M.L. 2015 Projects

MN Laws 2015, Chapter 76, Section 2 (beginning July 1, 2015)

Subd. 03 Foundational Natural Resource Data and Information

County Geologic Atlases - Part A
Subd. 03a $2,040,000 TF

Dale R. Setterholm
U of MN - MN Geological Survey
2609 Territorial Road
St. Paul, MN 55114-1009
Phone: (612) 626-5119
Email: sette001@umn.edu
Web: http://www.mngs.umn.edu/index.html

Appropriation Language
$2,040,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Minnesota Geological Survey to continue acceleration of the production of county geologic atlases for the purpose of sustainable management of surface water and groundwater resources. This appropriation is to complete Part A of county geologic atlases, which focuses on the properties and distribution of earth materials in order to define aquifer boundaries and the connection of aquifers to the land surface and surface water resources. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
This award is the seventh dedicated to creating County Geologic Atlases statewide. Geologic atlases provide maps and databases essential for management of ground and surface water resources. The program currently produces nearly 5 atlases per year, and only 32 counties have not yet been started. An average county atlas requires about $400,000 and 3 to 4 years to complete. Projects in very large or distant counties, those with particularly complex geology, and those with challenging data sets take more resources and time. This award included work in Lake, St. Louis, and Hennepin counties, all of which required greater than average resources. However, of the 12 atlases we are currently working on 9 are past the halfway mark and a few are nearly finished. This grant funded work in Lake and St. Louis ($882,684), Olmsted ($152,975), Kandiyohi ($129,244), Hennepin ($372,668), Dodge ($102,057), Hubbard ($222,582), Becker ($136,284), and Aitkin ($40,791) counties. An additional $715 supported initiation of work in new project areas. At this time bedrock mapping in Lake and St. Louis counties is about two thirds complete, and glacial mapping is slightly more than half complete. Federal cost-sharing has been applied to this work each year. The Olmsted CGA bedrock map is about 80% complete, and the surficial map about 90% complete. In Dodge County both those maps are at the 90% mark. In Kandiyohi County the surficial map has been drafted, the bedrock topography is about 50% complete, and the bedrock geology is just starting. For the Hennepin CGA the bedrock map is complete, the surficial geology is complete, the bedrock topography is complete, and the mapping of sand bodies is about 40% done. Similarly, in Hubbard County all products are ready except the sand model. In Aitkin County field work was the focus.

PROJECT RESULTS USE AND DISSEMINATION
Every atlas is produced in portable document format, as geographic information systems files, and in printed form. The digital files are compiled as a DVD, and are also available from the University of Minnesota Digital Conservancy https://conservancy.umn.edu/handle/11299/57196, and via link from the MGS web page. Each project culminates with a meeting held in the project area to present the results to the county staff, and any other interested parties.

At these meetings the products are described, access to the products is explained, and examples of applications of the products to common resource management situations are demonstrated. The products of subprojects in St. Louis and Lake counties are released in digital form immediately following technical review. When all the subproject areas are complete county-wide compilations will be created and distributed digitally and in print. The printed copies are shared with the county, who in turn can distribute them to libraries, schools, townships, and other agencies. They are also distributed by the MGS map sales office.

Project Completed: 06/30/2018
FINAL REPORT

Minnesota Biological Survey
Subd. 03c $2,450,000 TF

Bruce Carlson
MN DNR
500 Lafayette Rd
St Paul, MN 55155
Phone: (651) 259-5083
Email: bruce.carlson@state.mn.us
Web: http://www.dnr.state.mn.us/mbs/index.html

Appropriation Language
$2,450,000 the first year is from the trust fund to the commissioner of natural resources for continuation of the Minnesota biological survey to provide a foundation for conserving biological diversity by systematically collecting, interpreting, monitoring, and delivering data on plant and animal distribution and ecology, native plant communities, and functional landscapes.

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota Biological Survey plant and vegetation surveys continued towards statewide coverage, focusing on the last counties in the state for MBS to deliver: St. Louis, Koochiching, Beltrami and Lake of the Woods. Over 1,000 rare and notable terrestrial and aquatic vascular plant species were documented with specimens. Over 200 vegetation plots were placed in representative or rare forests, wetlands and peatlands.

MBS continued towards statewide collection of lake aquatic plant surveys, focusing in central and north-central Minnesota counties and putting the total to 2,025 lakes in 48 counties. This effort provides highly-valued foundational data to broaden DNR efforts to establish indices of biotic integrity for Minnesota lakes.

MBS continued to collaborate on monitoring efforts in prairies and forests. Long-term monitoring of rare prairie plant species continued from previous biennia. Prairie vegetation monitoring continued in high-priority prairie sites subject to cattle grazing. Surveys to establish baseline conditions for forest plant and animal monitoring projects were initiated in northern, north-central and southeast Minnesota. All of these monitoring efforts were selected and continued for their relevance to goals and desired outcomes found in Minnesota prairie and forest management and conservation plans.

MBS continued in several west-central counties to target sites in Minnesota Prairie Plan core areas that had not previously been surveyed by MBS. This involves use of LiDAR and high resolution aerial photography not available when MBS first surveyed these counties in the 1980s and 1990s. Over 200 previously undocumented high quality sites were completed.

MBS compiled and entered field survey and monitoring data to MBS databases. MBS information systems improvements were made that enhance data integration and accessibility. MBS continues to provide leadership in the management and use of the DNR's Native Plant Community database.

MBS provided survey and monitoring results to DNR and other partners and projects. MBS delivered a final manuscript to UMN Press for a new book on Minnesota sedges and rushes and completed major updates and improvements to the DNR Rare Species Guide (http://dnr.state.mn.us/rsg/index.html). MBS outreach included highly popular plant and native plant community field workshops throughout the state targeted at natural resource professionals and volunteers.

MBS Data Summary Table

Data Type	# added since July, 2015	Total Since 1987
Rare species records (Biotics) (all taxa)	360	21,838
Rare aquatic plant species records	6	1,251
Lakes with MBS botanical surveys	42	2,025
Counties with MBS lake botanical surveys	2	48
Vegetation plots (relevés)	174	5,540
Sites of Biodiversity Significance GIS polygons*	8	10,732
Native Plant Community GIS polygons*	1,929	84,626
Plant specimens submitted to the University of MN Bell Museum	640	~50,000 (source: Welby's estimate, includes Heritage Program submissions too)
Exotic aquatic plant species locations**	NA	302

Numbers reported based on data available on the Minnesota Geospatial Commons
**Encountered incidentally during the course of native aquatic plant surveys

PROJECT RESULTS USE AND DISSEMINATION

MBS data are stored primarily in the Division of Ecological and Water Resources information systems, which are increasingly linked to other databases in the MN DNR. In addition, MBS procedures, updates, recent maps, and links to related data are presented on the DNR website. Many GIS datasets are delivered to clients through the online data portal, Minnesota Geospatial Commons. MBS regularly provides vegetation plot data from the relevé database to researchers at academic institutions, other agencies and organizations. Data on rare species are available through agreements with the requesting agency and the DNR. For data on locations or rare features, a data request form is available via the web: http://www.dnr.state.mn.us/nhnrp/nhis.html

MBS publishes and distributes survey results in a variety of formats for various audiences. Many products are available as enterprise datasets on the DNR website, including GIS shape files of native plant communities and MBS sites, native plant community field guides, and guides to sampling techniques such as vegetation plot data collection using the relevé method. MBS web pages are updated with new information and have links to associated resources.http://www.dnr.state.mn.us/mbs/index.html

The DNR and Legislative libraries and other local information repositories (such as libraries within counties) have access to published products, including books, maps, reports, field guides and digital media. MBS has published several books and field guides.

Staff routinely make presentations that describe MBS methodologies and results to a wide range of audiences including county boards, local planning groups, citizen advisory groups, other biologists, land managers, and students. MBS staff provide local planners with ecological interpretations describing important sites of biodiversity identified during the Survey to assist with management plans.

Physical collections are deposited at Minnesota repositories, primarily at the University of Minnesota's J.F. Bell Museum of Natural History and at the Science Museum of Minnesota, St. Paul. As part of a larger network of museums and herbaria, these cooperators are essential to the documentation and sharing of MBS results. MBS and museum staff meet periodically to address curatorial, data management, and interpretive needs.
MBS also delivers data through an international organization, NatureServe, and also shares data with cooperators at colleges and universities.

Project Completed: 06/30/2017
FINAL REPORT

Minnesota's Biodiversity Atlas for Enhanced Natural Resource Management
Subd. 03d $340,000 TF

Keith Barker
U of MN - Bell Museum of Natural History
140 Gortner Laboratory,
1479 Gortner Avenue
St. Paul, MN 55108
Phone: (612) 624-2737
Email: barke042@umn.edu
Web: http://www.bellmuseum.umn.edu/

Appropriation Language
$340,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Bell Museum of Natural History to create a publicly accessible, online tool and repository that will electronically integrate over 600,000 existing biodiversity records, 300,000 existing images, and future data and associated imagery pertaining to Minnesota wildlife, plant, and fungi species in order to enhance research, guide field surveys, and inform conservation planning. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The Minnesota Biodiversity Atlas project aimed to digitally capture, integrate and disseminate data on Minnesota's plant and animal diversity and distributions, with a focus on specimens held by the Bell Museum, the state's official museum of natural history. The result of this work, the Minnesota Biodiversity Atlas (http://bellatlas.umn.edu/), makes the majority of these data specimen data available in one easily-accessible resource for the first time. The new Atlas includes data from over 326,000 specimens of nearly 9000 taxa (species and subspecies) collected from throughout Minnesota by museum curators and state biologists over the last 140 years. Importantly, this project has made georeference data (precise latitude and longitude coordinates) of nearly 223,000 Minnesota specimens available in an integrated platform that allows simultaneous mapping of specimens from distinct groups (e.g., birds and plants) interactively within the Atlas or with the user's own application of choice. The Minnesota Biodiversity Atlas also provides access to a massive archive of specimen images (currently over 135,000), particularly of plants, allowing direct access for identification, collection of phenology and other data, and label verification. In addition to being served directly through the Atlas to agency partners and the public, all of these specimen data, along with all of the Bell Museum's specimen data from other parts of the world, are now served directly to global biodiversity data resources including the National Science Foundation-funded iDigBio and the Global Biodiversity Information Facility, which are critical resources for managers and research scientists around the world. The Minnesota Biodiversity Atlas is now a key resource providing critical data to resource managers and scientists both in Minnesota and globally. Future development of the Atlas will integrate additional specimen data from collections throughout Minnesota, as well as observational data collected by state agency partners and others, creating an even more powerful management tool and a permanent archive for these critical data.

PROJECT RESULTS USE AND DISSEMINATION
The primary result of this work was production of the Minnesota Biodiversity Atlas (http://bellatlas.umn.edu/), an online resource interactively serving data on specimen records of Minnesota plants and animals to agency partners, the public, and scientists and managers worldwide. This Atlas is the primary means of disseminating data on Minnesota's biodiversity. Bell Museum curators have promoted use of this resource by: 1) interaction with and training of agency partners in use of the Atlas; 2) interviews with the media, including two radio interviews and at least two print interviews; 3) training of participants in the Minnesota Master Naturalists program in specimen data capture (through a related project , Mapping Change, within the Zooniverse citizen science platform) and use of the Atlas, and 4) promotion of the Atlas through electronic exhibits within the newly-opened Bell Museum.

Project Completed: 06/30/2018
FINAL REPORT

Updating the National Wetland Inventory for Minnesota - Phase V
Subd. 03e $1,500,000 TF

Steve Kloiber
MN DNR
500 Lafayette Rd, Box 25
St Paul, MN 55155
Phone: (651) 259-5165
Email: steve.kloiber@state.mn.us
Web: http://www.dnr.state.mn/eco/wetlands/nwi_proj.html

Appropriation Language
$1,500,000 the first year is from the trust fund to the commissioner of natural resources to continue to update and enhance wetland inventory maps for Minnesota. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Updating the National Wetland Inventory (NWI) is a key component of the State's strategy to ensure healthy wetlands and clean water for Minnesota. This effort is a multi-agency collaborative under leadership of the Minnesota Department of Natural Resources. These data are intended to replace the original 1980s NWI data. The NWI data provide a baseline for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use, conservation planning, environmental impact assessment, and natural resource inventories. The update project is being conducted in phases with data released for each region as it is finalized.

In this fifth phase of the overall effort, we provided updated wetland inventory maps for 20,385 square miles of northeastern Minnesota covering 15 counties in central and northern MN. With the completion of this phase, updated NWI data is now available for about 80% of the state.

The updated NWI were mapped in accordance with federal wetland mapping guidance. This update used spring aerial imagery acquired in 2013 and 2014, summer imagery acquired in 2015, and lidar elevation data as well as other ancillary data. Quality assurance of the data included visual inspection, automated checks for attribute validity and consistency, as well as a formal accuracy assessment based on an independent field data. Further details on the methods employed can be found in the technical procedures document for this project located on the project website (http://www.dnr.state.mn.us/eco/wetlands/nwi_proj.html).

PROJECT RESULTS USE AND DISSEMINATION

All wetland map data and aerial imagery are available free of charge to the public. The data have been made available through the Minnesota Geospatial Commons (https://gisdata.mn.gov/) as well as through an online wetland viewer. A new wetland finder application will be deployed this fall to replace the previous wetland viewer. A copy of the data has also been provided to the US Fish and Wildlife Service for inclusion in the national wetland database.

Use of the NWI data is being promoted through a variety of channels. The DNR will be giving presentations about the NWI data at both the Minnesota Water Resources Conference and the Minnesota GIS/LIS Conference. We are also developing a communications plan to identify audiences, key messages, and various communications mechanisms (e.g. presentations, press release, websites, social media, etc.). The DNR's communications effort will be timed to coincide with the release of the full statewide NWI update, which we expect in December 2018.

Project Completed: 06/30/2018
FINAL REPORT
Technical Procedures for Updating the NWI for MN
Back to Top

Creating a Statewide Wetland Bird Survey
Subd. 03f $146,000 TF

Kristin Hall
Audubon Minnesota
1 Water St W, Ste 200
St Paul, MN 55107
Phone: (651) 739-9332 x116
Email: khall@audubon.org
Web: http://mn.audubon.org/

Appropriation Language
$146,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Audubon Minnesota to develop a statewide wetland bird monitoring program to enable long-term monitoring of the status of wetland birds and the health of their wetland habitats. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
We have successfully developed and implemented the Minnesota Statewide Marshbird survey over the course of this grant. We set out to achieve a coordinated and sustainable approach to marshbird monitoring using both paid and volunteer surveyors. The first two years of data collection were fully executed as presented in the proposed work plan. We also conducted a third "bonus" field season in 2018 using minimal management oversight and limited staff involvement to see how long-term management and implementation could work going forward. The overall goals of this project were met and in most cases exceeded. Some highlights include:

- Engaging and retaining approximately 35 volunteers throughout the duration of this effort.
- Surveying a total of 73 routes (over 776 survey points) throughout MN in 2016-2017.
- Successfully collecting statistically rigorous data (defined as n>25 observations) on 9 of our 20 focal species
    - 4 primary species: American Bittern, Pied-billed Grebe, Sora and Virginia Rail.
    - 5 secondary species: Marsh Wren, Sandhill Crane, Swamp Sparrow, Wilson's Snipe and Yellow-headed Blackbird.
- Evaluating species-specific wetland habitat associations at multiple spatial scales.
- Assessing the sensitivity of marshbird occupancy (nine species) and abundance (three species) to anthropogenic disturbance variables (developed land, agriculture).

