2010 Project Abstract
For the Period Ending June 30, 2014

PROJECT TITLE: Updating the National Wetlands Inventory in Minnesota
PROJECT MANAGER: Steve Kloiber
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2010, Chp. 362, Sec. 2, Subd. 3b and M.L. 2013, Chapter 52, Section 2, Subdivision 17

APPROPRIATION AMOUNT: $1,100,000

Overall Project Outcome and Results

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land use planning, wetland permit screening and natural resource management, the original maps have grown increasingly out-of-date due to landscape alterations over the years.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

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

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

Project Results Use and Dissemination

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

The updated wetland map data are available through an interactive mapping application on the DNR's website at: http://www.dnr.state.mn.us/eco/wetlands/map.html. The data can also be downloaded, free of charge, for use in geographic information system applications through the

DNR's data deli at: http://deli.dnr.state.mn.us/. The data will eventually be incorporated into the national "Wetland Mapper" application maintained by the U.S. Fish and Wildlife Service.

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

Researchers at the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory conducted an extensive study of the effects of digital elevation model (DEM) preprocessing and mapping methods on the accuracy of wetlands maps in three different physiographic regions of Minnesota. This research covered two study sites in agricultural areas including the Minnesota River Headwaters (Big Stone County) and Swan Lake (Nicollet County) as well as a comparison site from northern Minnesota (St. Louis and Carlton Counties). The results of this effort were compiled and submitted for publication in several peer-reviewed scientific journals along with results from the earlier phase of the NWI update project. Three hard copies and one electronic copy of these publications have been submitted with the final report to LCCMR. There have also been numerous presentations at professional conferences.

Publications

Corcoran, J.M, Knight, J.F., B. Brisco, S. Kaya, A. Cull, and Murhnaghan, K. (2011) The integration of optical, topographic, and radar data for wetland mapping in northern Minnesota. Canadian Journal of Remote Sensing, 27(5): 564-582.

Corcoran, J.M., Knight, J.F., and Gallant, A.L. (2013) Influence of Multi-Source and Multi-Temporal Remotely Sensed and Ancillary Data on the Accuracy of Random Forest Classification of Wetlands in Northern Minnesota. Remote Sensing, 5(7): 3212-3238.

Knight, J.F., B. Tolcser, J. Corcoran, and Rampi, L. (2013) The effects of data selection and thematic detail on the accuracy of high spatial resolution wetland classifications. Photogrammetric Engineering and Remote Sensing, 79(7): 613-623.

Rampi, L.P., Knight, J.F., and Pelletier, K.C. (2014) Wetland mapping in the Upper Midwest United States: An object-based approach integrating lidar and imagery data. Photogrammetric Engineering and Remote Sensing. 80(5): 439-449.

Rampi, L.P., Knight, J.F., and Lenhart, C.F. (2014) Comparison of flow direction algorithms in the application of the CTI for mapping wetlands in Minnesota. Wetlands, 34(3): 515-525.

Environment and Natural Resources Trust Fund (ENRTF)
2010 Final Report

Date of Report:	July 31, 2014
Final Report	July 31, 2014
Date of Work Program Approval:	January 5, 2010
Project Completion Date:	June 30, 2014

I. PROJECT TITLE: Updating the National Wetlands Inventory: Phase 2

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Location: This phase of the project focuses on updating the National Wetland Inventory (NWI) maps for a 13-county area in east-central Minnesota surrounding the greater metropolitan region of Minneapolis and St. Paul (figure 1). This phase includes a pilot study to test wetland mapping methods for an as yet unspecified agricultural site in southern Minnesota. In addition, this phase also includes primary imagery acquisition and field validation data collection for southern Minnesota.

