreach to landowners, wildlife managers and the general public. In programs at the National Eagle Center and throughout the state, the Golden Eagle Project increased awareness and understanding of golden eagles as regular winter inhabitants of the blufflands region. The Project's outreach to conservation professionals and the general public continues to broaden awareness of this unique species in Minnesota.

PROJECT RESULTS USE AND DISSEMINATION<
Golden Eagle Survey Project data are publicly available on the National Eagle Center's website. Since January, 2012, the National Eagle Center's website has seen nearly 30,000 unique visits to the Golden Eagle Survey Project information pages. Here visitors learn about the presence of golden eagles in Minnesota, view data and project maps, and learn how they can get involved in efforts to understand and conserve golden eagles in Minnesota. In addition, updates on golden eagle tracking are posted on social media outlets, reaching an audience of more than 10,000 followers.

Detailed data from field observations, Annual Wintering Golden Eagle Surveys, and telemetry are made available to researchers and others upon request. Thus far, we have shared this data with at least one utility seeking information on golden eagle migration and habitat use in siting transmission lines.

The Golden Eagle Survey Project has been regularly featured in regional news media throughout the Project's duration. An attached list highlights some of the regional news stories about the Golden Eagle Survey Project. Links to the story are provided where available. In 2013, the Golden Eagle Project shared in the US Forest Service's Wings Across America award for work as part of the Eastern Golden Eagle Working Group. In January 2014, Minnesota DNR's monthly magazine Conservation Volunteer featured a cover story about the Golden Eagle Survey Project's work and golden eagles in Minnesota.

Project completed: 6/30/2014

Prairie Management for Wildlife and Bioenergy - Phase II
Subd. 03g $600,000 TF

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RESEARCH

Appropriation Language
$300,000 the first year and $300,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to research and evaluate methods of managing diverse working prairies for wildlife and renewable bioenergy production. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Bioenergy, a form of renewable energy derived from biological sources such as wood or grasses, is becoming an important component of the energy production mix. As the demand for bioenergy feedstocks increases in Minnesota and elsewhere, land use changes could impact wildlife. However, with proper management strategies it is possible that bioenergy production could actually improve conditions for wildlife rather than make them worse. This appropriation is allowing scientists at the University of Minnesota to continue developing best management practices for working prairies that maximize biomass harvesting while also promoting wildlife conservation and associated habitat diversity. This project is part of a broad effort at the University aimed at figuring out how to sustain Minnesota resources while improving the rural economy and developing energy independence.

OVERALL PROJECT OUTCOME AND RESULTS
Many wildlife areas and conservation lands were formerly marginal agricultural fields that have been converted into rich habitats of grasses and flowering plants. That habitat traditionally required maintenance by prescribed burning. However, mowing can be more feasible and can provide future commodity incentives through a carbon-negative energy source.

Our prevailing question was how grassland areas could be harvested annually without upsetting their ability to support wildlife. We organized over 1,000 acres into 60 production-size, 20-acre plots spanning the temperature gradient in western Minnesota. The plots were harvested in prescribed intensities and patterns each fall from 2009-2012 after plants had senesced and migratory wildlife left. Each year, surveys of songbirds, gamebirds, small mammals, reptiles, amphibians, insects, and plants were conducted and bioenergy potential calculated.

Our results showed that bioenergy can be harvested sustainably without harming resident wildlife by following simple protocols developed during the project. Specifically, leaving unharvested refuges of 5-10 acres rotated annually in a 20-acre plot minimized significant impact on wildlife, and we recommend such refuges as best practices. Harvesting without any refuge negatively affected some wildlife, specifically prairie and meadow voles, a shrew, sedge wren, common yellow throat, clay-colored sparrow, swamp sparrow, waterfowl nesting, and potentially native bees. Deer mice, grasshopper sparrows, common grackles, spiders, flies and beetles increased with harvest. Plant cover and biomass did not change significantly during our harvesting tests. We cut and analyzed over 3,000 tons of biomass with yields ranging from 0.6-1.8 tons/acre and projected ethanol yields averaging 108-gallons/ton. Recommendations for best harvesting equipment are low weight-to-tire-width ratio, easily repaired, and readily cleaned between fields.

The broad consensus among wildlife experts is that diverse ecosystems offer habitat that is superior for a spectrum of wildlife, The overall significance of this project is that it identified and tested better methods for maintaining such habitat on public and private grasslands of Minnesota.

PROJECT RESULTS USE AND DISSEMINATION<
During this six-year project the Environmental Trust Fund and other substantial federal and local funds have resulted in two graduate theses, 26 publications, posters and presentations, five outreach events and newspaper articles, nine symposia, a website, a publically available dataset carrying the raw data and metadata supporting our conclusions, and a draft Best-Management-Practices document.

That draft document has been formatted professionally for publication, with release scheduled this calendar year. Some managers in the Minnesota DNR have begun using harvesting as a grassland management tool on Wildlife Management Areas and through Cooperative Farm Agreements, and we expect that this can expand and become routine as project results, including the Best-Management-Practices document, are published and disseminated broadly.

Dissemination will be ongoing for some time, with new scientific papers in preparation and continuing presentations at conferences.

Project Publications:

- Best Management of Minnesota Native Grasslands for Wildlife and Ecosystem Services (PDF - 3.1 MB)
- Energy Potential of Biomass from Conservation Grasslands in Minnesota, USA (PDF - 0.7 MB)
- The Centinel Data Format: Reliably Communicating through Time and Place (PDF - 1.0 MB)
- Using the Centinel Data Format to Decouple Data Creation from Data Processing in Scientific Programs (PDF - 1.2 MB)
- Bioenergy from Reserve Prairies in Minnesota: Measuring Harvest and Monitoring Wildlife (PDF - 0.7 MB)
- Short-term harvesting of biomass from conservation grasslands maintains plant diversity (PDF - 0.3 MB)
- Bioenergy and Wildlife: Threats and Opportunities for Grassland Conservation (PDF - 0.5 MB)
- Managing Conservation Grasslands for Bioenergy and Wildlife (PDF - 6 MB)

Project completed: 6/30/2014

Evaluation of Biomass Harvesting Impacts on Minnesota's Forests
Subd. 03h $350,000 TF

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RESEARCH

Appropriation Language
$175,000 the first year and $175,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to assess the impacts biomass harvests for energy have on soil nutrients, native forest vegetation, invasive species spread, and long-term tree productivity within Minnesota's forests. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Minnesota's forests are currently being viewed as potential feedstocks for the production of renewable energy. A primary concern about harvesting forest biomass to generate renewable energy is the long-term impacts these harvests will have on soil nutrients and long-term ecosystem production, such as forest growth, carbon storage, and wildlife habitat. With this appropriation, scientists at the University of Minnesota's Department of Forest Resources are evaluating the ecological impacts of forest biomass harvesting in northern Minnesota. Results from this effort will be used by the energy industry and forestry professionals in both the public and private sector to guide long-term management that maximizes harvesting without negatively impacting forest productivity and ecological integrity.

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota's forests are currently being viewed as potential feedstocks for production of renewable energy. A primary concern about harvesting forest biomass to generate renewable energy is the long-term impacts these harvests will have on soil nutrients and long-term ecosystem productivity, particularly in forests growing on nutrient poor soils. This project was designed to increase our understanding of the ecological impacts of biomass harvesting through establishment of a network of research sites in forests on nutrient poor soils. Treatments representing various levels of biomass removal and live-tree retention were implemented at four large-scale (80 acre) research sites in Becker, Hubbard, and Wadena Counties and were used to evaluate the importance of post-harvest slash and live-tree retention in maintaining the resilience and sustainability of jack pine forests under different biomass harvesting regimes. Treatments included current site-level guidelines for slash retention to allow for evaluations of the effectiveness of this practice at reducing impacts on long-term soil nutrients and forest vegetation. Field measurements from these sites were used to model the long-term effects of repeated biomass removals on ecosystem productivity. Results from this project indicate that there is no difference in post-harvest slash levels between areas in which slash was retained to meet current site-level guidelines and in places in which whole trees were harvested (i.e., no slash deliberately retained). The overall levels of slash retention in these areas were half those found after similar treatments in aspen-dominated forests on nutrient rich sites, highlighting the potential for greater nutrient depletion following biomass harvesting on nutrient poor sites and suggest a need for refinement of site-level guidelines to increase retention levels for nutrient poor soils. Long-term field data and model results indicate that biomass harvests that retain less than 40% of available residues may result in lower soil carbon stocks after several harvest rotations.

PROJECT RESULTS USE AND DISSEMINATION<
The results of this project have been shared on numerous occasions with resource professionals, policy makers, citizens, and scientists over the past three years in efforts to inform forest conservation decisions regarding biomass harvesting impacts. These dissemination activities have included the development of a fact sheet for LCCMR members that was distributed on the LCCMR tour of Itasca State Park on July 18, 2013. In addition, an overview of the project and results were shared with private forest landowners through a University of Minnesota Extension Webinar to private forest landowners and

county, state, and federal natural resource managers on December 9, 2013, as well as through a meeting of the Forest Operations and Planning Section of the Minnesota DNR Division of Forestry on January 8, 2014. Results were also presented at the Annual Meeting of the Ecological Society of America in Minneapolis, MN on August 5, 2013. Finally, results regarding the impact of different levels of post-harvest slash retention on soil nutrients have been discussed with members of the Minnesota Forest Resources Council and are being used to inform future guideline revisions. Publications resulting from this work are available for download from the Department of Forest Resources web site (www.forestry.umn.edu). Additional publications from this work that are currently in development will also be posted on this site and shared with LCCMR staff for dissemination.

Project Publications:

- Fifteen-Year Patterns of Soil Carbon and Nitrogen Following Biomass Harvesting (PDF - 0.8 MB)
- Harvest residue removal and soil compaction impact forest productivity and recovery: Potential implications for bioenergy harvests (PDF - 1 MB)

Project completed: 6/30/2014

Change and Resilience in Boreal Forests in Northern Minnesota
Subd. 03i $150,000 TF

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RESEARCH

Appropriation Language
$75,000 the first year and $75,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to assess the potential response of northern Minnesota's boreal forests to observed and predicted changes in climate conditions and develop related management guidelines and adaptation strategies. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Boreal forests of spruce, fir, paper birch, aspen, and jack pine cover more than two million acres of northern Minnesota, including the Boundary Waters Canoe Area Wilderness. These forests are near the southern edge of their geographic range. With a warmer climate the health and productivity of these forests may be jeopardized by increased stresses such as heat, drought, fires, storms, and insect pests resulting in a much different forest ecosystem for northern Minnesota in the future. Scientists at the University of Minnesota's Department of Forest Resources are using this appropriation to evaluate how these forests are poised to respond to these changes and obtain the necessary data to guide forest management and planning efforts, such as determining practices that will help fend off threats from invasive species.

OVERALL PROJECT OUTCOME AND RESULTS

This project addressed the stewardship of forests in Minnesota's most renowned and iconic natural area - the Boundary Waters Canoe Area Wilderness (BWCAW) - under a changing climate. Forests of the BWCAW are at the very southern edge of the boreal forest biome (cold adapted forests of spruce, fir, pine, birch and aspen), with temperate forest species (primarily red maple) from the south, as well as exotic invasive species poised to invade in a warming climate. The purpose of the study was to map these species and temperatures across the BWCAW to gain insight into change that may occur in the BWCAW as the climate warms. For this purpose, PhD student David Chaffin placed 106 temperature sensors across the landscape, which measured temperature hourly for two years, accompanied by 106 plots on which all tree species abundances were measured. Also, 100 transects totaling nearly 16 miles in length were placed across the landscape to sample for the presence of temperate tree species and invasive species. Results show that European earthworms are a common invasive group of species; about 70%, and 33% of the forests within the BWCAW are at minimal and high stages of invasion, respectively. Earthworm invasion is related to distances from campsites, portage trails and motorized lakes, but not to temperature. Summer (June, July and August) daily maximum temperatures show a west (warm) to east (cool) gradient of about 12-13 degrees F across the BWCAW. Red maple abundance was positively related to summer temperature, being highest in the west. The main synthesis from all of the data collected during the project is that boreal conifers like black spruce, balsam fir, and jack pine may find a cool-temperature refuge and persist in the eastern BWCAW, even in a very warm future climate, but would be co-dominant with expanding red maple populations. Earthworms will continue to expand and facilitate these changes in tree species composition.

PROJECT RESULTS USE AND DISSEMINATION<

The project was highlighted in presentations by project manager Frelich several prominent venues:

1. Minnesota Soil and Water Conservation Districts webinar (statewide audience of MSAWCD staff), October 2, 2013;
2. The National Extension Educators Workshop, Cloquet, MN October 29, 2013;
3. Minnesota Climate Change Adaptation Workshop, Science Museum of Minnesota November 7, 2013 (very broad audience including many land managers from throughout the state; this also resulted in coverage in the Star Tribune and Minnesota Public Radio);
4. Climate Science Workshop for Teachers, University of Minnesota St.Paul Campus, November 9, 2013;
5. discussions with state staff directors in offices of U.S. Senators Amy Klobuchar and Al Franken, December 11, 2013;
6. Citizens Climate Lobby (Training in climate impacts on northern forests for ca 120 people, Minneapolis, January 25, 2014);
7. Jackson Middle School (A science immersion school in Champlin, MN), Expert Day presentations and workshops with ca 50 students, January 29, 2014;
8. Osher Life Long Learning Institute, Coffman Union, University of Minnesota, Minneapolis, lecture to ca 40 retired faculty, February 28, 2014;
9. Minnesota Master Naturalist Annual Meeting Keynote to ca 150 people, May 16, 2014, Camp Friendship, MN; and
10. Climate change adaptation planning workshop for National Park Service staff at Voyageurs NP, July 30, 2014, also attended by U.S. Forest Service and other agency personnel.

Publication in the form of a PhD thesis (David Chaffin) and at least 3 peer-reviewed journal articles will follow within about 2 years.

Project completed: 6/30/2014

Strengthening Natural Resource Management with LiDAR Training
Subd. 03k $180,000 TF

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Appropriation Language
$90,000 the first year and $90,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to provide workshops and Web-based training and information on the use of LiDAR elevation data in planning for and managing natural resources.

PROJECT OVERVIEW
The State of Minnesota is using an optical remote sensing technology called LiDAR (Light Detection and Ranging) to procure high resolution digital elevation data for the entire state. Precision, efficacy, and cost efficiency of numerous types of natural resource management activities can be greatly enhanced by use of this data. Potential users include natural resource professionals at all levels of government and in the private sector. However, most potential users have not yet had experience using this type of data because it's a relatively new technology. Through this appropriation the University of Minnesota's Water Resources Center is developing and implementing a training program that will enable natural resource professionals throughout the state to effectively employ this data in a variety of different applications in natural resource evaluation, management, and protection.

OVERALL PROJECT OUTCOME AND RESULTS
The State of Minnesota, in 2013, completed acquisition of high resolution digital elevation data using LiDAR (Light Detection and Ranging). Full use of the data can greatly enhance natural resource management and protection, however, most natural resource managers did not have experience using this very dense data or its applications.

- The goal of the project was to enable natural resource managers with GIS skills to effectively use LiDAR data in restoring, protecting, and managing natural resources.
- The methods used were to develop six teaching modules focused on major application areas, deliver the modules as hands-on workshops in computer laboratories around the state, and then enhance the modules for web-based self-learning. An additional set of four webinars was delivered, recorded, and posted to the web to supplement the workshop modules. An on-line user Forum was established to provide answers to questions about using LiDAR data and its applications.
- The module subjects are Basics of LiDAR, Terrain Analysis, Hydrology Applications, Engineering Applications, Wetland Mapping, and Forestry Applications. The on-line materials for the modules include lectures and exercises in Powerpoint slide, text, and video formats.
- The module workshops were delivered in 34 sessions at eight locations across the state, with a total attendance of 558, (226 individuals in one or more modules).

- Post-workshop surveys enabled workshop presenters to make adjustments to the workshop materials and presentations as the workshops progressed.
- The webinars addressed the use of hydrology tools recently developed in Minnesota, hydrology applications in the Red River Basin, and LiDAR for non-technical managers and staff. Total webinar participation was 437.
- The user Forum currently has 24 topic areas and 121 posts answering questions from technicians employing LiDAR data.

Post-workshop surveys indicated that participants increased field work efficiency and area covered, performed analyses not previously possible, better targeted practices and resources, and improved visualization of projects and communication with clients.

PROJECT RESULTS USE AND DISSEMINATION<

This was a training project, so advertising for and delivering the training (Activity 2) was a large part of dissemination of the project results. Announcements soliciting participants for the 34 workshop sessions and four webinars, and announcing the user Forum and on-line resources were distributed primarily as emails through organizations and associations of the target audience.

Information about the project has been presented at the 2012 Minnesota Water Conference, , the USDA 2012 National Land Grant/Sea Grant Water Conference, the 2011 and 2012 annual conferences of the Minnesota GIS/LIS Consortium, and the 2013 national meetings of the Soil and Water Conservation Society. We expect that use of the on-line project resources will extend well beyond Minnesota since other states have not yet developed LiDAR training programs.

Project completed: 6/30/2013

Measuring Conservation Practice Outcomes
Subd. 03l $340,000 TF

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Appropriation Language

$170,000 the first year and $170,000 the second year are from the trust fund to the Board of Water and Soil Resources to improve measurement of impacts of conservation practices through refinement of existing and development of new pollution estimators and by providing local government training.

PROJECT OVERVIEW

Accounting for on the ground outcomes and measurable environmental benefits (e.g., pollution reduction) to the quality of soil, water, and habitat is an essential component of implementing conservation practices. Natural resource professionals use models and "estimators" to quantify these outcomes and benefits and guide future efforts. Over time, as conditions change and new information becomes available, estimators need to be revised or added to ensure outcomes and benefits are being

accurately quantified. This appropriation is enabling the Minnesota Board of Soil and Water Resources to revise and create new estimators where needed, field verify the revised and new estimators, and provide local governments and other conservation professionals with training on how to use the revised and new estimators.

OVERALL PROJECT OUTCOME AND RESULTS

Accounting for on the ground outcomes and measureable environmental benefits to the quality of soil, water, and habitat is an essential component of implementing conservation projects. Local Government Units (LGUs), including Counties, Soil and Water Conservation Districts, and Watershed Districts, utilize pollution reduction estimators to quantify the outcomes of conservation projects. Board of Water and Soil Resources (BWSR) currently utilizes models or 'estimators' to measure the pollution reduction benefits of installed Best Management Practices (BMPs). Estimators quantify the outcomes of conservation practices in terms of reduced soil erosion, sediment and phosphorus reduction, carbon sequestered, etc. In order to improve the accounting of conservation practices and measurement of environmental benefits, existing estimators must be revised and new estimators developed.

Through a partnership with the University of Minnesota Department of Soil, Water and Climate, four new estimators were developed: Permanent Cover Erosion Reduction model, the Septic System Improvement Estimator, the Milkhouse Waste Practices Estimator, and the Hydrologic Soil Group - Knowledge Matrix tool. These estimators fill gaps where estimators did not exist previously. The existence of these estimators allows Local Government Units and other conservation partners to better quantify the environmental outcomes of conservation implementation. Training for LGUs and other conservation partners was conducted and made available in multiple formats (in-person, webinar, instructional videos). Many LGUs have already used the new estimators and we anticipate widespread adoption in the future.

Additional results include development of a framework to model and track movement of endocrine disrupting compounds and a data quality analysis of pollution reduction reporting. Three reports resulted from the work in the project. The reports are listed and briefly summarized below.

- Modeling Soil Erosion with Caesium-137: This report explains the process of modeling landscape-scale soil erosion and provides instructions on using the model to estimate long-term average erosion rates.
- eLINK Data Quality Control Analysis: This report provides an overview of the pollution reduction estimates in eLINK and recommends actions to improve data quality and completeness.
- Endocrine Disrupting Chemical Retention Framework: This report explains the behavior of endocrine disrupting compounds in the environment and provides a framework for measuring the movement and transport of such chemicals.

PROJECT RESULTS USE AND DISSEMINATION<

The estimators are used by LGUs and conservation partners to quantify outcomes of installed Best Management Practices. The measured outcomes are collected in BWSR's eLINK database. The associated eLINK Data Quality Control Analysis report helps BWSR improve reporting of conservation project outcomes by recommending actions for improving education and outreach and developing internal mechanisms for quality control. Work completed by the University of Minnesota has gained interest amongst the broader scientific community and has been presented at international conferences. All reports, estimators and training materials developed during this project are available on the BWSR website: www.bwsr.state.mn.us.

Project Publications:

- Modeling Soil Erosion with Caesium-137 (PDF - 1 MB)
- eLINK Data Quality Control Analysis (PDF - 0.6 MB)
- Endocrine Disrupting Chemical (EDC) Retention Framework (PDF - 0.7 MB)

Project completed: 6/30/2014

Conservation-Based Approach for Assessing Public Drainage Benefits
Subd. 03m $150,000 TF

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Appropriation Language
$75,000 the first year and $75,000 the second year are from the trust fund to the Board of Water and Soil Resources to develop an alternative framework to assess drainage benefits on public systems to enhance water conservation. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Artificial drainage exists in more than 25% of Minnesota. Runoff contributions from drained lands into these drainage systems contribute pollutants and degrade downstream water quality. Public drainage systems are funded by assessing costs to the lands benefitting from the systems. The current framework upon which these assessments are determined is based on maximizing crop production and does not account for overall water resources impacts, so there is no incentive for landowners to implement conservation practices that reduce runoff contributions to the drainage systems. The Minnesota Board of Soil and Water Resources is using this appropriation to develop and test an alternative framework for funding public drainage systems that would reduce costs to landowners if they implement conservation strategies that promote infiltration and reduce runoff.

OVERALL PROJECT OUTCOME AND RESULTS
Agricultural drainage provides an essential service to farmers and producers across the Midwest. However, maintenance and improvements of the drainage system are very costly. Landowners are charged via taxation based on the amount of benefits they receive from the drainage system. Currently in Minnesota benefits are determined by professional ditch viewers. Little guidance is provided to them by the drainage code and the process is highly laborious. Benefits are currently assigned per parcel based on discrete benefit classes. Professional judgment is an inherent component of the assessment. The main focus of this project is to investigate potential methods to improve on the current practices. The project was particularly interested in exploring the usefulness of geographic and hydrologic modeling software to automate the process, to objectively identify benefits, and to incorporate conservation practices in assessments.

Instead of using the current Minnesota method of discrete benefit classes, the project proposed a new

method called the UM method based on drainage volume for each parcel. The UM method does not use professional judgment to assign benefit classes. The method does, however, require an estimate of the surface and subsurface drainage volume for each parcel.

Applying these alternative methodologies prior to manual, in field assessments will likely save time and money in the assessment process. Knowledge of the corresponding reductions in drainage depth volume and fraction of benefits per parcel can be utilized as part of the decision making process of applying conservation drainage practices within a watershed.

The product of the project was a report, *Conservation Based Approach for Assessing Public Drainage Benefits: Final Project Report*. It delineates methodologies used, obstacles overcome, and the basis for recommendations.

PROJECT RESULTS USE AND DISSEMINATION<
At present the information derived from this project will be used for decision making concerning potential future investigation into establishing of viewing practices outlined in the project report. This project was presented to the stakeholder Drainage Work Group (the instigator of the project) once to update the Work Group on its progress, and a second time to make the Work Group aware of the recommendations. No action has been taken by the Drainage Work Group in regard to the recommendations coming from this project.

Project Publication:
Conservation Based Approach for Assessing Public Drainage Benefits (PDF - 4 MB)

Project completed: 6/30/2014

Mississippi River Central Minnesota Conservation Planning
Subd. 03n $175,000 TF

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Appropriation Language
$87,000 the first year and $88,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with Stearns County Soil and Water Conservation District to develop and adopt river protection strategies in cooperation with local jurisdictions in the communities of the 26 miles of the Mississippi River between Benton and Stearns Counties. This appropriation must be matched by $175,000 of nonstate cash or qualifying in-kind funds.

PROJECT OVERVIEW
From its headwaters to the Twin Cities, the Mississippi River has benefited from coordinated management plans and community efforts to protect its water quality and shoreland habitat - except for a 26-mile stretch in central Minnesota. Starting in St. Cloud and stretching north through Stearns and

Benton counties, the stretch is governed by 11 different jurisdictions and the communities have no uniform land use controls to protect this shared resource despite population growth and development pressure threatening the health of the river. Stearns County Soil and Water Conservation District is using this appropriation to coordinate an effort between these 11 different local governments to develop and implement specific river protection policies and work with landowners along the river to implement shoreland management practices. Ultimately the effort aims to protect the water quality of the Mississippi River, reduce habitat fragmentation, and prioritize on-the-ground efforts.

OVERALL PROJECT OUTCOME AND RESULTS
From its Headwaters to the Twin Cities, the Mississippi River has benefited from coordinated management plans and community efforts to protect its water quality and shoreland habitat--except for 26-mile stretch in Central Minnesota. Starting in St. Cloud and stretching north through Stearns and Benton counties, this stretch is governed by 11 different jurisdictions (four cities, five townships and two counties). These communities presently have no uniform land use controls to protect the magnificent river they share. Significant population growth and development pressure and contributing upland pollution could significantly damage the health of the Mississippi River.

This project's goal was to restore and protect the natural resources of the Mississippi River and its tributaries, and reduce habitat fragmentation along its banks in central Minnesota. The project coordinated with local units of government to develop and implement specific river protection policies with limited success. Individual landowners were contacted to implement sound shoreland and upland management practices. Also, in conjunction with this project a portion of the Sauk watershed was selected as part of the USDA NRCS Mississippi River Basin Healthy Watersheds Initiative (MRBI) to reduce pollution entering the river and reducing downstream impacts. Over 50,000 acres had conservation practices planned or applied.

Local units of government were offered workshops and technical assistance to implement policies, such as adopting a Natural Resource Overlay District along the river. The City of Sartell was key receiver of this assistance. Also, a major Take a Day OFF (Outdoor Family Fun) event was held to increase the publics' awareness of this wonderful natural resource in their backyard. Over 1000 people attend this event annually.

The public policies and landowner practices implemented has resulted in a healthier Mississippi River today and for decades to come.

PROJECT RESULTS USE AND DISSEMINATION<
The Stearns County Soil and Water Conservation District website (www.stearnscountyswcd.net) was used to disseminate information. Other media forms included radio, newspaper, and Facebook were used to increase awareness of activities pertaining to this project.

Project completed: 6/30/2013

St. Croix Basin Conservation Planning and Protection
Subd. 03o $175,000 TF

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Appropriation Language
$60,000 the first year and $60,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with the St. Croix River Association to develop an interagency plan to identify and prioritize critical areas for project implementation to improve watershed health. This appropriation must be matched by $120,000 of nonstate cash or qualifying in-kind funds. Up to $10,000 may be retained by the Department of Natural Resources at the request of the St. Croix River Association to provide technical and mapping assistance. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Portions of the St. Croix River Basin are now on the impaired waters list and rare landscapes, plants, and animal communities are increasingly threatened by development pressures. Up until now, conservation efforts in the St. Croix Basin have often been lacking focus and coordination between jurisdictions has been inadequate. Through this appropriation, the St. Croix River Association is establishing and coordinating a partnership effort between local, state, and federal government units and non-profits to develop a joint plan that will identify and prioritize areas for conservation implementation and guide efforts over time to improve overall watershed health in the St. Croix Basin.

OVERALL PROJECT OUTCOME AND RESULTS
Portions of the St. Croix River Basin are now on the impaired waters list and rare landscapes, plant, and animal communities are threatened by development pressures. Multi-jurisdictional conservation efforts are complex and often lack focus and coordination in the St. Croix Basin. This project was a means to streamline and focus conservation efforts on areas with the most critical need within the Basin. By linking local, state and federal governmental units, citizen-led non-profits, and design & technical expertise in an effective, well-coordinated partnership, this project set water quality, habitat, and recreational priorities; identified specific management practices in priority locations; and implemented on-the-ground projects to promote land and water stewardship to enhance and protect the very special place the St. Croix River Basin is to live, recreate, and work. The St. Croix Action Team, consisting of multiple partnerships throughout the Minnesota side of the St. Croix River Basin, worked diligently throughout the life of the project to produce a strategic prioritization of resources based on water quality, habitat, and recreation. The final products include:

- Identification of priority subwatersheds for resource management objectives in the St. Croix Basin (MN side) based on multiple benefits through an integrative modeling application.
- A protocol to assist in identifying Best Management Practices (BMPs) within priority subwatersheds.
- An expansive list of 188 BMP prescriptions for Chisago, Kanabec and Washington counties for water quality protection and habitat restoration.
- A cost benefit analysis of each practice to help determine the most cost effective management options for the benefit received from the practice.
- Six BMPs on the ground located in priority areas that demonstrate the use of an effective protocol and cost benefit analysis for resource protection and management.

This project was vital to create a well-coordinated procedure that identified areas of greatest resource concern and strategic, most cost-effective measures of protecting those resources.

PROJECT RESULTS USE AND DISSEMINATION
As a part of this project, Chisago, Kanabec, and Washington counties each constructed a master list of priority conservation activities to use in their work plans, build future funding strategies, and perform outreach activities to landowners for implementation. Project information has been shared with additional Basin partners, including those across the river on the Wisconsin side, through the annual St. Croix Basin Conference, Basin Team meetings, and SCRA newsletters and website.

Project completed: 6/30/2014

Species of Concern; Investigations
Subd. 03p $500,000 TF

Part A: Minnesota Common Loons and American White Pelicans ($250,000)
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Part B: Minnesota Breeding Bird Atlas ($250,000)
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Appropriation Language
$500,000 the first year is from the trust fund to the commissioner of natural resources for investigating species of concern.

Part A: Minnesota Common Loons and American White Pelicans - PROJECT OVERVIEW
Over a three month period in 2010, approximately five million barrels of oil was spilled into the Gulf of Mexico causing extensive damage to marine and wildlife habitats and resulting in significant losses in fish and wildlife populations. A number of Minnesota's migratory bird species spend parts of their lives in the areas impacted by the spill and impacts on their populations in the state could become evident over time. Impacts could result from immediate losses of birds that were present at the time of the spill or from cumulative negative effects resulting from contamination of the food chain by petroleum chemicals and the dispersants used on the oil. The two Minnesota species that are potentially most vulnerable are the common loon and the American white pelican - some of their young would have been present in the Gulf at the time of the spill and their behavior and feeding patterns put them at greater risk of exposure to chemicals from the spill persisting in the environment. The Minnesota Department of

Natural Resources is using this appropriation to determine whether or not common loon or American white pelican populations in Minnesota have been impacted by the Gulf oil spill. Besides population declines in the two species, other impacts that could occur as a result of chemical contamination in the food chain include changes in behavior, migratory abilities, reproductive success, or longevity. If a link is documented Minnesota may be eligible for remediation funds from the Federal Natural Resource Damage Assessment (NRDA) process currently underway, and those funds could be used to help restore the populations of these two species.

OVERALL PROJECT OUTCOME AND RESULTS - PART A: Minnesota Common Loons and American White Pelicans

Concerns about impacts of the 2010 Deepwater Horizon oil spill on Minnesota loons and white pelicans led to the need for an assessment of the extent to which pelicans and loons were exposed to impacts by PAH (polycyclic aromatic hydrocarbons) petroleum contaminants, which are carcinogenic, mutagenic, and teratogenic, and DOSS (dioctyl sodium sulfosuccinate) contaminants that cause respiratory, nervous system, liver, kidney, and blood disorders, cancer, and hormone disruption.

A statewide pelican count in 2012 showed an increase of 16-19% since 2010 to a level of 22,000 nesting pairs. Pelican egg and bill knob analysis revealed that 58 of 99 pelican eggs had PAH. For bill knobs, 29 of 37 had PAH. DOSS was found in 27 of 48 eggs in 2011 but no DOSS was found in 2012. Fourteen of 37 bill knobs had DOSS. In Phase 2 of this project, pelican eggs will continue to be tested, and a statewide pelican survey in 2015 will include population trend analysis and determination of the ratio of young birds to adults as an indicator of reproductive success.

Loon research included satellite telemetry on 13 loons and geolocator research on 42 loons. This work revealed migration phenology and routes, wintering sites, diving behavior, and on the extent to which PAH and DOSS have been accumulated by loons.

Loon eggs (6 of 27), fat (5 of 29), blood (20 of 52), and feathers (5 of 35) had PAH present. PAH and DOSS contaminants picked up in the Gulf of Mexico could cause long-term sublethal effects. Phase 2 of this project will involve assessment of egg hatchability and chick survival. This information will be used to develop a federal NRDAR court case to recover damages to Minnesota loons from the Deepwater Horizon oil spill. LCCMR-funded research (phase 2 and 3) will continue through 2017.

PROJECT RESULTS USE AND DISSEMINATION - PART A: Minnesota Common Loons and American White Pelicans

In summer of 2012 Ron Schara's photography team covered the capture and banding with geolocators the loons on Lake George in Anoka County. That story was featured on Minnesota Bound on September 1 and 7, 2013 on KARE-TV.

An article was published in the 2013 January-February issue of the Minnesota Conservation Volunteer magazine. Editor Kathleen Weflen devoted two pages of introduction to this study and reflecting concerns for protecting Minnesota's loons and water quality. The 12-page article "Flying with the Loons" by Adele Porter covered the work by Kevin Kenow and his staff from the US Geological Survey as they have studied Minnesota's loons over the past two years, and cited credits to the Environment and Natural Resources Trust Fund for financial support of this work.

Outdoor reporter Dennis Anderson accompanied the loon capture crew on July 16 and wrote an article in the Star Tribune on July 21, 2013, about this loon research project.

We have received recent requests from the media for updates on this study, but we have been deferring response until we have a more comprehensive analysis of the project results. We are also reluctant to release too much information at this point because BP has hired a person from Maine to find out what we are doing in regard to the loon study. Subsequently, their lawyers may try to use that information to minimize concerns or effects on Minnesota loons and pelicans related to the future NRDAR settlement from BP to the State of Minnesota for damages to the state's loon and pelican population due to the Deepwater Horizon oil spill.

Part B: Minnesota Breeding Bird Atlas - PROJECT OVERVIEW

A state Breeding Bird Atlas is a comprehensive systematic field survey of the occurrence, distribution, diversity, and breeding status of bird species within the state. Atlases are used to set conservation priorities, develop conservation plans, and guide habitat protection and restoration efforts. Minnesota is one of only seven states in the country that has yet to complete a Breeding Bird Atlas. Audubon Minnesota will use this appropriation to complete the Minnesota Breeding Bird Atlas and create related publications, including a book and online atlas with distribution maps, breeding status, and historical species information.

OVERALL PROJECT OUTCOME AND RESULTS - PART B: Breeding Bird Atlass

The Minnesota Breeding Bird Atlas project represents the most detailed, comprehensive assessment of the breeding distribution of Minnesota's birds ever undertaken. It is a multi-partner project which included: Audubon Minnesota, MN DNR, U.S. Fish and Wildlife Service, Minnesota Ornithologists' Union, individuals from the University of Minnesota, and many others. Representatives from these organizations made up a Steering Committee which helped oversee and advise the project. All field data collection was completed in August 2013 with incidental reports from volunteers coming into the database through September. The project recorded 372,172 bird sightings during the 5-years from 2009 - 2013 all of which are in our database. These sightings report 250 species, 232 of which we consider confirmed breeders. Data was collected from each of the 2,339 priority blocks which represent every Township in Minnesota. Additional point count data was collected from 99.5% of the Townships in Minnesota. Following the completion of our field data collection we reviewed, and reformatted 24 external datasets representing 20,000 records which were added to the database. An extensive quality control program was applied to the data involving species experts, regional reviewers from around the state and a verification committee. The number of registered volunteers in the project totaled 1,144 and they reported driving over 100,000 miles and spending 33,000 hours of contributed effort, which is an underestimate of their contribution since our data relies on self-reporting and we know many volunteers did not report this information. Our website, mnbba.org, which allowed volunteers to report their findings, provide county and species maps and a searchable database continues to provide information to the public. Data analysis and results dissemination will occur over the next 2 - 3 years.

PROJECT RESULTS USE AND DISSEMINATION - PART B: Breeding Bird Atlas

Preliminary data has been available on the mnbba.org website since the first year of the project. This website provides general information on the project, its methodology, and purpose. Through it data on specific species can be queried and mapped. We will continue to use this url as we migrate data analysis and information to a new format over the next 2 years. We are developing plans to store the data in the Avian Knowledge Network. Publications using BBA data have included the Minnesota Conservation Volunteer and presentations at the Midwest Bird Conservation and Monitoring Network meetings, the Minnesota Chapter of the Wildlife Society, and the Minnesota Ornithologists' Union meetings.

Project completed: 6/30/2014

Subd. 04 Land, Habitat, and Recreation

State Park and Recreation Area Operations and Improvements
Subd. 04a $3,627,000 TF

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Appropriation Language
$1,877,000 the first year and $1,750,000 the second year are from the trust fund to the commissioner of natural resources for state park and recreation area operations and improvements, including activities directly related to and necessary for this appropriation. This appropriation is not subject to Minnesota Statutes, sections 116P.05, subdivision 2, paragraph (b), and 116P.09, subdivision 4.

PROJECT OVERVIEW
Minnesota's extensive state park and recreation area system, the second oldest in the country, is currently comprised of a total of 76 state parks and recreation areas scattered throughout the state. The state park system provides abundant recreational and educational opportunities for citizens while also preserving some of the state's most valued natural, scenic, and cultural resources. The Minnesota Department of Natural Resources is utilizing the appropriation to accelerate natural and cultural resource management in the parks through activities including invasive species control, habitat restoration and enhancement, and natural resource inventory and monitoring to ensure desired outcomes are being achieved.

Project due to be completed: 6/30/2014

Work Plan: Not required per exemption granted to DNR at their request in MN Laws 2011, 1st Special Session, Chp. 2, Art. 3, Sec. 2, Subd. 4(a).

Metropolitan Regional Park System Acquisition
Subd. 04c $2,250,000 TF

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Appropriation Language
$1,125,000 the first year and $1,125,000 the second year are from the trust fund to the Metropolitan Council for grants for the acquisition of lands within the approved park unit boundaries of the metropolitan regional park system. This appropriation may not be used for the purchase of residential structures. A list of proposed fee title and easement acquisitions must be provided as part of the required work program. This appropriation must be matched by at least 40 percent of nonstate money and must be committed by December 31, 2011, or the appropriation cancels. This appropriation is available until June 30, 2014, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

PROJECT OVERVIEW
The Twin Cities area is host to a nationally renowned system of regional parks that provides numerous outdoor recreational opportunities for the public while preserving green space for wildlife habitat and other natural resource benefits. Through an existing grant program, the Metropolitan Council is using this appropriation to partner with local metropolitan communities to partially finance the acquisition of approximately 210 acres to be added to existing metropolitan regional parks. Priority will be given to lands with shoreland, lands that provide important natural resource connections, and lands containing unique natural resources.