- Determining the strength of association between marshbird occupancy (nine species) and abundance (three species) with ecoregion (Aspen Parklands, Boreal Hardwood, Prairie Parkland and Boreal Harwood Transition).
- Currently working on the publication of this project and analysis for a peer reviewed, scientific journal.

Audubon continues to participate in the Great Lakes regional partnership focused on marshbirds and their habitat, with this project leading the way in analysis and adding to the overall dataset. This report highlights some of the results and recommendations of the statewide marshbird survey effort.

PROJECT RESULTS USE AND DISSEMINATION
The results of this analysis are currently being drafted for submission to a scientific, peer reviewed journal. We will distribute the final accepted paper to the ENRTF for their records upon completion (anticipated in fall 2018) and highlight the write up on the Audubon MN website.

Project Completed: 06/30/2018
FINAL REPORT

Endangered Bats, White-Nose Syndrome, and Forest Habitat - RESEARCH
Subd. 03i $1,250,000 TF

Richard Baker
MN DNR
500 Lafayette Rd, Box 25
St. Paul, MN 55155
Phone: (651) 259-5073
Email: richard.baker@state.mn.us
Web: http://www.dnr.state.mn.us/eco/nhnrp

Appropriation Language
$1,250,000 the first year is from the trust fund to the commissioner of natural resources in cooperation with the University of Minnesota and the United States Forest Service to survey and radio-track endangered bats to define and understand summer forest habitat use in order to minimize forestry impacts and mitigate white-nose syndrome disease impacts. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The Northern long-eared bat's (NLEB) listing as threatened under the federal Endangered Species Act prompted the DNR to undertake this project. The federal listing was in response to the impact of White Nose Syndrome (WNS) on bats throughout North America. WNS was detected in Minnesota in 2016, and NLEB hibernating in the Soudan mine subsequently declined drastically. The project first (Activity 1) compiled historic data to identify past distribution of NLEB. We next (Activity 2) deployed acoustic detectors throughout the forested region of Minnesota and found NLEB at over half of the detector sites. Bats most common in southern Minnesota were NLEB, big brown bat, red bat, little brown bat, and silver-haired bat. In northern Minnesota, NLEB, little brown bat, and silver-haired bat were most common.

In Activity 3, we used radiotelemetry to locate bat roost trees. We captured 1,202 bats, with little brown bat (37%), big brown bat (31%), and NLEB (17%) most common. Pregnant females were captured into the third week of July, with lactating females more common after the last week of June. Juveniles were captured from the 3rd week of June to the end of July. We tracked 83 female NLEB to 238 roost trees. Surprisingly, almost 80% of the time a roost tree was used for only 1 night before switching to a different roost tree, which meant females carried young to a different roost tree often. Maternity roost home range size for female NLEB was about 18 acres.

In Activity 4, we found that NLEB females roosted in 27 different tree species, with 90% of roosts in deciduous tree species and 10% in conifer species. Most roost trees were in upland forests. Aspen trees were used most in northern Minnesota, maple and aspen trees in central Minnesota, and oak in southern Minnesota. Female NLEB preferred roost trees surrounded by mature forest. Roost tree habitat in northern Minnesota is broadly distributed. In southern Minnesota, female NLEB selected a wider range of roost trees than in the north, probably reflecting the greater presence of agriculture and development. We mapped areas of Minnesota that should be suitable habitat for female NLEB while raising young, based on distribution of NLEB in Minnesota and forest characteristics.

Results of this project benefit Minnesota because we have identified roost tree habitat for NLEB that is critical for successful reproduction. We have identified when female NLEB are pregnant and lactating, and shown that young must be carried from one roost to another. The data collected in this project will enable development of management strategies to help recover the NLEB population, and can also be used for management of other bat species.

PROJECT RESULTS USE AND DISSEMINATION
Over the 3 years of this project we disseminated information to several outlets as listed in the project work plan. Site level reports and annual reports have already been shared with LCCMR and with Resource Management Agencies. Technical Reports, and additional peer-reviewed papers that will be written based on data collected in this project will be used in to develop future management actions for the Northern long-eared bat, and other bat species that could be listed in the future in response to White Nose Syndrome. NLEB roost tree locations have been entered into the DNR's Natural Heritage Information System. The results of this project are serving a critical role in the development of the Lake States Forest Bat Habitat Conservation Plan, a collaborative effort involving the states of Minnesota, Wisconsin, and Michigan that will provide the basis for bat conservation efforts in the three states. A full list of reports can be found in the final report.

Project Completed: 06/30/2018
FINAL REPORT
Summary of 2016 Northern Long-eared Bat Research in MN
Summary of 2017 Bat Research in MN: Technical Report 2017
Histrocial northern long-eared bat occurrence in MN based on acoustic surveys: Technical Report 2018

Assessing Contaminants in Minnesota Loons and Pelicans-Phase III
Subd. 03j $141,000 TF

Carrol Henderson
MN DNR
500 Lafayette Rd, Box 25
St Paul, MN 55155
Phone: (651) 259-5104
Email: carrol.henderson@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language
$141,000 the first year is from the trust fund to the commissioner of natural resources to continue to assess the potential impact of petroleum, dispersants, and heavy metal contaminants from the Deepwater Horizon oil spill in the Gulf of Mexico on the wintering habitat of Minnesota's common loons and white pelicans using radiotelemetry, geolocators, and contaminant analysis.

OVERALL PROJECT OUTCOME AND RESULTS
The Deepwater Horizon oil spill in the Gulf of Mexico in 2010 exposed Minnesota-origin loons and white pelicans to direct mortality and to cancer-causing pollutants called Polycyclic Aromatic Hydrocarbons (PAH) and Dioctyl

Sodium Sulfosuccinate (DOSS). This study used radiotelemetry to study migration patterns of juvenile loons and to determine the extent of PAH and DOSS contaminants in live adult loons, loons found dead, and unhatched loon eggs.

Radiotelemetry efforts showed that juvenile loons migrate to the Gulf of Mexico in their first fall and then migrate to the northern Atlantic region offshore from Canada for their second summer and to the northeastern states and Ontario in their second year. They returned to the Gulf of Mexico each winter. Surviving birds wintered in the Gulf of Mexico where petroleum contaminants had settled offshore from Alabama and Florida. The subadult loons were expected to return to Minnesota for the first time in spring of 2017 but the last transmitter quit working in March of 2017.

A total of 17 of 22 juvenile loons marked with transmitters perished in their first two years and demonstrated that this species experiences high mortality in the first couple years of life.

Contaminant analyses revealed that 18 of 42 blood, feather, and fat samples from loons contained petroleum contaminants. Four of 29 unhatched loon eggs also contained PAH contaminants.

PROJECT RESULTS USE AND DISSEMINATION
The telemetry and contaminant data collected in this study have been incorporated with the results of previous research to validate and justify a claim to the US Fish and Wildlife Service for $6 million in remediation funds from the BP settlement to carry out long term restoration efforts for loon and pelican conservation in Minnesota. This would be the first of up to five three-year claims for loon and pelican remediation funds for Minnesota.

Project Completed: 06/30/2017
FINAL REPORT

Movement and Seasonal Habitat Use of Minnesota Elk - RESEARCH
Subd. 03k $200,000 TF

Lou Cornicelli
MN DNR
500 Lafayette Rd.
St. Paul, MN 55155
Phone: (651) 259-5202
Email: lou.cornicelli@state.mn.us
Web: http://www.dnr.state.mn.us/wildlife/index.html

Appropriation Language
$200,000 the first year is from the trust fund to the commissioner of natural resources to collect biological information about Minnesota elk, including movements and habitat use to enable long-term, sustainable management. This appropriation is contingent on a $50,000 match from state or nonstate sources. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The results of this study represent some of the first scientific knowledge of elk in Minnesota. By monitoring 20 adult female elk for 2 years, we were able to characterize the extent to which the 4 subgroups of elk in northwestern Minnesota utilize the landscape. Additionally, we identified habitats preferred by elk across seasons. Annual home ranges of elk were large, ranging from 71 km2 and 112 km2. Seasonal home ranges for elk varied little during our study, with an average size of 48.5 km2. Elk primarily selected for forested habitats, particularly on Wildlife Management Areas. Elk utilized open areas in close proximity to forested cover, including agricultural crops such as legumes and cereal grains, and fallow fields. Based on the movements of GPS-collared elk, female elk

do not interact with other females outside of their distinctive subgroups. Elk in northwestern Minnesota are non-migratory and maintained home ranges in the same general areas across the 2 years we monitored them. Our results provide specific information about the locations and movements of elk in Minnesota and habitats preferred by the species. This knowledge will enable managers to direct management to improve habitats most likely to be used by elk. Such efforts will improve the condition of elk and aid in minimizing elk-human conflicts.

Project Completed: 06/30/2018
FINAL REPORT
Space Use and Habitat Selection by Female Elk: Paper

Genetic and Camera Techniques to Estimate Carnivore Populations - RESEARCH
Subd. 03l $200,000 TF

Ron Moen
U of MN - NRRI
5013 Miller Trunk Hwy
Duluth, MN 55811
Phone: (218) 788-2610
Email: rmoen@d.umn.edu
Web: http://www.d.umn.edu/~rmoen

Appropriation Language
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota - Duluth for the Natural Resources Research Institute to use genetic sampling and remote cameras to improve monitoring of distributions and estimate population sizes of carnivore species.

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota has 20 carnivore species, 3 of which are very rare. Current monitoring methods of summer scent station surveys, winter track surveys, and population modelling could be complemented by camera traps and genetic DNA analysis. We used camera traps to obtain 3,400 images of carnivores over 12,000 camera-nights. American marten, fisher, short-tailed weasel, wolf, red fox, and gray fox were most frequently photographed. Occupancy analysis showed habitats used by each of these species. Mark-recapture estimation of population size was not possible. Camera traps could include significant public involvement, as is being done by the Wisconsin DNR. A second outcome of camera trap data is testing a Random Encounter Model to determine if population densities can be estimated without identifying individuals.

We implemented sampling protocols to obtain hairs non-invasively from weasels and larger carnivores. Hair collection was less efficient than camera traps. Wolf scat collection in snow was unpredictable. However, DNA analysis identified individuals in the collected samples. Hair and scat collection is technically feasible but logistically difficult to implement.

A consistent conclusion from genetic sampling protocols is that the cost to obtain and analyze genetic samples, at present, would make it difficult to implement a mark/recapture population estimate for management on a large spatial scale. We did not fully expend the ENRTF funding because genetics collaborators were fully occupied with their own research. One tangible outcome of this project is that a genetic collaborator with time to do the analysis is critical.

The Minnesota Carnivore website has descriptions, pictures from the camera trap project, and historical harvest data in Minnesota and adjoining jurisdictions. The website will be updated periodically to provide new information—it is the only Minnesota-specific Carnivore website available. In addition, we will finish 4 Technical Reports and a peer-reviewed paper on occupancy modelling in Fall 2018.

PROJECT RESULTS USE AND DISSEMINATION

1. Technical reports summarizing the entire project.
    a. **Camera Trapping:** Moen, R. and B. Houck. 2018. Monitoring Carnivore Populations in Northeast Minnesota with Camera Traps. NRRI Technical Report No. NRRI/TR-2018/44. University of Minnesota Duluth.
    b. **Weasel tube hair snares:** Houck, B. and R. Moen. 2018. Use of Tube Hair Snares to Detect Weasels in Minnesota. NRRI Technical Report No. NRRI/TR-2018/45. University of Minnesota Duluth.
    c. **Cable-Restraint hair snares:** Houck, B. and R. Moen. 2018. Use of Single-Capture Hair Snares to Detect Carnivores in Minnesota. NRRI Technical Report No. NRRI/TR-2018/43. University of Minnesota Duluth.
    d. **Wolf Scat Collection and Genetic Analysis:** Moen, R. 2018. Genetic Analysis of Wolf Scats Collected from Snow. NRRI Technical Report No. NRRI/TR-2018/51. University of Minnesota Duluth.
2. Occupancy modelling manuscript. Houck, B. and R. Moen. 2018. Occupancy modelling of carnivores in northeastern Minnesota from camera trap data. Manuscript to be submitted for peer review.
3. The Minnesota Carnivore website is currently located at https://champ.d.umn.edu/mc. It is being relocated to https://www.nrri.umn.edu/mc.

Project Completed: 06/30/2017
FINAL REPORT
Historical northern long-eared bat occurrence in MN based on acoustic surveys: Technical Report 2018

Digitization of Historic Gullions Ruffed Grouse Research
Subd. 03n $75,000 TF

Kent Montgomery
Central Lakes College
501 West College Dr
Brainerd, MN 56401
Phone: (218) 855-8155
Email: kmontgomery@clcmn.edu
Web: www.clcmn.edu

Appropriation Language
$75,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Central Lakes College to preserve the Gordon Gullion ruffed grouse data sets as permanent digital data files in order to improve accessibility to the information and inform forest wildlife conservation policies and practices.

OVERALL PROJECT OUTCOME AND RESULTS
Dr. Gordon W. Gullion is recognized as one of the world's foremost authorities on ruffed grouse. Dr. Gullion began his study of ruffed grouse ecology and habitat management in 1958 at the Cloquet Forestry Center, the Mille Lacs Wildlife Management Area and a privately owned Crow Wing Study Area.

More than 69,000 individual data records from his work exist on hard copy data cards today. These data document ruffed grouse habitat use throughout the year, food habits, reproductive success and mortality factors that provided the very foundation of ruffed grouse (and many other species) habitat and population management throughout much of the Great Lakes region.

Unfortunately, with Dr. Gullion's sudden death in 1991, and the deterioration of the data cards, this information was at a point where it may have been lost forever – and with it an important chapter in the history of wildlife conservation in Minnesota - without conversion of the data to a more permanent medium. This project set out to

transcribe 20,000 of these historic data cards into digital format and to develop of a data retrieval system that enables users to easily and efficiently navigate and retrieve data for specific analytical tasks from this electronic dataset. To assess this, a subset of Dr. Gullion's uncompleted manuscripts were to be completed using the data retrieval system to test its effectiveness.

Approximately 21,500 records were transcribed and archived in a digital database (MySQL). Data from MySQL files are easily exported into many analysis and spreadsheet programs, including MS Excel that increases accessibility to the data. Two of Dr. Gullion's manuscripts were reviewed using the archived data to determine the utility of the database. Additional funding provided by the Ruffed Grouse Society will allow digital transcription of the remaining 47,500 data cards. In addition, every data card will also be scanned front and back and a pdf version of each included in the database.

PROJECT RESULTS USE AND DISSEMINATION
Work will continue under Ruffed Grouse Society funding to continue to modify the digital database for ease of access as new card types and the remaining data cards are included. Upon the completion of transcription and scanning, the original data cards, files cabinets, maps, and any other materials from Dr. Gullion's collection currently housed at Central Lakes College will be returned to the Cloquet Forestry Center. The Center will also likely be the primary depository of the transcribed data and pdf images. Additional repository sites may include Central Lakes College, Minnesota Department of Natural Resources and the University of Minnesota. Archived materials in these collections will be available for electronic dissemination to anyone requesting the information.