Total ENRTF Project Budget:	**ENRTF Appropriation**	**$ 1,100,000**
	Minus Amount Spent:	**$ 1,100,000**
	Equal Balance:	**$ 0**

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 3b and M.L. 2013, Chapter 52, Section 2, Subdivision 17

Appropriation Language:
$1,100,000 is from the trust fund to the commissioner of natural resources to continue the update of wetland inventory maps for Minnesota. The availability of the appropriation for the following project is extended to June 30, 2014: (3) Laws 2010, chapter 362, section 2, subdivision 3, paragraph (b), Updating Minnesota Wetlands Inventory: Phase 2. This appropriation is available until June 30, 2014 by which time the project must be completed and final products delivered.

II. FINAL PROJECT SUMMARY AND RESULTS:
Updated wetland maps were created for 13 counties in east-central Minnesota (7,150 square miles), encompassing the Twin Cities metropolitan area. Wetlands in Minnesota were originally mapped by the U.S. Fish and Wildlife Service in the early 1980's as part of the National Wetlands Inventory (NWI). Although still widely used for land use planning, wetland permit screening and natural resource management, the original

maps have grown increasingly out-of-date due to landscape alterations over the years. The data created for this project marks the first significant update to the NWI in Minnesota.

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

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

III. PROGRESS SUMMARY AS OF:

July 31, 2014

The DNR Resource Assessment Office has completed the data processing for the LiDAR digital elevation model (DEM) and soils data for the remainder of the state. All tasks for this project have been completed.

January 31, 2014

The remaining imagery for southern Minnesota was acquired, processed, and delivered. The final quality assessment found the imagery data to meet the project requirements. The data was delivered to the State and is posted on the MnGeo web service for public access. With this, all of the tasks in the original work program have been completed.

The remaining budget was redirected to assist with completion of the data processing for the remainder of the state. This additional task is expected to be complete by mid-April 2014.

Amendment Request (9/9/13) – Approved (9/11/13)

A variety of cost savings were achieved for this project such that the project has an overall balance of $10,175.22 after accounting for the remaining anticipated invoices. We received approval for an amendment to direct the remaining funds into an effort to accelerate the overall project by completing the data pre-processing for the remainder of the state. Previously, this work was done on a phase-by-phase approach. The DNR Resource Assessment Office (RA) will process the LiDAR and soils data to create a number of derivative data sets for the update of the NWI. The LiDAR derived products include slope, topographic position index, and the compound topographic index. The derived soils data include percent hydric soils and the water regime class. This work is already complete for east-central and southern Minnesota. With phase 4 of the project just getting underway, RA will be pre-processing the LiDAR and soils data for northeastern MN. This work program request will partially fund the data preprocessing for the rest of the state. The total additional cost will be $19,171. We have proposed to

use the remaining $10,175.22 from this grant and an additional $8995.78 from savings achieved under the grant for phase 3 of this project.

July 31, 2013:
The remaining imagery for southern Minnesota was acquired and the processing is about 90% complete. Final processing and quality assessment will be performed in FY14. This is the only outstanding deliverable for this project. We anticipate that the project should be 100% complete by October of 2014. Ducks Unlimited completed all contracted tasks and provided a complete set of deliverables. The DNR reviewed these deliverables and conducted the final accuracy assessment on the data. The data have been publicly posted on the DNR Data Deli (http://deli.dnr.state.mn.us/) and a copy of the data has also been provided to the US Fish and Wildlife Service for posting on their Wetland Mapper website (http://www.fws.gov/wetlands/Data/Mapper.html). The University of Minnesota Remote Sensing and Geospatial Analysis Laboratory (RSGAL) delivered updated wetland map data for all the pilot areas along with a complete wetland mapping protocol document for southern Minnesota. Additionally, the University of Minnesota hosted a wetland mapping methods workshop with the mapping vendor for southern Minnesota and other project stakeholders.

We have received two additional invoices for a total of $28,456 that are not reflected in the financial report yet. Also, there will be another invoice from MnGeo for the remaining imagery acquisition costs of $20,016. The expected ending balance is $10,175. This reflects cost savings achieved on the project. We anticipate submitting an amendment to use the remaining funds to further advance the statewide NWI update.