OVERALL PROJECT OUTCOME AND RESULTS
The $2,226,288 of the appropriation leveraged $4,074,980 of other funds to acquire 291.7 acres for the Metropolitan Regional Park System as follows:

- 18 acres of wetlands and shoreline of Rice Creek as part of 85 acres acquired for Rice Creek Chain of Lakes Park Reserve by Anoka County Parks Department.
- 2.6 acres including shoreline of Big Marine Lake for Big Marine Lake Park Reserve by Washington County Parks Department.
- 19.3 acres including shoreline of Lake Waconia for Lake Waconia Regional Park by Carver County Parks Department.
- 45.1 acres as part of a 106 acre acquisition of prairie/grassland, tamarack fen and 6 acre pond for Kingswood Special Recreation Feature by Three Rivers Park District in Hennepin County.
- 148.7 acres of hardwood forest and wetlands for Doyle-Kennefick Regional Park by Scott County Parks Department.
- 58 acres of Minnesota River floodplain and upland prairie/forest as part of a 236 acre acquisition for Blakely Bluffs Park Reserve by Scott County Parks Department.

PROJECT RESULTS USE AND DISSEMINATION<
Requests for Park Acquisition Opportunity grants are reviewed and considered by the Metropolitan Parks and Open Space Commission and Metropolitan Council. The Metropolitan Council posts these requests and staff analysis of the requests as part of agenda packets for applicable meetings on the Metropolitan Council's website: www.metrocouncil.org

Project completed: 6/30/2014

Scientific and Natural Areas Acquisition and Restoration
Subd. 04e $1,640,000 TF

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Appropriation Language
$820,000 the first year and $820,000 the second year are from the trust fund to the commissioner of natural resources to acquire lands with high-quality native plant communities and rare features to be established as scientific and natural areas as provided in Minnesota Statutes, section 86A.05, subdivision 5, restore parts of scientific and natural areas, and provide technical assistance and outreach. A list of proposed acquisitions must be provided as part of the required work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Minnesota's Scientific and Natural Areas (SNA) Program is an effort to preserve and perpetuate the state's ecological diversity and ensure that no single rare feature is lost from any region of the state. This includes landforms, fossil remains, plant and animal communities, rare and endangered species, and other unique biotic or geological features. These sites play an important role in scientific study, public education, and outdoor recreation. The Minnesota Department of Natural Resources is using this appropriation to conduct restoration activities on approximately 1,800 acres in existing SNAs, to acquire an additional 80 acres to be added to the SNA system, and to increase citizen and student knowledge and skills pertaining to ecological restoration and biodiversity conservation through engagement with SNAs.

OVERALL PROJECT OUTCOME AND RESULTS
The biologically significant 900-acre Badoura Jack Pine Forest SNA was acquired in part through appropriation. Twenty-two conservation easement baseline property reports at 11 SNAs are completed. The SNA Strategic Land Protection Plan has been completed which prioritizes places of ecological importance for protection as SNAs and by partners.

Habitat restoration and enhancement actions are increasing the quality of habitat on SNAs through achieving: restoration of about 30 acres at 4 SNAs; woody invasive species control on 610 acres at 19 SNAs, herbaceous invasive species treatment on 487 acres at 33 SNAs, and installation of invasives control bootbrush kiosks at 6 SNAs; about 36 miles of burn breaks at 21 SNAs and completion of 1,190 acres of prescribed burns at 25 SNAs; and site development work (e.g. entry and boundary signs, new gates, and site cleanup) at 35 SNAs. Conservation Corps Minnesota was involved in 51 of these projects. Substantial monitoring was completed of pollinators at 10 SNAs, of snakes at 1 SNA, and of native plant communities at 2 SNAs.

The public's and youth involvement in SNAs and their knowledge and skills about biodiversity conservation has significantly increased through the SNA Outreach Initiative started through this appropriation. About 188 SNA events were held with 2,745 participants and 124 volunteer site stewards have committed to help care for SNAs. A broad range of communications tools have engaged people in

sharing information about SNAs. Electronic communications achievements include: a new quarterly electronic newsletter with over 2600 subscribers and a significantly improved new SNA webpage. Print communications created and distributed include: a statewide map with location and directions to SNAs, a new North Shore SNA guide, 3 series of pocket cards, and site-specific factsheets.

PROJECT RESULTS USE AND DISSEMINATION
Dissemination is primarily achieved through the upgraded SNA webpage on the DNR website: http://www.mndnr.gov/snas. The SNA Strategic Land Protection Plan is also disseminated through this website: http://www.dnr.state.mn.us/eco/sna/plan.html. All volunteer events are listed at the webpage. Volunteer site stewards submit periodic reports via a generic SNA email address sna.dnr@state.mn.us created through this appropriation for a broad variety of constituent communications. Through this appropriation, the quarterly electronic Nature Notes newsletter was initiated and 8 of 10 issues were emailed through govdelivery - with over 2600 current subscribers.

A statewide color map locating all SNAs (with directions to all sites and ENRTF acknowledgement on the back) has been designed, 5000 copies printed, and nearly all copies distributed through the DNR Information Center, at DNR region and area offices and state parks, at the State Fair, and through SNA event co-sponsors - with primary emphasis on facilities/organizations that are near SNAs and are cooperating on sponsoring SNA events. A color poster-booklet on "The Ten Best Places of the North Shore: A Visitor's Guide to North Shore Scientific and Natural Areas" was printed and distributed through a combination of this appropriation and federal Coastal Zone Management funding. Each year series of new business card-size "pocket cards" each featuring 1 SNA (and incorporating a QR code through which a smart phone with camera can directly connect to the SNA web) have been printed and almost all cards for the 32 SNAs produced to date have been distributed through the State Fair, DNR Info Center, and many DNR events.

Project Publication:
Scientific and Natural Area (SNA) Strategic Land Protection Plan (PDF - 2.9 MB)

Project completed: 6/30/2014

LaSalle Lake State Recreation Area Acquisition
Subd. 04f $2,000,000 $1,000,000 [Amended in ML 2012] TF

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Appropriation Language
$1,000,000 the first year and $1,000,000 the second year are is [Amended in ML 2012] from the trust fund to the commissioner of natural resources for an agreement with The Trust for Public Land to acquire approximately 190 acres to be designated as a state recreation area as provided in Minnesota Statutes, section 86A.05, subdivision 3, on LaSalle Lake adjacent to the upper Mississippi River. If this

acquisition is not completed by July 15, 2012, then the appropriation is available to the Department of Natural Resources for other state park and recreation area acquisitions on the priority list. Up to $10,000 may be retained by the Department of Natural Resources at the request of The Trust for Public Land for transaction costs, associated professional services, and restoration needs.

PROJECT OVERVIEW

LaSalle Lake, a 211 acre lake in northwestern Hubbard County, is the second deepest lake in the state at 213 feet. It is surrounded by thousands of acres of natural areas that include rare species, high-quality forest and wetlands, coldwater stream, and portions of the Upper Mississippi River. In partnership with the Minnesota Department of Natural Resources, the Trust for Public Land is coordinating a multi-phase effort to permanently protect a total of 980 acres surrounding LaSalle Lake for the creation of LaSalle State Recreation Area, making the area available for public enjoyment for generations to come. This appropriation is being used to purchase a 190 acre portion of the total acreage that includes some of the highest quality habitat and biodiversity as identified by the Minnesota County Biological Survey.

OVERALL PROJECT OUTCOME AND RESULTS

On October 27, 2011, The Trust for Public Land acquired 721 acres on La Salle Lake in Hubbard County and immediately conveyed the property to the DNR. Funding for approximately 94 of these acres was provided by the Environment and Natural Resources Trust Fund. Combined with 269 acres previously acquired on December 22, 2010, the land now forms the new La Salle Lake State Recreation Area. Funding for the acquisition of this property was as follows:

Funding Source	**Allocated Acreage**	**Amount**
Environment and Natural Resources Trust Fund	94	$990,000
Environment and Natural Resources Trust Fund	528	$5,547,000
Parks and Trails Fund	99	$1,953,000
TOTAL (puchase price and appraised value)	**721**	**$8,490,000**

In addition to the land acquisition capital noted above, the following amounts were appropriated for DNR land acquisition costs, initial site development and restoration: Environment and Natural Resources Trust Fund $10,000; Outdoor Heritage Fund $85,000; and Parks and Trails Fund $147,000. The DNR has used these funds to conduct a number of activities on the site including restoration of areas to native species, invasive species control, trail system establishment, fencing removal, and reforestation of areas damaged by a major blowdown in 2012.

Protection of the La Salle Lake property was a high priority for multiple stakeholders. It was the number one priority for the DNR Northwest Region in 2010-2011, which had sought to protect it for over a decade. The acquisition also enjoyed strong local support including unanimous approval from the Hubbard County Board. Numerous organizations and individuals provided letters of support including: the Park Rapids Area Chamber of Commerce, the Hubbard County Coalition of Lake Associations (COLA), the Minnesota Deer Hunters Association, Trout Unlimited, and the Audubon Society.

Acquisition of the La Salle Lake property successfully seized a rare opportunity to protect a large area of habitat of regional and statewide significance that includes the entirety of Minnesota's second deepest

lake, a coldwater stream, high-quality forest and wetlands, and over a half mile of Mississippi River shoreline. The property is ranked as having Outstanding Biodiversity Significance by the Minnesota County Biological Survey (MCBS). It also provides excellent recreational opportunities for hunting, fishing, hiking, camping and wildlife observation. The acquisition furthers the goals of multiple state conservation plans and connects large parcels of land already in public ownership preventing forest fragmentation and guaranteeing wildlife large landscapes in which to roam. This unique and important habitat was at risk of development and was listed for sale until The Trust for Public Land obtained an option to purchase the property and ultimately conveyed it to the DNR for permanent stewardship.

PROJECT RESULTS USE AND DISSEMINATION<
Information about this project has been widely disseminated in a variety of ways. The Trust for Public Land has publicized it on its website, http://www.tpl.org/what-we-do/where-we-work/minnesota/la-salle-lake.html, in broadcast emails to its list serve members, and in other Trust for Public Land publications. The DNR issued a press release on the acquisition, which many news providers covered including the Pioneer Press, MPR, the Park Rapids Enterprise and a number of other papers through the AP wire. Television coverage was provided by Channel 9 TV and Channel 11 TV. The DNR further did a story on this project in its Conservation Volunteer magazine, and has a great deal of information about it on its website. See the following link: http://www.dnr.state.mn.us/state_parks/la_salle_lake/index.html

Project completed: 6/30/2014

Native Prairie Stewardship and Native Prairie Bank Acquisition
Subd. 04h $1,000,000 TF

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Appropriation Language
$500,000 the first year and $500,000 the second year are from the trust fund to the commissioner of natural resources to acquire native prairie bank easements, prepare baseline property assessments, restore and enhance native prairie sites, and provide technical assistance to landowners. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Prior to European settlement more than 18 million acres of prairie covered Minnesota. Today less than 1% of that native prairie remains, and about half of those remaining acres are in private landownership without any formal protection currently in place. Through this appropriation the Minnesota Department of Natural Resources will work with private landowners of high quality native prairie sites to protect remaining native prairie using a variety of tools. Approximately 200 acres are expected to be permanently protected through Native Prairie Bank conservation easements. A variety of restoration and enhancement activities will be implemented on a total of about 900 acres. Additionally, education

and technical assistance will be provided to interested landowners to help them improve the management and stewardship of native prairie sites they own.

OVERALL PROJECT OUTCOME AND RESULTS
A total of 183 acres of native prairie was enrolled in the Native Prairie Bank easement program and permanently protected. The newly acquired easements included 6 easements in the Counties of Redwood, Brown, Pope, Traverse, Swift, and Renville. In total, 22 baseline property reports were written, including 6 baselines for the newly acquired easements. In addition to baseline reports, 22 existing Native Prairie Bank easements were monitored and data entered into the DNR's Conservation Easement Monitoring database.

SNA prairie specialists have completed 20 prescribed burns for 1,268 acres, 1 prairie reconstruction on 17 acres, and 61 invasive species control projects on 813 acres. 50 of these 82 projects involved Conservation Corps of Minnesota (CCM) crews. Boundary signing has been completed on the 6 NPB easements acquired with this appropriation. As part of the SNA Program's adaptive management efforts, management practices at 5 NPB sites were evaluated to determine if initial objectives were met.

SNA staff participated in 6 different events aimed at getting prairie stewardship information to landowners. Both SNA field specialists and acquisition staff engaged 76 different priority prairie landowners to discuss prairie protection and management options for their property. Over 290 landowners who potentially meet eligibility for Prairie Tax Exemption received mailings with Prairie Tax Exemption application forms. These mailings resulted in the certification of 204 new applications and the enrollment or re-enrollment of 6,936 acres in Prairie Tax Exemption. With the assistance of professional consultants, 20 landowners have received comprehensive Prairie Stewardship plans.

PROJECT RESULTS USE AND DISSEMINATION<
As part of the landowner outreach efforts in project activities 1 and 3, the Native Prairie Bank brochure was updated and re-printed. The new Native Prairie Bank brochure is being made available at public events that target prairie landowners. Over 290 letters were mailed to native prairie landowners informing them of their potential eligibility to participate in the Prairie Tax Exemption Program. Local Technical Teams (LTT's) have been forming in southern and western MN in an effort to coordinate implementation of the MN Prairie Plan (include SWCD, NRCS, USFWS, TNC, BWSR). SNA Prairie Specialists have been working with these LTT's to ensure landowners approached directly by these LTT's are made aware of their prairie stewardship options available through the SNA Program. In total, SNA field specialists have proactively engaged 76 different priority prairie landowners to discuss prairie protection and management options for their property, as well as provide native prairie stewardship information at 6 public events.

Project completed: 6/30/2014

Metropolitan Conservation Corridors (MeCC) - Phase VI
Subd. 04i $3,475,000 TF

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Appropriation Language
$1,737,000 the first year and $1,738,000 the second year are from the trust fund to the commissioner of natural resources for the acceleration of agency programs and cooperative agreements. Of this appropriation, $150,000 the first year and $150,000 the second year are to the commissioner of natural resources for agency programs and $3,175,000 is for the agreements as follows: $100,000 the first year and $100,000 the second year with Friends of the Mississippi River; $517,000 the first year and $518,000 the second year with Dakota County; $200,000 the first year and $200,000 the second year with Great River Greening; $220,000 the first year and $220,000 the second year with Minnesota Land Trust; $300,000 the first year and $300,000 the second year with Minnesota Valley National Wildlife Refuge Trust, Inc.; and $250,000 the first year and $250,000 the second year with The Trust for Public Land for planning, restoring, and protecting priority natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties, through contracted services, technical assistance, conservation easements, and fee title acquisition. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards, as determined by the commissioner of natural resources. Expenditures are limited to the identified project corridor areas as defined in the work program. This appropriation may not be used for the purchase of habitable residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. An entity that acquires a conservation easement with appropriations from the trust fund must have a long-term stewardship plan for the easement and a fund established for monitoring and enforcing the agreement. Money appropriated from the trust fund for easement acquisition may be used to establish a monitoring, management, and enforcement fund as approved in the work program. An annual financial report is required for any monitoring, management, and enforcement fund established, including expenditures from the fund. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

Overall PROJECT OVERVIEW
Though many parts of the Twin Cities metropolitan area are urbanized, there are also has large areas of natural lands that continue to serve as important habitat for fish, wildlife, and plant communities. However, pressure on these remaining lands continues to intensify as population and development pressures increase. This appropriation represents the sixth phase of an ongoing effort by a partnership of state and non-profit organizations, called the Metro Conservation Corridors (MeCC) partnership, to conduct strategic and coordinated land protection, restoration, and enhancement activities that build connections between remaining natural areas and ensures their benefits are available for future generations. This phase involves seven partners and is expected to result in the permanent protection of more than 600 acres and the restoration and enhancement of more than 750 acres.

Individual Partner PROJECT OVERVIEWs

- *1.1/1.2 - MeCC VI - Coordination, Mapping & Outreach & Mapping and Database Work - Minnesota Land Trust ($40,000)*

The Minnesota Land Trust provides coordination, mapping, and data management for the Metropolitan Conservation Corridors partnership. Funds are being used to coordinate the partnership, guide strategic outreach and implementation efforts, manage project data, and provide reporting and mapping of accomplishments.

- *2.1 - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000)*
  Friends of the Mississippi is using this appropriation to restore and enhance approximately 163 acres of permanently protected prairie and forest lands in Dakota, Washington, Ramsey, and Hennepin counties in order increase the amount of high quality habitat within designated conservation corridors. Specific activities will include updating management plans, soil preparation, prescribed burning, native vegetation installation, woody encroachment removal, and invasive species control.
- *2.3 - MeCC VI - Restoring Our Lands and Waters - Great River Greening ($400,000)*
  These funds will enable Great River Greening to restore approximately 121 acres of permanently protected forests, savanna, prairie, and wetland habitat and 0.18 miles of shoreland habitat while engaging hundreds of volunteers in the stewardship of the Metropolitan area's remaining natural areas. Specific activities include invasive species control, seeding/planting, prescribed burning, and other associated activities.
- *2.6/3.3 - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust Inc. ($600,000)*
  The Minnesota Valley National Wildlife Refuge Trust is using this appropriation to purchase a total of approximately 125 acres of land to expand the Minnesota Valley National Wildlife Refuge and to restore and enhance approximately 405 acres of oak savanna and remnant native prairie communities within the refuge. Many benefits are anticipated from this project, including improved habitat connectivity, protection of native species, improved water quality in the Minnesota River, and increased public access to natural lands for activities such as hiking, hunting, and fishing.
- *2.7/3.7 - MeCC VI - Dakota County Riparian and Lakeshore Protection - Dakota County ($1,035,000)*
  Through this appropriation Dakota County plans to permanently protect approximately 287 acres along rivers, including the Vermillion and Cannon Rivers, by securing conservation easements from willing landowners. For all acres protected, natural resource management plans will be prepared to ensure their long term stewardship. Additionally, restoration and enhancement activities are expected to occur on approximately 75 acres.
- *3.1 - MeCC VI - TPL's Critical Land Protection Program - Trust for Public Land ($500,000)*
  The Trust for Public Land is using this appropriation to purchase approximately 30 acres of land and 0.3 miles of shoreline with high ecological value and then convey the land to state or local governments for long-term stewardship and protection. Lands being considered for permanent protection in this round of funding include areas around the Rum River and Rice Creek in Anoka County, Lindstrom Natural Area in Chisago County, Savage Fen Scientific and Natural Area and Pike Lake in Scott County, and St. Croix/Fraconia-Scandia Scientific and Natural Area in Washington County.
- *3.2 - MeCC VI - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($400,000)*
  With this appropriation, the Minnesota Land Trust plans to protect 150 acres of high quality forest, prairie, or wetland habitat by securing permanent conservation easements and dedicating funds for their perpetual monitoring, management, and enforcement. Lands being

considered for permanent protection in this round of funding are located in Anoka, Carver, Goodhue, Hennepin, Isanti, Washington, and Wright counties.

- *3.5 - MeCC VI - Aquatic Management Area Acquisition - MN DNR ($300,000)*
  The Minnesota Department of Natural Resources is using this appropriation to purchase 35 acres, with 0.6 miles of shoreline, along the Vermillion River in Dakota County to be managed as Aquatic Management Areas. Priority will be given to lands that have a high risk of development, provide protection to shoreline and riparian zones, and allow access for anglers and habitat improvement projects.

Project due to be completed: 6/30/2015 [Extended in M.L. 2014, Chapter 226]

Individual Partner Work Plans:

- **1.1/1.2** - MeCC VI - Coordination, Mapping & Outreach & Mapping and Database Work - MLT ($40,000)
- **2.1** - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000): **PROJECT COMPLETED - SEE FINAL REPORT**
- **2.3** - MeCC VI - Restoring Our Lands and Waters - Great River Greening ($400,000)
- **2.6/3.3** - MeCC VI - Priority Expansion and Restoration MN Valley NW Refuge - Minnesota Valley National Wildlife Refuge Trust Inc. ($600,000)
- **2.7/3.7** - MeCC VI - Dakota County Riparian and Lakeshore Protection - Dakota County ($1,035,000)
- **3.1** - MeCC VI - TPL's Critical Land Protection Program - The Trust for Public Land ($500,000)
- **3.2** - MeCC VI - Protect Significant Habitat by Acquiring Conservation Easements - Minnesota Land Trust ($400,000)
- **3.5** - MeCC VI - Aquatic Management Area Acquisition - MN DNR ($300,000): **PROJECT COMPLETED - SEE FINAL REPORT**

ABSTRACTS AND FINAL REPORTS OF INDIVIDUAL PARTNER PROJECTS (Click project # to go to listing for that project)

2.1 FINAL REPORT - MeCC VI - Restore and Enhance Significant Watershed Habitat - Friends of the Mississippi River ($200,000)

Project Outcome and Results

High quality habitat within the Metro area is important for both resident and migratory species. The Metro Conservation Corridors partnership is working to establish a system of habitat corridors that also provide open space and water quality benefits for the residents of the area. One goal of this project was to increase the amount of high quality habitat within designated conservation corridors. During this project, FMR installed 86 acres of prairie, besting the projected amount by 31 acres. This prairie restoration took place at the Emrick property, Gores Pool WMA, Heritage Village Park, Pine Bend Bluffs SNA, and Mississippi River Gorge sites. FMR conducted woodland restoration activities on 2 acres at Mounds Park and Heritage Village Park, falling short by 3 acres of the proposed goal. Uncommon flooding at Gores Pool WMA prevented woodland restoration at the site. Activities associated with this restoration included updating management plans, soil preparation, seed/plant installation, mowing, and weed control. These additional acres of natural communities will provide critical habitat for many species that rely on prairie and woodland, some of which are rare or in decline.

A second goal was to enhance the quality of existing habitat areas. We conducted enhancement activities, mostly exotic invasive plant control and burning, on 275.8 acres, exceeding the number of acres committed to in the work program by 172.8.

The third goal achieved was to develop a list of potential future restoration and acquisition projects within the corridors by reaching out to 27 landowners. This outreach has lead to meetings and site visits with landowners interested in learning more about the natural resources on their property. In other cases, the follow up contact is still taking place. This outreach centered around existing conservation areas, including Gores Pool Wildlife Management Area, Mississippi River riparian area, Sand Coulee SNA, Pine Bend Bluffs Natural Area & the Vermillion River.

PROJECT RESULTS USE AND DISSEMINATION

FMR organizes many tours and stewardship events at the sites where we conduct restoration activities. We share information about this project with the participants of these events. FMR also occasionally publishes articles in its paper and electronic newsletters regarding restoration projects that it is involved in.

Project completed: 6/30/2014

3.5 FINAL REPORT - MeCC VI - Aquatic Management Area Acquisition - MN DNR ($300,000)

Project Outcome and Results

This appropriation provided funding to acquire land in fee title within the Metro Conservation Corridors Partnership (MeCC) areas. It focused on habitat linkage projects along the Vermillion River in southern Dakota County that have the following characteristics: high risk of development, angler access, environmental protection of the shoreline and riparian zone, and access for DNR personnel and constituent cooperators to do habitat improvement projects. Parcels acquired will be managed as Aquatic Management Areas (AMA). This funding also supported the finalization of three parcels acquired with a previous MeCC appropriation, but for which professional services bills were still needed. A total of $8,080 was spent on completion of the three previously acquired parcels. The remaining $292,000 was spent on acquisition of two additional parcels for the Vermillion River AMA. These two parcels closed in late 2013 and added 114 acres of land which provide permanent protection and public hunting, fishing, and trapping along almost 11,000 feet of stream. The AMA now consists of 450 acres and 27,650 feet (over 5 miles) of stream. The Vermillion River is known for production of large brown trout and is a popular anger destination. The acquisition of these two parcels relied on other public funding in addition to this appropriation. Dakota County contributed $40,000 and another $108,600 came largely from a 2011 Outdoor Heritage Fund appropriation to DNR. Both of the new sites have been surveyed and the boundaries posted in time for the 2014 trout opener. Costs for boundary posting and other initial development were paid from other DNR budgets.

PROJECT RESULTS USE AND DISSEMINATION

A press release announcing the two new parcels was issued in early April 2014: http://news.dnr.state.mn.us/2014/04/08/dnr-adds-2-miles-metro-trout-fishing-opportunities-along-vermillion-2/. The story was picked up by at least two local media outlets - CBS Minnesota (http://minnesota.cbslocal.com/2014/04/09/dnr-expands-trout-fishing-along-vermilion-river/) and Pioneer Press (http://blogs.twincities.com/outdoors/2014/04/10/minnesota-stream-trout-fishing-new-vermillion-river-properties-acquired/). In addition to this news release and subsequent stories, information about these and other AMA recreation opportunities is published on the DNR Recreation Compass (http://www.dnr.state.mn.us/maps/compass.html) on DNR's website at

http://www.dnr.state.mn.us.

Project completed: 6/30/2014

Habitat Conservation Partnership (HCP) - Phase VII
Subd. 04j $3,475,000 TF

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Appropriation Language
$1,737,000 the first year and $1,738,000 the second year are from the trust fund to the commissioner of natural resources for the acceleration of agency programs and cooperative agreements. Of this appropriation, $125,000 the first year and $125,000 the second year are to the commissioner of natural resources for agency programs and $3,225,000 is for agreements as follows: $637,000 the first year and $638,000 the second year with Ducks Unlimited, Inc.; $38,000 the first year and $37,000 the second year with Friends of Detroit Lakes Wetland Management District; $25,000 the first year and $25,000 the second year with Leech Lake Band of Ojibwe; $225,000 the first year and $225,000 the second year with Minnesota Land Trust; $200,000 the first year and $200,000 the second year with Minnesota Valley National Wildlife Refuge Trust, Inc.; $242,000 the first year and $243,000 the second year with Pheasants Forever, Inc.; and $245,000 the first year and $245,000 the second year with The Trust for Public Land to plan, restore, and acquire fragmented landscape corridors that connect areas of quality habitat to sustain fish, wildlife, and plants. The United States Department of Agriculture, Natural Resources Conservation Service, is an authorized cooperating partner in the appropriation. Expenditures are limited to the project corridor areas as defined in the work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum habitat and facility management standards, as determined by the commissioner of natural resources. This appropriation may not be used for the purchase of habitable residential structures, unless expressly approved in the work program. All conservation easements must be perpetual and have a natural resource management plan. Any land acquired in fee title by the commissioner of natural resources with money from this appropriation must be designated as an outdoor recreation unit under Minnesota Statutes, section 86A.07. The commissioner may similarly designate any lands acquired in less than fee title. A list of proposed restorations and fee title and easement acquisitions must be provided as part of the required work program. An entity who acquires a conservation easement with appropriations from the trust fund must have a long-term stewardship plan for the easement and a fund established for monitoring and enforcing the agreement. Money appropriated from the trust fund for easement acquisition may be used to establish a monitoring, management, and enforcement fund as approved in the work program. An annual financial report is required for any monitoring, management, and enforcement fund established, including expenditures from the fund. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

Overall PROJECT OVERVIEW

M.L. 2011 Projects Completed in 2013-2014

With continued land use changes in Minnesota, areas that once served as important areas for fish, wildlife, and plant habitat have become fragmented and disconnected resulting in adverse impacts on these ecological communities. Strategic and coordinated efforts in protection, restoration, and enhancement of lands throughout Minnesota can create land and water corridors that reconnect remaining habitat areas and reverse some of the adverse impacts. This appropriation represents the seventh phase of an ongoing effort by a partnership of state, federal, and non-profit organizations, called the Habitat Corridors Partnership (HCP), to do such strategic and coordinated land protection, restoration, and enhancement. Earlier phases of this project have resulted in the protection, restoration, or enhancement of more than 100,000 acres throughout the state. Many of these projects matched Trust Fund money with non-state funds, stretching these dollars to provide a greater benefit to the state. This phase involves eight partners and is expected to result in the permanent protection of approximately 1,100 acres and restoration or enhancement of more than 630 acres. Projects from the individual partners are listed below.

Individual Partner PROJECT OVERVIEWS

- *1a - HCP VII - Coordination, Mapping & Data Management - Pheasants Forever Inc. ($51,000)*
  Pheasants Forever provides coordination, mapping, and data management for the Habitat Corridors Partnership. Funds are being used to coordinate the partnership, guide strategic outreach and implementation efforts, manage project data, and provide reporting and mapping of accomplishments.
- *2e - HCP VII - Wild Rice/Waterfowl Habitat: Enhancement and Long-term Monitoring (2e) - Leech Lake Band of Ojibwe ($50,000)*
  The Leech Lake Band of Ojibwe is working within the Leech Lake Reservation boundaries to address loss and degradation of aquatic habitat for wild rice and waterfowl. Efforts will include regulating water levels on shallow lakes by controlling beaver activity and conducting periodic water level draw-downs, reseeding of approximately 200 acres of wild rice, and implementing adaptive management based on analysis of wild rice productivity.
- *2g - HCP VII - Restoration & Management - Wildlife Management Areas - MN DNR ($30,000)*
  An estimated 200 acres of lands acquired through this phase of the Habitat Corridors Partnership are expected to be transferred to the state for designation as Wildlife Management Areas (WMA). The Minnesota Department of Natural Resources is using these funds to conduct habitat restoration on these new WMA lands, as well as develop the infrastructure necessary for public access to them.
- *2h - HCP VII - Restoration & Management - DNR Fisheries - MN DNR ($200,000)*
  The Minnesota Department of Natural Resources is coordinating efforts to improve habitat for aquatic species and protect water quality on lakes, streams, and their surrounding sensitive shorelands. A total of up to 3.5 miles or 35 acres of water bodies in Kandiyohi, Otter Tail, Rice, or Stevens Counties are expected to benefit from restoration activities including installation of aeration systems, development of spawning areas, installation of native vegetation, and stabilization of stream banks.
- *2o - HCP VII - Prairie Pothole Restoration on Waterfowl Areas - Friends of the Detroit Lakes Wetland Management District ($75,000)*
  Friends of the Detroit Lakes Wetland Management District is using these funds to restore approximately 50 acres of prairie pothole wetlands in Clay and Becker Counties. Efforts aim to create wildlife habitat for waterfowl and other species and reduce downstream flooding of the Red River Valley by increasing the capacity of the land to hold and store water from spring runoff and severe storms.

- *3a - HCP VII - Shoreland Protection Program - Minnesota Land Trust ($450,000)*
  With this appropriation, the Minnesota Land Trust plans to protect approximately 500 acres of critical shoreline habitat along Minnesota's lakes, wetlands, rivers, and streams by securing permanent conservation easements and dedicating funds for their perpetual monitoring, management, and enforcement. Lands being considered for permanent protection in this round of funding are located in Becker, Beltrami, Blue Earth, Itasca, Kandiyohi, Lac Qui Parle, Le Sueur, Otter Tail, Pope, and Wabasha counties.
- *3c - HCP VII - Shallow Lake Conservation Easements - Ducks Unlimited Inc. ($500,000)*
  This appropriation is enabling Ducks Unlimited to help state and federal wildlife conservation agencies protect and restore shallow lakes for waterfowl. Conservation easements will be acquired on approximately 150 acres of privately owned shoreland and up to 60 acres of lands previously converted for cropping will be restored back to wildlife habitat. Lands being considered for permanent protection in this round of funding are located in Beltrami, Douglas, Freeborn, Grant, Meeker, Pope, Stearns, Swift, and Wright counties.
- *3d - HCP VII - Wetlands Reserve Program - Ducks Unlimited Inc. and USDA NRCS (775,000)*
  The U.S. Department of Agriculture and Ducks Unlimited are working together to provide technical assistance to landowners that that will result in the protection of approximately 2,500 acres of prairies and wetlands in southern and western Minnesota. As a result of this appropriation, an estimated $4 million of additional funding for conservation is anticipated to be provided in match by the federal Wetland Reserve Program.
- *4a - HCP VII - WMA/WPA Acquisition beyond Boundaries - Pheasants Forever Inc. ($434,000)*
  There funds are enabling Pheasants Forever to acquire in fee title approximately 86 acres of habitat along the borders of existing Wildlife Management Areas (WMA) or Waterfowl Production Areas (WPA) in LeSueur, Lincoln, or Rice counties and convey the lands to a public agency for long term stewardship and protection. These strategic acquisitions will leverage and expand the existing habitat, water quality, and recreation benefits already provided by existing protected lands.
- *4c - HCP VII - TPLs Critical Lands Protection Program - Trust for Public Land ($490,000)*
  The Trust for Public Land is using this appropriation to acquire in fee title approximately 44 acres of high quality habitat and convey it the Minnesota Department of Natural Resources for long-term stewardship and protection. Priority will be given to shoreland and other lands that provide natural buffers to water resources. Lands being considered for permanent protection in this round of funding are located in Hubbard, Kandiyohi, LeSueur, and Rice counties.
- *4h - HCP VII - Priority Acquisition, MN Valley Wetland Management District - Minnesota Valley National Wildlife Refuge Trust Inc. ($400,000)*
  The Minnesota Valley National Wildlife Refuge Trust is using this appropriation to purchase a total of approximately 80 acres of high quality grasslands and wetlands in Blue Earth or Le Sueur County to be managed as a federal Waterfowl Production Area (WPA) in the Minnesota Valley Wetland Management District.
- *4i - HCP VII - Habitat Acquisition - DNR Professional Services - MN DNR ($20,000)*
  An estimated 400 acres acquired by other Habitat Corridors Partnership (HCP) partners is expected to be transferred to the DNR for long-term management during this phase of the partnership. The Minnesota Department of Natural Resources (DNR) is using these funds to cover professional services costs associated with these property transfers.

ABSTRACTS AND FINAL REPORTS OF INDIVIDUAL PARTNER PROJECTS (Click project # to go to listing for that project)

- **1a** - HCP VII - Coordination, Mapping & Data Management - Pheasants Forever Inc ($51,000)

- **2e** - HCP VII - Wild Rice/Waterfowl Habitat: Enhancement and Long-term Monitoring (2e) - Leech Lake Band of Ojibwe ($50,000)
- **2g** - HCP VII - Restoration & Management - Wildlife Management Areas - MN DNR ($30,000)
- **2h** - HCP VII - Restoration & Management - DNR Fisheries - MN DNR ($200,000)
- **2o** - HCP VII - Prairie Pothole Restoration on Waterfowl Areas - Friends of the Detroit Lakes Wetland Management District ($75,000)
- **3a** - HCP VII - Shoreland Protection Program - Minnesota Land Trust ($450,000)
- **3c** - HCP VII - Shallow Lake Conservation Easements - Ducks Unlimited Inc. ($500,000)
- **3d** - HCP VII - Wetlands Reserve Program - Ducks Unlimited Inc. and USDA NRCS (775,000)
- **4a** - HCP VII - WMA/WPA Acquisition beyond Boundaries - Pheasants Forever Inc Inc. ($434,000)
- **4c** - HCP VII - TPLs Critical Lands Protection Program - The Trust for Public Land ($490,000)
- **4h** - HCP VII - Priority Acquisition, MN Valley Wetland Management District - Minnesota Valley National Wildlife Refuge Trust Inc. ($400,000)
- **4i** - HCP VII - Habitat Acquisition - DNR Professional Services - MN DNR($20,000)

1a FINAL REPORT - HCP VII - Coordination, Mapping & Data Management - Pheasants Forever Inc ($51,000)

OVERALL PROJECT OUTCOME AND RESULTS

The coordination, mapping, and data management work plan provided for the timely, consistent, and accurate reporting of all Habitat Conservation Partnership accomplishments and expenditures during the project period. Duties the project coordinator included: coordinating partners, projects and cultivating partnerships; managing project data and contracting/coordinating mapping services; soliciting and compiling partner information and providing reports to LCCMR and partners; scheduling, coordinating, and chairing meetings & providing meeting minutes; coordinating public relations outreach to media; serving as primary contact for LCCMR; facilitating executive & full committee meetings and coordinating subcommittee meetings; and managing contract for administration and mapping components of the partnership.

With this being the end of the formal Habitat Conservation Partnership, contracted mapping and website services were completed in November of 2013. This resulted in fewer ENRTF funds being required under this result, expending $16,503 of the budgeted $25,000. Additionally, as the partnership was winding down, less personnel time was required to conduct coordination among partners and projects, thus fewer ENRTF funds than anticipated were expended to provide the essential partnership coordination function. This work plan expended $1,286 of the budgeted $26,000 to coordinate the partnership. In total, this work plan turns back $33,211 to the ENRTF as the funds were not necessary for the completion of this work plan.

PROJECT RESULTS USE AND DISSEMINATION

Please refer to individual partner final work plan reports for the accomplishments.

Project completed: 6/30/2014

2e FINAL REPORT - HCP VII - Wild Rice/Waterfowl Habitat: Enhancement and Long-term Monitoring - Leech Lake Band of Ojibwe ($50,000)

OVERALL PROJECT OUTCOME AND RESULTS

The purpose of this project was to collect data on selected wild rice beds located on the Leech Lake Reservation and, using GIS, develop a method of quantifying the abundance from aerial photographs. Data collected from this work was then compared to fall waterfowl abundance data collected by the MN

DNR to determine if a correlation existed. We were able to develop the methodology for quantifying rice abundance from high resolution photographs into some broad categories, but were unable to statistically correlate this with fall duck abundance. Either the rice quantification methods or waterfowl counts are not refined enough to make a statistically valid determination or, more likely, waterfowl will still make use of rice even if it is not abundant, provided it contains sufficient cover. Even though we were unable to make a correlation between rice abundance and fall waterfowl numbers the methodology developed for quantifying rice from aerial photographs will be valuable to us and other managers in the future.

This project also had two smaller components. The first was to manage, maintain, and enhance some of the waterfowl impoundments and other waters that are located on the Leech Lake Reservation. Over the period of this grant we focused on five impoundments and other waterways to enhance these areas for waterfowl and other species that utilize these habitats. On impoundments water levels were managed and dike and control structures were repaired and maintained. Beaver plugging is an ongoing problem on many of these waterways so dam material was removed as needed, Clemson Levelers were installed, and in some cases beaver removal was utilized to reduce the problem.