Project Completed: 06/30/2017
FINAL REPORT

Effects of Grazing Versus Fire for Prairie Management - RESEARCH
Subd. 03o $414,000 TF

Susan Galatowitsch
U of MN
2003 Upper Buford Cir, 135 Skok Hall
St. Paul, MN 55108
Phone: (612) 624-3242
Email: galat001@umn.edu
Web: https://fwcb.cfans.umn.edu/personnel/susan-galatowitsch

Appropriation Language
$414,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to compare the effects of conservation grazing and prescribed fire on tallgrass prairie plants and pollinators in Minnesota in order to inform and improve land management practices. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Without disturbance, Minnesota's tallgrass prairies would transition to woodland and forest. Current management includes prescribed fire and conservation grazing to maintain prairie plant communities, with the assumption that pollinator communities will also benefit. While effects of fire on northern tallgrass prairie are well-documented, information has been lacking on effects of conservation grazing on vegetation and insects in Minnesota. To address this knowledge gap we evaluated vegetation, bees, and butterflies on burned or grazed remnant prairies in western Minnesota. Quantitative assessments of plant, bee and butterfly communities were based on randomly placed transects at each site; species lists were augmented by directed searches of the sites.

Of 328 plant species identified, 52 were found only on grazed sites and 57 only on burned sites. On a scale from 0 (weeds) to 10 (species found only in undisturbed remnant prairie), burned sites averaged 4.1 and grazed sites 3.7, which suggests that the grazed sites were a bit weedier than the burned sites.

Of 40 butterfly species observed, 30 were seen at both burned and grazed sites. Nine of the 40 species are reliant on native prairie. In general, species that were seen at more sites were also more abundant. Common species tended to be more abundant at burned sites and rarer species tended to be more abundant at grazed sites.
To date, 69 species have been identified from over 7,200 collected bees; a few taxonomically challenging specimens are as yet unidentified. Of conservation interest are the 11 species of bumble bees, three of which are listed as "vulnerable" by the IUCN (Bombus fervidus, B. pensylvanicus, and B. terricola).

Burning and grazing favored varying communities of plants, bees, and butterflies, suggesting that each management type has a role in maintaining Minnesota's prairie ecosystems. Results of our research are providing land managers with information necessary for them to be effective stewards of prairie plant communities and the pollinators that depend on them.

Project Completed: 06/30/2018
FINAL REPORT
Field Protocols
Prairie Vegetation and Insect Monitoring Workshop Handout

Foundational Dataset Characterizing Historic Forest Disturbance Impacts
Subd. 03q $200,000 TF

Michael Falkowski
U of MN
175 University Road
Colquet, MN 55720
Phone: (208) 218-726-6410
Email: mfalkows@umn.edu
Web: http://cfc.cfans.umn.edu/index.htm

Appropriation Language
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to quantify forest disturbance impacts over the past forty years on water quality, wildlife demographics, and wood fiber supply in order to identify management strategies that better respond to disturbance impacts and improve and sustain forest resources. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Forest disturbance (arising from harvesting, fire, land conversion, etc.) has a fundamental impact on the health and resilience of multiple forest resources including water quality, wildlife habitat, and wood resources, among others. Recently the United States Geological Survey made a revolutionary decision by allowing open access to a historic archive of Landsat satellite data dating back to 1972, providing a new opportunity to assess historic forest disturbance (type, timing, and patterns). The objective of this project was to utilize the historical satellite images to characterize >40 years of Minnesota forest trends and disturbance patterns, and provide spatial mapping resources for a variety of local forest management and research applications. After the necessary processing to compile the Landsat imagery in a way that would allow the data to be comparable through time, we created models to produce annual (1973-2015) state-wide maps of canopy cover. These maps allow for the characterization of forest resources at a given point in time, as well as the monitoring of forest change and recovery trends, providing a valuable and versatile dataset for a variety of Minnesota users. For the second part of this project, we focused on the Laurentian Mixed Forest Province, which contains much of the public and forested

lands of Minnesota, where we utilized additional Landsat data to map the most recent abrupt disturbance events over time. We further enhanced the disturbance map by classifying the disturbance agent (harvest, land conversion, fire, wind, flooding), as well as providing information about the year, duration, and magnitude of each event. Currently we are working with several collaborators to input our mapping products to address a variety of forest management, wildlife habitat, and water quality assessment applications.

PROJECT RESULTS USE AND DISSEMINATION
Our initial publication from this project, entitled "Extracting the full value of the Landsat archive: Inter-sensor harmonization for the mapping of Minnesota forest canopy cover (1973–2015)" was published in Remote Sensing and Environment in March 2018, and is already providing a valuable resource for fellow researchers through our approach for incorporating rarely integrated early Landsat MSS imagery to time series analyses for the creation of >40 years of annual forest attribute mapping. While only recently published, the paper has already received 4 citations in peer reviewed publications and boasts 423 reads on research focused social media platform. We were invited to present this work through a webinar for the USDA Forest Service's Forest Inventory and Analyses National Research Techniques Band (recording available at: https://usfs.adobeconnect.com/prjhzov1f5fi/), and continue to utilize the valuable state-wide data set presented in this publication for our disturbance mapping efforts and various forest, wildlife, and water resources applications.

We have worked with, and continue to work with, several collaborators to provide our canopy cover and disturbance mapping products for a variety of forest management, wildlife habitat, and water quality assessment applications. In addition to providing mapping resources to UMN moose biologists to assess habitat use and movement, we are also currently working with wildlife researchers from UMN-Duluth to incorporate our canopy cover and disturbance mapping products in a project assessing the impacts of harvest intensities and the quantity and spatial arrangement of retained tree canopy on avian and small mammal communities across a chrono-sequence of harvest ages. We have also provided initial harvest maps to contractors working with the MN PCA, to incorporate into a watershed planning tool for assessing forestry best management practices and impacts on water quality.

We have presented our work to a variety of research groups, local managers, and state and federal agencies throughout the project time period, and we continue to disseminate our results and mapping products to a variety of audiences to ensure that our products can provide vital additions to existing projects and management planning needs. We also continue to explore additional applications of the data and are working to compile manuscripts related to utilizing the disturbance products to assess various forest ecology and resource management questions and issues.

Project Completed: 06/30/2018
FINAL REPORT
Extracting the full value of the Landsat archive: Publication

Hydrologic Effects of Contemporary Forest Practices in Minnesota - RESEARCH
Subd. 03r $150,000 TF

Diana Karwan
U of MN
1530 Cleveland Ave N
St. Paul, MN 55108
Phone: (612) 624-2774
Email: dlkarwan@umn.edu

Appropriation Language
$150,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to install hydrologic monitoring stations to collect water quantity and quality data from lands managed for timber

production to better understand the relationship between harvest practices and water resources and related responses to changing climate and other disturbance factors in order to inform forest management practices. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

In forested landscapes, runoff amount and timing and sediment concentration and load are major water quality concerns. Previous studies on the effects of forest harvesting practices on water resources in Minnesota and throughout the Lake States region were conducted decades ago and their results have been widely applied beyond the conditions under which they were conducted. To facilitate effective, science-based forest management decisions, water quantity and quality information associated with contemporary forest harvesting practices is needed. To increase data on the hydrologic effects of contemporary forest management, we monitored stream discharge and water quality from early August 2016 to July 2018 at two river locations along the West Swan River in St. Louis county – one upstream and one downstream of ~100-acre growing season timber harvest. Average streamflow was approximately two times greater at the downstream site than the upstream site during the pre-harvest phase and increased to three times greater during the monitored post-harvest period. At the upstream site, average (± standard deviation) total suspended solids (TSS) concentrations remained relatively constant throughout the study (pre-harvest: 18.53 ± 21.49 mg/L; post-harvest: 19.81 ± 12.16 mg/L) whereas TSS concentrations at the downstream site very slightly increased from 22.13 ± 14.73 mg/L in the pre-harvest phase to 25.56 ± 24.85 mg/L in the post-harvest period.

Overall, this two-year data collection project quantified the variability of river flow and water quality as Total Suspended Solids concentrations. The variation water quality with approximately one year of pre- and post- timber harvest data showed slight differences that, for the most part, remain within the overall variability of pre-harvest conditions. Meaning that while the harvest had a nominal effect, this was seen only very local in space and near in time to the harvest. This relatively short case study provides data that is otherwise uncollected in this region. The results highlight the need to collect further data within the region and state to quantify the larger spatial effects of timber harvesting on water quality. In particular, additional efforts are needed to determine how site-level timber harvest effects scale up in space and factor into water quality planning at the watershed and/or hydrologic unit scale (e.g. in the Total Maximum Daily Load or One Watershed One Plan assessment and planning efforts).

PROJECT RESULTS USE AND DISSEMINATION

In the granting period, preliminary results of this project have been presented in 7 formal talks given by Dr. Karwan and Dr. Rose, as listed below. In addition to formal presentations, information learned from this project has been incorporated into teaching and broader conversation with forest management professionals by Dr. Karwan. First, Dr. Karwan provides forest hydrology instruction to silviculturists in the U.S.D.A. Forest Service National Advanced Silviculture Program every summer in Cloquet, MN. Lessons learned from this project, including working in mid-sized rivers and examining the effects of harvesting beyond small watersheds, are discussed as a part of this program. Second, information generated as a result of this project has been shared by Dr. Karwan as an invited participant to two groups affiliated with the State of Minnesota: (1) a 2018 panel convened to inform the research direction of the Minnesota Forest Resources Council, and (2) in meetings with a Technical Advisory Committee to the Minnesota Pollution Control Agency's team working to represent forestry Best Management Practices in hydrologic model scenarios (HSPF – SAM). Finally, work on this project formed the basis of an internship experience for two female high school students in Dr. Karwan's lab through the YWCA Minneapolis Girls Inc. Eureka! Program – a multi-year program for girls focused on STEM. In June – July 2018, two students assisted with water quality sample processing and traveled to the field site associated with this project. This experience formed a 4-week internship in which the high-school students experienced a STEM job first-hand and learned about both work in STEM fields and a university setting.

Upon completion of this project, we now have additional data and results to present. We are looking forward to doing this through venues that bring together scientists with forest and landscape managers, such as the annual Sustainable Forests Education Cooperative (SFEC) Forestry and Wildlife Research Review and the regional meetings of the National Council of Air and Stream Improvement, a timber industry group, which take places in the Great

Lakes region in the spring/summer of odd years. Furthermore, data from this project can be incorporated into graduate research and further work on the watershed functioning of northern MN forests.

Project Completed: 06/30/2018
FINAL REPORT

Habitat Mitigation for Goblin Fern Conservation
Subd. 03s $61,000 TF

Bobby Henderson
Leech Lake Band of Ojibwe
115 Sixth St NW, Suite E
Cass Lake, MN 56633
Phone: (218) 784-8620
Email: bobby.henderson@llojibwe.org

Appropriation Language
$61,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Leech Lake Band of Ojibwe to examine goblin fern populations, a threatened species in Minnesota, in relation to habitat degradation and to develop long-term habitat mitigation and species conservation strategies. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Goblin fern (Botrychium mormo) is a tiny, cryptic species of fern from the Great Lakes region of North America. The species once occurred throughout rich sugar maple and basswood forests of Minnesota, Michigan, and Wisconsin, but in recent times has become exceedingly rare and vulnerable throughout the entirety of its historic range. The primary goals of this project were to (1) evaluate habitat conditions and environmental factors influencing the decline of goblin fern populations; (2) quantify projected population extirpation rates for all recorded populations across Leech Lake Reservation, including Chippewa National Forest.

1. Habitat conditions were assessed by the degree of worm damage at each location and assigned an IERAT rank of 1-5 (1 = non-wormed, 5 = extremely wormed). Each site was also assigned a habitat ranking of 1-5 (1 = prime, 5 = non-extant); which directly correlates with the probability of goblin fern presence/absence at each location.
2. Our estimates of Minnesota goblin fern extirpation are consistent with previous publications; in fact our estimates indicate a significant increase in extirpation rates when compared to older publications addressing habitat issues and concerns.

Though startling, our study provides current published information about the loss of critical habitat, and subsequent decrease in occurrence and abundance of this state threatened species across its native range within Minnesota. With exception to the driftless area in southeastern Minnesota, there are no earthworm species native to the state, especially the rich maple and basswood forests of northern Minnesota. Contrary to long held belief, earthworms, especially those known as “crawlers”, cause irreparable damage to the forest floor and soil. As a result, much of the vital habitat required for the survival of goblin fern has become seriously degraded and fragmented across the north woods of Minnesota.

PROJECT RESULTS USE AND DISSEMINATION
Our abstract was submitted for peer review in June 2018. Upon receiving comment, review and revisions were made to the abstract, which was submitted in July 2018, and ultimately accepted for publication. The published article has been disseminated amongst select individuals within Minnesota Department of Natural Resources, Chippewa National Forest, Superior National Forest, and Ottawa National Forest for the purpose of developing and implementing improved habitat conservation measures. Additionally, all data collected from the project were shared with the USFS, Chippewa National Forest for the purposes of updating database records.

Project Completed: 06/30/2018
FINAL REPORT
Invasive earthworm damage predicts occupancy of a threatened forest fern: Publication

Subd. 04 Water Resources

A Novel Biofilm Technology for Water Nutrient Removal - RESEARCH
Subd. 04b $281,000 TF

Bo Hu
U of MN
1390 Eckles Ave
St. Paul, MN 55108
Phone: (612) 625-4215
Email: bhu@umn.edu
Web: http://www.bbe.umn.edu/People/Hu/index.htm

Appropriation Language
$281,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to develop a simulated lichen biofilm system that can be used to remove pollutants and recycle nutrients from storm water runoff and polluted lakes, ponds, and lagoons. This appropriation is subject to Minnesota Statutes, section 116P.10. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Nutrient pollutants such as nitrogen and phosphorus from urban and agricultural fields is the leading cause of water quality issues in Minnesota. We proposed a novel biofilm technology to remove nutrients such as nitrogen and phosphorus from water, based on a concept of a “simulated lichen biofilm”, mimicking the natural symbiotic lichen ecosystem, for efficiently removing and recovering nutrients and pollutants, by introducing a supporting matrix, binding filamentous fungal strains and microalgae. Different strain combinations, types of wastewater, reactor designs, and operational parameters were investigated. After laboratory scale experiments, the pilot demonstration was tested at the Sarita Wetland close to Saint Paul Campus of UMN and the pond next to the Frank and Sims Yard Waste Collection Site in East Saint Paul. Based on the results from the porotype model testing using a rotating paddle wheel design in Sarita wetland, we can conclude that the biofilm can be operated between 96-120 h with P removal efficiency of 80 %, N removal efficiency of about 66.2% and COD removal efficiency of about 74%, and needs replacement of biofilm for the next batch of operation. More future work is needed to address some technical challenges as it is applied in the field, including the competition from local microalgae in the wastewater, very effective in heavily polluted water while not effective with much diluted water nutrient pollution, and the biofilm as a food attraction to many insects, leading to the disintegration of biofilm. The technology developed from this project will contribute to a solution for both rural and urban communities to handle water sites polluted by nutrients. When communities can effectively manage their nutrient pollution in water systems, public health and the environment are adequately protected while the community has the management structure in place over the long-term.

PROJECT RESULTS USE AND DISSEMINATION
Even though a final applicable solution is still in needs of more research and development, we have presented our research in many national and local conferences, several publications either in press or in submission.
We published three journal articles and made a list of presentations to disseminate our research results and the Environment and Natural Resources Trust Fund was acknowledged at each of the presentation and paper publications. We also reached large amount of undergraduate students and high school teachers via the teaching module developed form this project. The project generates some excitement from both the scientific community

and industry. The technology developed from this project, together with the information obtained from the techno-economic analysis, can be beneficial to local communities to eventually find a solution for nutrient pollution issues. Besides the academic dissemination, a video of showcasing the pilot-scale testing system at Sarita Wetland will be posted on the group website for general public access. Below are the list of papers and publications and we are preparing for another two manuscripts for peer-reviewed publication.