Amendment Request (1/25/13) – Approved (5/9/13): A weather-related delay in imagery acquisition required a work program amendment. In 2011, imagery was acquired for 35 out of 36 counties during the targeted spring, leaf-off period. Mop-up imagery acquisition operations scheduled for 2012 were scuttled by an early onset of very warm temperatures in March coupled with an extended period of overcast skies. We are requested a one year extension, contingent on Legislative approval to allow the contractor to complete the necessary data processing and deliver the imagery to the state.

January 31, 2013: Ducks Unlimited (DU) has completed the photo-interpretation process for 437 out of 541 quarter quads (81%) in the East Central project area. DU's internal QA/QC process has been completed on 433 out of 541 quarter quads (80%) in the east-central project area. The DNR has conducted a secondary review on 317 quarter quads (59%) for this project area. Comments from the DNR have been incorporated by DU. DU finished the scripting for the plant community and hydrogeomorphic classifications and tested the results and has developed the input layers needed for the HGM classification for the entire East Central project area. RAP has completed draft NWI data for all 50 quarter quads in the Koochiching project area. The primary and secondary QA//QC have been completed for the Koochiching project area. Final revisions are in process.

The University of Minnesota RSGAL hosted a technical workshop on wetland mapping for the southern Minnesota NWI update project. RSGAL researchers continue to study the effects of DEM preprocessing and mapping algorithm choice on the accuracy of

wetlands maps. The results of this study have been compiled and are being prepared for publication in a peer reviewed scientific journal and will be included in final report to LCCMR. RSGAL researchers continued efforts at optimizing mapping methods for wetlands in agriculture dominated portions of Minnesota. Findings from this research will be incorporated into NWI mapping methods.

July 31, 2012
Ducks Unlimited (DU) has completed the image segmentation for 80% of the east-central Minnesota (ECMN) project area. DU has also completed 50% of the initial photo-interpretation and 33% of the ECMN project area has received an internal review for QA/QC. Data that have passed the internal review process are delivered to the DNR for review. The DNR has reviewed updated wetland maps for about 15% of the ECMN. DU is currently developing the computer code to generate additional wetland attributes for the wetland plant community classification and the hydro-geomorphic classification as well as the model code for the wetland probability layer.

Pre-processing of all data for the Koochiching project area was completed and the image segmentation has also been completed for all 50 quarter quads in this area. Initial image interpretation is nearly complete for all quarter quads in this area and an internal review has been completed for 20 quarter quads (40% complete).

The DNR has expanded the level of effort for QA/QC for the NWI data. This includes re-programming funds saved on data acquisition to support additional QA/QC review of the NWI data. This will be accomplished through a combination of additional DNR staff time as well as soliciting feedback from local wetland experts using a web-based review tool developed by the DNR.

Imagery data that was delivered by Surdex for 35 counties in southern MN has passed the quality control assessment. The data have been accepted and posted to the MnGeo web service for public access. Imagery acquisition for last remaining county in the acquisition area was delayed to spring 2013 due to weather issues this past spring.

The University of Minnesota RSGAL researchers have continued their efforts to study of the effects of DEM preprocessing and mapping algorithm choice on the accuracy of wetlands maps for different physiographic regions. In addition, RSGAL is also studying optimal geospatial data types and mapping methods for wetlands in agriculture dominated portions of Minnesota.

Amendment Request (1/25/12) – Approved (1/26/12)
The cost for the imagery acquisition of southern Minnesota came in 4.7% below the estimated cost. We proposed to re-allocate the savings toward updating of wetland maps (result/activity one). We propose to use $7000 to provide support for some additional staff time to work on web-based system for reviewing draft maps for accuracy. DNR staff will develop a web-based data review application that will allow the project team, technical advisory committee members, and local wetland experts to provide an efficient and standardized way of reviewing and commenting on draft NWI data. The remaining cost savings of $14,000 will be applied toward expanded quality control of NWI data.

January 31, 2012
Ducks Unlimited (DU) provided a working draft version of the technical procedures document. This document will be revised as adjustments are made to the method. DU conducted the tech transfer workshop with the DNR Resource Assessment Office RA to harmonize the methods and approach used by the groups working on the NWI update. DNR also participated in other coordination meetings in Duluth, St. Cloud, and Bloomington. DU has developed a website for the work they are doing on this project as well as a web-based status map that shows the state of data production.