A second aspect of this project was to enhance waterfowl food supply by planting wild rice. Wild rice has been degraded in some locations due to inappropriate water levels, damage from wind storms, and human activities. Two hundred acres of Natures Lake was reseeded with rice under this grant in an effort to reestablish rice in areas where it had historically occurred.

PROJECT RESULTS USE AND DISSEMINATION
The methodology and techniques used to quantify wild rice beds from aerial photographs will be available to other resource managers if they would like to use them to evaluate their rice beds.

Project Publication:
Comparison of Wild Rice Data and Waterfowl Surveys (PDF - 0.7 MB)

Project completed: 6/30/2014

2g FINAL REPORT - HCP VII - Restoration & Management - Wildlife Management Areas - MN DNR ($30,000)
OVERALL PROJECT OUTCOME AND RESULTS
Department of Natural Resources (DNR), Wildlife Management Areas (WMAs) are part of Minnesota's outdoor recreation system and are established to protect those lands and waters that have a high potential for wildlife production, public hunting, trapping, fishing, and other compatible recreational uses. DNR Section of Wildlife administers and manages habitat restoration and development of infrastructure necessary for public access on lands acquired by partners for State WMAs. Habitat restoration and infrastructure development of new WMAs needs to be tied to the proposed land acquisition efforts of the Habitat Conservation Partnership (HCP). This project funding component (2g) ensured that the DNR had funding available to complete necessary initial site development and habitat restoration for newly acquired lands when they are transferred from the partner organizations to the DNR for long term management. Adequate funding ensures that newly acquired lands can be entered into the WMA system on a timely basis.

Funding from this HCP project (2g) provided for the demolition of several dilapidated buildings along with site cleanup and rehabilitation at the newly acquired Dora Lake WMA in Le Sueur County. Removal

of the farmstead buildings and debris at Dora Lake was an important first step in providing wildlife habitat and making the unit safe for public users. Two newly acquired WMA parcels, Rice Lake WMA in Faribault County and Sanborn Lake WMA in Le Sueur County received professional boundary surveys in preparation for posting and public use.

PROJECT RESULTS USE AND DISSEMINATION
Outcomes from this HCP project (2g) will directly benefit public use of three newly acquired WMA properties. Safe and clearly signed WMA properties are a visible indicator of Environment and Natural Resources Trust Fund accomplishments on the landscape.

Project completed: 6/30/2014

2h FINAL REPORT - HCP VII - Restoration & Management - MN DNR ($200,000)
OVERALL PROJECT OUTCOME AND RESULTS
Efforts completed under this project consisted of improving water quality and fish/wildlife habitat by installing aeration systems in two waterbodies (Loon and Swansen Lakes in Waseca and Kandiyohi cos), creating and restoring a wetland (Horseshoe Lake in LeSueur Co.), stream improvement to reduce erosion (Hawk Creek in Kandiyohi Co.), and putting in a carp barrier (Diamond/Hubbard Lake in Kandiyohi Co). A total of 2,521 acres or 21 miles of shoreline were modified during this phase to create better fishing. Citizens of the state of Minnesota benefit from these projects by having a better fish community structure that is sustainable by natural reproduction. This then creates better fishing and recreation available in high priority waterbodies in the SW portion of the state. All of the projects were completed by June 30, 2014.

PROJECT RESULTS USE AND DISSEMINATION
As projects were completed the Department had press releases that were sent out to the local media. We also had an open house/tour for the local public who wished to visit those projects.

Project completed: 6/30/2014

2o FINAL REPORT - HCP VII - Prairie Pothole Restoration on Waterfowl Areas - Friends of the Detroit Lakes Wetland Management District ($75,000)
OVERALL PROJECT OUTCOME AND RESULTS
This project restored 31 wetlands on Lake Park Waterfowl Production Area in Becker County, Minnesota, ranging in size from 0.1 to 0.7 acres. A total of 6 acres of wetlands were restored. In the fall of 2012, the wetlands were restored by Subsurface, a local contractor. Any ditches leading from the wetlands were completely filled and any remaining fill was spread on the surrounding uplands in an effort to mimic the original topography of the site. Volunteers and Friends members hand harvested wildflower seed from nearby WPAs. USFWS staff, working with local contractors, harvested an additional 16,000 pounds of seed, also from native prairies in the area. USFWS staff seeded the bare dirt at these sites in March of 2013.

While these acres seem small, these small, Type I wetlands are the most impacted in western Minnesota's agricultural landscape. They are important for wildlife for two reasons. These small wetlands tend to melt before larger wetlands and lakes in the spring, providing habitat for the earliest arriving wetland dependent species. Second, many studies have shown that these small wetlands have some of the highest densities of invertebrates in the water. These inverts are a critical resource, especially because of their high protein content, for females trying to lay eggs early in the growing

season.

PROJECT RESULTS USE AND DISSEMINATION
Final Habitat work from this grant will be publicized through the USFWS' Field Notes Website and its Great Lakes-Big Rivers Regional website at http://midwest.fws.gov.

Project completed: 6/30/2014

3a FINAL REPORT - HCP VII - Shoreland Protection Program - Minnesota Land Trust ($450,000)
OVERALL PROJECT OUTCOME AND RESULTS
In the seventh phase of our Shorelands Protection project, the Minnesota Land Trust continued to work with landowners to secure permanent conservation easements on quality habitat along or containing critical riparian lands. We initiated or continued contact with more than 30 landowners and completed eight conservation easements. Collectively, these easements preserve approximately 700 acres of land - exceeding our original goal of 400 to 600 acres - and protect nearly 34,172 linear feet of fragile shoreline. Highlights from the eight completed projects include:

- One donated easement over 30 acres in Kandiyohi County that protected over 2,600 feet of natural shoreline along the Middle Fork of the Crow River.
- A complex of five easements surrounding five lakes in Becker County that protected approximately 474 acres and over 3 miles of undeveloped shoreline. Four of the five easements were donated to the Land Trust.
- One donated easement in Otter Tail County that protected 48 acres and over 2,900 feet of shoreline along Blanche Lake, immediately adjacent to Glendalough State Park.
- Another donated easement that protected 145 acres of forest and wetlands in Beltrami County and preserved almost two miles of shoreline along Black Lake and Three Island Lake.

Overall, this phase of the grant program protected 269 acres of forest, 183 acres of wetlands, and over 6 miles of undeveloped shoreline.
All eight projects met the following selection criteria:

1. Habitat: quality and quantity of existing habitat on site; protects riparian areas and buffers water resources
2. Context: proximity and relationship to other protected lands
3. Opportunity: cost-benefit ratio: landowners willingness and readiness to participate now
4. Other Benefits: meeting multiple objectives, including visual and physical access, forestry goals, water quality, etc.

Additionally, the Land Trust prepared baseline property reports for each easement, detailing the condition of the property for future monitoring and enforcement. To fund this required perpetual obligation, the Land Trust dedicated funds to its segregated Stewardship and Enforcement Fund for several completed projects. For these projects, we estimated the anticipated annual expenses of each project and the investment needed to generate annual income sufficient to cover these expenses in perpetuity - all in accordance with our internal policies and procedures as approved by LCCMR. We will report to LCCMR annually on the status of the Stewardship and Enforcement Fund and the easements acquired with funds from this grant.

All but one of the eight easements completed under this grant were entirely donated. The value is known for only two of the donated easements, which together total $204,000 in appraised donated value under this grant. The Land Trust purchased one of the Fischer Lakes easements for the appraised value of $170,000. The cost to the State of Minnesota to complete the eight projects completed under this phase of the grant was just under $600 per acre.

Cumulatively, across all phases of the HCP program, the Land Trust has completed 89 conservation easements, protecting 8,245 acres of critical habitat and more than 258,000 feet of shoreline, at a cost to the State of approximately $320 per acre.

The Land Trust's work on this project continues to demonstrate the cost effectiveness of working with conservation easements to protect natural and scenic resources along Minnesota's lakes, rivers, and streams, as the cost to the State was well below the cost to purchase land along our increasingly threatened shorelines. This grant continued to generate interest among landowners, and therefore, ongoing funding will be important to sustained success. Additionally, our experiences during this phase of the grant indicate that funds to purchase easements will be necessary in the future as work becomes more targeted, selective, and focused on building complexes of protected land.

PROJECT RESULTS USE AND DISSEMINATION

The Land Trust disseminated information about the specific land protection projects completed under this grant though our newsletter, email updates, web site, and press releases. The Land Trust also shared information about conservation easements generally and our experience with our partner organizations, other easement holders, local communities, as well as policy makers including members of the LCCMR and LSOHC.

Project completed: 6/30/2014

3c FINAL REPORT - HCP VII - Shallow Lake Conservation Easements - Ducks Unlimited, Inc. ($500,000)

OVERALL PROJECT OUTCOME AND RESULTS

Shallow lakes represent the core of Minnesota's remaining waterfowl habitat. Shallow lakes are defined by the Minnesota Department of Natural Resources (DNR) as basins 50 acres or larger with maximum depth of 15 feet or less. To help protect shallow lakes of importance to waterfowl, Ducks Unlimited (DU) works with private landowners to limit future subdivision and development of shoreland around shallow lakes by securing permanent DU conservation easements, and restores agricultural lands back to habitat where possible.

Through this grant, DU conducted landowner outreach to promote conservation easements to private landowners on select shallow lakes of importance to waterfowl, and offered to purchase or accept donated permanent conservation easements on shallow lakes DU has prioritized for shoreland protection. These included Lake Christina in Douglas County, Fish Lake in Stearns County, Cedar Lake in Meeker County, and Geneva Lake in Freeborn County. This effort addresses the goal of protecting lands adjacent to shallow lakes as outlined in the Legislative-Citizen Commission on Minnesota Resources' "Six-Year Strategic Plan for the Environment and Natural Resources Trust Fund" and in the Minnesota DNR's "Duck Recovery Plan".

DU attempted to work with 12 landowners on these lakes to secure conservation easements. Most were either non-responsive or declined to consider conservation easements for various reasons, and none were willing to consider donating easements due to the impact on the value of their land. Five landowners agreed to consider selling conservation easements, and easements were appraised. Three of these landowners declined to proceed, whereas two ultimately agreed to sell conservation easements. DU subsequently closed two purchased conservation easements permanently protecting 33 acres on Cedar Lake in Meeker County and 70 acres on Lake Christina in Douglas County. Of these 103.8 acres, 53 acres on Lake Christina were restored and the remaining 48 acres were intact natural habitats.

PROJECT RESULTS USE AND DISSEMINATION
Conservation easement land protection deals involve private landowners, and publicity of those legal arrangements is a sensitive issue. DU will report accomplishments through the LCCMR website and in DU publications such as our Living Lakes Initiative progress reports.

Project completed: 6/30/2014

3d FINAL REPORT - HCP VII - Wetlands Reserve Program - Ducks Unlimited, Inc. and USDA Natural Resource Conservation Services ($775,000)
OVERALL PROJECT OUTCOME AND RESULTS
Most of Minnesota's prairie wetlands and nearly all of our native prairie grasslands have been converted to agriculture or other uses. Restoring and protecting restored native prairie and prairie wetland complexes is a priority for the state as outlined in Minnesota's Prairie Conservation Plan. The federal Wetlands Reserve Program (WRP) administered by the USDA's Natural Resources Conservation Service (NRCS) is an important voluntary conservation easement program available to landowners to restore and protect prairie wetland complexes on private land. The objective of the WRP is to restore and protect wetlands and adjacent upland habitats to benefit migratory birds and other wildlife, and improve water quality.

To accelerate the WRP in Minnesota, Ducks Unlimited (DU) partnered with the USDA's NRCS to provide technical assistance through eight grant-funded wetland restoration specialist consultants contracted to help NRCS promote and secure new WRP applications and plan and implement restorations on WRP easements secured in previous years. In addition, DU provided engineering services to assist NRCS with survey and preliminary design of two larger wetland restorations requiring complex water control structures to restore wetland hydrology.

Through this grant, DU consultant specialists promoted WRP to 955 private landowners, secured/completed/submitted 83 WRP applications, developed or modified 174 WRP conservation plans to guide restoration of WRP easements, designed 15 water control structures for wetland restorations, and helped restore 192 wetlands on WRP easements. In addition, Ducks Unlimited wetland engineers also completed a preliminary engineering report for the large 4,000-acre Crooked Lake restoration project in Douglas County to help inform and guide future landowner outreach efforts, and completed engineering design plans for restoration of the 100-acre Rasmus Lake wetland project in Kandiyohi County. This technical assistance helped NRCS close 36 new WRP easements at a federal cost of $3,985,375 that protects 3,130 acres in Minnesota during this grant period.

PROJECT RESULTS USE AND DISSEMINATION
Ducks Unlimited consultants promoted the WRP through SWCD newsletters, articles in local newspapers, and in an article written by DU volunteers in the spring 2013 DU state newsletter Cattails. Two DU consultants also gave a PowerPoint slide presentation on the WRP partnership with NRCS at the February 2012 DU state convention.

Project completed: 6/30/2014

4a FINAL REPORT - HCP VII - WMA/WPA Acquisition beyond Boundaries - Pheasants Forever Inc ($434,000)
OVERALL PROJECT OUTCOME AND RESULTS

The objective of this work plan was to maximize benefits of fee-title acquisition by acquiring parcels where the footprint of the strategic acquisition is larger than the acquisition boundary itself. For example, the acquisition of a 40-acre WMA addition that allows for the restoration of an 80-acre drained wetland would bring benefits beyond the subject property boundary. This work plan set forth to protect and restore 141-acres of priority wildlife habitat (86 acres with ENRTF funds and 55 acres with non-state matching funds) falling within the project boundaries outlined by HCP. Despite numerous attempts, we were unsuccessful in fulfilling the requirements of this work plan. Some quality projects fell through due to unwilling sellers (e.g. Minnkota WMA Addition). Other projects considered under this work plan were completed using other funding mechanisms due to the high price tag. After consulting and coming to concurrence with LCCMR staff (please see the November 30, 2013 work plan update), it was decided that we not partially fund projects under this work plan with multiple state funding sources (e.g. Outdoor Heritage Fund). Thus, Pheasants Forever is returning the full $434,000 appropriated to this work plan back to the ENRTF to be used for other worthy projects.

PROJECT RESULTS USE AND DISSEMINATION
There are no results under this work plan to disseminate.

Project completed: 6/30/2014

4c FINAL REPORT - HCP VII - TPLs Critical Lands Protection Program - The Trust for Public Land ($490,000)
OVERALL PROJECT OUTCOME AND RESULTS
On June 16, 2013 The Trust for Public Land (TPL) acquired 120 acres of high quality habitat on Upper Cullen Lake in Crow Wing County, containing over 2,700 feet of lakeshore and 1,000 feet of a designated trout stream. TPL immediately conveyed the land to Crow Wing County, who added the land to its adjacent Memorial Forest and will manage the land for public hunting, fishing, and hiking.

The $610,000 in total funding for the acquisition of the 120 acres of this property was as follows: land value donations for 24 acres valued at $120,000 and Environment and Natural Resources Trust Fund for 96 acres at $490,000.

The land protected has high biodiversity significance according to Minnesota County Biological Survey. It provides critical habitat for a variety of species, including many of those in greatest conservation need including Bald Eagles and Blandings Turtles. It also is less than a mile from critical habitat for the Least Darter, the Red Shouldered Hawk, and Colonial Waterbird nesting areas. Protection of this land has been a priority of DNR for many years, as well as a priority to the Brainerd Lakes Area Conservation Collaborative Framework for Conservation and Recreation Planning.

Conservation of the Upper Cullen property not only protected high quality habitat that was threatened with development, but it has also enabled connections with existing public land, provided public lake access and recreation opportunities, and prevented forest fragmentation.

PROJECT RESULTS USE AND DISSEMINATION
Several local papers covered the acquisition of the Upper Cullen Lake land: http://pineandlakes.com/echo-news/2013-08-06/natural-area-on-upper-cullen-lake-protected; http://www.cullenlakes.org/ccfall13.html. Information about this acquisition is posted on TPL's website: www.tpl.org. Information about the Upper Cullen protection effort has also been disseminated through its network of supporters which include: Cullen Lakes Association, Leech Lake Area Watershed

Foundation, Crow Wing Lakes and River Association, Anglers for Habitat, Trout Unlimited, Crow Wing County, Pelican Township, and the MN Department of Natural Resources.

Project completed: 6/30/2014

4h FINAL REPORT - HCP VII - Priority Acquisition, MN Valley Wetland Management District - Minnesota Valley National Wildlife Refuge Trust Inc. ($400,000)

OVERALL PROJECT OUTCOME AND RESULTS

The MN Valley Trust acquired fee title to 78.96 acres to expand the Howard Farm Waterfowl Production Area (WPA) in Blue Earth County. The ENRTF grant acquired 45.98 acres and other, non-state private funds acquired the remaining 32.98 acres.

This tract is now an integral part of a 600+ acre complex called the Howard Farm WPA of the USFWS / Minnesota Valley Wetland Management District. The acquired property includes degraded prairie and wetland habitat that was drained so that it could be farmed.

Plans for this now-retired cropland include restoration of 62 acres of upland and 18 acres of wetland habitat that will be able to store up to 15 million gallons of water. The prairie seed mix will include the maximum diversity of plant species to benefit waterfowl, grassland birds, and pollinators.

This project will increase habitat quality and nest success for resident and migratory grassland birds, waterfowl, wading birds, resident species, and pollinators. It also will improve water quality to nearby Loon Lake, Lake Crystal, and the Watonwan and Minnesota Rivers through filtration and storage, and will increase wildlife-dependent recreational opportunities for the public.

To meet the 1:1 leverage obligation of its work plan, the MN Valley Trust also completed the following during the project period using other private, non-state funds:

- Acquired fee title to 17.39 acres for the Perch Lake WPA on the north end of this state-designated shallow lake that provides critical resting habitat for migrating waterfowl. Habitat work will include retiring the cropland and field road, restoring both to prairie grassland, and removing a shed cabin from the lakeshore.
- Acquired fee title to 160 acres to expand the Lincoln WPA. The tract includes a 152-acre CREP easement and an 8-acre building site. Habitat work will include restoring the building site to native prairie, enhancing 15 wetland acres, restoring 11 wetlands not previously restored, inter-seeding 152 acres with a diverse mix of prairie forbs and applying prescribed fire.

PROJECT RESULTS USE AND DISSEMINATION

Minnesota Valley Trust will announce the projects via news releases and the Trust website as habitat restoration work gets underway. Once habitat work is complete, the lands will be opened by the USFWS for the public's use for wildlife-dependent recreation.

Project completed: 6/30/2014

4i FINAL REPORT - HCP VII - Habitat Acquisition - DNR Professional Services - MN DNR ($20,000)

OVERALL PROJECT OUTCOME AND RESULTS

The purpose of this funding was to help cover the cost of professional services related to transfer of Wildlife Management Area (WMA) property to the DNR from Habitat Conservation Partnership (HCP) partners. Several HCP partners have received funding for WMA acquisition. The process of conveying

title to this land from partner to DNR results in direct costs to DNR for things such as staff time for DNR Division of Lands and Minerals and the Attorney General's Office, survey costs, recording fees, abstracting fees, property taxes, and deed taxes. These costs can be considerable and often create strain on other DNR budgets. This funding has supported the conveyance of thirteen WMA parcels from three HCP partners. These thirteen parcels added over 840 acres to the WMA system to be permanently protected and open to public hunting, fishing, and trapping. Although this was a 36-month (FY12 to FY14) appropriation, it was largely spent in the first 18 months. Therefore most of the FY13 and FY14 costs for conveyance of these lands have been paid from other DNR budgets. For these 13 properties approximately $21,500 has come from those other budgets. This illustrates that the costs associated with conveying land acquired by partners are protracted and do not end once the land is acquired. Appropriations that fund acquisition of land to be conveyed to DNR need to adequately budget for associated costs. This will ensure that newly acquired lands can be entered into DNR's Outdoor Recreation System in a timely manner, and that other DNR budgets do not bear the brunt of such costs.

PROJECT RESULTS USE AND DISSEMINATION
Acquired parcels are found on the DNR Recreation Compass and on DNR's website at www.mndnr.gov. In addition, HCP partners may have published news releases, articles, or other documents regarding these parcels. It was not the intent of this appropriation to fund or orchestrate dissemination. Dissemination was a function of the funding provided to the HCP partners that acquired and reported upon the land.

Project completed: 6/30/2014

Natural and Scenic Area Acquisition Grants
Subd. 04k $1,000,000 TF

Ronald Potter
MN DNR
500 Lafayette Rd, Box 52
St Paul, MN 55155

Phone: (651) 259-5632
Email: ronald.potter@state.mn.us
Web: http://www.dnr.state.mn.us/grants/land/natural_scenic_area_grants.html

Appropriation Language
$500,000 the first year and $500,000 the second year are from the trust fund to the commissioner of natural resources to provide matching grants to local governments for acquisition of natural and scenic areas, as provided in Minnesota Statutes, section 85.019, subdivision 4a. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Natural and Scenic Area Grant Program is a competitive, matching grant program that partners the state with local communities to help them acquire and permanently protect natural and scenic resources that do not qualify for state designation but have important local or regional significance. Natural and scenic areas provide for public use, protection of species and natural communities, appreciation of scenic vistas, and scientific and educational opportunities. This appropriation will allow the Minnesota Department of Natural Resources to provide up to six matching grants to cities, counties,

townships, or school districts for acquisition of approximately 150 acres of new or expanded natural and scenic areas.

OVERALL PROJECT OUTCOME AND RESULTS
The overall aim of this project is to ensure protection of natural and scenic resources by helping and encouraging local governments to acquire and protect land for appropriate public use, protection of natural communities, appreciation of scenic vistas, and scientific and environmental education purposes. This is achieved through competitive, matching grants through the Natural and Scenic Area Grant Program that provides financial incentive and ensures the land and natural resources are retained for public use in perpetuity. The primary results of the project were:

- Six grants totaling $975,000 resulted in the acquisition of 166.9 acres of natural and scenic areas. All grants were matched by local dollars of at least $975,000.
- Grants included Blue Earth County, acquisition of 41 acres adjacent to the Red Jacket Trail that includes wooded hillsides, meadows and a meandering creek that flows into the LeSueur River; the City of Brainerd, acquisition of 37 acres along the Mississippi River with 1,300 feet of shoreline to provide opportunities for low impact nature based outdoor recreation; the City of Elk River, acquisition of 22.6 acres of historic and scenic property with over 3,300 feet of natural, largely untouched shoreline at the confluence of the Mississippi and Elk Rivers; two grants to the City of Maplewood, acquisition of 48 acres of land that contains rolling hills, bluff top and steep slopes and views from the bluff tops look out over the Mississippi River Valley and Fish Creek; and the City of Prior Lake, acquisition of 18 acres with approximately 1,545 feet of lakeshore and 100 feet of shoreline on Prior Creek.
- Project administration for the program was completed for $25,000. Two application cycles were completed, applications reviewed and site visits were completed. Active projects were monitored, financial review completed, projects closed out, and initial land acquisition reports filed. A total of 419 hours were spent administering the project over three years.

PROJECT RESULTS USE AND DISSEMINATION<
Information about these natural and scenic areas has been added to the DNR website, under the Natural and Scenic Area Program, click on recent grants.

Project completed: 6/30/2014

Acceleration of Minnesota Conservation Assistance
Subd. 04l $625,000 TF

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Appropriation Language
$313,000 the first year and.$312,000 the second year are from the trust fund to the Board of Water and Soil Resources to provide grants to soil and water conservation districts to provide technical assistance

to secure enrollment and retention of private lands in federal and state programs for conservation.

PROJECT OVERVIEW
Enrollment of private lands in conservation programs can provide important natural resource and other public benefits by taking the lands out of production so that they can provide various wildlife and ecological benefits. This appropriation is enabling the Minnesota Board of Soil and Water Resources to provide grants to local soil and water conservation districts for employment of technical staff to assist private landowners in implementing conservation programs. This effort is expected to assist with the enrollment, retention, and management of 30,000 private acres of grasslands, wetlands, and forests in federal and state conservation programs, particularly in areas expected to lose enrollments in the Conservation Reserve Program (CRP).

OVERALL PROJECT OUTCOME AND RESULTS
This project accelerates the implementation of conservation programs on private lands. Numerous programs and funding sources exist or are being developed to implement conservation practices on private lands. This project provides the one on one link with landowners to identify programs and see them to completion. Accelerated staffing was accomplished by contracting with Soil and Water Conservation Districts (SWCD) who have a local connection with landowners. Experience has shown this level of service is required as programs are complex and competing land use changes are pulling in the opposite direction. Landowners have no shortage of options in managing their land. Assuring sound conservation practices that benefit water quality and wildlife habitat are part of that plan is a fundamental goal of this project. As Minnesota's agricultural landscape continues to change with even fewer grassland and wetland acres resulting from the expiration of CRP contracts it is ever more important that we slow this progression and work to retain the most critical areas with renewed contracts or easements. This project has paid to directly employ 10 full time equivalent positions within SWCD offices. In addition, this project leverages an added 9 positions funded by other sources from DNR, BWSR and SWCD's. Work affecting more than 54,000ac.was accomplished by this project, greatly exceeding the original goal of 30,000ac. This includes 10,300 acres of riparian protection, 10,000 acres of wetland restoration Projects, 23,100 acres of grassland protection, 11,900 acres of grassland management.

PROJECT RESULTS USE AND DISSEMINATION
Data is collected on staff time spent, acres impacted and landowners contacted on a quarterly basis and is available to the project partners and participants. The overall status of conservation programs in MN is available at www.bwsr.state.mn.us/easements/coenrol.xls.

Project completed: 6/30/2013

Conservation Easement Stewardship and Enforcement Program - Phase II
Subd. 04m $500,000 TF

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Appropriation Language
$250,000 the first year and $250,000 the second year are from the trust fund to the commissioner of natural resources to accelerate the implementation of the Phase I Conservation Easement Stewardship Plan being developed with an appropriation from Laws 2008, chapter 367, section 2, subdivision 5, paragraph (h).

PROJECT OVERVIEW
The purchase of conservation easements - restrictions on land use that protect natural features while keeping land in private ownership - has proven to be an effective means to protect land at a far lower initial cost than full state ownership. However, once an easement is purchased there are ongoing stewardship, monitoring, and enforcement responsibilities necessary to ensure the terms of the agreement between the easement holder and the landowner are met. An earlier effort funded by the Environment and Natural Resources Trust Fund in 2008 allowed the Minnesota Department of Natural Resources (DNR) to develop a central inventory and management system of the conservation easements held by the DNR, along with a plan for how the DNR's conservation easements would be administered into the future. This appropriation is allowing the DNR to continue and accelerate the implementation of the previously developed plan.

OVERALL PROJECT OUTCOME AND RESULTS
The Conservation Easement Stewardship and Enforcement Program Plan (Phase I) project inventoried DNR-held conservation easements, developed tools to identify fee owners of those easements and developed a prototype application to monitor those easements. The Phase II project intent was to expand on the foundation laid during Phase I. Project goals were to:

- Monitor, collect baseline data, and create baseline reports for 180 conservation easements;
- Enhance a set of tools to be utilized to perform stewardship activities that leverage the new DNR land records system;
- Develop a training program and to present it to groups within DNR that administer the easements;
- Develop enforcement protocols;
- Identify all fee owners and to develop a process for updating fee ownership information.

Project outcomes and results included:

- Monitoring and collecting baseline data on 378 easements with 1,171 landowners;
- Preparation of 237 baseline reports;
- Development and enhancement of computer applications that support conservation easement stewardship by storing site visit data and managing approval workflows;
- Development of training program materials, including a manual with comprehensive instructions about using computer tools developed in Phase II to perform stewardship activities;
- Conducting training sessions at 13 DNR locations;
- Development of DNR Operational Order #128, which details the elements of effective conservation easement stewardship, including enforcement protocols and how they are to be implemented in the DNR.

The Phase I project provided the strategic direction of what a stewardship program should include. Phase II went on to monitor and create baseline reports for the above 237 easements and in so doing, provided the DNR with a proven set of tools and a field-tested stewardship process that will provide consistent guidance to all DNR divisions that administer conservation easements and preserve the conservation value of the lands they protect for the citizens of the state of Minnesota.

PROJECT RESULTS USE AND DISSEMINATION<
At present the information derived from this project will be used for decision making concerning potential future investigation into establishing of viewing practices outlined in the project report. This project was presented to the stakeholder Drainage Work Group (the instigator of the project) once to update the Work Group on its progress, and a second time to make the Work Group aware of the recommendations. No action has been taken by the Drainage Work Group in regard to the recommendations coming from this project.

Project Publication:
Conservation Easement Stewardship and Enforcement Program, Phase II - Supplemental Final Report (PDF - 36.1 MB)

Project completed: 6/30/2014

Recovery of At-Risk Native Prairie Species
Subd. 04n $147,000 TF

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Appropriation Language
$73,000 the first year and $74,000 the second year are from the trust fund to the Board of Water and Soil Resources for an agreement with the Martin County Soil and Water Conservation District to collect, propagate, and plant declining, at-risk native species on protected habitat and to enhance private market sources for local ecotype native seed. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
With less than 1% of the original native prairie remaining in the state, many locally-adapted prairie species are in decline and at-risk of being lost due to continued habitat fragmentation and land conversion. This poses challenges to efforts to preserve these species because seed sources for these plants are therefore also becoming fewer. Using this appropriation the Martin County Soil and Water Conservation District aims to help reverse this trend. Through partnerships with local seed growers and nurseries they will collect, propagate, and plant these declining and at-risk, locally-adapted plant species on protected habitat as part of restoration efforts in order to encourage and increase their presence on the landscape.

OVERALL PROJECT OUTCOME AND RESULTS
The project focus was to accelerate the local ecotype seed availability of declining species for use on restoration projects. This project was undertaken in large part because 90 of the 238 species documented so far in Martin County by the Minnesota County Biological Survey of 2009 are considered to be at-risk. Native seeds were collected from 118 species off 33 different sites and we monitored

additional prairie remnants. This project protected remaining native populations and expanded populations to new sites, enhancing environmental conditions and improving habitat diversity for wildlife.

This project continuously proved to be a great educational opportunity. Each fall, area high school students were taught native plant species and assisted in native seed collection. High school athletic groups also volunteered with native seed collection. Over 250 people have been reached through one-on-one interactions. We have also heard repeatedly from these individuals that once they learn a little about native plant species, they continue to learn more independently and share the knowledge they have gained with others. We also educated landowners and students about identifying and distinguishing between native and invasive species. We have also gained a number of new volunteers.

Native seeds were planted on 22 protected sites. Sites that had been previously planted were monitored. Photographs were taken to document both the native stands and progress on the planted areas. A local conservation organization, Fox Lake Conservation League, provided land for plant propagation. From this site, we were able to propagate a variety of species, including Butterfly weed, Prairie phlox, Cream wild indigo, and others.

We also monitored the populations of Tuberous Indian plantain, Sullivant's milkweed, Small white lady slipper, Showy milkweed, Prairie bush clover and Eared false foxglove. Two additional Small white lady slipper populations were discovered during this project, bringing the total to three locations in Martin County. Martin SWCD visited and inventoried numerous sites with MCIA to source verify native stands and document populations on sites that will be planted.

Overall, this project greatly increased local ecotype native plant materials and increased the knowledge Minnesotans have of their environment.

PROJECT RESULTS USE AND DISSEMINATION
Information from this project was discussed numerous times during the Martin SWCD weekly radio program. "Recovery of At-Risk Native Prairie Species" was written about six times in the county-wide Conservation Update. This project was also discussed repeatedly with area students, local conservation organizations, and other Soil and Water Conservation Districts. First Rite of Spring events were also held where local residents are invited to look at the first Pasque flowers and other early spring plant species. One-on-one interactions with local citizens also proved to be a very effective way to share information learned from this project. We also gained new volunteers who were interested in learning more about native plant species.

Project completed: 6/30/2014

Understanding Threats, Genetic Diversity, and Conservation Options for Wild Rice
Subd. 04o $195,000 TF

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RESEARCH

Appropriation Language
$97,000 the first year and $98,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to research the genetic diversity of wild rice population throughout Minnesota for use in related conservation and restoration efforts. This appropriation is contingent upon demonstration of review and cooperation with the Native American tribal nations in Minnesota. Equipment purchased with this appropriation must be available for future publicly funded projects at no charge except for typical operating expenses. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The ecological, economic, and cultural and historical values embodied by wild rice is said to be unmatched by any other native plant species in Minnesota. However, naturally occurring wild rice in the state now faces a multitude of threats, such as loss of habitat from development, competition from invasive species, impacts from mining and other industrial activity, and hydrologic changes in lakes, rivers, and streams. It is recognized that to preserve wild rice in Minnesota it is critical to maintain its genetic diversity, yet knowledge of genetic diversity in wild rice is limited. Scientists at the University of Minnesota's Department of Plant Biology are using this appropriation to study the genetic diversity of wild rice in Minnesota in order to enhance options and inform best practices for wild rice protection and restoration.

OVERALL PROJECT OUTCOME AND RESULTS
Wild rice (*Zizania palustris L.*) was studied using DNA-based single sequence repeats and the tools of bioinformatics to determine the genetic diversity of wild rice among 70 populations across the state of Minnesota. This study had two objectives: 1) to document genetic diversity of wild rice populations; and 2) assess the usefulness of genetic information for the conservation of this important wild species in Minnesota. Results showed that genetic diversity of the populations in Minnesota is relatively high with a range of 0.37 to 0.73 in heterozygosity and a mean of 0.54. Hetereozygosity can range between 0.0 to 1.0 indicating that genetic diversity among wild rice populations is reasonably high. This also means that many populations are quite unique from a genetic standpoint. Two genetic phylograms are presented. These are figures that illustrate the genetic relationships among the populations using two different genetic models. Examples are given to illustrate how genetics may be used when restoring or rebuilding populations of wild rice.

PROJECT RESULTS USE AND DISSEMINATION
This project will be disseminated via a website report and via seminars and presentations both nationally and regionally. The data will be useful to resource managers across the state who are managing populations of wild rice. The genetics of wild rice in Minnesota has not been explored in detail, thus resource managers will now have another tool to use when making decisions about restoration of wild rice populations. The results will be published in a nationally recognized peer reviewed journal.

Project completed: 6/30/2014

Northeast Minnesota White Cedar Plant Community Restoration
Subd. 04r $250,000 TF

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Appropriation Language
$125,000 for the first year and $125,000 the second year are from the trust fund to the Board of Water and Soil Resources to assess the decline of northern white cedar plant communities in northeast Minnesota, prioritize cedar sites for restoration, and provide cedar restoration training to local units of government.

PROJECT OVERVIEW
Northern white cedar wetland plant communities provide a number of specialized habitat functions, including winter refuge for deer and other wildlife, thermal buffering for brook trout streams, and critical habitat for songbirds and other unique wildlife such as martens and fishers. However, these plant communities have been declining in Minnesota for decades mostly as a result of development impacts. The Minnesota Board of Water and Soil Resources is using this appropriation to try to improve the quantity and quality of white cedar wetland plant communities in Minnesota. Efforts will include assessing existing white cedar communities to prioritize sites for restoration and then providing training and demonstration of restoration and re-vegetation techniques for local natural resource managers.

OVERALL PROJECT OUTCOME AND RESULTS
Project Background: Northern white cedar (Thuja occidentalis) has been declining in Minnesota for decades. White cedar provides ecologically diverse plant communities and critical wildlife habitat and wetland functions.

Project Goals:
1. Reverse decline of white cedar plant communities in Minnesota.
2. Improve quantity and quality of white cedar plant communities.

Methods: Board of Water and Soil Resources (BWSR) established seven experimental white cedar restorations and reference sites in Beltrami, Koochiching, St. Louis, and Lake Counties. Experimental treatments were designed by Dr. Rod Chimner and evaluated use of cedar seedlings, transplants, seeding and natural regeneration. Protection from browsing by wildlife was by rigid tree protectors and wire mesh enclosures. (See attached technical Report).

Results:
Evaluation/Prioritization of White Cedar Restoration Sites:
Goal: Evaluate 100 white cedar sites for restoration/preservation.
Results: 132 sites were evaluated in Aitkin, Koochiching, Itasca, St. Louis, Lake, Cook and Beltrami Counties.

Establishment of Demonstration Sites:
Goal: 400 acres restored/preserved.
Results: 7 sites (485 acres) established in Beltrami, Koochiching, St. Louis and Lake County. Groundwater monitoring wells installed.

Training Resource Managers
Goal: Train 30 land managers.
Results: Two training sessions with 66 trained.

Project Findings:

1. Many white cedar swamps are degraded and need restoration.
2. Major disturbances were roads, ditches and herbivory.
3. Most harvested cedar sites have not regenerated back to cedar, but were replaced by tag alder/balsam fir/red maple.
4. Largest single factor affecting cedar survival was hydrological conditions.
5. Site level hydrological conditions altered by roads may end up explaining tree growth and mortality.

Project Significance: Northern White cedar provides unique wetland functions including:

- Thermal winter cover for white tailed deer.
- Critical habitat for pine marten, bear, fisher, songbirds.
- Provides thermal buffering for cold water fisheries (brook trout streams).

Project completed: 6/30/2014

Land and Water Conservation Account (LAWCON) Federal Reimbursement
Subd. 04s $750,000 LAWCON

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Appropriation Language
$750,000 is from the state land and water conservation account (LAWCON) in the natural resources fund to the commissioner of natural resources for priorities established by the commissioner for eligible state projects and administrative and planning activities consistent with Minnesota Statutes, section 116P.14, and the federal Land and Water Conservation Fund Act. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Through the Land and Water Conservation Fund (LAWCON) the Federal government designates a portion of receipts from offshore oil and gas leases to be provided to state and local governments to fund conservation and outdoor recreation efforts. The Minnesota Department of Natural Resources is using this appropriation to support costs required to maintain eligibility for future LAWCON funding and

for acquisition, development, and redevelopment of parks and recreation areas in the state.

Project due to be completed: 6/30/2014

Work Plan: Not required per change in statute in MN Laws 2011, 1st Special Session, Chp. 2, Art. 4, Sec. 23 and repeal of statute in MN Laws 2011, 1st Special Session, Chp. 2, Art. 4, Sec. 36.

Subd. 05 Water Resources

Itasca County Sensitive Lakeshore Identification
Subd. 05a $160,000 TF

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Appropriation Language
$80,000 the first year and $80,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with Itasca County Soil and Water Conservation District to identify sensitive lakeshore and restorable shoreline in Itasca County. Up to $130,000 may be retained by the Department of Natural Resources at the request of Itasca County to provide technical assistance.