Project Completed: 06/30/2018
FINAL REPORT

Biological Consequences of Septic Pollution in Minnesota Lakes - RESEARCH
Subd. 04c $364,000 TF

Heiko L. Schoenfuss
St. Cloud State University
720 Fourth Ave S WSB-273
St Cloud, MN 56301
Phone: (320) 308-3130
Email: hschoenfuss@stcloudstate.edu
Web: http://web.stcloudstate.edu/aquatictox/

Appropriation Language
$364,000 the first year is from the trust fund to the Board of Trustees of the Minnesota State Colleges and Universities system for St. Cloud State University to assess the presence of possible sources of contaminants of emerging concern in Minnesota lakes in order to determine their effects on fish health, understand the potential contribution from septic systems, and inform options for remediation and prevention to protect Minnesota lakes from these contaminants in the future. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
All activities proposed for the current study have been completed. The addition of a fifth lake and expansion from 16 to 20 study sites has provided a wealth of chemical and biological data that provide multiple avenues for further analysis and study. Pore-water sampling at all 20 lake sites has been completed and the samples have been analyzed for the presence of Contaminants of Emerging Concern (CECs). In addition, composite surface water samples from all five lakes were collected and analyzed. Composite pore-water samples were also collected and analyzed. Synoptic sampling of septic seepage flow into ground water was completed in the final year of the study. The chemical analysis of all samples has been completed and included pore-water, surface water, composite samples and laboratory water samples for confirmatory water chemistry. In total, well over 1,000 analyses were conducted to assess the presence and quantify the concentrations of CECs in Minnesota waters. These analyses revealed several key findings. First, CECs are ubiquitous in pore-water samples. Second, concentrations of CECs are higher in sites closer to lakeshore septic systems. Third, in addition to household-source signatures (i.e., CECs most likely used in households and as personal care products), some pore-waters also contain agricultural signatures (i.e., presence of pesticides in pore-water). Fourth, CECs are also ubiquitous in lake surface water -likely as result of incoming ground water flow.

The biological consequences of CEC exposures were evaluated using a combination of field and laboratory assessments. Native sunfish (Lepomis macrochirus) were captured near twenty field sites in which pore- and surface water chemistry was assessed for the presence of Contaminants of Emerging Concern (CECs) (Activities 1 and 2). In addition, hatchery-reared sunfish were exposed to mixtures of CECs derived from the pore-water measurements. We also exposed larval and adult fathead minnows (Pimephales promelas) in the laboratory to pore water (larvae only) and CEC mixtures. These analyses revealed several key findings. First, male fish taken from septic seepage-influenced lake sites and male fish exposed in the laboratory responded by producing the egg-yolk protein vitellogenin – a well-established biomarker of exposure to estrogenic CECs. Second, larval fathead

minnows exposed to either pore water collected from field sites or to a comparable mixture of CECs were less likely to survive than control larvae. Third, higher concentration CEC mixtures, matching those observed in lake pore-water produced subtle adverse biological effects. The biological findings identify CECs as a source of concern for the health and sustainability of Minnesota fish populations in lakes impacted by septic seepage.

PROJECT RESULTS USE AND DISSEMINATION
One peer-reviewed manuscript has been published, and two additional manuscripts are in preparation. In addition, results of the current study were disseminated widely in a series of presentations at regional and international scientific conferences:

- March 2016 – Society for Environmental Toxicology & Chemistry chapter meeting in Madison, WI
- November 2016 - Society for Environmental Toxicology & Chemistry world congress in Orlando, FL
- February 2017 - Fish & Wildlife Conference in Lincoln, NE
- March 2017 – MN Wastewater Conference, Brooklyn Park, MN
- March 2017 - Society for Environmental Toxicology & Chemistry chapter meeting in Minneapolis, MN
- April 2017 – Thesis defense (Les Warren) at St. Coud State University
- September 2017 – Seminar (Megan Guyader) at St. Cloud State University
- November 2017 - Society for Environmental Toxicology & Chemistry North America meeting in Minneapolis, MN (two presentations)

Project Completed: 06/30/2018
FINAL REPORT

Kenneth Valentas
U of MN
1479 Gortner Ave, 140 Gortner Labs
St. Paul, MN 55108
Phone: (763) 595-0365
Email: valentas@umn.edu

Appropriation Language
$505,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to develop a new nanocomposite material made from biomass that is designed to adsorb phosphorus, nitrogen, and pesticides from storm water and drain tile runoff discharge for recycling back to agricultural lands. This appropriation is subject to Minnesota Statutes, section 116P.10.

OVERALL PROJECT OUTCOME AND RESULTS
The effective production of food and fiber relies on fertilizers to provide plant nutrients and pesticides to control weeds, insects, and plant diseases that interfere with the yield and marketability of crops. In the fields, these do an important job, but when they run off into surface or groundwater they can pose a threat to water quality and raise environmental issues. The impact of pesticides on water quality' is a technically complex subject. Phosphorus, from fertilizers, is often the limiting nutrient in aquatic ecosystems and the main culprit in eutrophication. Once these chemicals enter our waters it is virtually impossible to remove them. The objective of this research was to determine if an engineered hydrochar, fabricated from inexpensive agricultural residues, would remove phosphorous, nitrates and pesticides from agricultural drainage waters. Our early research indicated that certain metals could be incorporated into chars to remove phosphorus and nitrates from dilute solutions. Subsequently, many experiments were performed with a wide range of biomass from corn stover to manures and with various potential activating metals.
Significant outcomes:

- Lanthanum (a transition metal) modified corn stover hydrochars have best phosphorus removal capacity in range of 25-45 mg of P/gram char from a 50ppm solution
- Zinc chloride modified bio-hydrochar sorbs nitrates comparably to activated carbon

- Lanthanum modified bio-hydrochar can simultaneously remove phosphorous and glyphosate from dilute solution
- Chars will sorb pesticides if first subjected to post-thermal heat treatment (PTT) in an oxygen-free atmosphere
- Dry biomass, like cornstover, can be converted directly by PTT to a biochar that will remove pesticides

These results provide a path forward in preserving the quality of our water resources by reducing the phosphorous, nitrates and pesticides that migrate to waterways through draintiles. The information generated here forms the basis for field trials leading ultimately to preservation of our aquatic ecosystems.

PROJECT RESULTS USE AND DISSEMINATION
The University has expanded the scope of the original provisional patent to include broader claims. The new provisional patent is:U.S. Provisional Application No. 62/718,705 Title: METHOD FOR REMOVING PHOSPHORUS COMPOUNDS FROM AN AQUEOUS MEDIUM, on August 14,2018. This technology was developed with trust funds from our LCCMR project and any future revenues will be shared as required.

Project Completed: 06/30/2018 [Extended in M.L. 2016, Chapter 186]
FINAL REPORT

Southeastern Minnesota Cover Crop and Soil Health Initiatives
Subd. 04e $253,000 TF

Matt Drewitz
Board of Water and Soil Resources
12 Civic Center Plaza, Suite 3000B
Mankato, MN 56001
Phone: (507) 344-2821
Email: matt.drewitz@state.mn.us
Web: http://www.bwsr.state.mn.us/soils/index.html

Appropriation Language
$253,000 the first year is from the trust fund to the Board of Water and Soil Resources to promote cover crops as a means of protecting soil and water quality in southeastern Minnesota through training and education for local practitioners, economic analysis of implementation, and on-farm demonstration sites. This effort must be coordinated with the University of Minnesota Forever Green Initiative. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
This project was very important in keeping the momentum going for cover crop and soil health awareness in Southeastern Minnesota. In 2014 when BWSR applied for the LCCMR grant, very limited outreach and awareness of implementing cover crops was occurring in Southeast Minnesota as well as Statewide. Over the last 4 years, the work of this project has helped keep cover crops and soil health on the forefront of innovative conservation in Minnesota. This project was successful in establishing cover crop demonstration sites, providing education and outreach through workshops and field days, and completing an economic analysis report of cover crops. The following includes the major accomplishments of this project:
Field Days: This project lead or assisted in sponsoring 9 different field days through the course of this project, which was the target goal for the project. A total of 575people attended these field days.
Workshops: A total of 832 people attended 11 workshops that were sponsored by this project, which exceeded our initial goal of 6 workshops.
Cover Crop Demonstration Sites: This project worked with 13 landowners to implement 2098 acres of cover crops over 2 years. These sites represented farmers from across the focus area using different farming methods and cover crop seed mixes

Soil Health Sampling and Method/Protocol Development: This project was important in working with our partners at USDA-NRCS and local SWCD staff to develop a sampling protocol for collecting soil samples for soil health analysis. Soil tests were collected at each of the landowner demonstration sites.
Cover Crop Economic Analysis: A report on the economics of cover crops based on data from the landowner demonstration sites was developed.
Partnership Development: This project was instrumental in bringing University of Minnesota, Federal, State, and local partners together to coordinate and ensure project success.

PROJECT RESULTS USE AND DISSEMINATION
This project provided dissemination of information regarding soil health, cover crops, and alternative crops through the many workshops and field days that were outlined above. This project utilized the U of M Soil Health website, as well as many other local sources, to provide information about upcoming workshops and field days. See web link: https://extension.umn.edu/soil-and-water/soil-management-and-health" .

Specific new information that was developed and disseminated through this project include:

- Cover Crop Economics Report by Dr. Bill Lazarus, U of M Applied Economics:
- Updates to U of M Cover Crop Economics Spreadsheet tools,
- Soil health testing results were supplied to each of the 13 cooperators,
- Project updates on BWSR's website, such as this BWSR Snap Shot article: http://www.bwsr.state.mn.us/news/webnews/december2016/1.pdf

Through this project over the last 3 years, BWSR has learned a lot about the positive impacts of soil health, the pros, cons, and risks of implementing cover crops into a farming operation, and what types of information farmers and local conservation practitioners are looking for. This project was instrumental in providing a basis for BWSR adopting cover crops as practice for our grant programs, helping provide insight into the development of the new BWSR/University of Minnesota joint venture with the Office for Soil Health, and was a precursor to a recently awarded Conservation Innovation Grant from the USDA-NRCS focusing on soil health metrics. BWSR is confident that the momentum created by this project will help move the State of Minnesota forward in developing new strategies for soil health that will lead to greater adoption of cover crops and other soil health practices.

Project Completed: 06/30/2018
FINAL REPORT

Shoreview Water Consumption and Groundwater Awareness Project
Subd. 04i $54,000 TF

Mark Maloney
City of Shoreview
4600 Victoria St N
Shoreview, MN 55126
Phone: (651) 490-4651
Email: mmaloney@shoreviewmn.gov
Web: http://shoreviewmn.gov

Appropriation Language
$54,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the city of Shoreview to provide biweekly water consumption data to at least 400 residential households for a two-year period to determine whether additional groundwater can be conserved with greater awareness of consumption data. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

The City of Shoreview is a suburb of approximately 26,000 people in the northeast metro area of the Twin Cities. Like many metropolitan municipalities, Shoreview supplies drinking water to residents and businesses via groundwater wells instead of surface water resources. Recent attention concerning the sustainability of groundwater resources in Minnesota is well documented and could pose a serious threat to future availability. Because of this threat, Shoreview decided to implement new initiatives to encourage water conservation in an attempt to conserve water resources. In 2015 the City applied for an LCCMR grant. Originally, Shoreview intended to use the grant to start reading water meters monthly, as opposed to quarterly, while also implementing a program called Know-Your-Flow that would provide a group of 400 resident volunteers with an at-home wireless Badger meter reader that displayed water use instantly inside the home. The goal of the increased meter reading frequency paired with the instant meter readers was to increase resident awareness of how much water was being used in their homes on a more frequent basis. The hope was that if water use were brought to the attention of residents more often, it could encourage conservation behaviors.

In March of 2016, city staff amended the grant to add an additional water conservation program, the behavioral water efficiency software company WaterSmart Software (WaterSmart), to the project. WaterSmart is a software platform that gathers publicly available data on water consumption, property and home metrics such as lot size and number of bedrooms, as well as climate data in order to provide individualized mailed “water reports” that compare each participant’s use to average and reduced water users within Shoreview. Sample email and print water reports are included with the supplemental attachments to this report. WaterSmart also provides residents with an online portal through which to view and update their property information in order to get a more accurate comparison. Shoreview continues to bill for water service on a quarterly basis. But, with now reading all water meters monthly, access to the online portal allows residents to keep up to date on their water use patterns between billings. The City added the WaterSmart program with the same hypothesis that increased water use awareness could lead to water conservation practices.

In order to test the hypothesis, the City and WaterSmart began a study that examined the effects of resident access to the WaterSmart online portal and mailed water reports on their water usage. A sample of single family residences in Shoreview were excluded from the program and labeled the “control group”. All other single family residences, including the 400 Know-Your-Flow volunteers, were given access to WaterSmart’s online portal and started receiving mailed water reports on their individual use. Over the course of 18 months, data on water use for both the control group and the group with WaterSmart access has been collected. Figures showing the difference in water use between the two groups are available in the supplemental attachment to this report. Based on the study, the City saved 4.1 million gallons of treated groundwater between January 2017 and June 2018. Four million gallons translates to an approximate 1% savings in total water use across Shoreview. The savings can be attributed to access to the WaterSmart program. This was determined by evaluating the amount of water used by the control group residents compared to residents who were given access to WaterSmart tools and outreach.

The initial results are encouraging because they suggest that increasing the amount and frequency of access to a resident’s water usage can lead them to conserve more water. Because of current conversations surrounding groundwater resource availability and conservation, and the fact that many Minnesotans are serviced by groundwater, the results of this project could be significant. If providing residents with more frequent access to their water use data can encourage conservation, other water suppliers could use similar techniques to achieve similar results. This would benefit Minnesota and Minnesotans by helping to preserve valuable groundwater resources while also helping shape environmental stewardship behavior in both children and adults.

PROJECT RESULTS USE AND DISSEMINATION

Outreach on Shoreview’s water conservation programs funded through this grant included press releases at the start of the project announcing both the Know-Your-Flow program and then the WaterSmart program. It should be noted that the exception to all dissemination activities in this section is the WaterSmart control group. They did not receive any mailings or other outreach described separate from press releases and city-wide newsletter articles. To start the programs, each eligible residence was mailed a welcome letter and instructional materials. The Know-Your-Flow group also received a Badger meter reader device. No other outreach was done for the Know-Your-Flow program as the City changed directions and began focusing on WaterSmart because the program

could be offered to more residents. For the WaterSmart program, eligible participants were sent a pre-launch survey along with their welcome letter. A sample of this survey is included in the supplemental materials for this report. The survey asked residents about their thoughts on Shoreview's water utility as well as their level of satisfaction and understanding. A summary of the pre-launch survey results is also included in the supplemental materials. As the program progressed, all single family residences in Shoreview who were not part of the control group received periodic individualized water reports at a rate of approximately 4 per year. These residents also had access to their online water conservation portal, specific to their residence. Examples showing the interface for the portal on both mobile and desktop devices are included in the supplemental materials. In addition to individual outreach, the City also published articles about the program in two editions of the ShoreViews community newsletter, mailed to all residents. City-wide outreach was limited due to the presence of the control group that excluded some from the program.