RA has completed all of the data preprocessing for 11 of the 13 counties in the east-central Minnesota project area and submitted this to DU. The data for the Koochiching NWI update area has been compiled, but is still being preprocessed. DU submitted draft data for nine quarter quads for DNR review. DNR has reviewed and provided comments on the draft data. Errors have all been addressed by DU. RA conducted follow-up field investigations to provide feedback to DU on difficult to interpret wetlands.

UMN continued to develop and test mapping methods for the Swan Lake pilot area near Mankato, MN and they have added another informal pilot area in Big Stone County. UMN has presented their wetland mapping methods to the U.S. Fish and Wildlife Service staff in the Bloomington, MN regional office. They have also submitted two papers based on these methods for publication.

Draft imagery for southern Minnesota was provided by the aerial photography vendor (Surdex, Inc.). A detailed review of the draft imagery was conducted by DNR, MnGeo, and other project partners. All comments were addressed by the vendor and final imagery was delivered for 35 out of 36 counties. Imagery for the last remaining county in this phase of imagery acquisition (Meeker County) will be acquired in spring 2012. UMN completed the field data acquisition and delivered the data to the DNR for 2703 sites (1722 upland and 981 wetland sites).

It should be noted that while the paid expenditures for this project currently total about 32% of the project budget, the task completion status is close to 50%. The reason for this apparent discrepancy is that tasks must be completed by contractors before invoices can be submitted for payment.

July 31, 2011
Data have been gathered for the east-central project area including aerial photos, radar imagery, soils data, DEMs derived from available LiDAR, original NWI data, and other wetland data. Processing of this data is ongoing. Twelve test areas have been selected and the mapping procedures have been tested, refined, and documented based on these test areas. Draft wetland maps for the 12 test areas (about 50-square miles for each test area) are currently being prepared. Field training data was collected for 510 sites this spring and processed along with other sources of wetland training data for input into the classification model.

Methods evaluation work for the agricultural pilot area was initiated. The pilot area is in the vicinity of Swan Lake near Mankato, MN. Optical and radar imagery data for the

pilot areas have been acquired. Processing of this data has begun. Other data have been ordered.

Acquisition of aerial photography was completed for 35 out of 36 counties. Imagery acquisition was conducted this spring. However, due to weather issues, the acquisition for Meeker County will be delayed until spring 2012. Preliminary image processing has been completed for all of the acquired images. Processing of the ortho-rectified imagery is ongoing. The UMN has hired and trained field staff for collecting field validation data. Acquisition of field data for southern MN was initiated this May.

January 31, 2011
A vendor was selected for updating the NWI maps for east-central Minnesota. A contract was signed this fall and a kick-off meeting was held in December. Efforts have begun to compile and pre-process data for the NWI update. A contract was also signed between the UMN and DNR to address the completion of the methods evaluation work and to collect additional field validation data. The process to select a vendor for acquiring spring, leaf-off imagery for southern Minnesota has begun and the DNR and MnGeo have developed an interagency agreement for assistance with managing this project.

IV. OUTLINE OF PROJECT RESULTS*:*

RESULT/ACTIVITY 1: Updating Wetland Maps

Description: This component of the project is devoted to updating the NWI maps for 13 counties in east-central Minnesota surrounding the greater Twin Cities metropolitan area (figure 1). The primary task of map production will be contracted out using the State's standard competitive bid process. The Minnesota DNR will provide oversight for this effort including contract management, supplying primary input data, approving mapping procedures, reviewing map products for accuracy, coordinating stakeholder involvement, and distributing updated NWI data to the public.