PROJECT OVERVIEW
Poorly planned development along lakeshores negatively impacts lake ecosystems by degrading water quality and fish and wildlife habitat. Given the increased demand for shoreland property, protection of the most ecologically sensitive shorelands is critical. The Itasca County Soil and Water Conservation District is using this appropriation to assess shorelands on high priority lakes in the county to identify the most ecologically sensitive lakeshore as a means of guiding and prioritizing future conservation efforts.

OVERALL PROJECT OUTCOME AND RESULTS
The impetus for this project was the need to better protect and manage functional lake ecosystems in Minnesota. There is widespread concern about the consequences of poorly planned development on water quality and fish and wildlife habitat. Given the increased demands for water and shoreland, continued habitat fragmentation and loss of species diversity, protection of sensitive lakeshores is critical.

Data on the distribution and ecology of rare plants and animals, native plant communities, and vulnerable lakeshores are needed to prioritize actions to conserve and manage lake ecosystems. As Minnesota assesses the status of its natural resources, develops plans for priority resources, and invests millions of dollars in resource protection efforts, information that helps target conservation decisions along lakeshores will be vital. This project delivered information specifically for that need. The project identified priority areas in Itasca County for shoreland reclassification and potential purchase or conservation easement, as well as provided interpretive products to shoreland property owners and

state and local governments.

Sensitive lakeshore assessments were completed on 51 Itasca County lakes. In total, 170 miles of shoreline and nearly 32,000 acres of shoreland were identified as highly sensitive lakeshore. Project partners conducted Sensitive Shoreline presentations to the Itasca Coalition of Lake Associations and individual Lake Associations. The project completed approximately 200 onsite shoreland property evaluations, and for those property owners it provided technical guidance/services for re-establishment of native vegetative buffers and shoreline erosion stabilization projects. Shoreline activities were also reviewed for ordinance compliance. The Itasca County Comprehensive Land Use Plan was updated to advance proactive protection of sensitive lakeshores, and information was developed that will be considered as the Itasca County Zoning Ordinances are updated.

PROJECT RESULTS USE AND DISSEMINATION
Information from this study was presented to several Lake Associations of targeted lakes and the information was made available on the Itasca SWCD and DNR's websites. Itasca SWCD will use this information Itasca County will take the information under consideration in prioritizing future activities on targeted lakes and as they commence their next zoning ordinance update planned for 2015 and for any future planned development or requested variances on identified sensitive shorelines.

Project completed: 6/30/2014

Trout Stream Springshed Mapping in Southeast Minnesota - Phase III
Subd. 05b $500,000 TF

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Appropriation Language
$250,000 the first year and $250,000 the second year are from the trust fund to continue to identify and delineate water supply areas and springsheds for springs serving as cold water sources for trout streams and to assess the impacts from development and water appropriations. Of this appropriation, $140,000 each year is to the Board of Regents of the University of Minnesota and $110,000 each year is to the commissioner of natural resources.

PROJECT OVERVIEW

Native trout require clean, cold water that usually originates from springs. However the groundwater springs feeding the 173 designated trout streams in southeastern Minnesota are under increasing pressure from current and expected changes in land use and increased groundwater withdrawals for domestic, agricultural, and industrial use. This joint effort by the University of Minnesota and the Minnesota Department of Natural Resources is working to identify and map the springs and the areas that feed them in order to understand how these springsheds might be affected by development and increased water use and determine what can be done to protect and restore their water quality.

OVERALL PROJECT OUTCOME AND RESULTS

Trout streams depend on a steady supply of clean, cold water which comes from groundwater springs. These trout springs are under increasing pressure from changing land use, climate change, and groundwater withdrawals for domestic use, mining, agriculture, and energy production. Delineation of the recharge areas or springsheds of trout springs using dye tracing is a necessary first step in the conservation and protection of the trout stream coldwater supplies. This project focused on delineating groundwater springsheds both in the Galena Group limestone karst areas of Fillmore and Olmsted counties, where this work has been done for over 30 years, and in the Cambrian St. Lawrence Formation and Tunnel City Group bedrock across southeast Minnesota. Prior to this project, no springsheds had been delineated in the St. Lawrence or Tunnel City bedrock units. We demonstrated that springs discharging from these units receive surface water recharge from sinking streams and that this recharge moves hundreds of feet per day through the bedrock. This has rewritten our understanding of the hydrology of southeast Minnesota and has demonstrated that these springs, which we formerly believed to be well-protected from land surface activities, are much more vulnerable than we previously realized. Overall, during this project we mapped 41 groundwater springsheds (delineated by dye tracing) and 54 surface water springsheds (surface watersheds sending water to a point where it sinks underground into a groundwater springshed). Twelve of the groundwater springsheds and sixteen of the surface water springsheds are in the St. Lawrence Formation and Tunnel City Group. The groundwater springshed delineated areas total 50,708 acres and the surface water delineated areas total 124,447 acres. Prior to this project there was a total of 54,091 acres of both springshed types delineated. Springsheds were delineated in Dakota, Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha and Winona counties.

PROJECT RESULTS USE AND DISSEMINATION

Information from this project was widely disseminated. A map of the delineated springsheds and a document on Spring Assessment Protocols were produced and submitted to the LCCMR and will be published by the Minnesota Geological Survey. The springshed coverage is being used by state and local governments to target areas for conservation efforts and for Clean Water Fund project ranking. The springshed mapping will be used by the DNR for Silica Sand Mining Trout Stream Setback permitting and in Water Appropriation permit review.

Project information was presented to numerous groups including the SE MN Water Resources Board, Root River Technical Advisor Group, Fillmore County Local Water Planning committee, Southeast Minnesota County and State Feedlot officers, Midwest Federal Agency Senior Managers, and at Silica Sand mining forums in Red Wing, Lewiston, La Crescent, and Winona. On the ground information was presented during tours of the southeast; groups that went "on tour" include Minnesota Groundwater Association, MPCA/DNR field staff, SE Minnesota water advocacy groups, Geological Society of America, Minnesota Association of Professional Soil Scientists, and state and federal agency staff from Minnesota,

Iowa, and Wisconsin.

A paper on the St. Lawrence tracing work has been was published in the journal Carbonates and Evaporites. The springshed mapping work was the subject of two stories on Minnesota Public Radio. Project results were presented at numerous scientific meetings including the 11th and 12th Multidisciplinary Conference on Sinkholes and the Environmental and Engineering Aspects of Karst, the Minnesota Groundwater Association, the Midwest Groundwater Conference, the Geological Society of America, The Driftless area Symposium, and at a Winona State University Geology Department seminar.

Project Publication:
Springshed Assessment Methods for Paleozoic Bedrock Springs of Southeastern Minnesota (PDF - 5.6 MB)

Project completed: 6/30/2014

Mississippi River Water Quality Assessment
Subd. 05c $557,000 TF

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RESEARCH

Appropriation Language
$278,000 the first year and $279,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to assess water quality in the Mississippi River using DNA sequencing approaches and chemical analyses. The assessments shall be incorporated into a Web-based educational tool for use in classrooms and public exhibits. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Minnesota contains the headwaters of the Mississippi River, one of the largest and most important waterways in the world. A vital force in all life processes, microorganisms play a major role in the river's water quality through the biological and chemical processing they provide and as indicators of how human activity is impacting water quality. However, relatively little is actually known about as much as 99% of the microorganisms present in the river. Improved understanding of these microorganisms and the effects they have on water quality will greatly enhance efforts by federal, state, and local agencies to maintain and improve the Mississippi River's water quality. Scientists at the University of Minnesota are using this appropriation to use DNA sequencing and chemical analysis technologies to capture for the first time a more complete picture of the diversity and function of microorganisms in the river and how they influence water quality. As part of this effort, hands-on student and teacher participation and public engagement through educational exhibits will help improve public understanding of the

importance of the river and water quality.

OVERALL PROJECT OUTCOME AND RESULTS
A metagenomics-based sequencing approach was utilized to characterize the bacterial community at sites along the Mississippi River in Minnesota to understand how these communities were influenced by or indicative of water quality. Results of this study revealed that the bacterial community throughout the river primarily consisted of a small number of highly abundant species that comprise a "core microbial community" that was stable both in terms of community membership and inferred functional traits. Variation in community membership and species abundances were primarily influenced by physicochemical parameters (e.g. pH and temperature) rather than spatial distance, and a reproducible community structure occurred annually toward the late summer. Furthermore, specific bacterial orders were related to chemical concentrations that co-varied with surrounding land use, suggesting that increases in abundance of these orders may be indicative of specific types of contamination throughout the river. Therefore, assessment of the total bacterial community provides more information about water quality and contamination sources than could be previously gleaned from traditional enumeration of indicator bacteria like Escherichia coli. In addition to these findings, construction of fosmid libraries to assess resistance of the bacterial community to antibiotics and heavy metals revealed that levels of resistance to both were low throughout the river. Municipal wastewater treatment was not associated with increased antibiotic resistance, but proximity to agricultural wastewater increased the frequency of resistance to the antibiotics kanamycin and ampicillin. Furthermore, the resistances to the heavy metals Cd and Cr were significantly elevated in primarily developed (urban) areas. These results indicate the influence of anthropogenic contaminants on the distribution of functional traits throughout the river. Results of this project as well as dissemination of these results are further discussed in an attached Final Report.

PROJECT RESULTS USE AND DISSEMINATION
Results of this study have been presented at national meetings of the American Society for Microbiology and submitted to peer-reviewed scientific journals for publication. In addition, exhibits have been prepared at the Bell Museum, the Science Museum of Minnesota, and Itasca State Park to inform the general community about the findings of this study. Summer workshops were also held in order to disseminate details of the methodology used in this study to high school teachers.

Project completed: 6/30/2014

Zumbro River Watershed Restoration Prioritization
Subd. 05d $150,000 TF

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Web: http://www.zumbrowatershed.org

Appropriation Language
$75,000 the first year and $75,000 the second year are from the trust fund to the commissioner of

natural resources for an agreement with the Zumbro Watershed Partnership, Inc. to identify sources of erosion and runoff in the Zumbro River Watershed in order to prioritize restoration and protection projects.

PROJECT OVERVIEW

Within the Zumbro River Watershed of southeast Minnesota, studies suggest that small areas of the landscape contribute disproportionately to nonpoint source pollution. However, because a coordinated, watershed-wide approach to prioritizing and implementing conservation practices in the watershed does not currently exist, conservation practices are being implemented opportunistically and not necessarily where they might have the greatest impact. Through this appropriation the Zumbro Watershed Partnership is coordinating a planning and prioritization effort that will guide future implementation of restoration and protection practices in order to maximize water quality benefits and ensure the most effective use of resources.

OVERALL PROJECT OUTCOME AND RESULTS

This project identified and prioritized areas in the Zumbro River Watershed that were determined critical for restoring and protecting water quality. Studies suggested that small areas of the landscape contribute disproportionately to nonpoint source pollution. So implementation of conservation projects that focus on those areas will maximize water quality benefits and ensure efficient use of resources.

Using tools like Light Detection and Ranging (LiDAR) data and other Geographic Information System (GIS) data sets, candidate sites were identified and ranked as critical areas of soil erosion and surface runoff in the watershed. In addition, in-field assessment techniques were developed and documented to further evaluate these source locations.

By the conclusion of the project a number of different methods to determine priorities of those critical areas were identified by local partners. They felt that using only one method to rank and sort the sites was not a good use of the dataset. The partners wanted to be able to sort and parse the results in a number of different ways according to both resource issues and impairments present. It was not always going to be similar for each sub-watershed. In the end the final selection of sites then became approximately 205 sites with resource attribution. This would allow a number of different ways of sorting and prioritizing.

By combining the identified sites and in-field assessment techniques a set of protocols were established to determine the most appropriate BMPs needed to restore the sites to sustainable levels.

A training session was provided to SWCD and County Staff's. A Digital Terrain Analysis Manual was published and is currently posted on the Zumbro Watershed Partnership website. This will be a guide to local partners in the watershed that along with the provided data sets, allows them to create their own priority sites data.

PROJECT RESULTS USE AND DISSEMINATION

The datasets were used to identify priority sub watersheds within the Zumbro. These sub watersheds were prioritized in the recently revised Zumbro Watershed Comprehensive Plan. In addition, the MN Board of Water and Soil Resources issued a request for information for the Targeted Watershed Demonstration Grant. This project was instrumental in identifying and defining the priority sub-watersheds that contained the most critical sites. In addition the in-field assessment and the BMP matrix allowed us to identify the most appropriate BMPs necessary to treat the sites. With BMPs identified,

typical cost helped estimate project cost and the amount and type of public assistance needed at $1.6 M. The type and quality of the data from this project application also helped secure additional commitments from USDA NRCS for $750,000 in EQIP funding.

The data continues to be used by county water planners in the development and revisions of County Water Plans. The GIS data sets are currently posted on an ftp site maintained by Barr Engineering. All county water planners and SWCD staff have access to the site. Because of the sensitive nature of the data access is limited to those staff persons at this time.

Project information was disseminated to project partners on an ongoing basis (usually quarterly to semi-annually) through meetings and presentations arranged by Zumbro Watershed Partnership in Rochester. In addition, individual meetings were held with the SWCD and NRCS staff in the Olmsted, Dodge, Wabasha and Goodhue County offices to convey our findings and solicit feedback on the development of guidance for assessing BMP suitability for various sites, based on agroecoregion location and site characteristics. A similar meeting was held with Rochester staff to discuss BMP priorities for urban and suburban applications. The digital terrain analysis manual content was disseminated to the project partners through a training session in Rochester.

The Zumbro Watershed Partnership project partners were trained in the protocols provided in the digital terrain analysis manual so they can apply this process in the future for identifying critical source areas at alternatives scales, and/or as new information becomes available they can monitor changing conditions to update the list of priority projects as necessary. Work relating to the project has been published in two manuals and the critical source areas identified throughout the watershed during the project have been stored in a GIS database, along with the background data used in the decision-making, for shared use by the project partners.

Project Publications:

- Zumbro River Watershed Restoration Priotization: Digital Terrain Analysis Manual (PDF - 5 MB)
- Zumbro River Watershed Restoration Priotization: Field Assessment Manual (PDF - 1.4 MB)

Project completed: 6/30/2014

Assessment of Minnesota River Antibiotic Concentrations
Subd. 05e $190,000 TF

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RESEARCH

Appropriation Language
$95,000 the first year and $95,000 the second year are from the trust fund to the commissioner of

natural resources for an agreement with Saint Thomas University in cooperation with Gustavus Adolphus College and the University of Minnesota to measure antibiotic concentrations and antibiotic resistance levels at sites on the Minnesota River.

PROJECT OVERVIEW

The occurrences of contaminants including antibiotics, other pharmaceuticals, and personal care products in the environment have gained increasing attention in recent years because of their potential health and ecological impacts. However, serious gaps remain in our understanding of these contaminants and the significance of the threats they may pose. Through this appropriation scientists at the University of St. Thomas, Gustavus Adolphus College, and the University of Minnesota are cooperating to focus specifically on the threats posed by antibiotics to understand which antibiotics are of the most concern - for example, because of their potential to increase antibiotic resistance - and to delineate their urban and rural sources. Findings will help develop strategies to manage threats and minimize future impacts posed by antibiotics to human and ecological health.

OVERALL PROJECT OUTCOME AND RESULTS

While the presence of antibiotics in surface waters has received attention due to concerns about health or ecological impacts, major gaps still remain in our understanding of the scope and significance of this potential problem. The goal of this study was to address the question of whether human or agricultural sources of antibiotics and antibiotic resistant bacteria may be the most significant in surface waters impacted by both. We focused on drainage ditches that receive farm runoff and municipal wastewater treatment plant effluents as possible sources for a portion of the Minnesota River in Southern Minnesota.

We studied four major classes of antibiotics used in agriculture (for veterinary purposes or as growth promoters) as well as in human medicine. We conducted 12 sampling campaigns over a 28-month period from 2011 - 2013, a time period that included extremely wet and dry seasons and therefore highly variable water levels. We collected samples from two agricultural drainage ditches, two municipal wastewater treatment plants, four locations in the river (upstream of both treatment plants, between the two plants, at the outfall of the second plant, and downstream of both plants), and from a nearby reference creek site. For collected samples we quantified six antibiotic resistance genes, susceptibility of cultivable bacteria to four antibiotics, and concentrations of six antibiotics.

The highest levels of antibiotics and antibiotic resistance were consistently associated with the municipal wastewater treatment plant samples. In addition, tetracycline-resistant bacteria isolated from wastewater treatment plants were found to be much more likely (103 out of 124 isolates) than tetracycline-resistant bacteria isolated from the river (0 out of 148 isolates) to have an integron, a mobile genetic element that can be associated with multiple-antibiotic resistance. These findings suggest human sources are much more significant than agricultural sources for this portion of the Minnesota River.

PROJECT RESULTS USE AND DISSEMINATION

The students who have been involved in this project have made multiple poster presentations in local venues on their work over the course of the project. In addition, the results have been disseminated via multiple poster and oral presentations at professional conferences. It is also anticipated that manuscripts currently in preparation will result in two peer-reviewed publications in scientific journals.

Project completed: 6/30/2014

Subd. 06 Aquatic and Terrestrial Invasive Species

Emerald Ash Borer Biocontrol Research and Implementation

Subd. 06b $500,000 TF

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RESEARCH

Appropriation Language

$250,000 the first year and $250,000 the second year are from the trust fund to the commissioner of agriculture to assess a biocontrol method for suppressing emerald ash borers by testing bioagent winter survival potential, developing release and monitoring methods, and piloting implementation of emerald ash borer biocontrol. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW

The Emerald Ash Borer (EAB) is an invasive insect that has been decimating ash trees throughout the Great Lake states and is currently advancing into Minnesota where it threatens the nearly 1 billion ash trees that occur throughout the state - the second most in any state. Loss of these trees would devastate ecosystems throughout Minnesota and have major economic impacts for the forest products industry as well as through the costs associated with treatment, removal, and replacement of lost trees. Biological control - the use of a natural enemy of a species from its native habitat to help with control of that species - is currently the only promising long-term management strategy for EAB. The Minnesota Department of Agriculture is using this appropriation to pilot and assess the effectiveness of a biocontrol method for EAB in Minnesota that involves the use of three types of tiny, stingless wasps that are parasitoids of EAB.

OVERALL PROJECT OUTCOME AND RESULTS

We made great progress with the biological control for emerald ash borer (EAB) in Phase 1 of this project. We simultaneously released wasps that parasitize EAB while we studied them. EAB can kill ash trees quickly (within 6 years). We have responded rapidly to EAB finds so that we might avoid large numbers of EAB over extensive areas, a situation that would be difficult to manage effectively. At the same time, we studied the parasitoid wasps to understand their cold tolerance and dispersal capability. Our studies improved our implementation strategies.

Over 127,000 parasitoid wasps were released at 21 sites in the Twin Cities and southeastern Minnesota. Recovery of immature parasitoids in the field demonstrated that these agents are dispersing then finding and parasitizing EAB. We will continue releases in Phase 2. Research efforts demonstrated that the egg parasitoid, *Oobius agrili*, is the most cold tolerant and the larval parasitoid, *Tetrastichus*

planipennisi, is the least cold tolerant. Therefore, we began releasing *T. planipennisi* earlier in the season to allow multiple generations to build a population sufficient to withstand anticipated cold induced mortality losses. We learned that *T. planipennisi* is capable of dispersing almost 5 miles within 24 hours but that most will fly 3/4 miles in 24 hours. Therefore, we began releasing *T. planipennisi* over a large area at a release site rather than at a central cluster to enable faster *T. planipennisi* dispersal. Research efforts trained a total of six graduate students, five undergraduate students, and three technicians in whole or in part on these projects.

We will continue a study of ash health, EAB, and parasitoid wasps in the Twin Cities area where EAB was first found in 2009. To date, ash mortality within the study area has been substantially lower than anticipated.

PROJECT RESULTS USE AND DISSEMINATION
Information about this project has been and will continue to be disseminated to the public, land managers and researchers. Media releases (3) and social media were utilized to inform the public of major developments. There were 15 scientific presentations to researchers and land managers. Additional training presentations (24) were given to the public, professional land managers, and tree care professionals at many venues. Outreach at public events (20) helped us to connect with people about our activities. Two research papers on parasitoid cold tolerance were published. An additional two papers on parasitoid dispersal are anticipated. In addition, we participate in the EAB Forum, a multi-agency/organization venue for discussing EAB management. We maintain a website www.mda.state.mn.us/plants/pestmanagement/eab/eabbiocontrol.aspx with project information.

Project Publications:

- Cold tolerance of Chinese emerald ash borer parasitoids: Spathius agrili Yang (Hymenoptera: Braconidae), Tetrastichus planipennisi Yang (Hymenoptera: Eulophidae), and Oobius agrili Zhang and Huang (Hymenoptera: Encyrtidae) (PDF - 1.9 MB)
- Thermocouple Design for Measuring Temperatures of Small Insects (PDF - 2 MB)

Project completed: 6/30/2014

Subd. 07 Renewable Energy

Supporting Community-Driven Sustainable Bioenergy Projects
Subd. 07 $150,000 TF

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Appropriation Language
$75,000 the first year and $75,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with Dovetail Partners, Inc. in cooperation with the University of

Minnesota to assess feasibility, impacts, and management needs of community-scale forest bioenergy systems through pilot studies in Ely and Cook County and to disseminate findings to inform related efforts in other communities.

PROJECT OVERVIEW
Small scale community bioenergy systems hold significant promise for increasing energy security, reducing carbon emissions, and contributing to local economies. These types of systems rely on materials such as wood and grasses sourced from the surrounding area as fuel sources for local energy production. However, many questions still remain about how to effectively and sustainably implement these types of community bioenergy systems. Dovetail Partners is piloting an effort with the City of Ely and Cook County to develop the information and tools necessary for communities to assess the viability of these types of energy systems based on the resources available within their own regions.

OVERALL PROJECT OUTCOME AND RESULTS
This project helps guide development of sustainable community-scale forest bioenergy programs in Northeast Minnesota and provides examples from the region to assist communities statewide considering similar projects. Locally produced, community-based renewable energy systems hold significant promise for increasing energy security, reducing carbon emissions, and contributing to local economies. The goals of this project were to develop and share information and tools that address key questions about the viability of community bioenergy systems. During the first phase, existing models and planning tools were adapted to evaluate feasibility, impacts, and management needs for community-scale and other small bioenergy applications being proposed in Ely and Cook County. During the second phase of the project, the information and tools developed in Ely and Cook County were shared with communities, land managers, policymakers, investors, and others interested in the long-term prospects and viability of locally produced bioenergy. The results of the project indicate that there are abundant potential biomass supplies that could meet the needs of the community-scaled biomass energy projects being considered. The financial analysis illustrates that a number of the projects being considered have reasonable potential payback periods and other positive indications of financial feasibility. The environmental review reports summarize major considerations that were identified in interviews with local stakeholders and provide information about the mitigations that are in place to manage risk (e.g., Minnesota"s use of biomass harvesting guidelines, third-party forest certification and ecological monitoring). At this time, the community of Ely is considering options for moving forward with a biomass system or systems that could serve the community college, hospital, school and/or other facilities. The community of Grand Marais has completed additional engineering analysis for a potential district heating system that could serve a number of public buildings and private businesses that represent the major potential customers for the system.

PROJECT RESULTS USE AND DISSEMINATION<
The study team has prepared and made publicly available the final reports and fact sheets from the project that address the estimates of available fuel supplies for biomass facilities in Ely and Cook County and evaluations of potential environmental impacts and available mitigations. An additional report, "Community-Driven Biomass Energy Opportunities - A Northern Minnesota Case Study" has been prepared and made publicly available. The report highlights the findings from the projects and also describes the approach and community-driven structure of the project, conclusions and recommendations that can assist other communities facing similar questions and decisions about renewable energy. The fact sheets, complete reports and the executive summary report are available at the project website (http://www.dovetailinc.org/content/lccmr-supporting-community-driven-sustainable-bioenergy-projects). Community meetings were held in Grand Marais and Ely throughout

the project to engage community input and present project findings to community members. Presentations about the project have been made to the Minnesota Forest Resources Council, Minnesota Forest Resources Partnership, and attendees of the Heating the Midwest Conference held in Carlton, Minnesota. Project information, products and results have been shared through the webpages that have been maintained throughout the project. These pages have shared the fact sheets, reports, and materials distributed at public meetings (e.g., presentation slides). News releases have also been distributed during the project, including radio interviews and newspaper articles in Ely and Grand Marais as well as statewide media engagement (e.g., Midwest Energy News). The activities of the project also included meetings with diverse partner groups, including staff of CERTs, landowner and land managers, loggers and forest product industry representatives, environmental and conservation organizations, local residents and other Minnesota citizens.

Project Publications:

- Executive Summary - Supporting Community-Driven Sustainable Bioenergy Projects (PDF - 1 MB)
- Community-Driven Biomass Energy Opportunities: A Northern Minnesota Case Study (PDF - 2.9 MB)
- Pre-Feasibility Financial and Wood Supply Analysis for Biomass District Heating in Ely and Cook County, MN (PDF - 15.3 MB)
- Local Environmental Considerations Associated with Potential Biomass Energy Projects in Cook County and Ely, Minnesota (PDF - 1.4 MB)
- Life Cycle Impacts of Heating with Wood in Scenarios Ranging from Home and Institutional Heating to Community Scale District Heating Systems (PDF - 4.2 MB)
- Local Biomass Supply Chain Logistics and Concerns (PDF - .2 MB)

Project completed: 6/30/2013

Subd. 08 Environmental Education

Youth-Led Renewable Energy and Energy Conservation in West and Southwest Minnesota
Subd. 08a $246,000 TF

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Appropriation Language
$123,000 the first year and $123,000 the second year are from the trust fund to the commissioner of natural resources for an agreement with Prairie Woods Environmental Learning Center to initiate youth-led renewable energy and conservation projects in over 30 communities in west central and southwest Minnesota.

PROJECT OVERVIEW
Adoption of renewable energy technologies and energy conservation practices can contribute in a

variety of ways to the environmental and economic health of rural Minnesota communities through costs savings and emissions reductions. Engaging and coaching students as the leaders in the process of implementing such practices provides the added benefit of increasing knowledge, teaching about potential career paths, and developing leadership experience. Using this appropriation the Prairie Woods Environmental Learning Center and its partners are expanding an existing program called the Youth Energy Summit (YES!) to implement additional youth-led renewable energy and energy conservation projects in over 30 communities in west central and southwestern Minnesota. These projects will be driven by collaboration between students, community members, and local businesses and organizations.

OVERALL PROJECT OUTCOME AND RESULTS

The Youth Energy Summit (YES!) project was designed to mobilize teams of youth to address critical environmental issues and emerging opportunities related to climate change and renewable energy in Greater Minnesota. The YES! program impacts includes:

1. 38 YES! Teams completed over 300 youth-led energy conservation and renewable energy projects during July 1, 2011- June 30, 2014.
2. 1,134 students in grades 7-12 worked with local community leaders, businesses, schools, public utilities, waste haulers, and other partners.
3. Over 44,380 students and 48,376 community members engaged in efforts to decrease waste and increase energy efficiency.

YES! teams leveraged over $625,000 in local support of projects which included: installing over 40 hydration stations, building three solar powered cold-weather greenhouses, installing waste oil recycling stations, designing and building solar boats and vehicles, improving recycling systems, reducing school energy bills, increasing recycling rates, implementing composting of school waste, promoting environmental stewardship through educational events, and more (please see www.youthenergysummit.org for project specifics).

YES! teams were guided by local coaches & mentors as well as regional YES! Coordinators who conducted 3 annual fall summits, 15 winter workshops tailored to meet the needs and interests of teams, and annual spring judging events. YES! Coordinators and team coaches helped students to organize more than 70 events such as "Green Week" and "Energy Expos" promoting sustainable practices in their communities.

The YES! project demonstrates that young people in Minnesota are ready, willing, and able to assume leadership roles and take action to address environmental issues and opportunities affecting our state and the world. YES! is a program of Prairie Woods Environmental Learning Center in partnership with Southwest Initiative Foundation and many local and regional supporters. The YES! program will be expanded to 40 teams during 2014-2016 in partnership with Laurentian Environmental Center and other regional partners.

PROJECT RESULTS USE AND DISSEMINATION

Information on YES! projects are regularly highlighted through the YES! website (www.youthenergysummit.org), blog posts, and Facebook updates. The YES! website received well over 45,000 page views from July 1, 2012 to June 30, 2014, with 65 % of these viewers being new to the site. Local media frequently print stories on YES! team accomplishments; the Warbler, a PWELC newsletter reaching 1,400 people, goes out 3 times a year and commits a page of each publication to YES!; furthermore, the YES! e-newsletter goes out 4 times a year.

Several communications and outreach activities have been done in relation to this Youth-Led project including three (3) Community Meetings, which brought together stakeholders to celebrate the team's successes and to evaluate the program for future improvements. These meetings served to both raise awareness of YES! teams in local communities and to highlight their good work. The program's funding partners are regularly updated on projects and show their support through continued funding and volunteer time. Coordinators submit Press Releases to local and regional outlets for Spring Award winners and other important stories.

YES! staff have presented at MN S.T.E.M. Network (2013), CERTs (2012), and Minnesota Association of Environmental Educators (2013) conferences. During YES! events, techniques such as S.M.A.R.T. goals have been developed and shared with the students and students have taken that information back to their Team to successfully plan and implement projects. Other types of techniques developed for use by Teams include; "How to Connect with Community Leaders," "Energy and You," "Benchmarking Your Projects," and Effective Meeting Strategies."

Of special note, YES! won the 2013 Minnesota Environmental Initiative Award and the Royalton YES! team won the state-wide 2014 "Red Wagon" award from the Minnesota Alliance with Youth!

Project completed: 6/30/2014

Experiential Environmental Education for Urban Youth
Subd. 08c $200,000 TF

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Appropriation Language
$200,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Hennepin County in cooperation with community partners to initiate new environmental education programs targeting inner-city youth that provide hands-on, experiential outdoor learning opportunities. This appropriation is available until June 30, 2014, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Many inner-city youth receive little, if any, exposure to outdoor and environmental education. This lack of exposure has implications for children's health as well as their knowledge about science, the environment, and the world. In the long term this also impacts the broad public awareness and understanding necessary to ensure long-term protection and stewardship of our environment and natural resources. Hennepin County is using this appropriation to develop a new program called UrbanWatch that will aim to provide hands-on, experiential outdoor learning experiences to inner-city students in North Minneapolis in order to increase their knowledge and skills relating to ecology, agriculture, water resources, and biological diversity.

OVERALL PROJECT OUTCOME AND RESULTS

TIn 2011, Hennepin County Environmental Services was awarded $200,000 from the Environment and Natural Resources Trust Fund for the UrbanWatch program. The goal of this program was to implement outdoor experiential environmental education in Minneapolis schools and communities that have traditionally been lacking in environmental programs. UrbanWatch brought a collective of proven curricula, activities, and tools to empower teachers and at-risk students to explore, monitor, and protect environmental resources.

The county partnered with five community organizations - Beez Kneez, Environmental Justice Advocates of Minnesota, Minnesota Internship Center High School, Phyllis Wheatley Community Center, and the Renewables Research and Policy Institute - to provide hands-on outdoor environmental activities to youth living in the near north side of Minneapolis.

The county partnered with the University of Minnesota Extension and the Beez Kneez to host the "Schoolyard Garden Sustainability and Support Teacher Workshop" held in March 2014. Working in conjunction with STEM coordinators and the Farm to School coordinator from Minneapolis Public Schools, the workshop provided curriculum instruction and educational resources to educators on how to maximize the potential of schoolyard gardens within the classroom.

The program increased youth's knowledge and skills regarding ecology, agriculture, water resources, and biological diversity in their own neighborhoods. These experiences equipped students and community members with the information necessary for healthier communities, a greater sense of stewardship, and increased appreciation for their natural world.

PROJECT RESULTS USE AND DISSEMINATION

- More than five hundred and fifty youth have been directly engaged.
- More than twenty organizations, schools, businesses, and faith communities partnered in this program.
- Eight gardens established.
- Two beehives established.
- Two public art installations completed.
- One toolshed built using compressed earth block construction.
- Two aquaponics labs established in schools.
- 7 Master gardeners paired with schools and their gardens.
- Pollinator curriculum written and published for grades K-12.
- 25 unique classes and outings implemented for youth.
- More than 10 newsletters distributed highlighting program successes.
- More than 30 presentations to students, staff, and community members developed and given.
- Resources for 30 teachers/schools established for garden classrooms.
- 14 Teachers attended garden workshop.
- 465 students reached through workshop, 3140-7340 youth hours spent in gardens spring 2014.

Project completed: 6/30/2014

Subd. 09 Emerging Issues

Chronic Wasting Disease and Animal Health
Subd. 09b $1,200,000 TF

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Appropriation Language
$600,000 the first year and $600,000 the second year are from the trust fund to the commissioner of natural resources to address chronic wasting disease and accelerate wildlife health programs, including activities directly related to and necessary for this appropriation.

PROJECT OVERVIEW
Chronic Wasting Disease (CWD) is a disease found in North American deer, moose, and elk that affects the animal's brain and nervous system and is ultimately fatal to the animals that contract it. A deer harvested in southeastern Minnesota during the 2010 hunting season was found to have the disease - the first time CWD has been found in a wild deer in Minnesota. Subsequent surveillance and testing has found no other such cases of CWD. However, the single finding has prompted accelerated efforts to contain and manage its potential spread due to the serious management problems and other implications posed by CWD were it to become widespread in the state. The Minnesota Department of Natural Resources is using this appropriation to accelerate its CWD management and response plans and efforts.

Project due to be completed: 6/30/2014

Work Plan: Not required per exemption granted to DNR at their request in MN Laws 2011, 1st Special Session, Chp. 2, Art. 3, Sec. 2, Subd. 9(e).

Aquatic Invasive Species
Subd. 09c $5,690,000 $4,690,000 TF [Amended in ML 2012]

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Appropriation Language
$2,177,000 the first year and $3,513,000 $2,513,000 [Amended in ML 2012] the second year are from the trust fund to the commissioner of natural resources to accelerate aquatic invasive species programs,

including the development and implementation of best management practices for public water access facilities to implement aquatic invasive species prevention strategies, including activities directly related to and necessary for this appropriation. $50,000 is for a grant to develop and produce a documentary identifying the challenges presented by aquatic invasive species. The documentary shall be available to the Department of Natural Resources to distribute to watercraft license purchasers and the general public through online and other media.

PROJECT OVERVIEW
Invasive species are species that are not native to Minnesota and cause economic or environmental harm or harm to human health. Minnesota's waters are threatened by a number of aquatic invasive species including zebra mussels, Eurasian watermilfoil, common carp, and an emerging threat of Asian carp. This appropriation is allowing the Minnesota Department of Natural Resources to accelerate a variety of efforts throughout the state aimed at managing and helping to prevent the spread of aquatic invasive species.

Project due to be completed: 6/30/2014

Work Plan: Not required per exemption granted to DNR at their request in MN Laws 2011, 1st Special Session, Chp. 2, Art. 3, Sec. 2, Subd. 9(e).

Reinvest in Minnesota Wetlands Reserve Acquisition and Restoration Program Partnership
Subd. 09d $1,645,000 TF

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Appropriation Language
$1,645,000 the first year is to the Board of Water and Soil Resources to acquire permanent conservation easements and restore wetlands and associated upland habitat in cooperation with the United States Department of Agriculture Wetlands Reserve Program. A list of proposed land acquisitions must be provided as part of the required work program.

PROJECT OVERVIEW
The Reinvest in Minnesota (RIM) Wetlands Reserve Program restores wetlands and grasslands through the purchase of permanent conservation easements on privately owned land. The easements limit future land use and put conservation plans in place for future management. The Minnesota Board of Soil and Water Resources is using this appropriation to accelerate the RIM Wetlands Reserve Program resulting in additional permanently protected wetlands and grasslands throughout the state.

OVERALL PROJECT OUTCOME AND RESULTS
The Reinvest in Minnesota (RIM) - Wetlands Reserve Program (WRP) partnership is a local-state-federal partnership delivered locally by the Natural Resources Conservation Service (NRCS), the Board of Water

and Soil Resources (BWSR), and county Soil and Water Conservation Districts (SWCDs). The goal of the RIM-WRP partnership is to protect land with perpetual conservation easements and restore high quality wetlands and native grassland in order to maximize wetland functions and values and optimize wildlife habitat. For this particular project, ENTRF funds were used to secure permanent conservation easements via the RIM-WRP partnership as part of a larger effort to protect and restore the drained Crooked Lake basin in Douglas County, MN.

The Crooked Lake Restoration project is a multi-partner project that aims to restore the drained shallow lake bed, which prior to its drainage in the early 1900s was home to diverse populations of aquatic invertebrates and provided thousands of acres of critical wildlife habitat. Project outcomes include reduced nutrient loading and sedimentation to nearby (impaired) Lake Osakis and improved water quality throughout the Sauk River watershed. The Crooked Lake restoration project was deemed a Federal priority in 2011 by USDA under the Mississippi River Basin Initiative (MRBI). Led by both the Douglas Soil and Water Conservation District (SWCD) and the Sauk River Watershed District and with the cooperation of USDA NRCS, BWSR, Ducks Unlimited, and many other local, state, and federal partners, the Crooked Lake Project evolved over the past decade.

Primary goals to restore this shallow lake for wildlife and water quality purposes have been at the forefront. The proposed pool elevation (1334.0'), along with adjacent upland makes up the project boundary. Scoring criteria was developed that had the highest priority applications being those located within the pool and secondary priority was then directed at the associated adjacent land to the pool.

ENTRF funds were used to protect 630.7 acres with perpetual conservation easements on which 586 acres of wetlands and 45 acres of associated upland/grassland will be restored, providing multiple ecological and wildlife benefits and assisting with local water quality goals.

PROJECT RESULTS USE AND DISSEMINATION
Public outreach for this project was conducted at the local level by Douglas SWCD, local NRCS staff, and other program partners. SWCD staff held public meetings to raise awareness of this project and to educate landowners about the public and ecological benefits of restoring the drained lake bed. SWCD staff also met with landowners in the project area one-on-one to discuss the options/benefits of enrolling in either the RIM-WRP or WREP conservation easement options available in the project area.