After a year's worth of portal access and water reports, all eligible residences were sent another, this time post-launch, survey. That survey and a presentation of the results are included in the supplemental materials for this report. Based on the surveys, residents in Shoreview had overwhelmingly positive things to say about their levels of satisfaction with their water utility, and they felt as though they understood their water use. In the second survey, a comparison was done between the pre-launch and post-launch survey results. Changes in results between the two surveys were attributed to WaterSmart access because the program was the only change made between the first and second surveys. Post-launch survey results showed that 88% of residents were satisfied or very satisfied with the value of water services in Shoreview, and 91% felt that the City helped them better understand their water use. These percentages had increased from 79% and 78% respectively since the pre- launch survey, highlighting the value of Shoreview's WaterSmart program for residents.

City staff has given several presentations to other municipalities and natural resource management groups in Minnesota about the WaterSmart program and preliminary results from the efficiency study. Based on these meetings, several other groups have expressed interest in WaterSmart and similar programs. The City has not yet shared the results of the project efficiency study with residents because the control group is still in effect and not all residents can opt-in to the program. Staff currently plans to continue the study through summer of 2019 and then start broader outreach on the value of WaterSmart and increasing knowledge and accountability in residential water use. The City is also currently considering making the online portal available to irrigation and commercial accounts as well as residential. Shoreview finds great value in all water conservation programs implemented through this grant, and has quantified over 4 million gallons saved to date. Staff plans to continue with WaterSmart portal and water report access through summer 2019 for those that are currently eligible. After the study is complete, Shoreview hopes to allow portal access to all residents so that outreach on the program can be more uniform.

Project Completed: 06/30/2018
FINAL REPORT

Subd. 05 Environmental Education

Connecting Students with Watersheds through Hands-On Learning
Subd. 05b $400,000 TF

John P. Lenczewski
Minnesota Trout Unlimited
PO Box 845
Chanhassen, MN 55317
Phone: (612) 670-1629
Email: jlenczewski@comcast.net
Web: http://mntu.org/

Appropriation Language
$400,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Minnesota Trout Unlimited to provide hands-on learning focused on water quality, groundwater, aquatic life, and watershed health stewardship. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Youth are increasingly becoming disconnected from the natural environment we live in. This lack of connection follows students into adulthood and impacts their ability to make well informed decisions about their environment. Most environmental education programming fails to adequately reinforce ongoing lessons through real-life applications outdoors. To remedy this, the program used field days to reconnect students with water, aquatic life, groundwater systems, and watersheds by getting them outdoors and providing hands-on learning experiences. Students were also exposed to outdoor recreation to encourage lifelong, tangible connections to aquatic ecosystems.

The program also utilized the Trout in the Classroom curriculum, which placed aquariums in classrooms so students could actively follow the development of trout from egg to juvenile. During this process, monitoring and scientific discovery took place and it was used as a spring board for fieldtrips to streams and as a focal point for reinforcing learning about watersheds, water quality and ecology. Fall field days preceded the fish rearing component of Trout in the Classroom and raised fish were released by students as part of spring field days. More than 2,000 students from 49 classrooms participated in these hands-on field days outdoors. This year-long program combined field studies and classroom visits, allowing students to apply the principles learned outdoors with realistic applications. Another 5,000 students in these schools participated in other aspects of the program. More than 2,000 students were encouraged to develop lifelong, tangible connections to aquatic ecosystems through school day introductions to fishing skills and fishing. Students and families were offered fishing clinics and mentorship opportunities outside of school.

Minnesota will benefit from students' increased awareness of their role in sustaining healthy aquatic ecosystems, especially as they carry a sense of stewardship forward into adulthood.

PROJECT RESULTS USE AND DISSEMINATION
Press advisories were issued for most field days and for three student summits. Many field days, and all summits, received good television coverage. Many newspapers also reported on the program. Minnesota Trout Unlimited highlighted this education program each year at the Great Waters Fly Fishing Expo in St. Paul, and featured an article on its accomplishments in each issue of its statewide newspaper (5,000 to 8,000 copies were distributed three times each year).

Project Completed: 06/30/2018
FINAL REPORT

Zumbro River Watershed Recreational Learning Stewardship Sites
Subd. 05c $300,000 TF

Brett Ostby
Zumbro Watershed Partnership, Inc.
12 Elton Hills Drive NW
Rochester, MN 55901
Phone: (507) 226-6787
Email: admin@zumbrowatershed.org
Web: http://www.zumbrowatershed.org

Appropriation Language
$300,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Zumbro Watershed Partnership to develop at least six recreational and educational sites on the Zumbro River with water quality demonstration elements and interpretative signage designed to encourage adoption of water protection practices. No more than 15 percent of this appropriation may be spent on site and construction consultation, planning, and design. Any plantings or restoration activities conducted with this appropriation must use native plant species according to the Board of Water and Soil Resources' native vegetation establishment and enhancement guidelines. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The Zumbro River and its tributaries flow through mostly private lands. Consequently, we have a population disconnected from this shared natural resource and relatively uninformed about its ecology, water quality challenges, flooding issues, and recreational uses. The ultimate goals of the Recreational Learning Sites were to reconnect citizens to this resource and encourage citizens to invest in its conservation. The Zumbro Watershed Partnership (ZWP) cooperated with local and state governments and non-profit organizations, including the Minnesota DNR, the Conservation Corps of Minnesota and Iowa and the University of Minnesota Extension, to enhance recreational access to the Zumbro River at eleven existing sites in six communities across four counties. Through a series of engagement events, we worked with communities to address local needs; for example, we built canoe landings in Pine Island, fire pits in Wanamingo and a hiking trail in Oronoco. These and other sites received natural plantings, stone benches, picnic tables and other amenities. Enhancements were intended to make the river more inviting. A series of permanent education kiosks were distributed among sites in each community. Education kiosks provided basic information about watershed science, ecology, land use history, recreation and actionable ways to improve water quality and mitigate flooding. This project benefited Minnesotans by enhancing the Zumbro River State Water Trail and community parks with regional significance, such as the Douglas Trail Head in Pine Island. Though substantial community engagement, this project benefited ecosystem management by focusing local governments and citizens on how they can improve public lands and waters. It also benefited ecosystems by planting trees, forbs and grasses native to Minnesota. This project provided concise and regionally-specific information about the Zumbro Watershed that can be the basis for productive engagement among informed citizens, governments and organizations.

PROJECT RESULTS USE AND DISSEMINATION
The recreation focused panels and the map panels that georeferenced other Recreational Learning Sites are the best tools that the ZWP created for dissemination. Many are placed in locations where visitors are likely to traverse. Beyond that, the ZWP continues to promote this project with Facebook posts and by maintaining a specific page for this project, easily accessed through our homepage (http://zumbrowatershed.org)

Project Completed: 06/30/2018
FINAL REPORT

Splash Screen: SciGirls Exploring Watersheds Using Mobile Technologies
Subd. 05d $147,000 TF

Joan Freese
Twin Cities Public Television
172 Fourth St E
St. Paul, MN 55101
Phone: (651) 229-1339
Email: jfreese@tpt.org
Web: http://www.tpt.org

Appropriation Language
$147,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Twin Cities Public Television to deliver an experiential, project-based educational program using mobile technologies to empower at least 200 middle school students in 4-H programs to engage in understanding and protecting local water resources.

OVERALL PROJECT OUTCOME AND RESULTS
Splash Screen: Students Engaging Local Watersheds Using Mobile Technologies environmental education pilot was designed to foster stewardship of water resources in middle school youth living in urban Minnesota communities. Ran in partnership with urban 4H clubs in the Twin Cities and Duluth, the project combined Place Based Education (project based learning experienced outside the classroom alongside community experts) with Mobile Learning, or education that uses portable technology, to teach about watersheds.

Project goals were for participating youth to:

- understand the importance of water resources in their community;
- be able to describe the major features of their local watershed;
- develop a basic understanding of some ways that humans can help and/or hurt this important resource;
- become acquainted with storm water runoff and what people can do to prevent it; and
- experience environmental advocacy first-hand by developing a public information campaign to share with their peers, family, and community, educating them about their watershed.

A total of 20 educators in Duluth and St. Paul were trained in: Splash Screen hands-on curriculum (Project Wet activities); place-based education, including working with community experts; and mobile technology. Bi-monthly webinars were held to provide updates and hear feedback from sites. Additionally, TPT and 4H held in-person meetings for educators prior to implementation for updates and technology distribution.

Two 4-H programs in Duluth and eleven in the Twin Cities implemented the Splash Screen curriculum during the spring and summer of 2016, reaching 107 youth participants with 25 hours of hands on learning per student. Summative Evaluation of Splash Screen was conducted by the Science Museum of Minnesota's Evaluation and Research in Learning group and measured the overall impact of the project on the educators and youth compared to project outcomes. The evaluation was guided by four questions, three aligned with project outcomes for educators and one aligned with project outcomes for youth. Project evaluation results, which showed that overall the project was more successful at addressing educator outcomes than it was at addressing youth outcomes, will guide TPT and 4H as the project staff plans scale-up of the program for youth. (See Splash Screen Summative Evaluation for an overview of the project evaluation.)

PROJECT RESULTS USE AND DISSEMINATION
On Saturday, October 8, 2016, Twin Cities PBS hosted a Splash Screen event at the station for project participants to share their watershed media project with family, friends, and community members. Youth presented a total of 9 final projects from 5 project sites, sharing their media-rich projects and discussing the importance of urban watersheds health for Minnesota communities.

In addition, SciGirls staff presented at TIES 2016 Education Technology Conference on Monday, December 12, 2017, in downtown Minneapolis. The session, titled Splash Screen: Engaging Local Watersheds Using Mobile Technologies, was attended by approximately 50 teachers, technology integrationists, and other education professionals from the formal education sector.

Here is a description of our offering:
Combine Place Based Education (project based learning experienced outside the classroom alongside community experts) with Mobile Learning to teach about watersheds. You will be given apps and other resources for environmental education, technology integration strategies and lessons learned from the pilot and evaluation done by the Science Museum of Museum. Splash Screen is a pilot project created by Twin Cities PBS in partnership

with Urban 4H with funding provide by the Minnesota Environment and Natural Resources Trust Fund, that is designed to foster environmental stewardship of water resources in youth living in urban Minnesota communities. While our project is now officially closed, TPT and Urban 4H are looking for funding opportunities to provide scale-up of the pilot program.

Project Completed: 06/30/2016
FINAL REPORT
Splash Screen Summative Evaluation

Mississippi Water Journey Camps
Subd. 05e $25,000 TF

Beth Mercer-Taylor
U of MN
1954 Buford Ave
325 LES Building
St. Paul, MN 55108
Phone: (612) 624-9430
Email: bethmt@umn.edu
Web: http://waterjourneycamps.blogspot.com/

Appropriation Language
$25,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to design and pilot two week-long summer camps for youth ages 6 to 11 focused around clean water and the Mississippi River and designed to get children outdoors exploring and engaged with the natural environment and creating educational materials to help their communities protect water quality.

OVERALL PROJECT OUTCOME AND RESULTS
Mississippi River Water Journey Camps get children ages 6-11 outdoors exploring water connections between the built and natural environment, doing wetland plantings, and teaching the public about water systems and how to improve water quality. The grant funded development of a toolkit and first year support for two one-week summer camps: “Water Journey: Drink” and “Water Journey: Rain,” held twice each at the Institute on the Environment, at St. Paul Campus, University of Minnesota as part of the University Recreation & Wellness Summer Youth Program. The camps adapt an existing arts/science adventure approach called Earth System Journey that engages youth with the infrastructure connecting daily water use to what happens at the other end of the pipes, in order to make conservation lessons relevant to students’ experience. This reflects environmental education needs for place-based education, bridging actions with impacts, getting kids outdoors, and engaging learners as real-world contributors.

The project goals were achieved. The evaluation report shows increased camper water system knowledge, stewardship attitudes and skills. This impacted 55 campers in summer 2016, with estimated 128-224 more campers reached in the coming four years of camp that the toolkit makes possible. While future camps are funded through camp tuition, support from the Institute on the Environment will continue. The project successfully demonstrated a model for formal and informal educators and increased public awareness of water issues and education methods. Outreach deliverables include a website, video, GIS story maps, summer art/science exhibit, and numerous educator and public presentations including at the 2016 EcoExperience. Inspired by this project, three education grants have been proposed including one in northern Minnesota, with one awarded so far. The model supports emerging approaches for integrated water management and education across public works and natural resource management organizations. Learn more and see all reports at http://waterjourneycamps.blogspot.com.

PROJECT RESULTS USE AND DISSEMINATION

A key outcome for Water Journey Camps is continuation of the program without LCCMR grant support in the summer for 2017, when 44 new children participated in four week-long camps that closely followed the model established in 2016. Another 3 years of camps are planned. In 2017, revenues from camp fees paid by each child, along with scholarships for low-income children, offset most of the costs, including staff pay, field trips, transportation and expendable art supplies like papers and beads. The bulk of art, science and photography supplies purchased in 2016, with LCCMR funds, were used again in 2017. The art and science "kit" should serve Water Journey Camps for at least 3 more years. Water Journey Camps is now a well-established and sustainable program that will ultimately reach more than 200 campers over 5 years.

Another outcome of Water Journey Camps is learning gains made by the campers themselves. The Evaluation Report details results of pre and post-camp surveys filled out by the children, with help from counselors for the youngest children. This survey data indicates gains in awareness of how we use water, knowledge of where water comes from and importance of water stewardship. In end-of-camp reflection on their experience, campers indicated more comfort with and interest in STEM projects, as they enjoyed 1) water quality testing and analysis, 2) learning about and planting plants and 3) crafting questions for professionals working in water systems. The art projects and mapping experiences were highlights for many campers. The Youth Program leaders offered informal feedback that parents were pleased with what their children learned. Water Journey Camps were the favorite of several children who enrolled in multiple camps at the University of Minnesota.

A Toolkit is now available on the Water Journey Camps website, aimed at serving teachers and informal educators interested in the approach to learning about water in a particular place or using specific projects. The Toolkit is itself an outcome of the grant. It is flexible enough to allow for replication of the entire overall concept of Water Journey Camps, the use of one or more of the projects in a class period or field trip, or the addition of a new element - such as story maps, photography, planting or tracking pipes – in an existing lesson. The website and materials available have been or will be shared with hundreds of educators through conference presentations and networking sessions as well as web and social media outreach done by IonE. The conferences include the Minnesota Association for Environmental Education (MAEE) meetings in 2016 and 2017, the Minnesota Educator's Academy annually in October as well as the Upper Midwest Association for Campus Sustainability (UMACS) in Pella, Iowa in late September, 2017, and on a national stage at the Association for Advancement of Sustainability in Higher Education (AASHE) annual conference in October, 2017. AASHE invited Beth Mercer-Taylor to serve on its first panel on K-12 sustainability summer programs supported by campus sustainability units.

As a key partner, the Institute on the Environment (IonE) gained the unexpected benefit of expansion into new water and K-12 programming as a result of Water Journey Camps. IonE's provision of significant staff support, no-cost space and a beautiful public gallery space for display of camp maps, art and science projects made more IonE staff and faculty keenly aware of the power of an art, science and storytelling approach to learning about water. The energy of the campers and their learning about water systems inspired the staff and faculty as well as many visitors attending meetings and events at IonE. In the last week of June, 2017, immediately after the camps were completed, over 100 educators saw the Water Journey Camp displays, including nearly 60 attending the Climate Generation Summer Institute at IonE and 45 attending a national workshop on Sustainability & Diversity in Higher Education at IonE. Water Journey Camps contributed to IonE staff and faculty expanding their engagement in water related and K-12 programming, including:

1. a new stewardship project starting in fall, 2017 at Sarita Conservation Area;
2. an partnership between IonE and the "Water Bar" where flights of local tap waters are served to students and community partners;
3. placement of 5 high school interns from the City of St. Paul Right Track program at IonE in summer 2017, including 3 assisting with Water Journey Camps;
4. hosting the Climate Generation Summer Institute for educators.