Summary Budget Information for Result/Activity 1: **ENRTF Budget: $410,742**
Amount Spent: $410,742
Balance: $ 0

Deliverable/Outcome	Completion Date	Budget
1. Updated digital wetland inventory maps for 13 counties in east-central Minnesota	06/30/13	$410,742

Result Completion Date: *June 30, 2013*

Result Status as of January 2011:

- A Request for Proposals was advertised and a vendor was selected to update the NWI maps for east-central Minnesota. Ducks Unlimited was selected through a competitive bid process. Their proposal was judged to provide the best overall value for the State. They have considerable experience with updating wetland

maps and provided the lowest overall cost. A contract between DNR and DU was developed and signed covering the update of the NWI maps for the 13 county east-central Minnesota project area (scope of work is attached). Some of the pre-processing of data and field-work will be conducted in-house, by the DNR Resource Assessment Office (RA).

- A kick-off meeting was held with Ducks Unlimited and members of the technical advisory panel for the NWI project to provide an overview of the scope of work, identify potential risks, and determine required actions to address these risks.
- DU and RA held a coordination meeting to plan for field logistics and technology transfer.
- DU and RA have begun gathering and formatting aerial imagery and other ancillary GIS data (soils, flood maps, local wetland inventories, DNR Public Water Inventory, and bathymetry). DU has acquired radar imagery from PALSAR.
- DU has begun testing of batch processing operations to move from pilot-scale operations to full production-scale.

Result Status as of July 2011:

- DU and RA have gathered all the data for the east-central project area including aerial photos, radar imagery, soils data, DEMs derived from available LiDAR, original NWI, and other wetland data. These data have been processed for 12 test areas (USGS quads). Some of the data has also been processed for areas outside the 12 test quads.
- Field training data was collected for 510 sites during May 2011 and processed for input into the classification model. Additional training data from other sources has also been processed for input in the classification model.
- Multiple iterations of the segmentation have been performed on the test quads with the aerial photos, digital elevation models, radar and soils data. Segmentation parameters have been optimized to generate segments for the photo-interpretation process.
- Initial runs of the potential wetlands classification have been tested and the process has been finalized. The photo interpreters have been through a two-day training session with the Senior GIS Analyst.
- Detailed methods and procedures have been developed, from data generation to data backup. The process steps from generating the segments and potential wetland classification to performing the photo interpretation and quality control have been determined and tested. Automation scripts have been written for processing the data, attribute editing, and quality control checks.
- The photo interpretation process to produce the draft classification is currently underway for the 12 test quads.

Result Status as of January 2012:

- DU provided a working draft of the technical procedures document. This document will be revised as adjustments are made to the method. A final version will be provided at the end of this project phase.
- DU conducted the tech transfer workshop with RA to harmonize the methods and approach used by the groups working on the NWI update.

- RA has completed all of the data preprocessing for 11 of the 13 counties in the east-central Minnesota project area. Processing continues for Rice and Goodhue counties, as this imagery was just recently delivered from the vendor.
- The data for the Koochiching NWI update area have been compiled, but are still being preprocessed.
- DU submitted draft data for nine quarter quads for DNR review. The production rate for draft NWI is beginning to accelerate.
- RA conducted follow-up field investigations to provide feedback to DU on difficult to interpret wetlands.
- DU has developed a website for the work they are doing on this project (http://www.ducks.org/Conservation/glaro/glaro-gis-mn-nwi-update) as well as a web-based status map that shows the status of data production. http://gis.ducks.org/MNNWI/
- DNR has reviewed and provided comments on the draft data submitted to date. Errors of omission and commission as well as classification errors have all been addressed by DU. Solutions to a few technical and cartographic issues with the data are still in the development stage, but issues will be resolved shortly.
- Results from the review of the initial draft data were presented to the Technical Advisory Committee to solicit additional feedback.
- DNR and USFWS held a meeting in October targeted at federal and state agencies to provide an overview of the NWI project, the current status, and to seek potential partnering opportunities with these agencies.
- DNR provided an overview and status report to GIS users at the Minnesota GIS/LIS conference in St. Cloud in October.