More information about the RIM-WRP program can be found online at http://www.bwsr.state.mn.us/easements/RIM-WRP/.

The ENTRF funded RIM-WRP easements (as with all RIM and RIM-WRP easements) can be viewed by the public via the BWSR webmap located at http://maps.bwsr.state.mn.us/rimonline/.

Project completed: 6/30/2014

Subd. 10 Administration and Contract Management

Legislative-Citizen Commission on Minnesota Resources (LCCMR)
Subd. 10a $946,000 TF

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Appropriation Language
$473,000 the first year and $473,000 the second year are from the trust fund to the LCCMR for administration as provided in Minnesota Statutes, section 116P.09, subdivision 5.

PROJECT OVERVIEW
Per M.S. 116P.09, up to 4% of the amount available for appropriation from the Environment and Natural Resources Trust Fund (ENRTF) for a biennium is available for expenses related to LCCMR administration. These expenses include the LCCMR's project selection and approval process and its ongoing oversight of projects funded by the ENRTF, including both new projects funded during the biennium and existing projects funded in previous bienniums. Historically, LCCMR has always used less than 3% of available funds for administration. This appropriation, which represents 1.86% of the amount available for the biennium, funds LCCMR administration expenses for FY 2012-13.

Project due to be completed: 6/30/2013

Contract Administration
Subd. 10b $175,000 TF

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Appropriation Language
$88,000 the first year and $87,000 the second year are from the trust fund to the commissioner of natural resources for expenses incurred for contract fiscal services for the agreements specified in this section. The commissioner shall provide documentation to the Legislative-Citizen Commission on Minnesota Resources on the expenditure of these funds. This appropriation is available until June 30, 2014.

PROJECT OVERVIEW
Appropriations to non-state entities must be made through a formal contract with a state entity that manages all of the funds for the project on a reimbursement basis. This appropriation to Minnesota's Department of Natural Resources (DNR) funds the expenses incurred by the DNR in contracting, contract management, and expense re-imbursement for most of the Environment and Natural Resources Trust Fund appropriations made to non-state entities, including both new projects funded during the biennium and existing projects funded in previous bienniums.

OVERALL PROJECT OUTCOME AND RESULTS

This appropriation, in conjunction with Outdoor Heritage Fund appropriations, was used to support the contract management program, which ensured ENRTF funds were expended in compliance with state law, session law, approved work plans, and Office of Grants Management grants policies.

Services provided under this appropriation included the following:

- Contract Management Services
    - Prepared grant agreements and amendments
    - Encumbered/Unencumbered Funds
    - Executed Use of Funds Agreements
    - Advanced funds for land acquisition (if approved)
    - Communicated regularly with LCCMR staff and grant recipients
    - Contract management documentation, including file management
- Training and Communications
    - Trained recipients on state grant requirements
    - Worked with recipients to ensure grantees understood the state's reimbursement procedures and requirements
    - Provided ongoing technical assistance/guidance to recipients
- Reimbursement Services
    - Reviewed reimbursement requests
    - Arranged for prompt payment once expenses were verified eligible for reimbursement
    - Detailed accounting by pass-through appropriation for each grant recipient
- Fiscal, Audit, and Close-out Services
    - Financial reconciliation
    - Financial reporting
    - Contract management reporting (fund balance/expenditures)
    - Examined or audited records of recipients
    - Worked with recipients to successful close out of grants
    - Worked closely with and responded to requests from the Office of the Legislative Auditor

In support of the above services to appropriation recipients, many contract management projects were completed:

- Two grantee surveys completed,
- Migration to a newly designed database,
- DNR, Admin, LCCMR, and LSOHC pass-through contract administration roles, processes, and guidelines finalized,
- Joint DNR/LCCMR/LSOHC orientation for appropriation recipients held,
- New DNR Grants Management Policy approved, including a financial Grants Monitoring Procedure.

PROJECT RESULTS USE AND DISSEMINATION

Project personnel were in frequent contact with appropriation recipients and LCCMR staff. Information was disseminated through manuals, training sessions, orientations, meetings, memos, letters, emails, and phone.

In addition, two new communication tools were added: a website that includes many appropriation recipient resources and frequently asked questions and a quarterly electronic newsletter, The DNR

Grants Journal was established in January 2013 in order to provide another quick and effective way to communicate information to appropriation recipients. Prior issues of the DNR Grants Journal are archived on the Training page of the DNR pass-through administration website.

Project completed: 6/30/2014

LCC Web Site
Subd. 10c $3,000 TF

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Appropriation Language
$3,000 in the first year is appropriated to the Legislative Coordinating Commission for the Web site required in Minnesota Statutes, section 3.303, subdivision 10.

PROJECT OVERVIEW
A website called "Minnesota's Legacy" was created by the Minnesota Legislature to help citizens monitor how dollars from the Legacy Amendment and the Environment and Natural Resources Trust Fund are being invested in the state. This appropriation is being used by the Legislative Coordinating Commission to assist with the administration of the website.

Project due to be completed: 6/30/2013

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3. M.L. 2010 Projects Completed
January 15, 2013 – January 15, 2015

MN Laws 2010, Chapter 362, Section 2

M.L. 2010 Projects Completed in 2013-2014

M.L. 2010 Projects
MN Laws 2010, Chapter 362, Section 2 (beginning July 1, 2010)

NOTE: Below are shore abstracts for projects funding during the 2010 Legislative Session and ending during 2013-2014. The final date of completion for these projects is listed at the end of the abstract. Final Reports for all completed projects are available at http://www.lccmr.leg.mn/projects/2010-index.html or by contacting the LCCMR office.

Subd. 03 Natural Resource Data and Information

03a County Geologic Atlases and Related Hydrogeologic Research
03b Updating the Minnesota Wetlands Inventory: Phase 2
03e Mitigating Pollinator Decline in Minnesota - RESEARCH
03f Science and Innovation from Soudan Underground Mine State Park - RESEARCH
03g Quantifying Carbon Burial in Wetlands - RESEARCH
03i Ecosystem Services in Agricultural Watersheds
03k Identifying Critical Habitats for Moose in Northeastern Minnesota - RESEARCH

Subd. 04 Land, Habitat, and Recreation

04a Ecological Restoration Training Cooperative for Habitat Restoration
04b Scientific and Natural Areas and Native Prairie Restoration, Enhancement, and Acquisition
04c State Park Improvements
04d State Park Land Acquisition
04e Protection of Rare Granite Rock Outcrop Ecosystem
04h Conserving Sensitive and Priority Shorelands in Cass County
04i Reconnecting Fragmented Prairie Landscapes

Subd. 05 Water Resources

05a Understanding Sources of Aquatic Contaminants of Emerging Concern - RESEARCH
05b Managing Mineland Sulfate Release in Saint Louis River Basin - RESEARCH
05c Ecological Impacts of Effluent in Surface Waters and Fish - RESEARCH
05e Assessing Septic System Discharge to Lakes - RESEARCH
05h Assessing Cumulative Impacts of Shoreline Development - RESEARCH
05i Trout Stream Assessmentss - RESEARCH

Subd. 06 Aquatic and Terrestrial Invasive Species

06a Biological Control of European Buckthorn and Garlic Mustard - RESEARCH
06c Healthy Forests to Resist Invasion - RESEARCH
06d Bioacoustic Traps for Management of Round Goby - RESEARCH

Subd. 07 Renewable Energy

07a Algae for Fuels Pilot Project
07b Sustainable Biofuels - RESEARCH
07c Linking Habitat Restoration to Bioenergy and Local Economies

Subd. 08 Environmental Education

08a Minnesota Conservation Apprenticeship Academy
08b Engaging Students in Environmental Stewardship through Adventure Learning
08d Urban Wilderness Youth Outdoor Education
08e Get Outside - Urban Woodland for Kids
08f Expanding Outdoor Classrooms at Minnesota Schools
08g Integrating Environmental and Outdoor Education in Grades 7-12

08i Fishing: Cross Cultural Gateway to Environmental Education
08j Minnesota WolfLink

Subd. 03 Natural Resource Data and Information

County Geologic Atlases and Related Hydrogeologic Research
Subd. 03a $1,130,000

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Appropriation Language
$1,130,000 is from the trust fund to the Board of Regents of the University ofMinnesota for the Geologic Survey to initiate and continue the production of county geologic atlases, establish hydrologic properties necessary to water management, and investigate the use of geochemical data in water management. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Minnesota County Geologic Atlas program is an ongoing effort begun in 1982 that is being conducted jointly by the University of Minnesota's Minnesota Geological Survey and the Minnesota Department of Natural Resources (DNR). The program collects information on the geology of Minnesota to create maps and reports depicting the characteristics and pollution sensitivity of Minnesota's ground-water resources. County Geologic Atlases are used in planning and environmental protection efforts at all levels of government and by businesses to ensure sound planning, management, and protection of land and water resources. The Minnesota Geological Survey will use this appropriation to:

- Initiate geologic atlases for Sherburne and Morrison counties;
- Continue work on county geologic atlases already in progress;
- Make collected data available in a digital format;
- Investigate the hydrologic properties of the St. Lawrence Formation in southeastern Minnesota;
- Evaluate methods for investigating groundwater flow pathways in urban areas, using Rochester, MN as the test area.

OVERALL PROJECT OUTCOME AND RESULTS
The Minnesota Geological Survey maps sediment and rock because these materials control where water can enter the subsurface (recharge), where and how much water can reside in the ground (aquifers), where the water re-emerges (discharge), and at what rates this movement occurs. This information is essential to managing the quality of our water and the quantity that can be sustainably pumped. This project completed geologic atlases for Sherburne and Morrison counties, and contributed to atlas work in Anoka, Wright, Hennepin, Hubbard, Becker, Wadena, St. Louis, and Lake counties. Information about the geology is gleaned from the records of domestic wells, and from drilling conducted for this project. In Sherburne County we used 14,450 wells and 5 cores and in Morrison County we used 6,400 wells and 21 cores, and soil borings and geophysical surveys. From the data we created maps of the geology immediately beneath the soil; the aquifers within the glacial sediment; and the shape,

elevation, and rock types of the bedrock surface. These maps and data support monitoring, wellhead protection, water appropriation, clean-ups, and supply management.

The deep bedrock aquifers in southeastern Minnesota are in most places not yet significantly impacted by pollution and presumed to be protected by low permeability overlying geologic layers, called aquitards. Even though aquitards are an important control on recharge and contaminant transport, their hydrologic characteristics are poorly understood compared to aquifers. This subproject investigated the St. Lawrence Formation through existing data, new data on fracturing, and by constructing an instrumented borehole to test the water-bearing characteristics. We learned that the St. Lawrence acts to retard vertical water flow where it is buried by more than 50 feet of overlying rock, but fails to do so in more shallow settings. Parts of the formation convey water horizontally in either setting.

A third subproject traced ground water movement in the Rochester area by examining the chemistry of the water. We learned that flow patterns are changing, apparently in response to high capacity pumping.

PROJECT RESULTS USE AND DISSEMINATION
County geologic atlases are distributed in print and digital formats. The digital format allows us to include all the data that support the maps and the ability to change the maps or create new ones. The products are available from the MGS web site (http://www.mngs.umn.edu/index.html). We also conduct post-project workshops in the map area to familiarize users with the products and their applications. The products are also distributed to libraries. Products of the Morrison County Geologic Atlas have been applied to finding new municipal water supplies in Little Falls and Motley. We expect both these atlases will be applied to understanding the widespread distribution of nitrate in ground water in this part of Minnesota. Additional funding from DNR has allowed us to continue to collect data from the instrumented borehole constructed for the St. Lawrence subproject. This additional data will be combined with what we have in a formal MGS Report of Investigations. The Rochester study is likely to improve computer simulations of water flow and influence decisions about the distribution and pumping rates of the wells that supply the city.

Project Publication:
Hydrogeologic Properties of the St. LAwrence Aquitard, Southeastern Minnesota (PDF - 1.87 GB)

Project completed: 6/30/2014

Updating the Minnesota Wetlands Inventory: Phase 2
Subd. 03b $1,100,000

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Appropriation Language
$1,100,000 is from the trust fund to the commissioner of natural resources to continue the update of wetland inventory maps for Minnesota. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW

The National Wetland Inventory, a program initiated in the 1970s, is an important tool used at all levels of government and by private industry and non-profit organizations for wetland regulation and management, land use and conservation planning, environmental impact assessment, and natural resource inventories. The data behind the National Wetlands Inventory for Minnesota is now considerably out-of-date and a multi-phase, multi-agency collaborative effort coordinated by the Minnesota Department of Natural Resources is underway to update the data for the whole state. This appropriation is being used to conduct the second phase of this effort, which involves updating wetland maps for 13 counties in east-central Minnesota surrounding the greater Twin Cities metropolitan area, evaluating imagery sources and mapping technologies for use in future mapping of agricultural regions of the state, and acquiring additional data needed to update wetland maps for southern Minnesota.

OVERALL PROJECT OUTCOME AND RESULTS

Updated wetland maps were created for 13 counties in east-central Minnesota (7,150 square miles), encompassing the Twin Cities metropolitan area. Wetlands in Minnesota were originally mapped by the U.S. Fish and Wildlife Service in the early 1980's as part of the National Wetlands Inventory (NWI). Although still widely used for land use planning, wetland permit screening and natural resource management, the original maps have grown increasingly out-of-date due to landscape alterations over the years. The data created for this project marks the first significant update to the NWI in Minnesota.

The new maps are much more accurate, capture more detail, and provide more information than the original maps. Besides showing the location, size, and type of each wetland, the updated map data includes information on the wetland's landscape position and hydrologic characteristics, which can be useful in assessing the benefits provided, such as water quality improvement, flood storage, and fish and wildlife habitat. Updating the NWI is a key component of the State's strategy to monitor and assess wetlands in support of efforts to assure healthy wetlands and clean water for Minnesota. The DNR is planning to complete the NWI update for the entire state by 2020.

Accomplishments for this project phase also include acquiring high-resolution, spring leaf-off digital aerial imagery for 23,900 square miles of southern Minnesota, acquiring field validation data for southern Minnesota, and developing wetland mapping procedures for the agricultural region of Minnesota.

PROJECT RESULTS USE AND DISSEMINATION

Imagery acquired for this project is available to the public through the Minnesota Geospatial Information Office (MnGeo): http://www.mngeo.state.mn.us/chouse/wms/geo_image_server.html. The MnGeo imagery service receives about one million page requests per month for the southern Minnesota imagery. This is the first publicly available leaf-off imagery data for southern Minnesota since 1991.

The updated wetland map data are available through an interactive mapping application on the DNR's website at: http://www.dnr.state.mn.us/eco/wetlands/map.html. The data can also be downloaded, free of charge, for use in geographic information system applications through the DNR's data deli at: http://deli.dnr.state.mn.us/. The data will eventually be incorporated into the national "Wetland Mapper" application maintained by the U.S. Fish and Wildlife Service.

The wetland mapping procedures and accuracy results for the 13-county updated NWI data are presented and discussed in a manuscript that has been submitted to the journal Wetlands, a publication of the Society of Wetland Scientists (SWS). Information from this project was also presented at the SWS annual conference in Duluth, MN in 2013. In addition, a press release was distributed regarding the updated NWI data and the story was published on several online news websites.

Researchers at the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory conducted an extensive study of the effects of digital elevation model (DEM) preprocessing and mapping methods on the accuracy of wetlands maps in three different physiographic regions of Minnesota. This research covered two study sites in agricultural areas including the Minnesota River Headwaters (Big Stone County) and Swan Lake (Nicollet County) as well as a comparison site from northern Minnesota (St. Louis and Carlton Counties). The results of this

effort were compiled and submitted for publication in several peer-reviewed scientific journals along with results from the earlier phase of the NWI update project. Three hard copies and one electronic copy of these publications have been submitted with the final report to LCCMR. There have also been numerous presentations at professional conferences.

Project Publications:

- Influence of Multi-Source and Multi-Temporal Remotely Sensed and Ancillary Data on the Accuracy of Random Forest Classification of Wetlands in Northern Minnesota (PDF - 2.7 MB)
- Comparison of Flow Direction Algorithms in the Application of the CTI for Mapping Wetlands in Minnesota (PDF - 15.3 MB)
- The Effects of Data Selection and Thematic Detail on the Accuracy of High Spatial Resolution Wetland Classifications (PDF - 0.2 MB)
- A semi-automated, multi-source data fusion update of a wetland inventory for east-central Minnesota, USA (PDF - 1.4 MB)
- Wetland Mapping in the Upper Midwest United States: An Object-Based Approach Integrating Lidar and Imagery Data (PDF - 1 MB)

Project completed: 6/30/2014

Mitigating Pollinator Decline in Minnesota
Subd. 03e $297,000

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RESEARCH

Appropriation Language
$297,000 is from the trust fund to the Board of Regents of the University of Minnesota to assess the role of insecticides in pollinator health in order to help mitigate pollinator decline. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
A class of insecticides known as systemic neonicotinyl insecticides have been identified as a potential factor in recently observed declines in pollinators - the beneficial insects that carry pollen from plant to plant - including the phenomenon amongst honeybees known as Colony Collapse Disorder. But only preliminary investigation into this potential link has been completed to date. This appropriation is enabling the University of Minnesota's Department of Entomology to conduct additional research needed to determine what impacts systemic neonicotinyl insecticides may be having on the health, behavior, and mortality of honeybees and other pollinators. Findings could be used to help mitigate pollinator decline and identify alternative approaches for managing pest insects.

OVERALL PROJECT OUTCOME AND RESULTS

The commonly used systemic neonicotinyl class of insecticides (imidacloprid, thiamethoxam, clothianidin, and dinotefuran) is implicated in bee decline since insecticide residues accumulate in pollen and nectar. These residues can kill foraging bees and decrease pollination, seeds, and fruits of native plants and crops.

Neonicotinyls are applied in numerous methods (seeds, soil drenches, and tree trunk injections). Of the 442 million acres of U.S. cropland, 143 acres are treated with over 2 million pounds of neonicotinyl insecticides. In Minnesota in 2009, 46,766 pounds of imidacloprid and 19,347 pounds of clothianidin were applied.

These research objectives were to understand the effects of imidacloprid residues on bee health. This research found that a standard, label rate of imidacloprid applied to soil of potted plants produced imidacloprid residues of 1973 ppb in mint and 1568 ppb in milkweed flowers. A residue in flowers of 185 ppb imidacloprid kills a bee.

Research on greenhouse colonies of bumblebees showed that 20-100 ppb imidacloprid or clothianidin provided in sugar syrup for 11 weeks increased queen mortality and decreased consumption, sugar syrup storage, colony weight, and male production. Consequently, 20 ppb had detrimental effects on bumblebees and will reduce pollination of native plants. Research on field colonies of honey bees showed that only 33% of the imidacloprid was stored in colony cells. At 200 ppb there was less brood, fewer returning foragers, and higher amounts of distorted wing virus, which can cause colony death.

This research demonstrated that applications of imidacloprid and clothianidin insecticides to soil result in high residues in nectar and pollen that will kill bees. Studies on bees showed how colonies died from these insecticides.

An 11 part website for outreach education in Minnesota on pollinator conservation was developed.

PROJECT RESULTS USE AND DISSEMINATION

The purpose of the research was to supply data to protect pollinators to ensure future seeds and fruits for wildlife and people. These research data are very important to groups trying to understand the impact of systemic, neonicotinyl insecticides on bee colonies and individual foragers. These data are used by bee keepers, advocacy groups, state agencies, and the US EPA for discussion on whether neonicotinyl insecticides are affecting bee health and whether their use needs to be restricted. In June 2013 The European Union's Food Safety Authority (EFSA) has restricted the use of neonicotinyl insecticides for 2 years on all flowering plants that bees utilize. The reports and discussion are on the LCCMR sponsored "Pollinator Conservation" website. This is a remarkable proactive decision to ensure the safety of pollinators.

An 11 part website on bee pollinator conservation was developed for outreach education in Minnesota. The website contains research results, manuscripts, workshop, bulletin on insecticides and bees, bulletin on pollinator conservation, and poster on bee plants. We will produce 4 manuscripts from these data and 3 are already in final form and available on the website.

These research data have been requested by groups that need to understand more about the risk of neonicotinyl insecticides to bees: US EPA, Center for Food Safety, PANNA (Pesticide Action Network), Xerces Society for Invertebrate Conservation, Washington State Department of Agriculture, Pesticide Research Institute, MN Honey Producers, Boulder County Bee Keepers, and Colorado State Beekeepers. The lab was interviewed by TV and radio many times: MN Public Radio (3), Harvest Public Media, Iowa Public Radio, WCCO, Kare 11 News, KSTP, Pioneer Press, Star Tribune, and the Minnesota State Fair. Krischik has provided her research results to the US EPA twice: an online slide show webinar to EPA scientists and a visit to UM by the US EPA Administrator for the Office of Chemical Safety and Pollution Prevention (OCSPP). Krischik's expertise from this research has made her a reviewer for 2 white papers from the Xerces Society of Invertebrate Conservation and another from the Friends of the Earth as well as peer reviewer on related scientific manuscripts.

Project completed: 06/30/2013

Science and Innovation from Soudan Underground Mine State Park
Subd. 03f $545,000

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RESEARCH

Appropriation Language
$545,000 is from the trust fund to the Board of Regents of the University of Minnesota to characterize unique microbes discovered in the Soudan Underground Mine State Park and investigate the potential application in bioenergy and bioremediation. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Soudan Iron Mine near Ely, Minnesota is no longer an active mine and is now part of a state park, as well as the home to a state-of-the-art physics laboratory at the bottom of the mine. The mine has also recently been discovered to contain an extreme environment in the form of an ancient and very salty brine bubbling up from deep below the Earth's surface through holes drilled when the mine was active. Strange microorganisms - part of an ecosystem never before characterized by science - have been found living in the brine. Scientists from the University of Minnesota will use this appropriation to:

- Study this unique ecosystem and its organisms;
- Examine the potential of using the microorganisms for applications in medicine, energy production, and other areas;
- Develop a program to educate mine visitors about the brine ecosystem and its organisms.

OVERALL PROJECT OUTCOME AND RESULTS
The Soudan Iron Mine near Ely, MN is home to an extreme environment where microorganisms are thriving 2300 feet below the surface in an ancient, salty brine. Though mining operations have been closed for almost 50 years, the mine is now a State Park managed by Minnesota's Department of Natural Resources. Visitors can tour the mine, learning about the history of mining at Soudan and can also tour the state-of-the-art physics laboratory built at the bottom of the mine. Just a few hundred feet away from the physics laboratory, bubbling up from holes drilled in the last days of iron mining, is strange water - an incredibly salty brine that lacks any oxygen gas - and strange microorganisms (bacteria and other single-celled microbes) living in the water. Our work has resulted in the characterization of the level 27 brine with respect to its chemical makeup, the rate that the brine mixes with surface water, cultured and uncultured microbial communities living in the brine, and speciation of minerals found in the brine channel. We have also specifically cultured about two dozen microorganisms from the mine that produce potent anti-fungal compounds, several of which have been shown to have activity against fungal pathogens. We have also isolated several novel species of iron oxidizing and iron reducing bacteria, which we continue to characterize. Finally, we developed an interactive touchscreen display and presentation about subsurface microbiology and geochemistry, specifically highlighting our work from this project. The goal of this touchscreen display is to both educate citizens of Minnesota broadly about subsurface microbiology and highlight some of the most exciting results from our project in a way that is broadly accessible to non-scientists.

Findings from this project formed the basis for a follow-up project begun in 2013 - "Harnessing Soudan Mine Microbes: Bioremediation, Bioenergy, and Biocontrol" - that is to exploring potential applications of using the microorganisms living in Soudan Iron Mine for removing metals from mine waters, producing biofuels, and developing a biocontrol for White-Nose Syndrome, which is decimating bat populations around the country.

PROJECT RESULTS USE AND DISSEMINATION
Project results have been disseminated through presentations made by students and investigators supported on this project. Co-Investigator Prof. Brandy Toner has presented research from our project at an international meeting in 2011 (Goldschmidt Conference, Prague, Czech Republic) and at a national meeting in 2012 (American Geophysical Union, San Francisco, CA). Prof. Jeff Gralnick presented some of the work supported by this project at the TEDxUMN 2012 event, students working on this project gave several poster presentations at national and local meetings (2 presentations in 2012, 4 presentations in 2013). Two scientific publications are currently in preparation (first authors Lindsey Briscoe from the Toner Lab and Benjamin Bonis from the Gralnick Lab) and one has been published in the open access journal of the American Society of Microbiology mBio (Summers, ZM, JA Gralnick and DR Bond. 2013. mBio. Cultivation of an obligate Fe(II)-oxidizing lithoautotrophic bacterium using electrodes. Jan 29;4(1)e00420-12.). Our project was also featured by several media outlets including the Northland's Newscenter, WCCO Channel 4 in the Twin Cities, MoBio's blog, and the University of Minnesota College of Biological Sciences.

Our specific outreach component for this project was to purchase, design and implement an interactive touch screen display for the Visitor's Center at the Soudan Underground Mine State Park. We purchased the equipment (computer, 42 inch touch screen display, mounting bracket, security cables) and have finished the first presentation featuring work from this project. The installation will take place before the mine reopens for visitors for the 2014 season.

Project completed: 06/30/2013

Quantifying Carbon Burial in Wetlands
Subd. 03g $144,000

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RESEARCH

Appropriation Language
$144,000 is from the trust fund to the Board of Regents of the University of Minnesota to determine the potential for carbon sequestration in Minnesota's shallow lakes and wetlands. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Shallow lakes are effective carbon sinks and could be used to mitigate carbon dioxide released from use of fossil fuels. Minnesota currently emits over 150 million metric tons of carbon dioxide annually due to fossil fuel use and has a stated goal to stabilize future emissions at 1990 levels. Reaching this goal will require both minimizing sources and maximizing carbon sinks such as shallow lakes. The University of Minnesota will use this appropriation

to study how effectively shallow lakes and wetlands in different regions of Minnesota remove and retain carbon dioxide from the atmosphere. Findings will be used to provide guidance on how to manage shallow lakes to maximize carbon sequestration and evaluate the potential for Minnesota shallow lakes and wetlands to have roles on the global carbon trading market.

OVERALL PROJECT OUTCOME AND RESULTS

We examined the potential for shallow lakes to mitigate carbon dioxide release from fossil fuels. The CO2 concentration in the atmosphere is increasing and it is a greenhouse gas that has been strongly connected to climate change on Earth. The state of Minnesota emits over 150 million metric tons of CO2 annually due to fossil fuel burning and a stated goal is to stabilize releases at 1990 levels. Reaching this goal will require both minimizing sources and maximizing sinks such as lakes.

To determine how much CO2 is removed from the atmosphere by shallow lakes, we collected sediment samples from over 100 lakes throughout the state, determined how much organic carbon resides in the sediments and determined the burial rate using a new method that is based on lead isotope dating. Our goals were to identify important variables that facilitate carbon burial and to estimate burial rates for the entire state. We found that shallow lakes bury organic carbon at very high rates compared to other landscape features and that effective burial is facilitated by high rates of productivity that occurs in these systems; anaerobic (no oxygen) conditions, when they occur, particularly in the wintertime under the ice, also facilitate increased carbon burial. Although burial represents a large quantity of carbon, about 6 Tg per year (or 6 million metric tons), the State of Minnesota releases about 150 million metric tons of carbon per year through the burning of fossil fuels.

In addition to the scientific results of our work, this project has helped train 10 undergraduate students from both the University of St. Thomas and University of Minnesota, two graduate students at the University of Minnesota and one post-doctoral fellow for two years.

More information on the results of this project can be found in our final project report.

PROJECT RESULTS USE AND DISSEMINATION

The results from this project have been incorporated into materials for use in the class room at St. Thomas and University of Minnesota. Cotner and Zimmer have used material from this project in lectures they have given locally, nationally and internationally (Sweden, Brazil, Japan). At the recent Ecological Society of America annual meeting, members of our team presented 11 posters and/or oral presentations that were very well received. We also organized a special session on terrestrial-aquatic linkages that had a strong focus on carbon burial. This was an extremely well-attended session at this international meeting. Also, 6 members of our group (Cotner, Zimmer, Hobbs and Ramstack-Hobbs, Herwig, and Hanson) presented results from this project at a Shallow Lakes Workshop that we helped organize in Fergus Falls this past August. This workshop was completely full and was attended by resource managers from throughout the state. Cotner has also been presenting some of this work through informal education talks that he has been giving in the past 18 months to various groups (mostly senior citizens) in the Twin Cities area. He has given approximately 20 presentations that have focused on marine and freshwater resources. Lastly, we have published three papers in the scientific literature based on results from this and a related project funded through the National Science Foundation. We have four other papers that are either currently being reviewed or that will be submitted by June 2014.

Project Publications:

- The altered ecology of Lake Christina: A record of regime shifts, land-use change, and management from a temperate shallow lake (PDF - 1.4 MB)
- Estimating modern carbon burial rates in lakes using a single sediment sample (PDF - 0.6 MB)

Project completed: 06/30/2013

Ecosystem Services in Agricultural Watersheds
Subd. 03i $247,000

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Appropriation Language
$247,000 is from the trust fund to the commissioner of natural resources for an agreement with the Chippewa River Watershed Project to develop local food and perennial biofuels markets coupled with conservation incentives to encourage farmers to diversify land cover in the Chippewa River Watershed supporting improvement to water quality and habitat. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The Chippewa River watershed faces many serious environmental problems such as water quality degradation, threats to biodiversity, and increased flooding. Agricultural practices have contributed to these problems, but they can also contribute to solutions. Through this appropriation, the Chippewa River Watershed Project and the Land Stewardship Project are collaborating to pilot an innovative approach that works with farmers to combine community-based markets for alternative crops and products with utilization of conservation incentives programs to achieve the level of landscape change needed to meet water quality goals and other environmental objectives.

OVERALL PROJECT OUTCOME AND RESULTS
The Chippewa River Watershed (CRW) subbasin of the Minnesota River has extensive corn and soybeans, grazing livestock, diminishing longer crop rotations and natural systems. Stream and lake impairments in the CRW include turbidity, bacteria, and excessive nutrients. The LCCMR project is part of the ongoing Chippewa 10% Project (C10) that includes: stream monitoring, mapping sensitive areas, modeling cropping systems with historical and future climate to predict changes and extensive farmer engagement through individual contacts, organizing four farmer learning networks and connecting farmers to markets, conservation incentives and technical assistance. We held a total of twelve educational events attracting 494 people with Environment and Natural Resources Trust Fund (ENRTF) and other funding. Partners developed four networks working with 63 farmers and landowners on 8500 acres with ENRTF and other funding. These will continue and grow past the completion of this project. Networks and events developed during this time with assistance from other funding, as detailed in the report, include:

- Women Caring for the Land network with 15 women landowners engaged in conservation efforts on their land
- Nitrogen management network with 8 farmers utilizing soil tests, corn stalk nitrate tests and nitrogen management strategies
- Soil Health workshop with 270 attendees

The goals for the ENRTF project were to identify sensitive fields on 10% of corn and soybean fields, engage landowners with information about benefits of diversification, including available conservation incentives and markets, and monitor for changes on fields. ENRTF funds and other funding accomplished these deliverables to achieve the goals:

- Mapped three focal areas based on water quality monitoring, multi-year crop rotations and scenarios for diversifying 110,000 acres to rotational grazing, forage strips at the toe of steep fields, longer rotations on poorer soils or cover crops;
- Calculated Ecosystem Service Coefficients (ESC) using the Agricultural Production Systems Simulator model for localized future climate and included warm season grass and grazing operations;
- Modeling predicted decreases of 16% sediment load and 7% NO2-NO3 nitrogen load when converting sensitive fields to perennial crops;
- Integrated ESC into the Hydrologic Simulation Program - Fortran for the CRW;
- Conducted one-on-one interviews and follow-up with 74 landowners;
- Networks developed included: 1) The 25-landowner Simon Lake Challenge, a landscape-scale grazing network on 6,000 acres; and 2) Cover crop network of 15 farmers on 943 acres; soil biological activity was monitored with soil tests on 150 acres, showing higher soil moisture from cover crops resulted in higher biological activity in the fall;
- Five educational events attracting 165 people;
- Published multiple articles and a website (http://landstewardshipproject.org/stewardshipfood/foodsystemslandstewardship/chippewa10).

PROJECT RESULTS USE AND DISSEMINATION

Within the team and beyond, interaction with research scientists, agency personnel, farmers and nonprofit staff create opportunities for longer-term engagement. These opportunities may help bring about land management and landscape changes that result in increased ecosystem goods and services along with better community support.

We have learned together that:

- There are many benefits associated with grazing systems and longer-term rotations.
- Riverine or stream systems can be very flashy in terms of flow, and by extension, ecosystem services the more corn and soybeans dominate the landscape.
- Market signals can sometimes be amplified, distorted or misinterpreted so that the price of one commodity can drive behavior in a direction that may not necessarily be benefiting farmers in the long run.
- It may be possible to tie monitoring, modeling and on-farm changes in practices by linking scenarios, modeling diverse production systems, stream monitoring linked to land-cover, and on-farm practices being monitored with and by farmers and demonstrated through farmer networks.
- Better modeling output can be developed if research scientists work with applied scientists, extension personnel, producers and nonprofit staff to generate information from models on different grazing systems, conventional and organic production systems and different weather patterns.

Based on the strength of the Chippewa 10% Project and its partners and modeling, the Chippewa River Watershed was chosen the by United States Department of Agriculture's Agricultural Research Service to be part of the Long-term Agroecological Research Sites (LTAR). This was officially announced in 2012 and funding allocated to North Central Soil Conservation Research Lab in Morris for this purpose in 2013.

The Chippewa 10% Project regularly provides opportunities for farmers and landowners to learn about new approaches they may not be familiar with. For example, most of the farmers we have engaged who graze ruminant livestock use continuous grazing or a very non-intense, low-level management, e.g., moving the animals every 8 days. Early winter of 2013 we brought a group of farmers to a presentation on soil health building strategies. A number of them were quite taken with a presentation by North Dakota rancher Gene Goven who has increased the productivity of his grasslands to boost his cattle stocking rate by 400%. He did so using sound planning strategies, fundamental soil-building techniques, and building diversity of flora and fauna above and below his soil, not by acquiring more land or throwing money at his challenges.

Since then we have selected a few farmers from the group who are open to the message of planning for a grazing system that is multi-functional, improving profit, water quality, wildlife habitat and soil health, and gave them an intense two day course on the Holistic Planning techniques they could use to move their farms toward those goals. Seven farmers participated, some enthusiastically embracing the approach and expressing willingness to show others what they're doing and provide some coaching for friends and neighbors.

LSP staff working in the Root River Watershed were engaged to learn about GIS and outreach techniques and begin to plan for and apply them in Minnesota's Root River Watershed.

The Chippewa 10% Project has shared information through conference presentations at National Institute of Food and Agriculture Project Directors meeting, two Green Lands Blue Waters conferences about watersheds in IA and MN, the 4th Interagency Conference on Research on the Watershed in Anchorage, AK, the MOSES conference in La Crosse and several other in-state venues with staff from multiple agencies.

In addition we are sharing information for the general public through extensive coverage in the Land Stewardship Letter published by the Land Stewardship Project and front page coverage through AgriNews in November, 2013.

We have held 9 field days with 166 attendees over the course of this project and several workshops on cover crops, grazing, markets and conservation programs. There have been eight team meetings over the period.

A list of other reports and posters appended to the project is as follows:

- Rohweder, J.R, G. Boody, S. Vacek. 2012. Modeling Important Bird Habitat Using Multiple Alternative Land Cover Scenarios within the Chippewa River Watershed, Minnesota. US Geological Survey.
- A study by USGS paid for with funds by National Institute of Food and Agriculture.
- DeVore, B. 2012. Feeding the subterranean herd: How putting soil at the center could help revitalize farmland...& farming. September to December 2012. Land Stewardship Project
- Olson, K, et al. 2013. The Chippewa 10% Project: Achieving Needed Ecosystem Services in an Agricultural Watershed. Poster and presentation at the Green Lands Blue Waters annual conference section on watersheds. November 20-21, 2013. Minneapolis, MN. Published by Land Stewardship Project.
- LSP et al. 2013. Farmer/Landowner Outreach and Organizing in the Chippewa and Root River Watersheds: Achieving a healthy ecosystem in agricultural watersheds. Poster presented at Green Lands Blue Waters annual conference section on watersheds. November 20-21, 2013. Minneapolis, MN. Published by Land Stewardship Project.
- Jaradat, A.A, J. Starr, G. Boody. 2014. Comparative Assessment of Organic and Conventional Production of Row Crops under Climate Change: Empirical and Simulated Yield Variation in the Chippewa River Watershed, MN. Poster at MOSES conference on Organic Farming. La Crosse, WI. February 2014

Materials are being added to the Chippewa 10% Project website at http://landstewardshipproject.org/stewardshipfood/foodsystemslandstewardship/chippewa10. A related website is http://landstewardshipproject.org/stewardshipfood/foodsystemslandstewardship/soilquality. LCCMR and other funders are acknowledged on these websites.

In addition, research papers were published with other funding. More research will be published that references ENTRF funding.

Project Publication:
Modeling Important Bird Habitat Using Multiple Alternative Land Cover Scenarios within the Chippewa River Watershed, Minnesota (PDF - 5.0 MB)

Project completed: 06/30/2014

Identifying Critical Habitats for Moose in Northeastern Minnesota
Subd. 03k $507,000

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RESEARCH

Appropriation Language
$507,000 is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute to identify critical habitats for moose, develop best management habitat protection practices, and conduct educational outreach in cooperation with the Minnesota Zoo. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Moose are one of Minnesota's most prized wildlife species. Recently observed increases in mortality rates amongst some moose in northeastern Minnesota have led to concern that the population there may be starting a decline like that seen in the northwestern part of the state, where moose populations fell from over 4,000 to fewer than 100 in less than 20 years. Researchers from the Natural Resources Research Institute at the University of Minnesota - Duluth, are using this appropriation to determine what factors may be responsible for increases in moose mortality rates in northeastern Minnesota in order to determine if it is possible to slow or prevent significant, long-term decline in the moose population there.

OVERALL PROJECT OUTCOME AND RESULTS
Moose are one of Minnesota's most prized wildlife species. In less than 20 years moose in northwestern Minnesota declined from over 4,000 to fewer than 100. The northeastern Minnesota moose population, which had over 7,000 moose until 2009, is in the middle of what appears to be a similar decline. Higher mortality in radiocollared moose is correlated with warmer temperatures. We used satellite collars to track moose in northeastern Minnesota and collected GPS locations day and night 365 days a year. Over 2 million moose locations and activity data were obtained. Specific habitats needed by moose were identified using the satellite collars. Spatial distribution and availability of habitat types has guided identification of specific sites for enhancement, protection, or acquisition. Habitat guidelines and recommendations help private and public land managers provide the best possible habitat for moose.