Project Completed: 06/30/2017
FINAL REPORT
Mississippi River Water Journey Camps Toolkit Guidance Document
Mississippi River Water Journey Camps Evaluation Report

Subd. 07 Air Quality, Climate Change, and Renewable Energy

Reducing Emissions from Open Burning through Biomass Gasification
Subd. 07b $268,000 TF

William Northrop
U of MN
111 Church St SE
Minneapolis, MN 55455
Phone: (612) 625-6854
Email: wnorthro@umn.edu
Web: http://www.me.umn.edu/

Appropriation Language
$268,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota in cooperation with the Department of Natural Resources to characterize and promote distributed biomass gasification of wood waste as a means for producing renewable and sustainable energy in rural areas through a demonstration at the Department of Natural Resources regional office facility in New Ulm.

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota forests produce 2.4 million tons of wood waste per year, a significant portion of which is burned in open piles or in large-scale gasification facilities to generate heat and power. However, open burning wastes energy and emits harmful pollutants while large-scale power generation facilities rely on transporting fuel long distances. This project demonstrated that a small-scale distributed gasifier-generator system could produce heat and power for remote rural areas while reducing harmful pollution. In laboratory tests conducted at the University of Minnesota, the research team found that small-scale gasification emitted fewer pollutants like nitrogen oxides (NOx), soot, and carbon monoxide per amount of wood consumed than open burning and comparable emissions to large-scale wood energy operations. Further, due to clean engine combustion and production of biochar, small-scale gasification was found to achieve the lowest lifecycle greenhouse gas emissions compared to open burning, large-scale gasification and wood decomposition.

In the second phase of the project, the gasifier generator system was packaged into a weatherproof container and installed at the Minnesota Department of Natural Resources Southern Regional Office in New Ulm, MN. There it supplemented the facility's installed photovoltaic solar array on winter mornings, offsetting 10-15 kW of utility purchased power used to operate geothermal heat pumps. The system's performance at DNR supports small-scale gasification's potential for use in remote applications like state park facilities. Although promising when operational, excessive DNR staff time was required to regularly start and maintain the system, and prepare dry fuel. Other operational deficiencies included internal clogging and equipment failures. To be viable for further deployment, additional development work must be done to realize a more reliable and automated system. Ultimately, this project proved that small-scale distributed biomass gasification, if improved, could be an environmentally and economically favorable alternative to open burning and large-scale gasification.

PROJECT RESULTS USE AND DISSEMINATION
To disseminate the results of the gasifier-generator emissions analysis, a graduate thesis explaining all elements of the project was completed. In addition, a paper emphasizing the applications and merits of distributed small-scale gasification using waste biomass was submitted to the journal Biomass and Bioenergy. Several tours were held at the DNR facility to showcase the gasifier offsetting the facility's electricity costs and to discuss the benefits and challenges of biomass gasification technology. Finally, power output data from the gasifier operating during winter months was published to the DNR's Energy Smart website http://www.dnr.state.mn.us/energysmart/.

Project Completed: 06/30/2017
FINAL REPORT

Building Deconstruction to Reduce Greenhouse Gas Emissions and Solid Waste
Subd. 07c $1,000,000 TF

Part 1 - $845,000
Steve Thomas
The NetWork for Better Futures
2620 Minnehaha Avenue
Minneapolis, MN 55406
Phone: (612) 325-7856
Email: sthomas@betterfutures.net
Web: hhttp://www.betterfuturesminnesota.com

Part 2 - $155,000
Victor Krause
U of MN - Duluth NRRI
5013 Miller Trunk Highway
Duluth, MN 55811
Phone: (218) 788-2769
Email: vkrause@d.umn.edu
Web: http://www.nrri.umn.edu

Appropriation Language
$845,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Better Futures Minnesota in cooperation with the Northwest Indian Opportunities Industrialization Center and $155,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota - Duluth for the Natural Resources Research Institute to develop and test a model for implementing building deconstruction and material reuse as a competitive alternative to demolition for the purpose of reducing greenhouse gas emissions, reducing landfill waste, and providing job training. The project report must quantify and document greenhouse gas emissions reductions resulting from specific deconstruction techniques and materials reuses.

Part 1 - OVERALL PROJECT OUTCOME AND RESULTS
This project promoted building deconstruction as an alternative to demolition. The project also developed viable techniques for reducing greenhouse gas emissions and diverting significant amounts of reusable and recyclable building materials from landfills. Construction and demolition debris is the second largest component of our waste stream; only 20-30 percent is recycled. Deconstruction is the systematic disassembly of a building, with the purpose of recovering materials for reuse or manufacturing into new products. Overall, material reuse reduces the industry's consumption of virgin materials, helps preserve natural resources, and protects the environment from pollution related to extraction, processing, and disposal of raw materials.

The partners exceeded nearly all the expectations related to this project:

1. 29 LCCMR-eligible properties were deconstructed.
2. 303 unemployed people were trained and/or employed. 18 FTE positions were created.
3. The partners compiled environmental impact data for the projects. Over 2,600 tons of building material was diverted from landfills. For projects in the Twin Cities, more than 85% of the waste was diverted and 5% of the materials were reused. It was difficult to achieve these diversion rates in Greater Minnesota due to the lack of building material recycling facilities.
4. The environmental benefits generated by deconstruction compared to traditional demolition are significant. The practice of dumping a building into a landfill emits, on average, 248 metric tons of CO2 for each property demolished. Better Futures' deconstruction work emitted on average just 51 metric tons of CO2.

5. This project averted the emission of 5,288 metric tons of CO2. This decrease in CO2 emissions is equivalent to taking 1,114 cars off the road for one year. The social cost of this carbon offset is $190,548.

These activities and accomplishments confirmed the multiple benefits of building deconstruction. This approach for building removal reduces the release of harmful toxins and gasses to our air, water and land. Deconstruction also creates meaningful employment with opportunities for advancement in numerous industries. This process also preserves a wide range of fixtures and other materials that are in demand for reuse or repurposing.
But significant challenges hinder the financial viability of deconstruction since the current cost of demolition is artificially low. The existing price for demolition does not reflect the true environmental, health, economic, and social cost of burying material in landfills. The solution, based on the testing, work, and research completed under this grant is to adopt building material stewardship policies statewide.

Part 1 - PROJECT RESULTS USE AND DISSEMINATION
Throughout the grant period, the partners were consistently engaged in promoting the practice of deconstruction and material reuse. Over time, the visibility of workers taking a part a building generated the most publicity and heightened the level of interest among the public. The actual work helped to highlight the futility and wastefulness of demolition and showcased a practical way to significantly reduce trips to a landfill. Homeowners emerged as the prime drivers for deconstruction of privately owned buildings. Accordingly, the partner's revised its messages and materials to address a homeowners' demands and concerns about demolition. An added advantage is homeowners secure a tax deduction for the materials donated to the partners. This tax benefit helps with making the case for deconstruction.

Part 2 - OVERALL PROJECT OUTCOME AND RESULTS
NRRI partnered with Better Futures MN and Northwest Indian Community Development Center to promote building deconstruction as an alternative to demolition. Deconstruction is the systematic disassembly of a building, with the purpose of recovering materials for reuse or manufacturing into new products. This partnership hopes to bring awareness to Minnesotans that building deconstruction is a reliable way to manage our natural resources used for construction, and reduce the environmental impact and costs associated with disposal of demolition wastes.

NRRI activities during the project period:
1. Assisted with the development of safe, cost-effective methods for the removal of materials to retain maximum value of items harvested. As an aid to the partners, a final report was generated by NRRI that covers a list of potential end uses for materials and suggests some methods for determining value for the various materials that were harvested during the project period.
2. Provided training to participants from Better Futures and NWICDC to select quality materials, practice safety in the wood shop, build indoor/outdoor benches, and suggested methods to determine value of the items built. Participants learned additional skills to make themselves more marketable to future employers.
3. Assisted with the promotion of building deconstruction across the state of Minnesota by participating in the assembly and presentation of several case studies with examples of the benefits of deconstruction; shared the case studies during meetings with county officials, at regional Green Building meetings, and at two conventions in Minneapolis and Duluth.
4. Provided input to Ecotone Partners, who developed a tool for calculating yield and environmental impact of materials harvested from deconstruction. Reports produced using the tool provide information on greenhouse gas reduction, energy savings, reduced landfill use, and materials reused.

Part 2 - PROJECT RESULTS USE AND DISSEMINATION
Over the course of the project, NRRI was consistently promoting deconstruction and material reuse by engaging the public during public tours at our facility in Duluth. A display was constructed from harvested materials that highlighted the value and the environmental impact of diverting materials from the landfill and reusing or converting them into usable commodities. NRRI engaged others through the use of social media to promote activities that the partners were involved with. Media events connected to specific projects in St. Louis County

helped to showcase the positive impact offered through deconstruction by highlighting local job creation, landfill diversion, and the lack of material recycling and reuse in greater Minnesota.

Project Completed: 06/30/2018
FINAL REPORT

Subd. 08 Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Prioritizing Future Management of North Shore Trout Streams
Subd. 08a $416,000 TF

Lucinda B. Johnson
U of MN - NRRI
5013 Miller Trunk Hwy
Duluth, MN 55811
Phone: (218) 788-2651
Email: ljohnson@nrri.umn.edu
Web: http://www.nrri.umn.edu/staff/ljohnson.asp

Appropriation Language
$357,000 the first year is from the trust fund and $59,000 the first year is from the Great Lakes protection account to the Board of Regents of the University of Minnesota - Duluth for the Natural Resources Research Institute to identify key areas in North Shore streams that supply the cold groundwater essential to sustaining trout fisheries, in order to focus habitat restoration, protection, and management efforts on the areas that are most essential for long-term stream health and sustainability. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Since the last report we have used the stream temperature data collected by NRRI and DNR to develop models predicting the presence of groundwater and the presence of cold water in North Shore streams. Two different models were developed predicting: 1) presence/absence of cold-water features; 2) actual mean July mean, minimum and maximum July temperature. We then used a "weight of evidence" approach from these model predictions to predict the tributaries with a high probability of encountering a cold-water feature. Maps were developed to depict the location of these cold-water tributaries and reaches with cold-water features; a database was developed showing the location of sampled streams along with their status with respect to 1) observation of cold-water features; 2) existence of cold-water tributaries; 3) no cold-water features. In addition, we created stream temperature models for several tributaries, and used them to project future changes in stream temperature and studied the potential for mitigating temperature changes with increased riparian shading. Throughout this project a member of the angling community was embedded in the project planning meetings, participated in project meetings in which data and models were evaluated, provided perspectives on data and outreach products, and has assisted in the development of management recommendations. This individual will be assisting with further outreach to the angling community throughout the coming spring (2019).

Overall Project Outcomes
Water temperature is generally considered one of the primary physical habitat parameters determining the suitability of stream habitat for fish species, but climate change is threatening these cold-water habitats. The primary goal of this project was to provide the information to ensure that restoration and management are targeted at stream reaches essential to ensuring long-term sustainability of cold-water fisheries. Project goals were: (1) collect temperature data and map the locations of thermal refuges in "top tier" North Shore trout streams; (2) determine the environmental characteristics (flow, geology, and land use / land cover) associated with cold-water refuges, and predict areas most resilient to climate change; and (3) recommend actions to protect / manage these cold-water features. We developed an inventory and database of cold water tributaries and features

in North shore streams based on manual surveys (n = 121 stream reaches; of which 83 were found to contain cold-water features), and continuous monitoring (n = 36 locations); developed empirical models predicting the probability of encountering a cold-water tributary or a reach with a cold-water feature; assessed the relative influence of climate versus riparian shading on stream temperature; developed management recommendations to promote the persistence of cold-water habitat under future climate conditions. Fishery personnel were involved throughout the project development and execution to help assess results and develop recommendations. Recommendations for future data needs included: depth to bedrock, extent of bedrock fracturing, more detailed map of Quaternary Geology. Additional temperature monitoring is recommended to include locations within and outside cold-water features. Management actions focused on restoring or enhancing riparian vegetation near high value streams with narrow channels, streams in smaller subcatchments, and, where groundwater seeps enter warmer channels, maintaining tree cover to preserve lower groundwater temperatures. Data will be posted on a public website for distribution (https://data.nrri.umn.edu/data/).

PROJECT RESULTS USE AND DISSEMINATION
MN Trout Unlimited personnel have been involved in all aspects of this project, starting with the study design, development of sampling methods, site selection, data analysis / interpretation, and information dissemination. MN DNR staff were consulted extensively in site selection; data from MN DNR temperature surveys have been incorporated into modeling efforts. Personnel from the Minnesota Spring Survey were also consulted periodically to exchange site selection information.

We have given periodic talks to fishing organizations, attended fishing expos, and will meet with fishing organizations and DNR staff during the coming winter to further disseminate results and discuss recommendations. PI Johnson and student Jonathan Utecht made a presentation to the Arrowhead Fly Fishers group on February 16, 2015 to invite volunteers; they also attended two additional events at the Nemadji Water Fest in Carlton County (March 12th) and the Great Waters Fly Fishing Expo (March 19-20) in St. Paul. Informal interactions between project personnel and the angling community occurred at MN Trout Unlimited and MN Steelhead Association meetings throughout the project.

Project Completed: 06/30/2018
FINAL REPORT

Preserving and Protecting Minnesota Native Orchid Species
Subd. 08c $167,000 TF

David Remucal
U of MN - Landscape Arboretum
3675 Arboretum Dr
Chaska, MN 55318
Phone: (612) 301-1838
Email: remucald@umn.edu
Web: http://www.arboretum.umn.edu

Appropriation Language
$167,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Minnesota Landscape Arboretum for propagation and cultivation research to enable long-term conservation of at least 15 selected species of the 48 native orchid species in Minnesota. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Minnesota is home to 48 species of native orchids, 20% of which are on the state endangered species list. Even "common" orchids are generally regarded as rare. These plants are charismatic state treasures that evoke the imagination of Minnesota residents and people around the world. Orchid hunting – both photographing and

poaching – has increased the threat to these plants while , in turn, increasing conservation efforts. Beyond poaching, orchids have a more complex relationship to their environment than many other plant species and are easily affected by local disturbances, especially those that change local groundwater levels and flows.
The Native Orchid Conservation Program (NOCP) at the Minnesota Landscape Arboretum (MLA) follows a vision unique to the U.S.: to conserve the genetics of all Minnesota orchid species and bring as many as possible to MLA to display. Building a seedbank for 15 of the state's species was the initial objective and research to develop propagation techniques for all species is on-going. Some species have known growth-from-seed techniques; for most, however, that knowledge is unknown. As both conservation and propagation of seed efforts continue, the goal is to share information in order to encourage obtaining orchids for personal gardens through sustainable seed-produced orchids, rather than poached transplants (which have a high failure rate). Displaying these orchids is vital and will accomplish two goals: 1) show visitors the beauty of these treasured plants – plants they might otherwise never see due to the remote habitats they often occupy, and, 2) educate people about the importance of protecting these species and about their known successful propagation techniques.