Result Status as of July 2012:

- DU has completed the initial image segmentation for all quarter quads in the ECMN project area except Rice & Goodhue (80% complete). Image segmentation on the remaining area is awaiting approval of an updated process for ensuring an accurate and efficient edge-matching procedure.
- DU has also completed initial photo-interpretation on 274 quarter quads (50% complete) and conducted an internal QA/QC review on 178 of these (33%). For this reporting period, DU has done the initial photo-interpretation for 244 quarter quads and internal QA/QC for 168 quarter quads.
- Quarter quads that have passed the internal review process are delivered to the DNR for its review.
- Processing has been finalized for 61 quarter quads, except for the addition of the requested enhanced wetland attributes.
- DU is currently developing the computer code to generate additional wetland attributes for the Eggers and Reed wetland plant community classification and the hydro-geomorphic classification.
- DU has also developed the model code for the wetland probability layer.
- Pre-processing of all data for the Koochiching project area was completed and the image segmentation has also been completed for all 50 quarter quads in this area.
- Initial image interpretation is nearly complete for all quarter quads in this area and an internal review has been completed for 20 quarter quads (40% complete).

- The production-level mapping methods developed for this project were presented at the ASPRS annual conference in Sacramento by Aaron Smith (DU/Equinox Analytics)
- The DNR has expanded the level of effort for QA/QC for the NWI data. This includes re-programming funds saved on data acquisition toward a service level agreement with the DNR Resource Assessment (RA) office to provide support for QA/QC review of the NWI data.
- Some of the funds saved from the data acquisition component of this project were re-programmed toward a service level agreement with the DNR Management Information Service (MIS) bureau to develop an online review tool. The purpose of this review tool is to provide a simple and efficient way to gather stakeholder review comments on the NWI from local wetland experts. This web-based mapping application displays the draft NWI data along with aerial imagery and LiDAR data. The application has tools that allow users to submit suggested revisions to the data. This tool has been developed, tested and deployed.
- The budget detail (Attachment A) has been modified to identify the service level agreements with other DNR units as separate line items.
- During this reporting period the DNR developed a Request for Proposal (RFP) for updating the NWI data for southern Minnesota. This RFP has been noticed in the State Register and we will be selecting a contractor to conduct the next phase of the NWI Update project.
- The DNR has completed its review of 78 quarter quads of draft data.

Results Status as of January 2013:

- Ducks Unlimited (DU) has completed the photo-interpretation process for 437 out of 541 quarter quads (81%) in the East Central project area (201 within the last 6 months).
- DU's internal QA/QC process has been completed on 433 out of 541 quarter quads (80%) in the east-central project area (265 within the last six months).
- The DNR has conducted a secondary review on 317 quarter quads (59%) for this project area. Two-hundred and twelve of these were reviewed by the DNR Resource Assessment Program (RAP) and 105 of these were reviewed by DNR Ecological and Water Resources (EWR). Comments from the DNR have been incorporated by DU.
- DU finished the scripting for the plant community and hydrogeomorphic classifications and tested the results and has developed the input layers needed for the HGM classification for the entire East Central project area.
- RAP has completed draft NWI data for all 50 quarter quads in the Koochiching project area.
- RAP completed an internal QA/QC review and EWR conducted a secondary review for the entire Koochiching project area. Final revisions are in process.

Results Status as of July 2013:

Ducks Unlimited completed all contracted tasks and provided a complete set of deliverables. The DNR reviewed these deliverables and conducted the final accuracy assessment on the data. The data have been publicly posted on the DNR Data Deli (http://deli.dnr.state.mn.us/) and a copy of the data has also been provided to the US

Fish and Wildlife Service for posting on their Wetland Mapper website (http://www.fws.gov/wetlands/Data/Mapper.html). Aaron Smith (Equinox Analytics – Ducks Unlimited) presented at the Society of Wetland Scientists annual meeting in Duluth Minnesota on June 6, 2013 based largely on work that was done for this project.