The project was part of a coordinated effort involving many resource management agencies to determine if it is possible to slow or prevent a decline in the northeastern MN moose population. Public outreach and education was accomplished with a website that provides information on moose in Minnesota and allowed the public to report almost 2,000 moose sightings. The Minnesota Zoo developed an on-site informational kiosk about Minnesota moose and zoo educators developed a curriculum for teacher workshops to be held both at the zoo and at the Boulder Lake Environmental Learning Center near Duluth. We gave over 70 moose presentations during the project, and continue to give presentations now.

The project combined research and education to increase public understanding of Minnesota moose now and in the future. Results and data from this project are still being used in current projects. We expect that there will be at least 2 more M.S. theses, 5 peer-reviewed publications, and additional NRRI Technical Reports developed from

the data collected in this project that will be used to improve moose management. We also continue to work with the MN DNR adult and calf moose mortality projects using data and expertise obtained during this moose research project, and we have an ongoing collaboration with the Minnesota Zoo in Apple Valley with a deer-moose parasite project and a moose-wolf predation project.

PROJECT RESULTS USE AND DISSEMINATION
The project has had relatively wide dissemination, both in formal settings and in working with DNR and other resource management agencies to implement recommendations arising from the project. We gave over 70 presentations to the public about this project. We also developed a moose website that is used extensively by both biologists and the public. We will continue to update this website in the future.

In addition, because of the interest in moose, the project has received attention from the media, with newspaper and magazine articles, and radio and television interviews. Among the media outlets are the Duluth News Tribune, Minneapolis Star Tribune, and St. Paul Pioneer Press Dispatch, local TV stations, Minnesota Public Radio, Duluth News Tribune, Minneapolis Star Tribune, Los Angeles Times, BBC in Ontario and Newfoundland, Sweden Public Radio, Toronto Star, and others.

Although not limited to this project, Moen was also asked by the DNR to present on the current status of moose in Minnesota at the 2014 Roundtable, and also gave testimony to the Environment and Natural Resources Policy Committee on February 25, 2014.

Finally, there are several peer-reviewed publications, theses, and technical reports that have arisen from work conducted on this project. Some of these publications are currently being peer-reviewed. We expect to produce several additional publications and theses from the data obtained in this project.

Project completed: 06/30/2013

Subd. 04 Land, Habitat, and Recreation

Ecological Restoration Training Cooperative for Habitat Restoration
Subd. 04a $550,000

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Appropriation Language
$550,000 is from the trust fund to the Board of Regents of the University of Minnesota for improving ecological restoration success in Minnesota by developing and offering training programs for habitat restoration professionals. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Restoration work is increasingly relied on as a conservation strategy in Minnesota even though project failure rates remain high. Although there are many competent professionals working in the field, the quality of work varies

across the profession and lack of expertise contributes to failures, partly because there is currently a lack of professional restoration training available. In order to help improve the success rates of restorations, scientists and educators at the University of Minnesota's Department of Horticultural Science are using this appropriation to develop an ecological restoration education program and cooperative. The effort will make training opportunities for practicing restoration professionals available statewide and facilitate improved and increased communication amongst the restoration community.

OVERALL PROJECT OUTCOME AND RESULTS

Ecological restoration is increasingly relied on as a conservation strategy in Minnesota even though project failure rates remain high. To improve ecological restoration success in Minnesota, this project developed training opportunities for practicing restoration professionals. We established the Ecological Restoration Training Cooperative (ERTC), which is based at the University of Minnesota, and coordinated as a partnership between state agencies and the University. A program of web-based, instructor-guided learning, combined with field sessions offered at multiple locations, are the first of its kind in the US for restoration. As part of this project, the training cooperative developed and offered five application-oriented online courses accessible statewide. These courses covering site assessment, seeding, planting, vegetation management and monitoring, were taken by 113 people during the "pilot phase". Each course will be offered at least twice a year through the U of MN College of Continuing Education. In conjunction with the online courses, field training sessions were developed for the seeding and vegetation management courses. These sessions focus on hands-on restoration skills introduced in the online courses. A four-year agreement with DNR Parks and Trails will allow each of the two field sessions to be taught by DNR natural resource specialists at four out-state locations each year in order to facilitate access to the training opportunities by individuals from around the state.

In addition to the five training courses, the ERTC developed several other ways for restoration practitioners to learn skills and stay current. A webinar series, an annual workshop, social network, and website were all launched as part of ERTIC programming. During this grant period, five webinars were held, which were attended by over 1000 people. These presentations were recorded and are available on the practitioner's network, which has 187 members to date. The first annual conference, focused on restoration monitoring, was held in May 2013. Information on all upcoming events, including online courses can be found on the ERTC website, www.restoringminnesota.umn.edu. Details about the content of online courses, field sessions, webinars, and the workshop are presented in a supplemental report.

PROJECT RESULTS USE AND DISSEMINATION

Information from this project has been made available in the following ways:

- Information on training opportunities is made available through the ERTC website, which was accessed over 2600 times in the past 18 months.
- Recorded webinar presentations are available through the ERTC practitioner's network, which is also linked to the website.
- Course and workshop information has been (and will continue to be) disseminated to over 6000 people, which is part of an active marketing effort led by the College of Continuing Education.
- The innovative approaches taken to the online courses have been communicated by press-releases connected to the R1Edu national university network.
- The innovative suite of training opportunities will be communicated with restoration researchers and practitioners at a talk to presented to the Society for Ecological Restoration International Congress to be held in October 2013.

Of the 140 people that completed the course as beta-testers or in the pilot phase, many were middle-level managers responsible for contracting and program coordination. These individuals have first-hand experience with the course and are in a position to recommend it to colleagues that need/want to advance their skills.

Project Publication:

Ecological Restoration Training Cooperative: Supplemental Report (PDF - 6 MB)

Project completed: 06/30/2013

Scientific and Natural Areas and Native Prairie Restoration, Enhancement, and Acquisition
Subd. 04b $1,750,000

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Appropriation Language
$1,750,000 is from the trust fund to the commissioner of natural resources to acquire lands with high quality native plant communities and rare features to be established as scientific and natural areas as provided in Minnesota Statutes, section 86A.05, subdivision 5, restore parts of scientific and natural areas, and provide assistance and incentives for native prairie landowners. A list of proposed acquisitions must be provided as part of the required work program. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Minnesota's Scientific and Natural Areas (SNA) Program is an effort to preserve and perpetuate the state's ecological diversity and ensure that no single rare feature is lost from any region of the state. This includes landforms, fossil remains, plant and animal communities, rare and endangered species, and other unique biotic or geological features. These sites play an important role in scientific study, public education, and outdoor recreation. The Minnesota Department of Natural Resources is using this appropriation to conduct restoration activities on approximately 3,200 acres in existing SNAs, to acquire an additional 80 acres to be added to the SNA system, and to provide technical assistance to private landowners of native prairie.

OVERALL PROJECT OUTCOME AND RESULTS
Permanent protection of biodiversity significance sites was achieved on 235 acres: 162 acres were acquired in fee as Scientific and Natural Areas (SNAs) and 73 acres were protected through Native Prairie Bank (NPB) conservation easements. This appropriation helped create the new Mille Lakes Moraine SNA and Badoura Jack Pine Forest SNA. Additions were acquired to Blanket Flower Prairie and St. Wendel Tamarack Bog SNAs. Two NPB easements were acquired in the Correll Working Lands area. Seventeen NPB easement baseline property reports were completed.

Restoration and enhancement accomplishments on over 4,000 acres included: native seed collection from 186 acres (16 sites) and seeding of 68 acres (11 sites); invasives species control on 1,175 acres (about 73 sites), invasive species inventory on 2,646 acres (36 sites), and 4 invasives boot brush kiosks installed (3 sites); prescribed burning of 3,733 acres (54 sites); new interpretive signs for 5 SNAs and installation of other signs (31 sites); 4.3 miles of fence removed, repaired or built; and 6 sites cleaned up. About 84 of these projects involved CCM. Twenty-six adaptive management plans were completed by primarily by contractors (covering 5603 acres) all or in part with this appropriation. Ecological prairie monitoring has been conducted on pollinators at 14 SNAs, snakes at 1 SNA, birds at 2 SNAs, and prairie vegetation at 6 SNA and 6 NPB sites. Improvements to the Adaptive Management Spatial Database were implemented.

Prairie stewardship work was comprised of two prairie landowner workshops, three prairie practitioner forums, presentations at an environmental fair, and direct technical assistance to 75 native prairie landowners. Contractors prepared 36 Prairie Stewardship Plans and staff have completed 2 Prairie Stewardship Plans. All 500 Prairie Tax Exemption sites were reviewed, re-enrollment letters were sent to 250 PTE landowners, and 30 applications were processed.

Project completed: 06/30/2014

State Park Improvements
Subd. 04c $814,000

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Appropriation Language
$567,000 is from the trust fund to the commissioner of natural resources for state park capital improvements and natural resource restoration. Of this amount, $250,000 is for solar energy installations in state parks and the remaining amount shall be used for park and campground restoration and improvements. Priority shall be for projects that address existing threats to public water resources. On July 1, 2010, the unobligated balance, estimated to be $200,000, of the appropriation for clean energy resource teams and community wind energy rebates in Laws 2005, First Special Session chapter 1, article 2, section 11, subdivision 10, paragraph (a), as amended by Laws 2006, chapter 243, section 15, and extended by Laws 2009, chapter 143, section 2, subdivision 16, is transferred and added to this appropriation. On July 1, 2010, the $47,000 appropriated in Laws 2009, chapter 143, section 2, subdivision 6, paragraph (f), for native plant biodiversity, invasive plant species, and invertebrates is transferred and added to this appropriation.

PROJECT OVERVIEW
Several of Minnesota's state parks and recreation areas will be receiving energy efficiency improvements, water quality enhancement upgrades, or additional visitor facilities. The Minnesota Department of Natural Resources is using this appropriation to install photovoltaic energy generation equipment and solar-powered water wells, rehabilitate stormwater collection and storage systems, repair and stabilize stream bank erosion, and construct rustic camper cabins. A number of parks are slated for improvements, including St Croix State Park near Hinckley, Soudan Underground Mine State Park near Ely, and Split Rock Lighthouse State Park and Tettegouche State Park along the north shore of Lake Superior.

OVERALL PROJECT OUTCOME AND RESULTS
The purpose of this project was to focus on renewable energy improvements, water quality enhancement, and attracting new users at Minnesota State Parks and Recreation Areas. This project consisted of installation of photovoltaic solar generation facilities at Tettegouche State Park, the construction of 4 rustic camper cabins at Lake Bemidji State Park, and the major rehabilitation of the storm water management system and repair of an eroding river bank at St. Croix State Park.

The first activity was to install photovoltaic solar panels at Tettegouche State Park. This allows us to showcase renewable energy at one of our busiest parks. There were 24KW of pole-mounted photovoltaic generating equipment installed. The system has 96 panels and each panel has a nameplate power rating of 250 watts. These

panels will generate power for the brand new visitor center that will open to the public in the spring of 2014. Any excess power is exported to the electrical grid. The Utility, MN Power will credit any net excess kWh generation on the meter's monthly invoice. Annual saving are $3,200.

The second activity was to rehabilitate storm water collection and storage systems at the St. Croix State Park Visitor Center and repair and stabilize river bank erosion on the St. Croix River. Storm water treatment and storage facilities were lacking. The original storm water management system was built by the Civilian Conservation Corps (CCC) in the 1930's. A 20 car parking lot was re-graded and repaved with historic features such as stone curbing preserved. Best management practices are now demonstrated including natural treatment systems such as rain gardens, grassy swales and infiltration pipes were used to redirect storm water from the parking lot away from the river. The hillside that had eroded into the St. Croix River has been stabilized. It was re-graded and restored with native vegetation. The delta of sediment has been removed from the river.

The third activity was to construct 4 rustic camper cabins at Lake Bemidji State Park. They are well insulated to exceed the energy code by 30% and they exceed Minnesota Sustainable Design Guidelines. FRC sustainably grown lumber was used. Camper cabins have been found to attract new users who may not have camping equipment or feel comfortable sleeping out in a tent. These cabins are open for use year round. All 4 cabins have heat and electricity, a screened in porch, an outdoor fire ring for cooking and a picnic table. Two of the cabins sleep 6 while the other two are wheelchair accessible and sleep 5. Along with the cabins, 2 vault toilets were installed within close proximity as well as 2 wells for drinking water. Since the cabins opened in June 2012 there have been 959 occupied site nights.

Project completed: 6/30/2014

State Park Land Acquisition
Subd. 04d $1,750,000

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Appropriation Language
$1,750,000 is from the trust fund to the commissioner of natural resources to acquire and preserve critical parcels within the statutory boundaries of state parks. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards as determined by the commissioner of natural resources. A list of proposed acquisitions must be provided as part of the required work program.

PROJECT OVERVIEW
Privately owned lands exist within the designated boundaries of state parks throughout Minnesota. Purchase of these lands from willing landowners for addition to the state park system makes them permanently available for public recreation and enjoyment and facilitates more efficient management. The Minnesota Department of Natural Resources is using this appropriation to acquire 9 acres for Crow Wing State Park northeast of Brainerd, 160 acres for Scenic State Park north of Grand Rapids, 55 acres for Tettegouche State Park north of Silver Bay, and 19 acres for Split Rock Lighthouse State Park northeast of Two Harbors.

OVERALL PROJECT OUTCOME AND RESULTS

Environment and Natural Resources Trust Fund funding resulted in the Department of Natural Resources acquiring approximately 267 acres of land within the statutory boundaries of five Minnesota State Parks:

- Acquired approximately 13 acres in Crow Wing State Park comprised of three parcels on the Crow Wing River. This acquisition provides additional shoreline protection and adds to the recreational opportunities now offered in this State Park such as hiking, and access to the river.
- Acquired approximately 160 acres at Scenic State Park with very high quality natural and cultural resource value and adjacent to state park lands on two sides. A Civilian Conservation Corps. (CCC) built cabin is located on the lakeshore.
- Acquired approximately 55 acres at Tettegouche State Park to preserve and protect over 700 feet of the Baptism River gorge and views from nearby Illgen Falls. The state park surrounds this parcel on three sides and may offer additional hiking trail opportunities.
- Acquired a portion of 19 acres at Split Rock Lighthouse State Park which directly overlooks Lake Superior with views of Split Rock Lighthouse. The property is surrounded by state park land.
- Partially funded the acquisition of approximately 20 acres of land in Nerstrand Big Woods State Park located in Rice County. This property was identified as outstanding biodiversity significance by Minnesota County Biological Survey and has not been logged in over 100 years. Spring ephemerals are prevalent in this area of the park and the site is important to maintaining the closed canopy and diverse understory characteristic of 'big woods' in Nerstrand Big Woods State Park.

PROJECT RESULTS USE AND DISSEMINATION
As state park maps are updated these former private lands are identified as public land open to use by all park visitors.

Project completed: 06/30/2013

Protection of Rare Granite Rock Outcrop Ecosystem
Subd. 04e $1,800,000

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Appropriation Language
$1,800,000 is from the trust fund to the Board of Water and Soil Resources, in cooperation with the Renville Soil and Water Conservation District, to continue to acquire perpetual easements of unique granite rock outcrops, located in the Upper Minnesota River Valley. $418,000 of this appropriation is for fiscal year 2010 and is available the day following final enactment.

PROJECT OVERVIEW
Granite rock outcrops along the Upper Minnesota River are among the oldest exposed rock in North America, dating back approximately 3.6 billion years. These outcrops are also home to rare and specialized plant and animal communities rarely found elsewhere in Minnesota, including several types of cactus and one of Minnesota's only three lizard species, the five-lined skink. However, these rock outcrops are increasingly threatened by mining, overgrazing, and development. Through this appropriation, the Renville County Soil and Water Conservation

District is working with Minnesota's Board of Water and Soil Resources to acquire conservation easements that will permanently preserve approximately 700 acres of this endangered habitat in Chippewa, Lac qui Parle, Redwood, Renville and Yellow Medicine counties.

OVERALL PROJECT OUTCOME AND RESULTS
A total of 748.4 acres of rare and unique Minnesota River Valley landscape were permanently protected and sixteen landowners were paid $1,741,580 for voluntarily placing perpetual conservation easements on those acres. Five counties participated in the project including Lac qui Parle, Chippewa, Yellow Medicine, Redwood, and Renville. Easement applications were scored by resource professional teams and funding was based on those scores.

Soil & Water Conservation District (SWCD) employees saw a need to protect the natural environment and to provide economically viable choices for the landowners. The Minnesota River Valley contains exposed ancient granite rock outcrops that provide unique landscape features and habitat for specialized plant and animal communities rarely found elsewhere in Minnesota. No programs existed that would give landowners a payment if they chose to protect the area from development by mining, overgrazing, and other development interests. Rock outcrops are a component of the Minnesota River's riparian zone, and destruction of this unique habitat degrades water quality and wildlife habitat in the Minnesota River and its tributaries. Removal of the rock results in severe degradation and permanent loss of these unique landscape features. The Minnesota River Corridor is easily susceptible to fragmentation because it comprises such a small percentage of the Minnesota River Watershed. Past development activities and mining operations have already fragmented large areas of the fragile Minnesota River Corridor.

Demand for aggregate is growing as our population and infrastructure grow. Interest in mining exposed granite rock outcrops in the Minnesota River Valley is high because the rock is readily available and there is no overburden to remove. This encourages the practice of horizontal mining, removing the easiest and most profitable rock, and moving on. Unlike gravel mining operations, there is no reclamation plan possible for replacing this unique landscape feature once it is removed.

PROJECT RESULTS USE AND DISSEMINATION
The Renville SWCD website (www.renvilleswcd.com/) continues to update the public on the Rock Outcrop projects by posting information & photos in the "News" section of the website. Each SWCD in Minnesota is required to maintain a website. Those websites contain information on available programs and update the public on current topics of interest in the county.

Each SWCD has a unique position within their community to deliver conservation programs. SWCDs are the local "go to" agency for conservation program delivery and the staff are both trusted and respected by local landowners. Each SWCD office will personally contact landowners who have high quality rock outcrop landscapes on their property. This one-on-one contact will be a major source of providing information to the public.

Individual SWCD offices will continue to keep their local press informed on the progress of the program. In November 2009 the West Central Tribune featured a front page story which reported on Mr. Kalahar's appearance at the Renville County Board work session where he updated the County Board on the status of the project.

Project completed: 06/30/2013

Conserving Sensitive and Priority Shorelands in Cass County
Subd. 04h $300,000

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Appropriation Language
$300,000 is from the trust fund to the commissioner of natural resources for an agreement with Cass County to provide assistance for the donation of perpetual conservation easements to protect sensitive shoreland parcels for long-term protection of recreation, water quality, and critical habitat in north central Minnesota. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Cass County's 500+ high quality lakes provide habitat for fish and wildlife, recreation opportunities for Minnesotans, and they are the cornerstones for the region's local economy. However, the future of these water resources is threatened by increasing population growth and shoreland development. Cass County is using this appropriation to provide assistance to riparian landowners interested in permanently protecting critical shoreline areas through donation of perpetual conservation easements on their lands. County officials expect they will be able to help protect 1,200 to 1,500 acres of riparian land, including 3-5 miles of shoreland.

OVERALL PROJECT OUTCOME AND RESULTS
Cass County's 500+ high quality lakes provide critical fish and wildlife habitat and opportunities for public recreational enjoyment. These natural resources are also the economic engines that sustain local communities. Yet, the future quality of these water resources is threatened by increasing population growth primarily along priority lakeshores.

This project focused on permanently protecting some of the most critical shorelands in Cass County using donated conservation easements. Target shorelands were strategically identified by Cass County, the Leech Lake Area Watershed Foundation, and the Minnesota DNR through its Sensitive Shoreland Study (2008-21010) on 17 lakes in Cass County. Nine (9) landowners donated a conservation easement on their sensitive shoreland to permanently limit future development. As an incentive, the project funds assisted landowners with the closing costs associated with the conservation easement, including an IRS appraisal to enable them to take a charitable deduction for the public conservation benefit donated to the people of Minnesota. In total, 305 acres and 12,039 feet (2.5 miles) of sensitive shoreland was permanently protected.

Cass County holds 8 easements and the Minnesota Land Trust holds one easement. They will annually monitor the properties to ensure compliance with the easement terms. The 9 participating landowners on six lakes (Ten Mile, Washburn, Wabedo, Little Boy, Deep/Rice Portage, and Pine Mountain lakes) donated almost a million dollars of land value to permanently protect critical shorelands by voluntarily restricting future development. The public benefit is the protection of critical fish and wildlife habitat, reduced runoff to further protect water quality, and ultimately the assurance of continued high quality recreational opportunities on some of Minnesota's best recreational lakes. With permanent conservation accomplished at approximately $13/shoreland foot, this project is a model for cost-effective, long-term protection of recreational opportunity, water quality, and critical land and aquatic habitats on highly developed and sensitive lakeshores in North Central Minnesota.

PROJECT RESULTS USE AND DISSEMINATION
The science-based identification of sensitive shorelands and methodology for this project was the premise for Legacy Amendment funding for donated conservation easements on critical shorelands in Cass County and expanded into Crow Wing and Aitkin Counties as recommended by the Lessard Sams Outdoor Heritage Council and approved by the Minnesota Legislature in 2011. The Legacy Funding resulted in an additional 320 acres and 3.5 miles of critical shorelands permanently conserved in North Central Minnesota. To date, the two projects have

permanently protected over 6 miles of high priority shorelands in North Central Minnesota. Subsequently, due to the success of both of these projects, Phase II Legacy Funding for additional shoreland conservation in the North Central region was approved by the 2014 Minnesota Legislature.

In addition, it is anticipated that several conservation easements initiated but not completed for various reasons within the ENRTF project time frame will still come to fruition within the next several years to potentially conserve another 100 acres and 1.5 miles of critical shorelands.

The location of the 9 conservation easements in Cass County is included as a data layer in the interactive mapping on the Cass County website at www.co.cass.mn.us.

Throughout the project, hundreds of targeted landowners of sensitive shoreland received information on the benefits of conservation easements. Many presentations were made to lake associations, local governments, and community groups about the benefits of shoreland conservation. Landowner stories can be read on the Leech Lake Area Watershed Foundation website at www.leechlakewatershed.org. Seeds of interest have been sown that could result in future conservation of priority shorelands and continued assurance of public enjoyment of Minnesota's high quality lake resources in Cass County.

Project completed: 06/30/2014

Reconnecting Fragmented Prairie Landscapes
Subd. 04i $380,000

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Appropriation Language
$380,000 is from the trust fund to the commissioner of natural resources for an agreement with the Nature Conservancy to develop prairie landscape design plans and monitoring protocol involving local landowners and businesses to guide conservation, restoration, and related economic development. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Less than 1% of Minnesota's original tallgrass prairie remains today and what is left exists in scattered remnants. Restoration of healthy prairie ecosystems requires both protection and reconnection of remnants to create prairie-dominated landscape areas of 10,000-50,000 acres. However, it is unlikely such aims can be achieved without balancing desired conservation goals with an ability for local communities to utilize prairies for generating sustainable income. Through this appropriation the Nature Conservancy will work with the University of Minnesota and the local communities of two prairie landscapes in order to develop a framework for how prairie-based economic uses that balance with prairie conservation goals could provide sufficient return on labor and investment to sustain rural families and communities.

OVERALL PROJECT OUTCOME AND RESULTS
The Minnesota Prairie Conservation Plan calls for protecting native prairie and restoring connectivity to prairie core areas using grass-based agriculture as a conservation tool. To provide information and techniques needed to

meet these goals, we studied two prairie landscapes in western Minnesota: Agassiz Beach Ridges (127,000 acres) and Glacial Lakes (169,000 acres). Using GIS analysis and field survey, we developed a current land use/land cover map that revealed that even in high-quality prairie landscapes, over 25% was cropland and 31% was invasive dominated or mixed native-invasive grassland. To guide conservation activities, we identified conservation targets and specified methods for measuring progress. To rebuild functioning prairie systems, we identified all parcels containing native prairie for possible management and protection, as well as tracts that if restored, could buffer and reconnect prairie. A social analysis using interviews with local constituencies revealed support for conservation if it were tied to working grasslands that promoted rural socio-economic vitality. To facilitate needed restoration, we developed a state transition model that identified feasible restoration transitions from common "start states" (based on current land cover) to conservation and utility prairie and meadow "end states". We developed restoration plans including techniques, seed mixes, and estimated costs for twenty transitions. To make the expansion of grass-based agriculture feasible, landowners will need assistance with the restoration costs. As land use decisions are driven not only by financial returns but also potentially by the value of ecological services, ongoing InVest modeling will highlight land use patterns where the provision of public and private benefits in future scenarios is optimized. These scenarios are designed to reflect the goals of the Prairie Plan, as well as social and economic constraints. This comprehensive approach provides resources for implementing prairie conservation in western Minnesota and could serve as a model for conservation planning elsewhere.

PROJECT RESULTS USE AND DISSEMINATION
The primary purpose of this project was to provide information and techniques for the implementation of the Minnesota Prairie Conservation plan in two prairie landscapes in western Minnesota. The primary audience is individuals and organizations interested or involved in prairie conservation, especially the Prairie Plan Local Technical Teams. Some parts of the final report, including the prairie conservation planning maps and the social analysis, have already been shared with the teams. Information from the report has also been included in presentations to the teams and other local groups including the County Board of Commissioners. Parts of the report will be available on Conservancy or University websites. Over the next year, information from the report will form the basis for several planned publications in scientific journals.

Project Publication:
Implementing the Minnesota Prairie Conservation Plan in Landscapes of Western Minnesota (PDF - 11 MB)

Project completed: 6/30/2014

Subd. 05 Water Resources

Understanding Sources of Aquatic Contaminants of Emerging Concern
Subd. 05a $640,000

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RESEARCH

Appropriation Language

$640,000 is from the trust fund to the Board of Regents of the University of Minnesota to identify chemical markers to characterize sources of endocrine disruptors and pharmaceuticals entering surface waters in the Zumbro River Watershed. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Pharmaceuticals, hormones, and other contaminants of emerging concern are increasingly being found in surface waters in Minnesota and elsewhere. These contaminants can cause adverse ecological and human health impacts. However, there is a lack of understanding regarding the sources of these contaminants. Scientists at the University of Minnesota's Water Resources Center are using this appropriation to study these contaminants in the Zumbro River watershed in order to:

- Help determine what contaminants are associated with specific land uses;
- Identify methods for monitoring sources and loads of the contaminants;
- Develop science-based recommendations for prevention, reduction, and remediation strategies.
- Ultimately this information should help lead to cleaner surface waters in Minnesota.

Project due to be completed: 6/30/2014* [Extended in M.L. 2013]

***PROJECT INCOMPLETE - FINAL REPORT DUE 08/15/14 NOT RECEIVED**

Managing Mineland Sulfate Release in Saint Louis River Basin
Subd. 05b $270,000

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RESEARCH

Appropriation Language
$270,000 is from the trust fund to the commissioner of natural resources to map current sulfate sources and assess treatment options to minimize potential impacts of mercury on fish and wildlife from sulfate releases in the St. Louis River Basin. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Over a century of iron mining in northeastern Minnesota has left numerous waste rock piles, open pits, and tailings basins that appear to be the dominant sources of sulfate in the St. Louis River. This sulfate has become a recent environmental concern due to the possibility that one of the byproducts of its increased presence, methylmercury, may lead to mercury contamination in fish and other wildlife. Through this appropriation, the Minnesota Department of Natural Resources and the University of Minnesota are evaluating the sources and fate of sulfate in the St. Louis River Basin in order to better understand its impacts and determine the best means for reducing or eliminating these impacts, particularly in environments where methylmercury is a byproduct of sulfate presence.

OVERALL PROJECT OUTCOME AND RESULTS
Taconite mining on the Iron Range sends an average of approximately 35 tons of sulfate per day down the St. Louis River. Another 15 tons per day arises from non-mining sources. Loading from both sources is episodic and depends on hydrologic conditions in the watershed. Most mining-related sulfate arises from the oxidative weathering of minor iron sulfide minerals present in the mined rocks. The predominant pathway for sulfate introduction into the streams is through pumping and overflow of water from taconite pits.

In some source regions, a large percentage of sulfate released near the mines was removed by natural reactions that convert sulfate back to insoluble sulfides ("sulfate reduction"). However, once the sulfate reached the open channel ways in streams, little, if any, additional sulfate was removed by sulfate reduction. Laboratory experiments demonstrated that sulfate reduction can also be stimulated artificially in mine waters by adding organic compounds and iron minerals and eliminating oxygen. However, water hardness and the production of hydrogen sulfide were difficult to control using the methods that were tested.

Methylmercury is a toxic compound that can form as a byproduct of biologic sulfate reduction. Widespread sampling and measurement of methylmercury reveal that its concentration is minimally impacted by sulfate concentration in the main stream or river channels. The dominant source of methylmercury to streams involves the slow passage of water falling on the land through reduced, organic rich materials that surround streams in this area. Except in a few instances, sulfate from mining, added directly to streams, has limited ability to access and impact methylmercury formed in this source region. Laboratory experiments conducted on estuary sediments also indicated that the rate of methylmercury addition to the water column is not directly controlled by sulfate concentration in the overlying water.

PROJECT RESULTS USE AND DISSEMINATION
The work by our group has been widely presented to outside groups including scientists and stakeholders. Plans are in works to publish all or parts of the above reports in peer reviewed journals over the next year.

Three reports and two MS theses were produced directly as a result of this research. Several reports were placed on the DNR's website in late October 2012. This website will be updated to reflect more recent reports by October 2013.

Project Publications:

- Carbon and Iron Additions to Stimulate In-Pit Sulfate Reduction and Removal (PDF - 0.7 MB)
- On the Cycling of Sulfur and Mercury in the St. Louis River Watershed, Northeastern Minnesota (PDF - 5.5 MB)
- Mineralogy, Spatial Distribution, and Isotope Geochemistry of Sulfide Minerals in the Biwabik Iron Formation (PDF - 4.6 MB)
- Sulfur and Carbon Controls on Methyl Mercury in St. Louis River Estuary Sediment - Phase II (PDF - 1.4 MB)
- Sulfate and Mercury Chemistry of the St. Louis River in Northeastern Minnesota (PDF - 1.3 MB)
- Sulfate and Mercury Cycling in Five Wetlands and a Lake Receiving Sulfate from Taconite Mines in Northeastern Minnesota (PDF - 7.0 MB)

Project completed: 06/30/2013

Ecological Impacts of Effluent in Surface Waters and Fish
Subd. 05c $340,000

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RESEARCH

Appropriation Language
$340,000 is from the trust fund to the Board of Regents of the University of Minnesota in cooperation with St. Cloud State University to determine the chemical and biological fate of phytoestrogens in surface waters and the impacts on fish. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Phytoestrogens are plant-based compounds that are discharged into surface water from wastewater treatment plants and certain industrial facilities. Phytoestrogens mimic the hormone estrogen and can therefore interfere with normal biological development. For example, it is known that they can feminize male fish. However, the broader effects of phytoestrogens have not been studied and almost nothing is known about their long-term fate or persistence in the environment. Through this appropriation scientists from the University of Minnesota and St Cloud State University will collaborate to examine the persistence of phytoestrogens in surface waters and their effects on fish. Findings will be used to enhance wastewater treatment and help facilitate continued industrial development and production in Minnesota done in an environmentally sensitive manner.

OVERALL PROJECT OUTCOME AND RESULTS
Phytoestrogens are plant-based compounds that mimic estrogen and can interfere with normal biological development. Research shows that phytoestrogens are discharged into surface water from wastewater treatment plants and certain industries. The biological effects of these compounds have not been well studied, although it is known that they can feminize male fish. Almost nothing is known about their environmental fate. When these compounds enter rivers and streams, it is likely that they will be degraded and therefore may have a lessened impact on biota, but this needs to be confirmed.

In this project, the persistence of two common phytoestrogens (genistein and daidzein) was studied. Fathead minnow exposure experiments at realistic environmental concentrations were also performed. Experiments demonstrated that genistein and daidzein reacted with sunlight. These two compounds also biodegraded rapidly in natural water samples; the rate of degradation depended on phytoestrogen concentration, water/incubation temperature, and the source of the water. Sorption experiments showed that phytoestrogens sorb to sediment, but this is not likely to be an important loss mechanism. Adult fathead minnow exposure experiments showed that only subtle effects on anatomy, physiology, and behavior of fathead minnows occurred as a result of exposure to phytoestrogens singly or in mixtures. The one exception to this was the fact that adult fathead minnows produced significantly more eggs when exposed to daidzein. Larval minnow exposures showed that exposure to genistein, formononetin (another common phytoestrogen), and a mixture of phytoestrogens had a negative impact on larval survival. Adult and larval exposures to microbiologically degraded phytoestrogens showed negative impacts on adult egg production. This research indicates that genistein, daidzein, and formononetin are unlikely to cause widespread ecological harm themselves in the absence of other stressors; nevertheless, caution should be exercised with respect to high concentration effluents due to the potentially anti-estrogenic effects of phytoestrogen degradates.

PROJECT RESULTS USE AND DISSEMINATION

Results have been disseminated at several conferences. In addition, one manuscript has been published, two additional manuscripts have been submitted, and a fourth is being revised and will be submitted for publication in August or September, 2013. This project also resulted in the generation of two Master's theses and one Ph.D. thesis.

Project Publications:

- Phytoestrogens in the Environment I: Occurrence and Exposure Effects on Fathead Minnows (PDF - .7 MB)
- Phtoestrogens in the Environment II: Microbiological Degradation of Phytoestrogens and the Response of Fathead Minnows to Degradate Exposure (PDF - 1.2 MB)
- Direct and Indirect Photolysis of the Phytoestrogens Genistein and Daidzein (PDF - 2 MB)

Project completed: 06/30/2013

Assessing Septic System Discharge to Lakes
Subd. 05e $594,000

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RESEARCH

Appropriation Language
$594,000 is from the trust fund to the commissioner of health for department activities and for an agreement with the United States Geologic Survey in cooperation with St. Cloud State University to develop quantitative data on septic system discharge of estrogenic and pharmaceutical compounds and assess septic and watershed influences on levels of contamination and biological responses in Minnesota lakes. The United States Geologic Survey is not subject to the requirements in Minnesota Statutes, section 116P.10. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Pharmaceuticals, hormones, and other contaminants of emerging concern are increasingly being found in surface waters in Minnesota, including the state's lakes. Recent research surveying Minnesota lakes found that the most frequent occurrence of these chemicals was in lakes with a high density of septic systems. In river ecosystems some of these chemicals have been known to cause extinction of forage fish species and abnormal sexual development in other fish species, such as bass and walleye. However, little is known about how these compounds affect fish populations in lake ecosystems. Researchers from the U.S. Geological Survey, St. Cloud State University, and the Minnesota Department of Health will cooperatively use this appropriation to help assess which of these chemicals are most frequently present in lakes with high septic system concentration and determine whether native fish populations are being affected. Part of this appropriation will help pay for specialized equipment to study these chemical compounds, expanding the capability of the research laboratory at the Department of Health.

OVERALL PROJECT OUTCOME AND RESULTS

The current study (1) sampled 20 Minnesota lakes that receive groundwater under the potential influence of septic systems to determine the occurrence of pharmaceutically active compounds (PhACs) and endocrine active compounds (EACs), (2) assessed watershed and groundwater characteristics that may contribute to the frequency of PhAC and EAC detections, (3) assessed the histo-pathology of actively spawning bluegill sunfish for biomarkers of EAC exposure to compounds in the near-shore zone of four target lakes, and (4) enhanced EAC analytical capabilities at the Minnesota Department of Health (MDH) through the purchase of new analytical equipment. Study lakes were chosen based on depth to water table, septic system density regardless of functionality, bluegill nesting habitat, and groundwater temperature surveys in the near-shore zone. Lake water or lake-sediment pore water (water stored between sediment particles,contained within the lake-bed sediment) samples were collected and analyzed for a broad suite of 179 PhACs, EACs, and other waste compounds. All surface water samples and over three quarters of pore water samples had at least one compound detected. Overall, 43 of 69 (62%) waste compounds and 5 of 110 (4%) pharmaceuticals were detected in all samples. Twelve known or suspected endocrine active compounds were detected in at least one lake. On average, the prevalence of detections normalized to the number of compounds tested was three to four times higher in near-shore lake water than in near-shore pore water. Actively spawning male bluegill sunfish were collected from reference and groundwater discharge sites in four lakes. Pathologies were more common in fish collected at near-shore sites when compared to fish collected across entire lakes in the 2008 statewide study. The greater abundance of indicators of adverse biological impact suggests that a lake-wide sampling of fish will underestimate the impact of contaminant exposure to fish during reproductively important life stages.

PROJECT RESULTS USE AND DISSEMINATION
Information from this project has been disseminated to scientific audiences via presentations at Minnesota Water Resources and Midwest Groundwater Conferences.

Project completed: 6/30/2014

Assessing Cumulative Impacts of Shoreline Development
Subd. 05h $300,000

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RESEARCH

Appropriation Language
$300,000 is from the trust fund to the Board of Regents of the University of Minnesota to evaluate near-shore, in-water habitat impacts from shoreline development activities to assist in the design and implementation of management practices protecting critical shorelands and aquatic habitat. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Near-shore areas of lakes are critical to the health of lake ecosystems because they contain a majority of the vegetation and are generally the spawning areas for fish. Increases in the rate and extent of shoreline development - including docks, boatlifts, and other structures - and disturbance from recreational activity may be having cumulative detrimental impacts on these ecosystems. However, there is a lack of scientific knowledge

about these impacts and that has been hindering lake managers in their ability to guide landowners toward better practices. Researchers from the University of Minnesota and the U.S. Geological Survey are using this appropriation to study the cumulative impacts of shoreline development on aquatic habitat, water quality, and fish populations in order to develop a tool that can be used to help guide sustainable near-shore development. Approximately 100 lakes in Aitkin, Becker, Cass, Crow Wing, Douglas, Hubbard, Morrison, Otter Tail and Todd counties will be used in the study.