While the NOCP and MLA are committed to long-term orchid conservation, success was achieved quickly within the project's first phase, banking more species than expected. Through this process, it became clear that: there is untapped enthusiasm throughout Minnesota for orchid conservation, finding some species in the wild remains difficult, and there may be lower population numbers than expected for even the "common" species. We created a diverse genetic bank for nearly 1/3 of Minnesota's species, covering much of the state, and have worked with nearly 2/3 of Minnesota's species to research, establish, or further propagation. This advanced our work, allowing us to display some of our new orchids already, to the delight of MLA visitors. Our data will increase understanding of how these species are distributed across the state and provide locations of vital populations identified for conservation. Ultimately, as we bank seed and establish propagation techniques for each species and pair this work with an increased understanding of how each species lives in its natural environments we will better equip ourselves and others to keep these treasures on Minnesota landscapes for years to come.

PROJECT RESULTS USE AND DISSEMINATION
Over the course of the granting period the public visibility of the Native Orchid Conservation Program increased steadily. With articles in magazines/newspapers, a story on MPR and social media posts, we engaged the public in multiple ways and the success bred interest across the state. The result was that we had people from around the state contacting us with offers to help, information about orchid populations in need, and requests to have us bank seeds on private landowners' lands. This reaction from around the state was unexpected this early in the program and demonstrates both a real need for this kind of program and general support among Minnesotans. As we continue to establish this program and develop our strategy to educate visitors and the public, this broad base of support will allow us to continue to reach the farthest corners of the state. This kind of reach will allow us to share our work and Minnesota's orchids with people who may not be able to visit the Arboretum and, interestingly, will also allow us to share our plant treasures with people around the world.

Project Completed: 06/30/2018
FINAL REPORT

Conservation Assistance Acceleration Project
Subd. 08d $1,000,000 TF
Tabor Hoek
Board of Water and Soil Resources
1400 East Lyon Street
Marshall, MN 56258
Phone: (507) 537-7260
Email: tabor.hoek@state.mn.us
Web: http://www.bwsr.state.mn.us

Appropriation Language
$1,000,000 the first year is from the trust fund to the Board of Water and Soil Resources for the final phase of a pilot program to provide grants to soil and water conservation districts and other units of local and state government for employment of staff to provide technical assistance to secure enrollment and retention of private lands in federal and state conservation programs. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
This project has come to a close exceeding expectations and should be credited with stemming the loss of conservation acres in this state enrolled in the CRP program. This project has allowed the much needed local staff commitment to follow through on federal program assistance at a time when federal agencies have reduced staffing and cut budgets shifting workload to anyone left able to do the job all under tight deadline and ever changing program requirements. The existing SWCD structure in this state along with the expanded partnership at the local level with Pheasant Forever to hire, train, and support upwards of 40 full time equivalent staff positions in 53 county offices has made this all a reality. It will never be known the status of conservation acres in this state had this project not been in place, but it can be said with confidence that we would have lost acres at a higher rate. Project totals for the project period are 11,521 landowner contacts and 167,500 ac. enrolled in conservation. See Attachment C for result totals. For the first time in a while, MN did actually have a net gain conservation acres as can be seen in the updated Conservation Lands Summary. Specifically CRP grew by 70,000 ac. in the past year although is slated for some significant reductions again on Oct. 1, 2018. The future of this effort will continue under diverse funding sources to maintain the 40 fte's and more of an emphasis is currently on the ongoing CREP initiative, not approaching 10,000ac. in enrollment.

PROJECT RESULTS USE AND DISSEMINATION
The MN Conservation Lands Summary can be found at:
http://www.bwsr.state.mn.us/easements/CLS_Statewide_Summary_August_2018.pdf and was recently updated 8/17/2018
Project Completed: 06/30/2018
FINAL REPORT

Metro Conservation Corridors Phase VIII - Prairie, Forest, and Savanna Restoration Greater Metropolitan Area
Subd. 08e $276,000 TF

Betsy Daub
Friends of the Mississippi River
101 East Fifth Street, Suite 2000
St Paul, MN 55101
Phone: (651) 222-2193
Email: bdaub@fmr.org
Web: http://www.fmr.org

Appropriation Language
$276,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Friends of the Mississippi River for Phase VIII of the Metro Conservation Corridors partnership to conduct restoration activities on at least 195 acres of forest and savanna and at least 60 acres of prairie to preserve and increase wildlife habitat in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties. Expenditures are limited to the identified project corridor areas as defined in the work plan. A list of proposed restorations must be provided as part of the required work plan. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

Friends of the Mississippi River improved 260 acres of forest, savanna and prairie habitat at six sites in the Twin Cities Metro Area. The sites are situated within the Mississippi River flyway, a corridor that is vital for migratory birds. Site restoration improved habitat connectivity for wildlife dispersal and enhanced the quality of habitat for native pollinators and Species of Greatest Conservation Need. Prairie restorations returned deep-rooted plant species to sites along the Mississippi River that help retain and filter water runoff. Removal of invasive woody plant species from forested sites re-established healthier woodlands, allowing native plant species to thrive.
Prairie restoration activities took place on 198 acres and included removal of non-native species, seeding of native plants, prescribed burns and mowing. At Spring Lake Park Reserve's east prairie restoration, 41 of 69 species of native plants were detected, achieving a very diverse prairie. At the small two-acre Ole Olson prairie, 25 species of prairie plants replaced turfgrass, creating habitat for diverse pollinator populations. At Grey Cloud Dunes SNA, we had originally planned to burn 10 acres of prairie, but an unplanned wildfire in April 2018 burned 90 acres. While more than what was planned, the burn did help rejuvenate the prairie and maintain the area free of woody encroachment.

Forest restoration activities took place on 62 acres and included removal of invasive woody plants, treatments with herbicide, native plant seeding, hand-pulling invasive plants, and prescribed burns. At Hampton Woods WMA, where native woodland wildflowers were once sparse under the buckthorn canopy, they now proliferate following buckthorn removal. At Old Mill Park, a prescribed burn on the savanna in spring 2018, resulted in native prairie species returning to dominate the site with about 90% cover. The state-threatened kittentail population (Besseya bullii) population remains stable at the site.

PROJECT RESULTS USE AND DISSEMINATION
The restoration projects received regular coverage over the three years, particularly in Friends of the Mississippi Rivers' outreach through newsletters and social media. We also received some good coverage in print media and on television.

Project Completed: 06/30/2018
FINAL REPORT

Metro Conservation Corridors Phase VIII - Enhancing Restoration Techniques for Improved Climate Resilience and Pollinator Conservation
Subd. 08f $400,000 TF

Wiley Buck
Great River Greening
251 Starkey Street, Suite 2200
St Paul, MN 55017
Phone: (651) 665-9500 x15
Email: wbuck@greatrivergreening.org
Web: http://www.greatrivergreening.org

Appropriation Language
$400,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Great River Greening for Phase VIII of the Metro Conservation Corridors partnership to pilot and evaluate innovative restoration techniques aimed at improving the resilience of bur oak communities to changing climate conditions and enhancing prairie management to benefit pollinators with the help and engagement of citizen volunteers. Expenditures on restoration efforts are limited to the identified project corridor areas as defined in the work plan. A list of proposed restorations must be provided as part of the required work plan. This appropriation is available until June 30, 2018, by which point the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

Greening and our partners Xerces, Maplewood Nature Center, and U of MN, advanced prairie and oak woodland restoration practices for vegetation and pollinators in multi-faceted fashion. We implemented quality restorations and enhancements, and gathered 12,000 data points, analysis of which is already guiding restoration, pollinator, and engagement practices. Improvements include a successful climate-resilient approach to oak restoration; using conservation haying to benefit prairie plants and pollinators; refining our approach to pollinator refugia, overwintering and nesting needs during restoration; improving student knowledge of native plants and pollinators; implementing citizen science practices for valuable data collection and outdoor citizen engagement; increasing our understanding of native pollinators' macro- and micro- floral resource needs; improving pollinator habitat along trails; and documenting the federally endangered rusty-patched bumble bee. This program further accomplished 32 acres restored, including 6,000 bur oaks, 12,000 pollinator plants, and 45,000 milkweed seeds getting into the ground.

PROJECT RESULTS USE AND DISSEMINATION
Dissemination of the results is also multi-faceted and robust, underway and promising to continue beyond the grant period. This includes the publication of a bee monitoring guide for citizen science, and five presentation-ready reports; five social media outreach avenues reaching thousands; eight conference presentations reaching over 400 professionals; partnering with five local government land-owning units; and active engagement of over 1,500 citizens, including 841 K-12 students, 45 Master Naturalists, 200 citizen scientists, and 235 restoration volunteers.

Project Completed: 06/30/2018
FINAL REPORT

Shoreland Protection for the Lower St. Croix River
Subd. 08j $190,000 TF

Deb Ryun
St. Croix River Association
230 S. Washington Street, Unit 1 PO Box 655
St Croix Falls, MN 54024
Phone: (715) 483-3300
Email: debryun@scramail.com
Web: http://stcroixriverassociation.org/

Appropriation Language
$190,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the St. Croix River Association to provide technical assistance to landowners, local governments, realtors, and developers on shoreland conservation and protection of the lower St. Croix River. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The Lower St. Croix Wild and Scenic River (LSCWSR) is federally designated and state managed; it is about 52 miles long, and ¼ mile wide, and was the focus of this project. This heavily visited National Park is a high-quality fishery, offers spectacular natural views and has high recreational value. Development pressure has been constant. An insufficient understanding of the river's unique protection status has led to conflicts and weakening of adherence to established rules designed to protect bluffs and shoreland.

The St. Croix River Association (SCRA) has worked to protect, improve and restore natural vegetation adjacent to the St. Croix River through educational workshops, resource creation, and strategic outreach to realtors, local governments, and landowners in the Riverway. Over 5,000 landowners received information about Riverway regulations and over 500 realtors attended workshops or presentations about Riverway protections, native plants, raingardens and scenic easements. SCRA presented at more than 35 city council meetings for ten local

governments in the Lower Riverway and provided six training opportunities for over 170 local officials. The most significant resources created were The Landowner's Guide to the Lower St. Croix Riverway, Best Practices for Zoning Applications in the Riverway, and a video about the Lower St. Croix River.
Development pressure remains constant, but SCRA has seen immense improvement in the collaboration between cities, landowners, and realtors to prioritize water quality and habitat as a result of this project. The resources created will continue to educate landowners about best practices and protections on the Lower St. Croix River, and are available online on SCRA's website and at city halls, realty offices, watershed groups, the National Park Service, and the MN DNR.

Minnesotans are now able to easily access information about the Lower St. Croix River's history, significance, and protections. Whether they live on the St. Croix, have considered purchasing property there, or simply enjoy visiting the Riverway, Minnesotans will know the story of the Riverway and the importance of upholding its unique protections. The results of this project reflect the power of education, collaboration, and communication between diverse stakeholders to work together to protect the river they love.

PROJECT RESULTS USE AND DISSEMINATION
Materials Created

- The Landowner's Guide to the Lower St. Croix Riverway
- Best Practices for Zoning Applications in the Lower Riverway
- 3-minute animated video about Riverway history, significance, and regulations
- Safe Harbor Earth Tone Color List
- Riverway GIS layer hosted publicly

Outreach and Dissemination:

- Over 3,000 copies of the Landowner's Guide to the Lower St. Croix Riverway have been disseminated to landowners either directly or through local governments and realtors.
- 1,000 copies of the Lower Riverway panel cards were distributed to businesses along the River
- Over 50 presentations were given to landowners, realtors, and local governments about Riverway history, significance, protections, and best practices for landowner stewardship

Project Completed: 06/30/2018
FINAL REPORT

Redwood and Renville Counties Outdoor Recreation and Conservation Master Plan
Subd. 08k $75,000 TF

Scott Refsland
Redwood County and Renville County
105 Fifth St S, Ste 311
Olivia, MN 56277
Phone: (320) 523-3664
Email: scottr@renvillecountymn.com
Web: http://www.renvillecountymn.com/

Appropriation Language
$75,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Renville County in cooperation with Redwood County to develop a joint outdoor recreation and conservation master plan to guide future development and protect cultural, historical, and natural resources in the Minnesota River Valley.

OVERALL PROJECT OUTCOME AND RESULTS

The development of a Minnesota River Valley Recreation and Conservation Master Plan is complete and all deliverables in the contract with the consultant have been delivered. The development of this plan has resulted in a solid direction to advance the interests of improving the recreation and conservation opportunities in the valley. Once adopted by the Counties, this plan provides a prioritized list of action items to begin immediate implementation. This will hopefully result in an increased use and respect for the incredible resource that is shared by Renville and Redwood Counties.

The Master Planning process resulted in a large collection of public opinion from both local residents as well as those outside of the area. Our public meetings had many local residents and averaged an attendance of around 35 people per meeting. Our online survey collected 382 usable surveys from 42 different counties in Minnesota. The data collected from the public was necessary to create this plan, but will also provide many benefits for other efforts in the area for years to come.

The Master Plan is a catalyst for future conversation about how to invest in the Valley for ways to increase the value and benefits of valley resources for those who live in or visit the area. The shared vision in this plan creates a picture of what the Valley can become in the future.

PROJECT RESULTS USE AND DISSEMINATION
All outcomes have been completed with some amendments being made to Outcome 6. Throughout the course of this project it became clear that providing detailed cost estimates was overly ambitious and beyond the scope of this project. Strategies for prioritizing land use decisions and long term funding opportunities and project management were completed. We held one more public meeting than stated with an additional meeting to present the final plan to the public. Final Master Plan was printed and sent to the counties in June 2017 along with digital copies of all files created by consultant throughout this project.

Project Completed: 06/30/2017
FINAL REPORT
Minnesota River Valley Recreation and Conservation Master Plan

Subd. 09 Land Acquisition for Habitat and Recreation

Metro Conservation Corridors Phase VIII - Coordination and Mapping and Conservation Easements
Subd. 09e $515,000 TF

Wayne Ostlie
Minnesota Land Trust
2345 University Ave W, Ste 240
St. Paul, MN 55114
Phone: (651) 917-6292
Email: wostlie@mnland.org
Web: http://www.mnland.org

Appropriation Language
$515,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with the Minnesota Land Trust for Phase VIII of the Metro Conservation Corridors partnership to provide coordination and mapping for the partnership and to acquire permanent conservation easements on at least 120 acres of strategic ecological landscapes to protect priority natural areas in the metropolitan area, as defined under Minnesota Statutes, section 473.121, subdivision 2, and portions of the surrounding counties. A list of proposed easement acquisitions must be provided as part of the required work plan. 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 plan. Up to $40,000 may be used for coordination and mapping for the Metro Conservation Corridors. All conservation

easements must be perpetual and have a natural resource management plan. A list of proposed easement acquisitions must be provided as part of the required work plan. This appropriation is available June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
In this eighth phase of the Metro Conservation Corridors the Minnesota Land Trust (MLT) sought to protect 120 acres of critical habitat through conservation easements within designated Metro conservation corridors. To facilitate this outcome, MLT implemented a competitive RFP process (a revision of the MMAPLE framework developed for the ENRTF-funded Avon Hills program in Stearns County) to solicit bids from interested landowners within areas of high biological value targeted for the program. A framework for scoring and prioritizing bids was developed for the Metro Corridors program that placed emphasis on a set of ecological criteria (size of habitat to be protected, condition of the habitat, and ecological/protection context within which the parcel lies) and cost. Along with their proposal for inclusion into the program, landowners identified the funding level necessary for their participation.