OVERALL PROJECT OUTCOME AND RESULTS

The littoral zone contains all of the vegetation within a lake and is critical to the physical and biological integrity of lakes. Aquatic macrophytes and coarse woody structure provide refuge, foraging area, and spawning substrate for many fish species. The goal of this study was to evaluate shoreline development by measuring a number of variables that reflect human activity, including terrestrial vegetation, physical alterations, and in-lake structures. Previous studies have found reductions in abundance of aquatic vegetation and coarse woody structure; however, few studies have quantified the specific influence of docks on aquatic habitat structure. Coarse woody structure and three measures of macrophyte abundance increased with distance to the nearest dock structure. Presence of coarse woody structure and emergent species were significantly and negatively related to lake-wide dock density. We intensively investigated effects of lakeshore development on nearshore habitat across 11 northern Minnesota lakes using the Minnesota Department of Natural Resources Score Your Shore (SYS) survey to assess development intensity. Developed sites (a residence and dock present) had lower macrophyte species richness, emergent, and floating-leaf macrophytes and coarse woody structure than undeveloped sites (no residence, no dock). SYS score was a significant factor in models of most macrophyte community variables, supporting the hypothesis that site-scale development intensity is related to littoral vegetation. A fish Index of Biological Integrity decreased as the density of docks increased for the 11 intensively studied lakes. Development density across 29 lakes and 114 lakes were also examined, but less intensively. Effects of development in these less intensively studied lakes were less apparent for most lake macrophyte and fish community variables than for the intensively studied lakes. These findings suggest that riparian management on residential lots and reduced removal of aquatic macrophytes and coarse woody structure could improve fish habitat at both local and lake-wide scales of development.

PROJECT RESULTS USE AND DISSEMINATION

The project was conducted in conjunction with the Minnesota Department of Natural Resources and several meetings to disseminate our findings took place with Jacquelyn Bacigalupi, the Lake IBI Coordinator with MNDNR and colleagues. Additionally multiple conference presentations were given and two Master's theses resulted from the work on this project.

Project completed: 6/30/2012

Trout Stream Assessments
Subd. 05i $300,000

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RESEARCH

Appropriation Language

$300,000 is from the trust fund to the Board of Regents of the University of Minnesota to assess cold water aquatic insect abundance related to warming water temperatures as predictors of trout growth in southeastern Minnesota and assess options to minimize stream temperature changes. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW

Trout require streams with excellent water quality that are fed by groundwaters that keep streams cold in summer but ice-free in winter. Minnesota has more than 680 designated trout streams that represent a valuable natural resource having high economic, sport, and habitat importance. However, over the long term this resource is under threat from climate change, which will likely increase stream temperatures and could detrimentally impact trout behavior, reproduction success, and food sources, particularly the cold-adapted aquatic insects that are essential in winter diets of trout. This appropriation is enabling University of Minnesota's Department of Entomology to study the health of trout streams in southeastern Minnesota and how changes in stream temperatures could impact the diets and growth of trout populations.

OVERALL PROJECT OUTCOME AND RESULTS

Trout streams in southeastern Minnesota differ markedly in brown trout abundance and growth during winter. Our project objectives were to better understand stream thermal regimes, fish feeding, and fish growth patterns between November and March, so habitat management strategies can be designed to maximize trout production. Prior to this study there was very little detailed knowledge of the winter diets of trout, and virtually no knowledge of the kinds and quantitative abundances of aquatic insects growing during winter. To achieve project objectives, we assessed trout lengths and mass two or three times per winter in 36 streams (12 streams/year for three years) and determined the types of aquatic invertebrates eaten by the trout, the abundances of these dietary organisms in the streams, and the corresponding patterns of trout growth. Our findings show trout are most abundant in streams where groundwater (springs and seeps) inputs keep water temperatures significantly warmer and ice-free in winter. These thermal conditions promote high abundance or emergence of aquatic insects specifically adapted for emergence and reproduction in winter, even when air temperatures are substantially below freezing. Some species that we discovered have never been described and are new to science. We developed predictive models relating air temperatures to water temperatures in areas buffered by groundwater. The models also demonstrate linkages between groundwater input and (1) the corresponding aquatic insect composition and their abundances, (2) the trout diets during winter and (3) trout growth patterns as a function of types of aquatic insects eaten. Based on our predictive models we are able to recommend conditions under which in-stream habitat management efforts can be better spatially focused to maximize trout growth and abundance. This information is being communicated to Trout Unlimited and the MN Department of Natural Resources to help inform their programs to manage trout streams.

PROJECT RESULTS USE AND DISSEMINATION

Our results have been presented at local, state, regional, national and international scientific meetings and at local and state conservation planning sessions. Staff of the MN DNR assisted with much of our field work and have participated in interpreting and writing summaries and drafts of manuscripts for peer review. Consequently, they are very familiar with our findings. In addition, we are communicating our results to regional Trout Unlimited members, and hope to be able to discuss how our findings can help guide the in-stream habitat improvement programs. Two theses have been completed, and three additional graduate students will use portions of our findings as sections for their Ph.D. dissertations. One undergraduate worked on a class activity in Spanish to help serve as an "in-reach" effort to inform undergraduates in areas such as humanities and arts of our research. One newspaper article was written, and we have put videos of our field work on-line for public viewing via our Facebook sites.

Project Publication:

Winter feeding, growth and condition of brown trout Salmo trutta in a groundwater dominated stream

Project completed: 6/30/2013

Subd. 06 Aquatic and Terrestrial Invasive Species

Biological Control of European Buckthorn and Garlic Mustard
Subd. 06a $300,000

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RESEARCH

Appropriation Language
$300,000 is from the trust fund to the commissioner of natural resources in cooperation with the commissioner of agriculture to continue the development and implementation of biological control for European buckthorn and garlic mustard.This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
European buckthorn and garlic mustard are non-native, invasive plant species that have rapidly spread throughout Minnesota posing serious threats to native plant communities and degrading wildlife habitat in forests and riparian areas. The two plants are considered to be the species of highest priority for development of long-term management solutions, such as biological control, which involves using natural enemies of a non-native species from its native region to control or reduce the impact of the species in the areas where they are invasive. Introducing one non-native species to control another, though, is something that must be done with care so that the introduction doesn't have unintended consequences. This appropriation is enabling the Minnesota Departments of Natural Resources and Agriculture to continue to research and evaluate biological control options for European buckthorn and garlic mustard.

OVERALL PROJECT OUTCOME AND RESULTS
European/common buckthorn (Rhamnus cathartica) and garlic mustard (Alliaria petiolata) are non-native invasive plants that severely threaten native plant communities and degrade wildlife habitat. They are widely distributed in the state and current control options, such as mechanical and chemical control, are labor and cost-intensive. They are of the highest priority for development of long-term management solutions, such as biological control. The purpose of this research was to determine 1) if there are suitable insects that can be used to reduce impacts caused by buckthorn and 2) implement introduction of insects to control garlic mustard and assess their establishment and success.

Over 30 specialized insects were identified as potential common buckthorn biocontrol. Most of these species were discarded because they lacked host-specificity. Two psyllids were host-specific, but did not cause significant damage to buckthorn and the insects were infected with the plant disease 'Candidatus Phytoplasma rhamni' (buckthorn witches' broom). A seed-feeding midge proved too difficult to work with in a research setting. After 11 years of searching for a biological control insect that is host-specific and damaging to buckthorn, we conclude that there are not promising agents at this time.

Four Ceutorhynchus weevil species are being studied as biological control agents for garlic mustard. Petitions for release were submitted to the USDA-APHIS Technical Advisory Group starting in 2008, but they have requested

additional host-specificity testing over time. No biological control insects have been approved for release as of 2014. Studies conducted in the University of Minnesota Containment Facility allowed the development of efficient and consistently reliable methods to rear C. scrobicollis from garlic mustard plants. Long-term monitoring at twelve sites in Minnesota shows that garlic mustard populations can fluctuate widely from year to year. There is little garlic mustard herbivory in Minnesota. Garlic mustard cover is negatively correlated with cover of other species.

PROJECT RESULTS USE AND DISSEMINATION
Buckthorn biological control research has been disseminated in one peer reviewed journal publication, a summary report by CABI, four poster presentations, and a webpage on the DNR website: http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorn/biocontrol.html.

Garlic mustard biological control research has been disseminated in one peer reviewed journal publication, a U.S. Forest service report (http://www.fs.fed.us/foresthealth/technology/pdfs/GarlicMustardBiocontrol_FHTET-2012-05.pdf), project reports, and seven conference presentations.

Project Publications:

- Garlic Mustard (Alliaria petiolata) Monitoring in Minnesota: 2005-2013 (PDF - 1.2 MB)
- Biology and Biological Control of Garlic Mustard (PDF - 2.8 MB)
- Garlic Mustard Biological Control Developing Biological Control Insects, Working Towards Field Release (PDF - 0.2 MB)
- The Garlic Mustard (Alliaria petiolata) Case, What Makes a Good Biological Control Target: The Intersection of Science, Perspectives, Policy and Regulation (PDF - 0.4 MB)
- Biological control of common buckthorn, Rhamnus cathartica (PDF - 4.6 MB)
- Biological control of Rhamnus cathartica: is it feasible? A review of work done in 2002-2012 (PDF - 0.1 MB)

Project completed: 06/30/2013

Healthy Forests to Resist Invasion
Subd. 06c $359,000

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RESEARCH

Appropriation Language
$359,000 is from the trust fund to the Board of Regents of the University of Minnesota to assess the role of forest health management in resisting infestation of invasive species. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW

Invasive plants cause considerable ecological and economic damage in Minnesota and their control is often difficult to achieve in a long-term cost-effective manner. Although not immune from invasion, healthy forests may be somewhat resistant to invasion; therefore management aimed at maintaining, restoring, or enhancing key forest characteristics might be a useful strategy for slowing forest invasion. Scientists from the University of Minnesota's Department of Forest Resources will use this appropriation to study 80 different forest sites in order to determine the links between forest attributes and plant invasion. Findings will be used to make recommendations for how to best manage forests to resist invasive species.

OVERALL PROJECT OUTCOME AND RESULTS

The primary project goal was to identify forest characteristics effective as deterrents to invasive plants. Healthy forests are likely more resistant to invaders, so management to enhance these key characteristics might slow the spread of invaders.

Invasive plants sometimes form dense thickets that affect recreation and wildlife and exclude native plant species. To determine how various site characteristics affected the abundance of common buckthorn and other invaders, we surveyed plant diversity in 67 sites in central and southern Minnesota. At each site, we measured environmental characteristics to simultaneously account for other factors that might influence invasibility. Buckthorn was most abundant in sites with sparse leaf litter, where seed availability was high, and where native plant diversity was low. Both a greenhouse experiment and a second field study indicated that introduced earthworms also benefit germinating invasive plants by eliminating leaf litter.

We propose the idea of "preventive environmental care" that, like preventative medicine, manages forests to maintain "wellness". Although not a panacea for reducing invasion, it is worth considering given the challenges of controlling established invasive species. We suggest managers enhance the competitive challenge to invaders by increasing the diversity of native species by seeding natives and/or reducing the density of white-tailed deer, a species that severely impacts native forest plants. Furthermore, timber harvests should be limited to the winter season and trail maintenance should be done in a way that limits disturbance. This will help maintain intact native understory plants and litter layers, important deterrents to invasive plant establishment. However, none of these approaches are likely to be successful without a strong effort to control landscape level seed availability. Collaborative management with neighboring landowners is crucial to any effort that hopes to reduce invasibility.

PROJECT RESULTS USE AND DISSEMINATION

To summarize results from the project and provide guidelines for management, we prepared a pamphlet that included all aspects of the research, as it pertains to the invasion of buckthorn. The pamphlet also provides suggestions for pre-invasion management to reduce invasibility, the main focus of the "Healthy Forests" research project. We distributed the pamphlet to all participants at a symposium held on August 14, 2013. The pamphlet is available as a pdf from the project website, http://forestecology.cfans.umn.edu/Research/Buckthorn/index.htm.

We presented talks at the Upper Midwest Invasive Species conference (a regional meeting focused on invasive species) and the Ecological Society of America conference (an international conference focusing on all aspects of ecology) in 2012 and 2013. The talks focused on measuring propagule pressure, the greenhouse study, the relationship between earthworm and buckthorn buckthorn, and the effects of native species diversity on buckthorn abundance.

On August 14, we hosted a symposium on the St. Paul campus that brought together managers, researchers, and private landowners to share the latest information on invasive plants in Minnesota forests. In addition to talks based on this LCCMR project, other speakers presented information about buckthorn invasion on the prairie-forest border in west central Minnesota, garlic mustard (another common plant invader in Minnesota's forests) as a driver of species invasion, management of buckthorn from a forester's perspective, and management efforts to control other common invasive plants. The symposium was attended by 100 people. The project website has links to recordings of all the symposium talks, as well as links to the MS Access database, species lists from all survey sites, and a photo gallery.

We have published one paper ("Community phylogenetic diversity and abiotic site characteristics influence abundance of the invasive plant Rhamnus cathartica L.") in the Journal of Plant Ecology. A second paper based on results from our greenhouse experiment (Native plant diversity and introduced earthworms have contrasting effects on the success of invasive plants") has been submitted to the peer-reviewed journal Biological Invasions. More papers are in preparation including one focusing on propagule pressure and another that documents the relationship between earthworms and buckthorn abundance.

Project completed: 6/30/2013

Bioacoustic Traps for Management of Round Goby
Subd. 06d $175,000

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RESEARCH

Appropriation Language
$175,000 is from the trust fund to the Board of Regents of the University of Minnesota to evaluate bioacoustic technology specific to invasive round goby in Lake Superior as a method for early detection and population reduction. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The round goby is an invasive fish that is rapidly spreading throughout the Great Lakes. One reason for its rapid expansion is that round goby outcompetes native fish through its ability to spawn throughout the spring and summer in contrast to native fish, which only spawn once a year. Interrupting this reproductive cycle in some way could be used to help halt further expansion of round goby and control existing populations. Scientists from the University of Minnesota - Duluth are using this appropriation to develop and test a method for trapping these fish using sounds that mimic those that male gobies use to attract females to the nest.

OVERALL PROJECT OUTCOME AND RESULTS
The bioacoustics of the round goby population in the Duluth-Superior Harbor were investigated over the course of three summers. The goal of the project was to assess the behavior and the sound production of this invasive species to develop a fish trap to target this invasive species. Fish were found to move offshore during the winter and thus subsequent concentrations were thought to have great potential for collection. However, fish were found to be inactive the majority of the winter and did not produce sound. Sound production coincided with the resumption of swimming activity and feeding in late spring with vocalization first recorded when water temperature exceeded 8 degrees C, which correlated with the initiation of spawning. Two choice experimental trials succeeded in attracting the fish to sound sources using both pure tones and round goby vocalizations, indicating that fish can find the origin of sound. Several different traps were produced and bioacoustical field trials were conducted. We were able to capture, for the first time, round gobies in unbaited traps using sound as the only stimulus and observed many round gobies approach sound sources but fail to enter the traps. As they readily enter the same traps when baited, it was concluded that although sound is an effective attractant, it is not the only sensory modality that round goby use to approach calling males. Future experiments that would combine sound

with a large sexually mature fish and/or pheromones could significantly increase the number of fish that enter the trap and could prove to be an effective strategy.

PROJECT RESULTS USE AND DISSEMINATION
Project manager collaborated with the Great Lakes aquarium to produce a audio video exhibit on invasive fish. Two master's students, Jared Leino (degree pending) and Elise Cordo (degree in progress), received funding from the project and five undergraduate students received funding for summer research. Additionally several manuscripts are in preparation and will be submitted for publication.

Project completed: 6/30/2013

Subd. 07 Renewable Energy

Algae for Fuels Pilot Project
Subd. 07a $900,000

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Appropriation Language
$900,000 is from the trust fund to the Board of Regents of the University of Minnesota to demonstrate an innovative microalgae production system utilizing and treating sanitary wastewater to produce biofuels from algae. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Biomass-based energy holds important potential as a viable renewable alternative to non-renewable fossil-based energy supplies; however significant challenges to biomass energy technologies remain to be overcome before such a role can be achieved at a large scale. Researchers at the University of Minnesota's Center for Biorefining, in partnership with the Metropolitan Council, are using this appropriation to develop, build, and test a pilot scale fuel production system that uses the nutrients in sewage wastewater to grow algae that can then be harvested to produce biodiesel. Additional benefits resulting from the system may include improved water quality, minimized freshwater and land use, reduced carbon emissions, and capture and recycling of plant nutrients. With additional research and development of this system it could potentially be implemented at other wastewater treatment facilities and adapted to other waste streams throughout Minnesota and beyond.

OVERALL PROJECT OUTCOME AND RESULTS
Current biomass energy technologies have encountered economic, ecological, and policy concerns, including feed stock procurement, energy balance, carbon footprint, competition for food and fuel, water use, and others. This project was built on our existing collaborative R&D partnership to demonstrate an innovative photosynthetic algae production system which simultaneously produces high lipid oil for bio-fuel production, captures and recycles nitrogen and phosphorus from wastewater, and sequesters carbon dioxide. The goal of the project was to develop, build, and test a pilot scale algae production system that will treat concentrated wastewater and animal facility wastewater and generate algal biomass for production of biofuels and bioproducts. More than 10 high

performance algae strains have been developed for specific applications such as oil accumulation, nutrient removal, growth under low temperature and low light conditions, and accumulation of high value lipids. Growth conditions were optimized for specific applications. A pilot cultivation facility with a cultivation volume of 20,000 liters was developed and demonstrated. The microwave assisted pyrolysis was found to be an excellent conversion alternative to conventional oil extraction based biodiesel process, and the hydrothermal process is a cost effective pretreatment technology to improve dewatering of algal biomass. The life cycle analysis results indicate that our technologies, which integrate wastewater into algal cultivation, can improve the environmental performance of algal biofuels. The life cycle analysis study also suggests that utilization of multiple major waste streams in wastewater plants should be developed to maximize the economic and environmental benefits of algae based technologies. The outcomes of the project point to a great potential of algae technologies for simultaneous removal of nitrogen, phosphorus, chemical oxygen demand (COD), and other nutrients in municipal and animal wastewaters; sequestration of carbons in organic matters and flue gas; and at the same time accumulation of biomass for production of high vale biofuels and bioproducts.

PROJECT RESULTS USE AND DISSEMINATION
Information about the project results were disseminated through more than 10 presentations at national and international conferences, five demonstrations to stakeholders, eleven peer-reviewed journal publications, and through a website: http://biorefining.cfans.umn.edu.

Project completed: 6/30/2014

Sustainable Biofuels
Subd. 07b $221,000

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RESEARCH

Appropriation Language
$221,000 is from the trust fund to the Board of Regents of the University of Minnesota to determine how fertilization and irrigation impact yields of grass monoculture and high diversity prairie biofuel crops, their storage of soil carbon, and susceptibility to invasion by exotic species. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Perennial grasslands have the potential to provide Minnesota with locally grown energy sources that reduce greenhouse gas emissions, improve water quality, and provide other important benefits. However, much remains unknown about how these crops will be impacted by factors such as climate change and invasive species. Through this appropriation, researchers at the University of Minnesota's Cedar Creek Ecosystem Science Reserve will study how irrigation, fertilization, and climate warming impact perennial grassland biofuel crops in terms of yield, carbon sequestration, plant biodiversity, water quality, and susceptibility to invasive species. Findings will be used to develop methods for optimizing biofuel production, carbon storage, and habitat restoration.

OVERALL PROJECT OUTCOME AND RESULTS

Minnesota's perennial grasslands produce considerable biomass that could become a valuable resource for producing renewable energy. How might Minnesota's capacity to produce biomass for biofuels be impacted by climate change and anticipated mitigation practices? We explored the impacts of warming, fertilization, and irrigation on biomass production at the Cedar Creek Ecosystem Science Reserve.

Our major overall finding is that high diversity mixtures of prairie perennials provided the best combination of biomass production, invasion resistance, carbon storage in soil, and response to climate warming of all the biomass crops we tested.

Specific findings from the Climate Experiment include:

- Compared to low diversity mixtures of prairie plant species, high diversity mixtures produced much more biomass when experiencing normal weather, were more resilient to the stress of warming, and had their biomass production increase the most from warming.
- High diversity mixes enhanced ecosystem services more than low diversity mixes by sequestering more carbon in soils and being less prone to invasion by non-native species.
- Warming inhibited seed establishment. This could reduce invasions by non-native species, but might threaten establishment of native prairie restorations.

The Fertilization & Irrigation Experiment found:

- Fertilization had similar impacts across all species mixtures.
- Moderate fertilization and irrigation increased productivity, with the largest effects in the Panicum, Panicum+Grasses, and High Diversity plots.

Overall findings on plant invasion showed:

- Invasion is inhibited by higher diversity species mixtures.
- A potential biofuel crop, Miscanthus (as a sterile hybrid), was ineffective at producing biomass in central Minnesota, at least on sandy, drier soils. It had detectable, but moderate invasion into native prairies.

This research has been documented in one publication. Two manuscripts have been submitted and are either in review or under revision. Another manuscript is in preparation. We anticipate additional publications will follow. In 2012, the education programming Cedar Creek reached 6,619 users, including K-12 students, teachers, and the general public.

PROJECT RESULTS USE AND DISSEMINATION

The data from these studies will be included in Cedar Creek's database and made publicly available on the Cedar Creek website. Researchers around the world access and use the data on this site for diverse ecological analyses in many research areas including, among others, biodiversity, invasion, and climate change studies.

The results of these studies are integrated into the educational programming and outreach at Cedar Creek. In 2012, 1,777 K-12 students participated in on-site programs. 1,062 K-12 students participated in off-site programs. Furthermore, 120 K-12 teachers participated in professional development opportunities at Cedar Creek and in their schools. At the university level, 845 students and faculty have made use of Cedar Creek programs, courses, meetings, and workshops both on and off-site. There have been 1,070 visitors to the experimental sites where this study took place.

One journal article that documents findings from this study has been published. See:
Isbell, F., 2013, Nutrient enrichment, biodiversity loss, and consequent declines in ecosystem productivity, PNAS, 110: 29.

A second publication by Heather Whittington is under revision in Oecologia and a third has been submitted to Functional Biology. Jane Cowles has a fourth article in preparation. We anticipate additional publications will result from this work.

Project completed: 6/30/2013

Linking Habitat Restoration to Bioenergy and Local Economies
Subd. 07c $600,000

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Appropriation Language
$600,000 is from the trust fund to the commissioner of natural resources to restore high quality native habitats and expand market opportunities for utilizing postharvest restoration as a bioenergy source. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
More than 7,000 acres of public and private lands needing restoration have been identified within 75 miles of St. Paul. Given the various emerging markets for woody biomass, a unique opportunity has been identified. The Minnesota Department of Natural Resources will use this appropriation to continue development of an innovative approach to improving lands by harvesting ecologically inappropriate woody vegetation and working with local markets to turn the resulting biomass into marketable products such as mulch, animal bedding, firewood, and wood pellets for energy generation. Funds raised from the sale of these products could then be used to expand this type of model into other areas of Minnesota. In addition to helping stimulate local economies, benefits of this approach also include enhanced biodiversity and effective utilization of woody material traditionally burned or landfilled.

OVERALL PROJECT OUTCOME AND RESULTS
This innovative project helped restore 385 acres of critical habitat and high quality native plant communities by removing ecologically inappropriate woody vegetation (exotic and/or native species) while stimulating local economies through jobs and strategic utilization of the biomass material for bioenergy and other products. This project facilitated habitat restoration efforts that might not have otherwise occurred while making the woody material, traditionally burned or landfilled, available to established and emerging woody biomass markets.

Of the $600,000 appropriation, $490,666 was spent on eleven projects. Seven non-DNR public and private landowners received a total of $324,530 granted through a competitive process. Four DNR projects received a total of $166,136. A variety of types of projects (based on restoration goals, species/type of woody biomass material, density, distance, land ownership, utilization opportunity, etc.) were completed.

Projects were selected based on critical requirements including ecological value and recovery potential of the project site, current ecologically-based management plan, project-specific harvest plan, post-harvest restoration plan, and demonstrated capacity and long-term commitment to effectively manage the site to achieve and maintain restoration goals.

Viable markets were identified prior to project implementation. Utilization of the woody biomass resulted in 291 semi-truck loads or 5,280 tons for bioenergy, 242 semi-truck loads of commercial mulch, 450 cords of pine sawlogs, 6 log loads of cottonwood for pallets, and pine cabin logs. Biomass material was either sold separately from the harvest with revenue collected, or in conjunction with the harvest where contractors valued the material (deducted from the harvest bid) and were responsible for final utilization. Revenues collected ($11,100) and values attributed ($4,000) were reinvested for further purposes of the project.

This project demonstrated that there are opportunities to sell or properly utilize ecologically inappropriate woody vegetation removed through habitat restoration activities. The long-term vision for this effort is to achieve an ecologically sound and systematic approach that addresses: current and future issues of habitat restoration and enhancement; renewable energy and climate change; invasive species, and natural resources conservation planning and implementation - all of which are effected, to some degree, by the impacts and opportunities of woody biomass.

PROJECT RESULTS USE AND DISSEMINATION
The webpage "Linking Habitat Restoration to Bioenergy and Local Economies" located at http://www.dnr.state.mn.us/eco/habitat_biomass.htmlprovides an overview of the entire project, the project fact sheet, the LCCMR-approved Work Program, and the final report.

Project data were compiled and regularly updated for the DNR's Grant Outcomes webpage to provide project descriptions, funding information, indicators, targets and outcomes information. The website is located at http://www.dnr.state.mn.us/grants/outcomes/index.html.

Project information was shared at public workshops, conferences and meetings through formal presentations, panel discussions, informal conversations and handouts, such as the project fact sheet and other printed materials, targeted for the audience. Project information was also shared with DNR staff through staff meetings, project coordination, formal presentations, and informal discussions.

Telephone conversations and meetings were convened with land managers/owners, harvest contractors, and biomass market industry representatives to discuss the project, garner insights for improvements to implementing this project, identify challenges and opportunities to move this effort forward and to facilitate connections between landowners, contractors, and biomass end-users.

The key messages were:

- For land managers/owners conducting habitat restoration projects: explore and implement the option to utilize the biomass material removed versus piling and burning or landfilling;
- For contractors: provide the combined service of harvest and utilization of the material; and
- For end-users: acknowledge habitat restoration projects as a potential significant source of material and to seek this opportunity.

Project completed: 6/30/2013

Subd. 08 Environmental Education

Minnesota Conservation Apprenticeship Academy
Subd. 08a $368,000

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Appropriation Language
$368,000 is from the trust fund to the Board of Water and Soil Resources in cooperation with the Minnesota Conservation Corps or its successor to train and mentor future conservation professionals by providing apprenticeship service opportunities to soil and water conservation districts. This appropriation is available until June 30, 2013, by which time the project must be completed and the final products delivered.

PROJECT OVERVIEW
Many of the most experienced conservation practitioners at local soil and water conservation districts throughout the state are nearing retirement, and with their departure will go much of their practical, on-the-ground knowledge, experience, and skills. Meanwhile, college students seeking to be the next generation of conservation practitioners have knowledge of emerging technologies and other innovations that can improve and contribute to current conservation efforts. Through this appropriation the Minnesota Board of Soil and Water Resources will work with the Minnesota Conservation Corps to find and place a total of 60 students in apprenticeship positions with county soil and water conservation district offices throughout the state. This unique program will provide an opportunity for interns to gain valuable in-the-field experience from current practitioners while sharing their knowledge with those practitioners about the newest ideas and solutions for meeting today's natural resource challenges.

OVERALL PROJECT OUTCOME AND RESULTS
Many of Minnesota's conservation districts' most experienced conservation professionals and practitioners are nearing retirement age but due to budget constraints will not be replaced until they have left employment. Consequently, Minnesota is missing a great opportunity to transfer knowledge and experience to the next generation responsible for Minnesota's conservation.

While college graduates with conservation-related degrees are knowledgeable in technology, theory, and research methods, their practical, on-the-ground skills need development. Communicating with landowners and adjusting designs for field nuances are vital skills for the success of conservation projects and are best learned from seasoned professionals. In turn, apprentices bring knowledge of emerging technologies and other innovations to improve the quality and productivity of current conservation efforts. This allows for a cross-pollination of ideas and solutions for natural resource challenges.

From 2011 to 2012, 65 students were placed with 60 Conservation Districts. During this time, the apprentices planted 33,339 trees, took 5,219 samples to monitor water quality; provided environmental education to 1,495 people; conducted 1,372 surveys; restored 1,542 acres of habitat through invasive species removal; completed 466,773 square feet of rain garden planting and maintenance; 272,173 square feet of erosion control and shoreline restoration; and 12,933,645 square feet of seeding. Due to the 2011 state shut down, a shifting of allocated funds allowed for the placement of an additional 35 students with conservation districts in May of 2013.

This program has benefits to both students and conservation districts. 100% of apprentices indicated the hands-on experience gained during the apprenticeship will enhance their future academic studies, and that they now have increased technical conservation skills and are more prepared for a future career in conservation.

98% of the Districts were satisfied with the work their apprentices completed, and 100% indicate they would participate in the program again. Managers also indicated that the work conducted by the apprentices increased the amount of conservation practices delivered by their districts during the program period.

PROJECT RESULTS USE AND DISSEMINATION
Information from the project has been disseminated through reports to LCCMR, press releases by BWSR and the Governor's Office, local press releases by SWCDs, and through the Conservation Corps newsletter and annual report. Information was used to recruit apprentices and increase awareness of the project.

Communication and outreach activities include the aforementioned reports, press releases, and electronic newsletters. Additionally, BWSR and Conservation Corps staff conducted outreach to SWCDs to find optimal matches between districts and apprentices. Through the course of their work, the apprentices conducted significant outreach to land owners and residents in topics ranging from easement protection, to water quality education, to plant biodiversity.

Project completed: 6/30/2013

Engaging Students in Environmental Stewardship through Adventure Learning
Subd. 08b $250,000

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Appropriation Language
$250,000 is from the trust fund to the commissioner of natural resources for an agreement with the Will Steger Foundation to provide curriculum, teacher training, online learning, and grants to schools on investigating the connection between Minnesota's changing climate and the impacts on ecosystems and natural resources. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Climate change poses many challenges for Minnesota's future. To successfully engage people in overcoming these challenges it is important for them to have a developed sense of connection to Minnesota's ecosystems and an understanding of the immediate and long-term impacts climate change will have on them. Through this appropriation, the Will Steger Foundation will partner with a number of academic and civic organizations to develop an age appropriate program for students in grades 3-12 that ties Arctic explorer Will Steger's adventures with engaging content on Minnesota's natural environment, the short and long term impacts of climate change, and related student-led action projects.

OVERALL PROJECT OUTCOME AND RESULTS
The Will Steger Foundation developed Engaging Students in Environmental Stewardship through Adventure Learning (MCC) with the understanding that environmental stewardship begins with a local connection and sense of appreciation, or environmental sensitivity, towards the natural environment. This project's primary audience, educators, have the unique opportunity to lead their students through the environmental education continuum of knowledge, awareness, and skills that lead to an informed and active environmental citizenry.

Climate change is one of the most critical environmental issues of our time and educators have an important role to play in educating their students and providing them the skills to mitigate and adapt to climate change. In order to make the issue relevant and connected to the lives of those reached through our project, we focused specifically

on the impacts of climate change on Minnesota's biomes. Additionally, we wove in stories from Will Steger's life and examples of his own early observations of the natural world and his curiosity of weather and climate. We also tapped into the expertise of many Minnesota scientists and educators in the development of our Grades 3-12 curriculum, online classroom and two public forums and three Summer Institutes for climate change education.

Over the three years of the project we were able to reach and increase the climate literacy of over 5000 educators, members of the public and students via our Summer Institutes for Climate Change Education, year round workshops, conference presentations, school visits, field trips, public forums and our online classroom (classroom.willstegerfoundation.org). The project also resulted in the development of a number of valuable, mutually beneficial, and long-term partnerships. The partnership with the Mississippi River Fund, National Park Foundation and Mississippi National River and Recreation Area resulted in the ability to support 20 student service projects and field trips for over 500 students to enhance their learning on Minnesota's changing climate. MCC was recognized in 2012 by Environmental Initiative in the area of environmental education in part due to these important partnerships. A final evaluation report showed overall success for the project in providing a curriculum and training that increased climate literacy, environmental stewardship and educator confidence in teaching about climate change.

PROJECT RESULTS USE AND DISSEMINATION
Over 500 formal and informal educators from all four biomes received a copy of the Minnesota's Changing Climate Curriculum via three Summer Institutes and customized workshops for school districts and at professional education conferences. The curriculum was used to teach over 10,000 Grades 3-12 students about Minnesota's unique biomes, what makes them unique, how they are threatened by climate change and what they can do to mitigate the impacts. Additionally, the curriculum has been shared nationally and regionally via the Climate Literacy Network, the Great Lakes Education Collaborative, Green Teacher, Humphrey Institutes Innovations in Education Forum and the North American Association for Environmental Education as a model of place based climate change education.

Additionally, over 1,000 students submitted their observations of Minnesota's biomes during the school year to our online classroom, with at least 2,000 more viewing and/or commenting on their observations.

Minnesota's Changing Climate curriculum has been used as a framework to develop curriculum specifically focused on the Mississippi River and climate change impacts on Wisconsin. Additionally the Minnesota Phenology Network and Minnesota Master Naturalists have used portions of it and endorse its effectiveness for communicating the connection between phenology and climate change. The curriculum has been aligned with the St. Paul Public Schools "power standards" and Minneapolis Public schools elementary STEM standards and used as an example of how to meet those standards. Finally, teachers from Minnesota American Indian reservations that are participating in The CYCLES project, a project of the STEM Center at the University of Minnesota, received training and are using the curriculum in their schools because the place based focus of the curriculum resonates culturally.

The online classroom, created in partnership with Hamline's Center for Global Environmental Education, has been used by educators around the state to learn more about Minnesota's unique biomes, their cultural history and climate change impacts. Finally, the Minnesota Phenology Network has utilized it has the perfect curriculum for connecting individuals with a reason why phenology is important.

Project completed: 6/30/2013

Urban Wilderness Youth Outdoor Education
Subd. 08d $557,000

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Appropriation Language
$557,000 is from the trust fund to the commissioner of natural resources for an agreement with Wilderness Inquiry to provide an outdoor education and recreation program on the Mississippi River. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
There has been a sharp decline in participation in outdoor recreation and education amongst urban youth. Some argue that youth who have meaningful outdoor education experiences are more likely to become engaged in environmental stewardship and invested in outdoor resources as adults. Wilderness Inquiry- in partnership with state and federal agencies, non-profits, and local school districts - will use this appropriation to expand an environmental education and recreation program that provides disadvantaged urban youth and families, some of whom have never even been on a boat, with hands-on educational and recreational experiences of the Mississippi River in 24 foot Voyageur canoes. Funds are enabling the program to serve an additional 23,000 urban youth and families in the Twin Cities metro area. Public school groups have day trips and overnight excursions available to them to augment their classroom learning, while other youth and families have access through community events.

OVERALL PROJECT OUTCOME AND RESULTS
The goal of Urban Wilderness Youth Outdoor Education (UWYOE) was to provide accessible, outdoor education and recreation opportunities on the Mississippi River and surrounding watershed for more than 20,000 urban youth over a three-year period. UWYOE was developed in response to the sharp decline in participation in outdoor education and activities such as canoeing, camping, hunting and fishing by urban youth.

UWYOE provided experiential environmental learning experiences on the Mississippi River and surrounding watershed for 24,899 Twin Cities middle and high school students, exceeding our initial goal of 20,000. 80% of the youth served identify as a person of color and 80% are eligible for free or reduced lunch. The majority, 76%, had very little or no prior experience with outdoor activities.

Environmental education experiences were provided through outdoor workshops on local lakes and rivers, guided day trips on the Mississippi River, and overnight camping trips in local parks. National Park Service Rangers and Wilderness Inquiry guides provided natural and cultural history and science lessons as part of each program activity. We developed, refined and implemented classroom activities, provided three teacher trainings for Minneapolis Public Schools summer school staff, and developed a program website. We also purchased four 24' Voyageur canoes to expand our capacity to serve more youth.

A three-year evaluation was conducted by the University of Minnesota's Center for Applied Research and Educational Improvement (CAREI). Major outcomes include:

- 77% of participants reported an increased interest in science and the environment
- 87% of teachers agreed that students learned about environmental issues
- 100% of students said they would like to participate in an outdoor activity like this again

This program has gained national attention as a model for engaging urban youth with the environment and building skills to grow future stewards and managers of our public lands. In the summer of 2012, Secretary of the Interior Ken Salazar and Governor Mark Dayton recognized the program as a leader in America's Great Outdoors initiative.

PROJECT RESULTS USE AND DISSEMINATION
The Environment and Natural Resources Trust Fund's investment in UWYOE has resulted in the establishment of a model program for engaging youth in the outdoors, which we now call Urban Wilderness Canoe Adventures (UWCA). The UWCA has been recognized by the EPA, the Department of Interior, and Gov. Mark Dayton, among others, as a leader in America's Great Outdoors Initiative. Within the National Park Service and National Forest Service, the UWCA is being held up as an example of how these agencies need to engage in urban communities across the country.

In 2010, Wilderness Inquiry and the Mississippi National River and Recreation Area unit of the National Park Service piloted the UWCA concept developed in the Twin Cities to Washington DC, with support from the National Park Service, US Forest Service, the US Army Corps of Engineers, and several DC based nonprofit organizations. Serving 1,000 DC area school kids on the Anacostia River, this effort helping bring together 20 DC area organizations focused on though and/or the Anacostia River. To build on this success, we launched the "Canoemobile" to introduce youth to urban waters in multiple cities, and to help build local coalitions dedicated to providing outdoor opportunities to disadvantaged youth. In 2013, the Canoemobile will serve youth in Milwaukee, Michigan City, Chicago, Louisville, Cincinnati, Cleveland, Philadelphia, New York City, and Washington DC. Nature Valley has signed on as a sponsor of the Canoemobile.

We held two outcomes briefings (one in 2011 and one in 2013) to present the University of Minnesota's Center for Applied Research and Educational Improvement (CAREI) evaluation results. The first was hosted by the Minneapolis Foundation and the second by Mayor Chris Coleman and the Saint Paul Foundation. Each had more than 35 community leaders, funders, and educators present. Information about the project has also been disseminated through the project website.

The UWCA has received coverage on Kare 11 News, the Star Tribune, Pioneer Press, and Mpls/St. Paul Magazine.

Project completed: 6/30/2013

Get Outside - Urban Woodland for Kids
Subd. 08e $218,000

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Appropriation Language
$218,000 is from the trust fund to the commissioner of natural resources for an agreement with the city of St. Paul, Department of Parks and Recreation, to restore and develop an outdoor classroom for ecological education and historical interpretation at Como Regional Park in St. Paul. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Outdoor classrooms provide students and community members with an opportunity to have hands-on experiences learning about the environment and about core subjects like science, math, and social studies using nature as the base context. This appropriation will help the city of St Paul develop an outdoor classroom at Como Regional Park

that will provide environmental education, historical interpretation, and habitat for native wildlife in an inner-city community where environmental learning opportunities are rare. The development plan calls for control of invasive species for the 17 acre area, gravel pathways and signs to help visitors travel and interpret the site, and outdoor study areas featuring coniferous forest, oak savanna, tall-grass prairie, sedge meadow, transitional woodland, and propagation gardens for native plants. Site planners will work to establish the area as a MN DNR School Forest.

PROJECT OVERVIEW
Trends amongst youth are showing decreasing interest in the nature world and declining involvement in outdoor recreation. Some attribute these changes to increased usage of computers and other technology that compete for the attention of young people. Through this appropriation, the Minnesota Department of Natural Resources is partnering with several organizations to build on this potential contributing factor as being part of a possible solution by expanding a successfully piloted environmental education program that uses digital photography as a bridge between technology and outdoor experiences. Outdoor nature photography workshops for at least 1,000 teachers and naturalists are being conducted throughout the state that provide guidance on how to use outdoor digital photography to enhance student learning on classroom subjects including math, science, geography, arts, and language arts.

OVERALL PROJECT OUTCOME AND RESULTS
The City of Saint Paul developed a 17.65 acre outdoor classroom in Como Regional Park to provide environmental education, historical interpretation, and habitat for native wildlife in an inner-city community where environmental learning opportunities are rare. The woodland is located within five miles of over 75 public and private schools. To date, the Como Woodland Outdoor Classroom has been utilized by 2,103 students and educators. It has become the School Forest for Great River School and Crossroads Elementary School through the MN DNR's School Forest Program.

The Environment and Natural Resources Trust Fund's investment in the Como Woodland Outdoor Classroom has resulted in the development of outdoor study areas featuring coniferous woodland, oak savanna, tallgrass prairie, shortgrass prairie, transitional woodland, and terrace forest plant communities. Additionally, a propagation garden area has been constructed within the Classroom that will serve as a native plant demonstration garden for the public and will be utilized by students to grow native plants for the Classroom. ENRTF funds were also utilized to install 2,525 feet of ADA accessible gravel trails within the Classroom.

Funds were used to install four entry signs at each of the major entrances to the Como Woodland Outdoor Classroom. 27 numbered, interpretative posts were installed at key locations throughout the site. The City of Saint Paul has received $17,000 from the Minnesota Historical Society and is in the final stages of developing a guide book to the cultural and natural history of the site, referencing these numbered posts. When published, the guide book will be an invaluable resource for educators wishing to bring students to the Como Woodland Outdoor Classroom.

Community volunteers were engaged throughout the restoration process. 2,005 volunteers participated in restoration activities, including planting, invasive species removal, and trail construction.

PROJECT RESULTS USE AND DISSEMINATION
Our advisory committee, the Como Woodland Advisory Committee, has set up a website dedicated to the classroom: http://www.comowoodland.org/.. Progress about our project has been shared with the general public through our blog (http://restoresaintpaul.blogspot.com/.) and our Facebook page (https://www.facebook.com/saintpaulnaturalresources). Community volunteer events taking place in the classroom are highlighted on the City's website (http://www.stpaul.gov/index.aspx?NID=1043). The Minnesota Lottery recently highlighted the Como Woodland Outdoor Classroom in their newly launched blog: http://blog.mnlottery.com/blog/2014/07/24/64/where_the_money_goes_como_woodland_outdoor_classroom.

Project completed: 06/30/2014

Expanding Outdoor Classrooms at Minnesota Schools
Subd. 08f $300,000

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Appropriation Language
$300,000 is from the trust fund to the commissioner of natural resources to establish additional and enhance existing outdoor school forest and prairie classroom networks throughout Minnesota.

PROJECT OVERVIEW
Since 1949 the School Forest Program has been providing Minnesota's K-12 students with outdoor classrooms where they can learn core subjects like math, science, and social studies outdoors using nature as the base context. Statewide there are currently 100 School Forests - which can also include prairie, wetland, and other natural areas other than forest - located in both urban and rural areas. This appropriation will help the Minnesota Department of Natural Resources establish 20 new school forests and provide better training and support services for teachers and school districts with existing forest areas.

OVERALL PROJECT OUTCOME AND RESULTS
The School Forest Program is Minnesota's outdoor classroom program. This project provided support to create new School Forest sites; develop and deliver site-specific outdoor education trainings, regional workshops, a multi-day conference, and a summit; create new online and in-person resources to better support School Forests; and investigate long-term support options for the School Forest Program. Funding provided 1.5 FTEs of School Forest educators for three years and an additional .75 FTE School Forest Specialist for one year.

Minnesota has 125 School Forests throughout the state. As a result of this project, 22 new School Forest sites were developed on 256 acres of land, complete with proper applications, legal paperwork, School Forest committees, and land management plans. To meet teacher needs, several assessments were conducted (see 2012 School Forest Survey Report) and the results were used to create support materials for online and in-person delivery. The School Forest website was revamped and new sections relating to land management, outdoor education, and lesson plans/activities were created. More than 39,000 visitors used the website. School Forest staff participated in hundreds of crucial in-person site visits, meetings, and presentations to bolster support for new and existing School Forests.

To encourage and support outdoor education activities, this project delivered 21 site-specific outdoor education trainings, reaching 523 teachers. These workshops involved Project Learning Tree materials and content was tied to Minnesota academic standards in math, science, and social studies. One hundred outdoor education kits were developed and delivered. The kits provided tools, materials, and lesson plans to allow teachers to easily prep and teach age-appropriate outdoor activities meeting Minnesota academic standards. In addition, two regional trainings, one multi-day conference, and one summit were developed and delivered. These events provided School Forest teachers the opportunity to delve into outdoor education strategy, discover practical teaching tips, and network with teachers, natural resource, and education experts; 106 teachers participated in these events.

Over three years, this project provided new outdoor education opportunities to over 400 teachers and 11,000 students at 22 new School Forests. The total project activities reached over 1,500 teachers and 30,000 students statewide at all 124 School Forests.

PROJECT RESULTS USE AND DISSEMINATION
The School Forest website (www.mndnr.gov/schoolforest) houses many materials created by this project. It is viewed by thousands of people every month. The School Forest Activity Board, within the website, is home to more than 100 new lesson plans created by School Forest teachers and staff. Of particular note are over 20 newly developed activities and lesson plans that correlate to math standards from Prekindergarten to eighth grade, meeting the need to effectively teach math outside.

Dozens of newspaper articles and websites posts were created regarding the new 22 School Forest sites created during this grant.

The results of the School Forest Survey were presented at the 2013 Minnesota Environmental Education Conference and are being reviewed by DNR staff, teachers and naturalists statewide. This information is being used to create or provide better resources to support teachers interested in outdoor education.

Delivery of the "How to Teach in Your School Forest" trainings have evolved and been modified to meet teacher needs. For example, appropriate outdoor and reflection time is incorporated into each training and several other DNR and partner education programs have begun to use these techniques. In addition, the Minn. Dept. of Education asked School Forest staff and teachers to present much of the outdoor education training delivered as part of their ENRTF Environmental and Outdoor Education project. This provided positive outcomes for all partners involved.

About 70 percent of the 22 new School Forest sites are in an urban area. Results from the 2013 Urban School Forest focus groups were used to identify needs specific to urban sites. Strategies are needed for dealing with vandalism, dogs, invasive species, and high community use on small, urban parcels.

Two School Forest site coordinators were awarded the "Formal Environmental Educator of the Year" by the MN Association for Environmental Education for their work with their school forests (2012 & 2013). The School Forest program was recognized as one of Governor Dayton's Education Highlights for 2011-2012.

Project completed: 6/30/2013

Integrated Environmental and Outdoor Education in Grades 7-12
Subd. 08g $300,000

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Appropriation Language
$300,000 is from the trust fund to the commissioner of education in cooperation with the commissioner of natural resources to train and support grade 7-12 teachers to integrate environmental and outdoor education into the instruction of academic standards.

PROJECT OVERVIEW
Trends amongst youth are showing declining participation in outdoor recreation, a decreased understanding of the natural world, and a shift to a more sedentary lifestyle. Through this appropriation, the Minnesota Department of Education is working to combat these trends while also improving the achievement of students in grades 7-12. Professional development and grants for innovative programs are being provided to help teachers use the environment and outdoors as a context for student learning in science, mathematics, social studies, and physical education.

OVERALL PROJECT OUTCOME AND RESULTS
With research indicating that students are increasingly disconnected from nature, the Minnesota Department of Education (MDE) in cooperation with the Department of Natural Resources was funded to hire a full-time coordinator to lead a project to train and support grade 7-12 teachers to integrate environmental and outdoor education (EOE) into the instruction of academic standards. Professional development and grants of up to $8,500 were provided to six pilot schools to support 50 teachers and administrators in their use of the environment and outdoors as a context for student learning, which resulted in engaging over 1,000 students in EOE on a regular basis. A full report of the project, including evaluation of the training and student learning and model lessons, was submitted to LCCMR.

Beyond the original goals of the project, the project coordinator also developed partnerships with several EOE providers to coordinate and offer five, additional, day-long regional workshops at minimal cost that were attended by 108 additional educators not from the pilot schools.

The project coordinator also developed and implemented Minnesota's participation in the first two years of the U.S. Department of Education's Green Ribbon Schools Program that recognizes schools for efforts to reduce their environmental impact and implement EOE throughout their curriculum. Minnesota led the nation with the most applicants in 2013 and seven Minnesota schools and districts were among 156 schools that received the national award to date. Workshops led by the coordinator at the sites of Minnesota's three 2012 national honorees were attended by over 100 people.

A position at MDE to integrate EOE has provided credibility and prioritization of EOE at Minnesota schools and within the department. It has resulted in better coordination among Minnesota's many EOE providers and plans exist for future coordination with MDE standards and health program staff.

PROJECT RESULTS USE AND DISSEMINATION
Information about the project, including the final report and model lessons, will be posted on the SEEK (Sharing Environmental Education Knowledge) website at www.seek.state.mn.us, hosted by the Minnesota Pollution Control Agency.

In addition to the numerous EOE workshops and training led by the coordinator, the coordinator has directly reached over 2,300 other educators through technical assistance and teaching, including participating in several workshops, programs and events. The coordinator also made regular efforts to promote activities related to the project and the benefits of environmental and outdoor education whenever possible throughout the duration of the project. EOE information, resources and achievements, such as the Green Ribbon Schools honorees, were regularly shared through MDE's Superintendents mailings and department listserves, and newsletters and listserves by SEEK, Minnesota Association for Environmental Education, Minnesota Science Teachers Association, Green Schools Coalition, Children and Nature Connection, Minnesota Sustainable Communities Network and many others.

The coordinator had occasional opportunities to do some media activities, including a 20 minute interview about the value of EOE on the April 1, 2013 show of the podcast, Mom Enough, which has a national following of several thousand listeners. The interview can be found at http://momenough.com/2013/04/lets-get-outside-tips-for-parents-and-teachers-from-an-environmental-educator-and-creative-dad. Local media from the communities of

the pilot schools and Green Ribbon School honorees also developed news stories covering the value of EOE activities.

The introductory EOE regional workshops developed with the DNR, Jeffers Foundation and other local partners have led to additional opportunities for coordinated workshops. In particular, the Jeffers Foundation has expressed interest in continuing to work with MDE on future workshops patterned after those developed during the project.

The evaluation of the project, which was conducted by Dr. Julie Ernst, University of Minnesota - Duluth, was a great opportunity for her to expand on her nationally-recognized environmental education research. She is hoping to publish a research paper at some point summarizing the evaluation of the project, which will hopefully help inform and guide future research in the field.

Project completed: 6/30/2013

Fishing: Cross Cultural Gateway to Environmental Education
Subd. 08i $155,000

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Appropriation Language
$155,000 is from the trust fund to the commissioner of natural resources for an agreement with the Association for the Advancement of Hmong Women in Minnesota to provide environmental information and teaching skills to and increase participation of Southeast Asian communities through the gateway of fishing skills. Information on mercury in fish advisories must be included as part of the educational outreach. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
The number of people from other cultures and with other native languages is increasing in Minnesota. It is important for these new Minnesota residents to have knowledge of behaviors that best ensure protection of Minnesota's natural resources into the future. However, effectively communicating with people across cultures to change behaviors can be challenging. Through this appropriation, the Association for the Advancement of Hmong Women in Minnesota and the Mississippi Watershed Management Organization are partnering to use the common ground of fishing as a foundation for community outreach on environmental stewardship to Southeast Asian elders, youth, and families. Public events will be held that combine fishing and environmental education on topics including water quality, invasive species, lead-free tackle, mercury and other contaminants, fish consumption advisories, and fishing regulations.

Project Incomplete: Project failed to comply with reporting requirements and was closed out as incomplete in 2013. No final report.

Minnesota WolfLink
Subd. 08j $193,000

Sharon Reed

M.L. 2010 Projects Completed in 2013-2014

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Appropriation Language
$193,000 is from the trust fund to the commissioner of natural resources for an agreement with the InternationalWolf Center to develop interactive onsite and distance learning about wolves and their habitat. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

PROJECT OVERVIEW
Wolves are an important part of Minnesota's ecosystems and natural history. Minnesota is one of the only places in the lower 48 states where wolves were not completely eliminated by the 1970's and the state has been at the center of wolf population recovery and range expansion ever since. Because of people's widespread interest in wolves, they also provide an important vehicle for educating about nature and the environment. The International Wolf Center in Ely will use this appropriation to expand an educational program to an additional 2,500 students that utilizes wolves as an interdisciplinary educational tool for K-12 students, their teachers, and others throughout Minnesota. The program uses live, interactive distance learning through video conferencing in conjunction with on-site kits to bring wolves directly into the classroom.

OVERALL PROJECT OUTCOMES AND RESULTS
The project funded:

- 118 live interactive video broadcasts from the International Wolf Center in Ely, Minnesota to inner-city, suburban and rural schools throughout Minnesota.
- Two new loan boxes. These boxes are shipped to schools in advance of the broadcast. Each box contains: Wolf pelts, claws, teeth, scat, bones of the wolf prey, wolf related books, ink stamps, projects that they can work on and keep and lesson materials in English, Spanish, Hmong, Somali, and Braille.
- New video broadcasting equipment. It will provide quality broadcasts for many years.
- A portion of an educator wages and benefits. The educator has a master's degree and many years of wolf exposure and training.
- The creation, printing and mailing of promotional materials and some promotional travel expenses.

The original goal was to offer 100 WolfLink programs reaching 2,500 students and teachers along with the wolf loan boxes to educate, engage, and promote future stewardship of the state's environmental resources. To provide translation for three languages and braille to the classroom educational materials. Also, to provide improved broadcasting technology by acquiring new technology.

International Wolf Center was able to reach 118 schools and 3,804 students, exceeding the original goal by 18 schools and 1,304 students. The 2 additional loan boxes were added and much needed due to the frequency of programs. One Minnesota school was able to be included in a broadcast with schools from Canada and Mexico, making their wolf education also a multi-cultural event with the ability to interact with these foreign students. The lesson materials are translated and opened the education to children where English is their second language.

There were several schools that were not aware they possessed the necessary technology to receive the live interactive broadcasts. After the wolf broadcasts those schools were open to Internet broadcast learning opportunities.

Minnesota tourism increased somewhat as many children brought home their souvenirs and other lesson materials from the wolf loan boxes and requested their family make a trip to Ely, where many families visited the International Wolf Center and viewed in person the same live wolves seen in their WolfLink program.

The advanced technology made available by this grant will continue to serve well for many years.

The question may be asked why this education is important and even relevant today. It is best answered by the enthusiasm displayed by the children's faces when the wolves howled or showed other wolf behavior. They learned all about wolves based on scientific based research. They were able to figuratively leave their school, via the internet broadcast, to experience the great outdoors of Minnesota, all the while learning about taking care of Minnesota's natural resources. By involving children in this educational process it is preparing our next generation to be stewards of Minnesota resources. The facts are taught in the hopes that a better informed public can be involved in making better informed public policy relative to wolves and other Minnesota natural resources.

PROJECT RESULTS USE AND DISSEMINATION
The WolfLink programs reaching out to 118 schools has been spread by word of mouth. The original plan of having 100 interactive broadcasts was an aggressive goal at the time of grant application. Having exceeded it has shown how successful the new technology presents the materials. When a teacher in a school completed a program, they naturally shared their enthusiasm with their fellow teachers. This led to other teachers within the same school to request programs for their classroom.

Part of the marketing plan included printing of postcards which were done for less money than originally planned. The Internet and emails, which were not funded by this grant, were also used effectively to market the WolfLink programs to Minnesota schools. In all the communications credit was given to the Minnesota Environment and Natural Resources Trust Fund for making these free programs possible.

The lessons plans were updated before and during the WolfLink presentations. The updating is a continue process. The split screen capability allows the teacher and the wolves to be presented on the same screen to hold the attention of the class to what is being taught. We believe that part of this program that teachers will repeat this process each year, as the cost after the completion of this grant is not cost prohibitive.

Project completed: 6/30/2013

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4. M.L. 2009 Projects Completed
January 15, 2013 – January 15, 2015

MN Laws 2009, Chapter 143, Section 2

M.L. 2009 Projects
MN Laws 2009, Chapter 143, Section 2 (beginning July 1, 2009)

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

The following documents are short abstracts for projects funded during the 2009 Legislative Session. The final date of completion for these projects is listed at the end of the abstract. When available, we have provided links to a project's web site. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 05 Water Resources

Vulnerability of Fish Populations in Lakes to Endocrine Disrupting Contaminants
Subd. 05b $297,000

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RESEARCH

Appropriation Language
$297,000 is from the trust fund to the commissioner of natural resources for an agreement with the United States Geologic Survey and St. Cloud State University to develop quantitative data on juvenile and adult fish vulnerability to endocrine-active emerging contaminants found in Minnesota lakes. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Overall Project Outcome and Results
Effects of endocrine active compound (EAC) exposure to fish have been assessed predominantly at the molecular to organismal level, leaving questions regarding implications for population sustainability.

One EAC, 17 beta-estradiol (E2), is frequently detected in aquatic environments because it is a hormone produced by vertebrates. This study assessed developmental and reproductive effects of E2 exposure on fathead minnows and bluegill sunfish. Continuous, six week exposures were conducted in outdoor tanks to simulate natural lake environments. First generation (F0) fathead minnows and bluegill sunfish were exposed during sexual maturity. Second generation (F1) fathead minnows were exposed during early development, sexual maturity, or both stages. Multiple biomarkers were measured to assess the effects of E2 exposure on fecundity, fish health, and development. Differences in the timing of egg production for both species indicate differences in lifetime fecundity between unexposed and exposed females. Exposure to E2 resulted in lower relative health and reduced expression masculine secondary sexual characteristic expression in F0 fathead minnows. Similar results were not observed in F1 fathead minnows. First generation bluegill sunfish males exposed to E2 had significantly smaller testes compared to controls. Supplemental, laboratory exposures were conducted on a separate fathead minnows cohort to assess reproduction and larval ability to escape a predator threat. Predation tests suggest E2 exposure of the current generation has the greatest effect on larval survival. Larval fathead minnows exposure to E2 in the F2 generation had longer escape responses and lower survival rates when compared to controls. Females exposed to E2 tended to lag behind controls in terms of larvae production after an initial period of similar activity. Results from this study suggest that exposure to E2 (in the absence of other estrogenic compounds) at environmentally relevant concentrations has subtle reproductive and developmental effects on fathead minnows and bluegill sunfish and implications for long-term survival in a predator-rich environment.

Project Results Use and Dissemination

Results from this study feed into an ongoing study assessing septic system discharge to lakes and effects on bluegill fitness (Assessing Septic System Discharge to Lakes, funded by Environment and Natural Resources Trust Fund in 2010).

A manuscript was submitted to the Journal of the American Water Resources Association for inclusion in a special issue on contaminants of emerging concern (originally submitted in February 2013, revised copy submitted in July 2013). A copy of the revised manuscript is included as an attachment to this final report.

Results from portions of this study have been included in two graduate student theses at St. Cloud State University under the supervision of Co-PI, Heiko Schoenfuss.

Results have been presented at the following scientific conferences:
March 2012 - Midwest Society of Environmental Toxicology and Chemistry (Minneapolis, MN)
June 2012 - American Water Resources Association specialty conference on contaminants of emerging concern (Denver, CO)
October 2012 - Minnesota Water Resources Conference (Minneapolis, MN)

This study was discussed in conjunction with similar work in a MPR story that aired on February 20, 2013.

Project Publications:

Fathead Minnow and Bluegill Sunfish Life-Stage Responses to 17 Beta-Estradiol Exposure in Outdoor Mesocosms (PDF - .2 MB)
Master's Thesis: Effect Differences of Estrogenic Exposure Between an Endangered Species and Two Model Species and Across Life Stages (PDF - 2.1 MB)

Project completed: 06/30/2013

Cooperative Habitat Research in Deep Lakes
Subd. 05c $825,000

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RESEARCH

Appropriation Language
$825,000 is from the trust fund to the commissioner of natural resources to assess the consequences of large ecological drivers of change on water quality and habitat dynamics of deep water lakes with coldwater fish populations. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Overall Project Outcome and Results
We designed a long-term lake monitoring program that incorporates a synoptic view of lakes, including understanding historic and current lake conditions along statewide gradients of nutrients, climate, ecoregion, and land use. Twenty-four lakes and their associated watersheds were established as sentinel systems to serve as focal points of collaborative long-term monitoring, research, and environmental education. The research funded here focused primarily on the 7 deep-water sentinel lakes with coldwater fish populations. With our project partners, we examined current and forecasted relationships among resident lake biota, water quality, and lake habitat features, and extrinsic factors including watershed inputs, climate, and invasive species. Key deliverables include:

- U.S. Geological Survey developed biophysical water quality models to predict responses in the distribution of temperature and oxygen in Carlos, Elk, and Trout lakes based on current conditions. In Phase 2, models will be used to simulate the consequences of land-use change and climate dynamics on lake ecosystems, including sensitive cold-water fish communities.
- St. Croix Watershed Research Station provided a reconstruction of the historical water quality and diatom communities of seven sentinel lakes. Results provide a context for interpreting future community-level shifts based on land-use changes and climate trends.
- A data visualization tool has been developed that enables interested scientists and others to interact with SLICE data. Improvements are planned to make the tool more user-friendly and provide greater access to databases currently managed by DNR, PCA, and other partners.
- Analysis of zooplankton collections from 24 sentinel lakes suggests that zooplankton will be a sensitive indicator of current and changing lake conditions. Data collected thus far has allowed us to focus sampling on specific times and components of the zooplankton community.
- Our understanding about cisco behavior and population status in Minnesota lakes has been greatly enhanced. We developed and refined sampling techniques, and now have baseline information to understand climate and land use impacts to cisco lakes.

Project Results Use and Dissemination
The information gathered during the SLICE project has been invaluable to fisheries and lake managers in a number of ways. First, the ability to collect water quality, zooplankton, fisheries, and historical lake data over consecutive years from a suite of lakes has been foundational for the implementation of a long-term monitoring program for Minnesota lakes. That information will provide researchers and managers with a wide variety of specialties and interests to focus on specific metrics that are most likely to reflect change from various stressors. The ability to identify those metrics and their response to specific stressors will enable managers to quickly respond and develop best management practices in lakes facing environmental changes. Second, techniques developed and refined during the project have strongly influenced our basic understanding of the ecology and behavior of cisco population in Minnesota. Understanding how cisco populations, vulnerable to both biotic (i.e. invasive species) and abiotic (i.e. climate change) stressors, respond to change will be important for the management of not only cisco but other cold and cool water species as well. Third, by including partners with differing discipline backgrounds and expertise, e.g., USGS, St. Croix Watershed Research Station, et al., the project was able to provide unique and holistic insights into how lake ecosystems function now and in the future (models), as well as how they may have in the past (sediments).
Project Publications:
Assessing the Water Quality and Habitat Dynamics of Deepwater Lakes with Coldwater Fish Populations (PDF - 8.5 MB)
Reconstruct historical water quality and habitat conditions in the seven coldwater sentinel lakes (PDF - 1 MB)
Exploring Hydraulic Residence in Minnesota's Sentinel Lakes: Implications for Management (PDF - .7 MB)

Project completed: 06/30/2013

Subd. 06 Aquatic and Terrestrial Invasive Species

Emergency Delivery System Development for Disinfecting Ballast Water
Subd. 06b $125,000

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RESEARCH

Appropriation Language
$125,000 is from the trust fund to the commissioner of the Pollution Control Agency for an agreement with the United States Geologic Survey to test the viability of treating ballast water through tank access ports or air vents as a means to prevent the spread of invasive species.

Overall Project Outcome and Results
This project was part of Phase III of an overall effort to produce an Emergency Response Guide to

Handling Ballast Water to Control Non-Indigenous Species. Phase I ($25,000) was funded by National Oceanic and Atmospheric Administration and resulted in a study plan entitled "Mixing Biocides into Ships' Ballast Water: Efficiency of Novel Methods." Phase II ($185,000) was funded by the Great Lakes Fisheries Trust and studied in-line injection, bulk dye dosing, perforated hose dosing, and passive mixing methods, such as ship's motion.

Similar to Phase II, this effort (Phase III) prepared ballast tank mixing and sampling equipment, field work on a working ship to trial promising ballast mixing methods, and analysis/report. The active methods being studied in Phase III are venturi eductors and air lifts. The outcome will be the incorporation of these methods (if determined to be effective and practical) into a best practices guide for treating the ballast water of ships either:

- Arriving in port with high risk ballast water,
- Leaving a port that contains ballast known to be high risk for the destination port, or
- Grounded and laden with high risk, untreated ballast water.

Project Results Use and Dissemination
Preliminary information from Result 1 and Result 2 activities were shared at the May 18, 2010 Great Lakes Ballast Water Collaborative meeting in Montreal, QC and at the June 1, 2010 Lake Superior Binational Program - Invasive Species Workshop in Duluth, MN.

The final project results consisting of two reports entitled "Emergency Response Guidance for Handling Ballast Water to Control Aquatic Invasive Species" and "Mixing Biocides into Ship's Ballast Water-Great Lakes Bulk Carrier Field Trials" are posted on the National Park Service web site at http://www.nps.gov/isro/naturescience/handling-ballast-water-to-control-non-indigenous-species.htm.

Project Publication:
Emergency Response Guidance for Handling Ballast Water to Control Aquatic Invasive Species (PDF - 2.2 MB)
Mixing Biocides into Ship's Ballast Water: Great Lakes Bulk Carrier Field Trials (PDF - 3.5 MB)

Project completed: 06/30/2012

Controlling the Movement of Invasive Fish Species
Subd. 06d $300,000

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Appropriation Language
$300,000 is from the trust fund to the Board of Regents of the University of Minnesota to develop and test sonic barriers that could be effective in preventing and controlling the movement of invasive carp in Minnesota's waterways. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

Overall Project Outcome and Results

The abundance of common carp in lakes has a negative impact on water quality. Hence, great ecological benefit for many Minnesota lakes will be gained if effective barriers can be constructed to control carp movements. The aims of this project were to construct, implement, and test common carp barriers based on air bubble curtain technologies. This work comprised three main results. In result 1 the construction and engineering of bubble curtain barriers was investigated. Focus was placed on generating, measuring, and controlling the sound and flow fields generated by bubble curtains. This work has led to engineering bubble barrier designs that can reliability produce stimuli (sound level and frequency) in the ranges that would deter carp movement. Result 2 focused on the laboratory testing of the barriers of Result 1. This work, representing the first known rigorous and detailed testing of bubble barriers, showed that the barriers are 75-80% effective in reducing fish passage through a control section. In addition, a model capturing fish behavior in the vicinity of the barriers was build and tested. The emphasis of Result 3 was field implementation and testing of bubble barriers. The main work here, in cooperation with Ramsey-Washington Metro Watershed District, was the design and implementation of a test barrier in Kohlman Creek, Maplewood. This barrier construction cost was $5,000 and operating cost was $300 per month when operating continuously. Data collected from this site has shown that the barriers are effective in stopping 60% of downstream carp movements, thereby corroborating the laboratory results. Upstream movements of motivated spawning adult carp, however, while deterred by the bubbles were not stopped. The overall results from this work have clearly indicated when bubble curtain barrier technologies for controlling carp movement will and will not work. Thereby providing critical information for land managers to more wisely implement and use this low cost and environmentally friendly barrier technology.

Project Results Use and Dissemination

The engineering design and testing of the bubble barriers has been documented in the MS thesis by Dan Zielinski:
Zielinski, D.P. (2011) Bubble barrier technologies for common carp, University of Minnesota, MS Thesis

The laboratory and field testing, modeling and data analyses is reported in a the PhD Thesis of Dan Zielinski
Zielinski, D.P. (2013) An engineering perspective on invasive fish control: A study of bubble curtain deterrent systems to control carp movement, University of Minnesota, Ph.D. Thesis.

This work also reports the behavioral modeling of fish in the vicinity of the barrier along with the development of the necessary theory to support this model.

A detailed reporting of the laboratory effectiveness is found in the paper:
Zielinski, D.P., Voller, V.R., Svendsen, J.C., Hondzo, M., Mensinger, A.F., Sorensen, P., (2013) Laboratory experiments demonstrate that bubble curtains can effectively inhibit movement of common carp. Submitted to Ecological Engineering.

A detailed reporting of behavioral model is found in the paper
Zielinski, D.P., Hondzo, M., Voller, V.R. (2013a) Mathematical evaluation of behavioral deterrent systems to disrupt fish movement. Submitted to Ecological Modeling.

Elements of all of these works was presented at a number of conferences:

- Zielinski, D.P., Sorensen, P. (2013), Field study of an air bubble curtain to inhibit Common Carp movement, Minnesota Chapter of American Fisheries Society Annual Meeting, St. Cloud, MN, USA.
- Zielinski, D.P., Voller, V.R., Svenden, J., Hondzo, M. Mensinger, A., Sorensen, P. (2012), Inhibiting Common Carp Movement with a Bubble Curtain, 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN, USA.
- Zielinski, D.P., Voller, V.R., Svenden, J., Hondzo, M. Mensinger, A., Sorensen, P. (2011), Controlling the Movement of Invasive Species, 2nd Annual Upper Midwest Stream Restoration Symposium, Oconomowoc, WI, USA.
- Zielinski, D.P., Voller, V.R., Svenden, J., Hondzo, M. Mensinger, A., Sorensen, P. (2011), Bubble Barrier Technologies for Common Carp, Minnesota Chapter of American Fisheries Society Annual Meeting, Sandstone, MN, USA.

Project completed: 06/30/2013

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5. M.L. 2008 Projects Completed
January 15, 2013 – January 15, 2015

MN Laws 2008, Chapter 362, Section 2

M.L. 2008 Projects Completed in 2013-2014

M.L. 2008 Projects
MN Laws 2008, Chapter 367, Section 2 (beginning July 1, 2008)

NOTE: For all projects, contact us to obtain the most up-to-date work programs for current projects (project updates are required twice each year) or the final reports of completed projects.

The following documents are short abstracts for projects funded during the 2008 Legislative Session. The final date of completion for these projects is listed at the end of the abstract. When available, we have provided links to a project's web site. The sites linked to this page are not created, maintained, or endorsed by the LCCMR office or the Minnesota Legislature.

Subd. 04 Water Resources

04g Southeast Minnesota Stream Restoration Projects

Southeast MN Stream Restoration Projects
Subd. 04g $240,000

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Overall Project Outcome Results:
The overall objective of this project was to accelerate stream restoration in Southeast Minnesota by building the capacity of county and federal conservation staff and private citizens to implement future projects.

Early European settlement and agricultural practices from the 1850's to the 1930's led to wide scale erosion, flooding, and altering of streams and valleys in Southeast Minnesota. Many of the streams today still have steep eroding banks, incised channels, and poor in-stream habitat. Annual sedimentation coming off streambank ranges from 250 to 1000 tons per mile and is responsible for as much as 85% of the total sediment load that enters the stream.

One of our primary goals was to have eight showcase stream restoration projects; we were successful in having eleven. Our other primary goal was to educate and train volunteers and professionals about the various techniques and the planning involved in implementing a stream restoration project. Through a combination of 12 workshops, 4 symposiums, and 8 in-the-field demonstrations over 45 volunteers were trained on how to install various habitat practices for fish and non-game species, and contributed over 2,300 volunteer hours working on stream restoration projects. Projects were completed in four of the seven targeted counties, and approximately 3 miles were restored.

Volunteers and contractors installed over 100 different habitat structures for trout, and non-game

species of fish, turtles, birds and frogs. Cost of designs, permits, materials, earth moving, and professional oversight of the projects was close to half a million dollars. Environmental and Natural Resources Trust Fund dollars contributed $188,535, with Trout Unlimited Chapters, County and Federal agencies contributing over $357,447.

Project Results Use and Dissemination

Over the three year period of this project we more than quadrupled the educational and informational events we proposed for in our original plan. Promoting, educating and accelerating stream restoration projects were accomplished through a variety media formats:

- 41 Workdays - involving volunteers clearing brush, installing habitat for fish and nongame species, seeding and mulching grade banks.
- 6 News releases - on completed projects.
- 8 Newsletters - newsletters to volunteers, county, state and federal employees.
- 4 Driftless Symposiums - regional symposium on riparian and watershed management.
- 2 Driftless Stream Bus Tours - free tour for professionals and volunteers of recently completed projects.
- 7 In-the-field workshop - for volunteers on how to seed, mulch and install fish and non-game habitat practices.
- 4 Minnesota Great Waters Fly Fishing Expos - handouts, talks, displays on cold water stream restoration projects.
- 2 Television Programs - on cold-water stream restoration.
- 5 Stream Restoration Project Planning Workshop - 2-day workshop for volunteers on how to organize projects, write grants, workdays, easements, etc.
- Conducted one tour for Outdoor Writers Association - Southeast MN streams.
- 7 Presentations to MN TU chapters on cold water stream restoration.
- 12 Presentations to County and Federal employees of Southeast Minnesota on cold water stream restoration.
- Presentations to Winona State students and St. Paul Fisheries graduates.
- Presentation at the Lakes and Rivers Conference in Rochester.
- 4 presentations in MN at the American Fisheries Association conference.
- 6 Local Work Group meetings (meeting of local Soil and Water Conservation Districts and Natural Resources Conservation Service) to plan on where spending of federal Farm Bill dollars will be directed.
- 42 Hand guides on habitat practices for trout and non-game species to volunteers, county, state and federal employees.

FINAL REPORT

Project completed: 6/30/2013

- Spreadsheet of all research projects completed between January 1, 2013 and December 31, 2014.

Environment and Natural Resources Trust Fund (ENRTF)

Research Projects completed between January 1, 2013 and December 31, 2014

Full abstracts are included in Section III. Completed Research Projects

Research projects completed June 30, 2013				
Appropriation Year	**Subdivision**	**Title**	**Organization**	**Funding Appropriation**
Minnesota Laws 2009, Chapter 143, Section 2				
M.L. 2009	05b	Vulnerability of Fish Populations in Lakes to Endocrine Disrupting Contaminants	U.S. Geological Survey	$297,000
M.L. 2009	05c	Cooperative Habitat Research in Deep Lakes	MN DNR	$825,000
M.L. 2009	06b	Emergency Delivery System Development for Disinfecting Ballast Water	US Geological Survey	$125,000
Minnesota Laws 2010, Chapter 362, Section 2				
M.L. 2010	03e	Mitigating Pollinator Decline in Minnesota	U of MN	$297,000
M.L. 2010	03f	Science and Innovation from Soudan Underground Mine State Park	U of MN	$545,000
M.L. 2010	03g	Quantifying Carbon Burial in Wetlands	U of MN	$144,000
M.L. 2010	03k	Identifying Critical Habitats for Moose in Northeastern Minnesota	U of MN - NRRI	$507,000
M.L. 2010	05b	Managing Mineland Sulfate Release in the Saint Louis River Basin	MN DNR	$270,000
M.L. 2010	05c	Ecological Impacts of Industrial Effluent in Surface Waters and Fish	U of MN	$340,000
M.L. 2010	05h	Assessing Cumulative Impacts of Shoreline Development	U of MN	$300,000
M.L. 2010	05i	Trout Streams Assessment	U of MN	$300,000
M.L. 2010	06c	Healthy Forests to Resist Invasion	U of MN	$359,000
M.L. 2010	06d	Bioacoustic Traps for Management of Round Goby	U of MN - Duluth	$175,000
M.L. 2010	07b	Sustainable Biofuels	Cedar Creek Ecosystem Science Reserve	$221,000

Research projects completed June 30, 2014				
Appropriation Year	**Subdivision**	**Title**	**Organization**	**Funding Appropriation**
Minnesota Laws 2010, Chapter 362, Section 2				
M.L. 2010	05a	Understanding Sources of Aquatic Contaminants of Emerging Concern	U of MN	$640,000
M.L. 2010	05e	Assessing Septic System Discharge to Lakes	U.S. Geological Survey	$594,000
M.L. 2010	06a	Biological Control of European Buckthorn and Garlic Mustard	MN DNR	$300,000
Minnesota Laws 2011, 1st Special Session, Chapter 2, Article 3, Section 2				
M. L. 2011	03g	Prairie Management for Wildlife and Bioenergy - Phase II	U of MN	$600,000
M. L. 2011	03h	Evaluation of Biomass Harvesting Impacts on Minnesota's Forests	U of MN	$350,000
M. L. 2011	03i	Change and Resilience in Boreal Forests in Northern Minnesota	U of MN	$150,000
M. L. 2011	04o	Understanding Threats, Genetic Diversity, and Conservation Options for Wild Rice	U of MN	$195,000
M. L. 2011	05c	Mississippi River Water Quality Assessment	U of MN	$557,000
M. L. 2011	05e	Assessment of Minnesota River Antibiotic Concentrations	University of St Thomas	$190,000
M. L. 2011	06b	Emerald Ash Borer Biocontrol Research and Implementation	Minnesota Department of Agriculture	$500,000