The Land Trust utilized an array of strategies to effectively target landowners within priority areas, ranging from direct mail to face-to-face meetings and web-based methods (Facebook and web postings). Subcontracts were entered into with Anoka Conservation District, Isanti SWCD, Sherburne SWCD, and Washington Conservation District to conduct landowner outreach within priority areas.

Three properties were projected under this phase of the program. In total, 158 acres of high-quality habitat were protected through conservation easement, including 14,152 linear feet of undeveloped shoreland. This ENRTF grant leveraged $71,850 though landowner donation of easement value and support provided by partners toward the costs of easement project development and acquisition, equivalent to roughly 14% of the overall project budget. Though a large portion of project funding was left unspent MLT was able to exceed protection deliverables while efficiently utilizing state funds to secure conservation easements on strategically-located parcels containing high-quality habitat which buffered, or connected to, protected habitat complexes.

PROJECT RESULTS USE AND DISSEMINATION
MLT also convened and led quarterly meetings of the MeCC partnership to review project accomplishments, share information related to each respective partner's conservation work across the MeCC program area, and to strategically plan and coordinate conservation activities.

The MeCC web-based project database upgrade work was completed by the DNR during Spring 2016. A web-based map for public use can be accessed on the DNR's website at: http://www.dnr.state.mn.us/metroconservationcorridors/index.html. An upgrade to the MeCC web-based project database was completed under Phase VI was used and the MeCC corridor map was revised and posted for public use in early 2017.

Project Completed: 06/30/2018
FINAL REPORT

Metro Conservation Corridors Phase VIII - Wildlife Management Area Acquisition
Subd. 09h $400,000 TF

Patrick Rivers
MN DNR
500 Lafayette Rd
St. Paul, MN 55155
Phone: (651) 259-5209
Email: pat.rivers@state.mn.us
Web: http://www.dnr.state.mn.us/index.html

Appropriation Language
$400,000 the first year is from the trust fund to the commissioner of natural resources for Phase VIII of the Metro Conservation Corridors partnership to acquire in fee at least 82 acres along the lower reaches of the Vermillion River in Dakota County within the Gores Pool Wildlife Management Area. Land acquired with this appropriation must be sufficiently improved to meet at least minimum management standards. This appropriation may not be used to purchase habitable residential structures, unless expressly approved in the work plan. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
The DNR, in partnership with Dakota County, acquired 169.59 acres of high quality habitat along the lower reaches of the Vermillion River on April 27, 2016. The acquisition consists of several disjoint parcels that are inholdings within the Gores Pool Wildlife Management Area (WMA) and the Vermillion River Complex. This was a high-priority acquisition for the Department of Natural Resources as the area is classified as an Outstanding Regionally Significant Ecological Area for documented colonial waterbird nesting and red shouldered hawks. The property includes more than one mile of river shoreline, high value wetlands and floodplain forest (red oak- sugar maple-basswood forest; silver maple floodplain forest) important for waterfowl, beaver and mink, whitetail deer and numerous other species including non-game species of special concern. Bald eagles and common snapping turtles are present; lake sturgeon and blue sucker occur in Mississippi River Pool 3 nearby. The acquisition reduced the WMA boundary by approximately one mile and resolves potential for boundary dispute.

PROJECT RESULTS USE AND DISSEMINATION
This parcel will soon be designated as part of the statewide WMA system (anticipated in August, 2016). This process involves publishing a designation order in the State Registrar, and a news release announcing this and other recently acquired WMA lands. The news release will mention the use of Environment and Natural Resource Trust Fund for the acquisition.

Project Completed: 06/30/2017
FINAL REPORT

Multi-benefit Watershed Scale Conservation on North Central Lakes
Subd. 09j $950,000 TF

Katherine DonCarlos
Leech Lake Area Watershed Foundation
PO Box 124
Walker, MN 56484
Phone: (218) 547-4510
Email: kathyd@leechlakewatershed.org
Web: http://www.leechlakewatershed.org

Dan Steward
Board of Water and soil Resources
1601 Minnesota Drive
Brainerd MN 56401
Phone: (218) 828-2598
Email: dan.steward@state.mn.us
Web: http://www.bwsr.state.mn.us

Appropriation Language
$950,000 the first year is from the trust fund to the Board of Water and Soil Resources to secure permanent

conservation easements on at least 480 acres of high-quality habitat in Crow Wing and Cass Counties. Of this amount, up to $65,000 must be deposited in a conservation easement stewardship account; and $54,000 is for an agreement with the Leech Lake Area Watershed Foundation in cooperation with Crow Wing County Soil and Water Conservation District and Cass County Soil and Water Conservation District. Deposits into the conservation easement stewardship account must be made upon closing on conservation easements or at a time otherwise approved in the work plan. A list of proposed easement acquisitions must be provided as part of the required work plan. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS

Land conservation is a critical tool in the water plans of Crow Wing and Cass County. Limiting development within the watershed has multiple benefits that extend far beyond water quality protection. Science and geographic information system studies were used to strategically identify and prioritize the most significant lake watersheds on which to focus conservation efforts. This pilot project acquired five conservation easements protecting approximately 218 acres and 1,750 feet of strategic shoreland and forestland within the watersheds of priority recreational lakes in Cass and Crow Wing counties.

The focus was on 8 strategic "tullibee-refuge lakes" that are near 75% protection and where additional protection in the watershed can measurably move the needle of protection towards or to full 75% protection. These included notable lakes such as Ten Mile, Roosevelt, Thunder, Washburn, and the Whitefish Chain of Lakes –some of Minnesota's premier recreational lakes.

BWSR's RIM Reserve easement program has been a successful tool to protect environmentally sensitive land and water quality throughout agricultural regions of the state. In recent years, BWSR has received increasing requests from soil and water conservation districts for BWSR to make available a RIM tool in the forested region of the state.

Geographic data and existing technical criteria were used to identify parcels that would provide the highest conservation protection investment with a goal of 75% watershed protection. Leech Lake Area Watershed Foundation focused on landowner recruitment including presentations at targeted lake association meetings, direct mail, landowner visit's and a workshop. Applications were ranked based on the scoring criteria. Approved applications were integrated into the standard BWSR RIM process using soil and water conservation districts (SWCDs) as local agents teamed up with easement acquisition expertise of BWSR staff. Long –term monitoring and enforcement will be provided by BWSR in partnership with the SWCDs.

PROJECT RESULTS USE AND DISSEMINATION

Landowner outreach was conducted to provide information to landowners on the opportunity for conservation easements to protect land and preserve water quality. A press release announced two workshops which were hosted in May 2016 at the Crooked Lake Town Hall (Outing, MN) and the Ideal Town Hall (Pequot Lakes, MN).

Project Completed: 06/30/2018
FINAL REPORT

Conservation Easement Assessment and Valuation System Development
Subd. 09k $250,000 TF

Bonnie Keeler
U of MN
301 19th Ave. S.,
Minneapolis, MN 55455
Phone: (612) 625-8905
Email: keel0041@umn.edu

Web: https://www.hhh.umn.edu/directory/bonnie-keeler-0

Appropriation Language
$250,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to assess the effectiveness of existing conservation easements acquired through state expenditures at achieving their intended outcomes of public value and ecological benefits and to develop a standardized, objective conservation easement valuation system for guiding future state investments in conservation easements to ensure the proposed environmental benefits are being achieved in a cost-effective manner. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

OVERALL PROJECT OUTCOME AND RESULTS
Our research sought to address a problem that conservation practitioners and the LCCMR face; how do we know that a proposed easement acquisition is a good use of resources? What benefits does it provide, and is it the best parcel to provide those benefits? We set out to understand existing approaches, and create a tool to complement their strengths and improve conservation targeting.

After researching the methods state agencies and NGOs use to prioritize acquisitions in the state, we designed a tool to complement existing approaches in two ways. First, we observed that existing systems all use a rubric to score proposed acquisitions on a parcel-by-parcel basis. Detailed local knowledge gathered in site visits is important for decision-making, however, it is impossible to gather site-level data for the entire state. Valuable parcels will be missed without a statewide, landscape-level perspective. To complement existing rubrics, our approach scored over 300,000 privately held, undeveloped parcels to provide the context of how a proposed acquisition compares to all other parcels in the state.

Second, our approach created 11 environmental benefit metrics, designed to complement those used in existing prioritization systems. Our metrics combine spatial data to map not just where high quality natural resources are, but also where the public would benefit the most from conservation. For example, our bird watching metric considers where experts have identified as important bird habitat, and where the public actually goes to engage in bird watching. The resulting metric recognizes both important habitat, and where bird watchers go, but gives the highest scores to locations where both occur.

Our research provides conservation practitioners with the data and tools to quickly assess the environmental benefits of a parcel, and how those benefits compare to hundreds of thousands of other parcels in the state. By assessing all of the parcels in the state, practitioners will be able to identify the best parcel to meet their objectives and cost-effectively provide multiple benefits to all Minnesotans

PROJECT RESULTS USE AND DISSEMINATION
We have been presented this research to conservation practitioners at organizations including:

- UMN Natural Resources Research Institute (they agree to include our metrics in their spatial data atlas)
- The Nature Conservancy Freshwater and Land teams
- Lessard-Sams Outdoor Heritage Council working group on impact assessment
- BWSR
- DNR Easement stewardship working group
- Authors of the MN Gulf nutrient reduction strategy
- Minnesota Land Trust

We will continue to communicate with these groups to ensure they are able to make the most of our research products.

In addition to traditional outreach through presentations, we also produced a professionally developed website (pebat.umn.edu), with a particular focus on explaining our methods in a simple, non-technical way. While the site has online been online for a month, it has had 100 visits and 25 downloads of the tool. We will continue to track

visits and downloads. Furthermore, will also be publishing an article on the UMN Institute on the Environment site that publicizes the research products from this project. It will be produced in the same style as the post we used to publicize the manuscript that was produced in activity 1 of this project: http://environment.umn.edu/news/new-study-conservation-investments-working-harder-minnesotans/

Project Completed: 06/30/2018
FINAL REPORT

Subd. 10 Emerging Issues Account

Emerging Issues Account
Subd. 10 $1,000,000 TF
Becca Nash
Legislative-Citizen Commission on Minnesota Resources
100 Rev Dr Martin Luther King Jr Blvd, Rm 65
St. Paul, MN 55155
Phone: (651) 296-6264
Email: becca.nash@lccmr.leg.mn
Web: https://www.lccmr.leg.mn
Appropriation Language
$1,000,000 the first year is from the trust fund to an emerging issues account authorized in Minnesota Statutes, section 116P.08, subdivision 4, paragraph (d).

Sub-Project 01: Avian Influenza distribution, evolution, and impacts on ring-billed and herring gulls in Minnesota

Project Completed: 06/30/2017
Sub-Project 01: Avian Influenza distribution, evolution, and impacts on ring-billed and herring gulls in Minnesota - $213,443 TF

Marie Culhane
U of M
1988 Fitch Av.
Saint Paul, Minnesota 55108
Phone: 612) 624-7423
Email: grame003@umn.edu
Web: https://experts.umn.edu/en/persons/marie-r-culhane%28a6117d66-04f5-4716-bcf2-e10ac8984f87%29.html

OVERALL PROJECT OUTCOME AND RESULTS
In summary, this project provided novel and important information regarding the avian influenza prevalence and viral shedding routes in Minnesota ring-billed gulls and the genetic characteristics of the influenza A viruses detected. We addressed a gap in influenza A virus surveillance by sampling 1346 ring-billed gulls (Larus delawarensis) during Spring and Fall migrations and at three breeding sites in 2017 across Minnesota. Results indicated noticeable age-cohort dynamics in AI virus prevalence within ring-billed gulls in Minnesota. Immunologically naïve juveniles represented the cohort with the highest prevalence rate (57.8%). Regardless of age, more gulls had AI virus detected in oropharyngeal than in cloacal swabs.
Our results varied among colony sites and seasons, but a consistent finding was that juvenile and hatch year birds had higher avian influenza virus prevalence than adults. Furthermore, swabs from the oropharynx and cloaca demonstrated a significant difference in avian influenza virus prevalence. Oropharyngeal swab testing yielded true avian influenza virus prevalence estimates of 23.55%, versus 10.64% for cloacal swab testing. These results suggest, as other studies have shown, that gulls more commonly shed avian influenza virus via the oropharyngeal

route which may facilitate transmission to other species and have implications for surveillance strategies. Although our results indicate that gulls shed virus predominately through the oropharyngeal cavity it is important to consider the apparent prevalence bias of sampling only the oral cavity. If only oral cavities were sampled, our estimates of sample prevalence would have been negatively biased by 2.5% considering all sampled birds together. Using this approach, avian influenza virus detection would have been missed in 34 birds. This negative bias would have been highest at 6.4% if we conditioned the analysis on local birds, resulting in 86 missed detections. The negative bias would have been negligible for adults at < 1% yet would still result in 12 missed detections. This example supports the practice of swabbing both oropharyngeal and cloacal cavities for avian influenza virus surveillance efforts in gulls. If funding is limited, then oropharyngeal and cloacal swabs should be taken and pooled into one tube.

During our study, we identified only two H5 avian influenza viruses that were detected by subtype specific rRT-PCR and neither was confirmed as highly pathogenic avian influenza virus by gene sequencing. We further analyzed all swabs that tested positive for avian influenza virus with Ct values < 30 and subjected them to whole genome sequencing to further characterize the viruses detected and found H13N6, H13N8, and H13N2 viruses. Analyses of these genes showed that there was apparently no virus movement between wild gulls and domestic poultry in Minnesota in the time period studied.

The high AI virus prevalence within ring-billed gulls, particularly in immunologically naïve birds, warrants further targeted surveillance efforts of ring-billed gulls and other closely related species. Sequence analyses completed on the viral genes identified, suggest that our data group separately from highly pathogenic H5NX avian influenza viruses that devastated Minnesota poultry in 2015 which is interesting and suggests that gulls are not part of the poultry transmission cycle (see Figure 2 as an example). Additional analyses will be conducted and we look forward to further research using the data generated from this successfully completed project.

Subproject 01 Completed: 06/30/2018
FINAL REPORT

Subd. 11 Administration and Contract Agreement Reimbursement

Contract Agreement Reimbursement
Subd. 11b $135,000 TF

Katherine Sherman-Hoehn
MN DNR
500 Lafayette Rd, Box 10
St. Paul, MN 55155
Phone: (651) 259-5543
Email: Katherine.sherman-hoehn@state.mn.us
Web: http://www.dnr.state.mn.us

Appropriation Language
$135,000 the first year is from the trust fund to the commissioner of natural resources at the direction of the Legislative-Citizen Commission on Minnesota Resources for expenses incurred for contract agreement reimbursement 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.

OVERALL PROJECT OUTCOME AND RESULTS
This appropriation was used to support the ENRTF contract management program, which ensured that ENRTF grantees expended grant funds in compliance with state law, session law, approved work plans, and Office of Grants Management grants policies.

The DNR Grants Unit managed 59 grants active in FY 2016. In FY 2017, the Grants Unit managed 67 active grants. Between 7/1/2015 when the services began and 06/30/2017 when they ended, the DNR Grants Unit:

- Made 270 reimbursements to grantees totaling $6,186,311.59
- Prepared and executed 21 ML 2016 grant agreements
- Published 6 editions of the quarterly newsletter for all grantees
- Billed 976 hours at the FY 2016 professional services rate of $59.00/hr
- Billed 1,245 hours at the FY 2017 professional services rate of $62.00/hr
- Monitored all grants in compliance with Office of Grants Management policies.

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, newsletter, and phone.

Project Completed: 06/30/2017
FINAL REPORT