Results Status as of January 2014:
All of the original tasks under this activity are complete and the data have been posted publicly. The remaining $10,175 in the budget was re-directed to accelerate the data processing task for the rest of the state. The DNR Resource Assessment Office has developed automated procedures for data processing. The initial results are currently under review. Once the results have been approved, the input GIS data for the rest of the state will be processed. This final additional task is expected to be complete by mid-April of 2014. The DNR and other project participants have also written a manuscript that will be submitted to the journal Wetlands for publication.

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

RESULT/ACTIVITY 2: Methods Evaluation

Description: The goal of this component of the project is to complete the methods evaluation work that was started under phase one of the overall project. Specifically, this entails completing a pilot test of wetland mapping techniques for a site located in an agricultural setting in southern Minnesota. The methods evaluation aims to help develop high-accuracy, cost-effective procedures for updating NWI maps for the various major landscapes in Minnesota. The agricultural region pilot study is important because it addresses issues that are unique to wetland mapping in an area that is scheduled for update in the next phase of the overall project. This component of the project will be conducted by the University of Minnesota Remote Sensing and Geospatial Analysis Laboratory.

Summary Budget Information for Result/Activity 2: ENRTF Budget: $126,040
Amount Spent: $126,040
Balance: $ 0

Deliverable/Outcome	Completion Date	Budget
1. Updated wetland maps for pilot area	6/30/12	$32,000
2. Wetland mapping protocol for southern MN	12/31/12	$87,040
3. Conduct workshop on wetland mapping	9/30/12	$7,000

Result Completion Date: *June 30, 2012*

Result Status as of January 2011:

- A contract between the DNR and the UMN was developed and signed covering the completion of a third pilot test area in the agricultural region of Minnesota (scope of work is attached).
- Preliminary data gathering and evaluation for the third pilot area has begun.

Result Status as of July 2011:

- A pilot area was selected in the vicinity of Swan Lake near Mankato, MN.
- Imagery and other data are being acquired for the pilot areas. Currently, PALSAR and optical data are in hand. Radarsat-2 and lidar-derived DEM data have been ordered.

Result Status as of January 2012:

- UMN continued to develop and test mapping methods for the Swan Lake pilot area near Mankato, MN.
- An additional (informal) pilot area was selected in Big Stone County to look at the effects of a different landscape on wetland mapping methods.
- UMN presented wetland mapping methods to the US Fish and Wildlife Service Regional Office.
- UMN has authored two publications related to the methods development work for this project. One paper has been accepted for publication and the second paper is in review.
    - Corcoran, J., J.F. Knight, B. Brisco. K. Shannon, A. Cull, and K. Murnaghan. Integration of Optical, Topographic, and Radar Data for Wetland Mapping in Northern Minnesota. *Canadian Journal of Remote Sensing*. Accepted for publication.
    - Knight, J.F. and B.P. Tolcser. Remote classification of wetlands using decision trees. *Photogrammetric Engineering and Remote Sensing*. In review.

Result Status as of July 2012:

- RSGAL researchers conducted an extensive study of the effects of digital elevation model (DEM) preprocessing and mapping algorithm choice on the accuracy of wetlands maps in three physiographically different regions of Minnesota. The results of this study are being compiled and will be submitted for publication in a peer reviewed scientific journal and included in reports to LCCMR.
- RSGAL researchers continued studying optimal geospatial data types and mapping methods for wetlands in agriculture dominated portions of Minnesota. Current study sites are in the Swan Lake watershed near Mankato and the Big Stone watershed in western MN. Findings from this research will be incorporated into NWI mapping methods.
- <u>Presentations</u>:
    - Corcoran, J., Knight, J. Incorporating Data from Several Remotely Sensed Platforms to Map Current and Potentially Restorable Wetlands. International Association for Ecology (INTECOL), Orlando, FL, June 6, 2012.

- Corcoran, J., Knight, J. Incorporating Data from Several Remotely Sensed Platforms to Accurately Map Current and Potential Wetlands. American Society for Photogrammetry and Remote Sensing (ASPRS), Sacramento, CA, March 5, 2012.

Results Status as of January 2013:

- The University of Minnesota Remote Sensing and Geospatial Analysis Laboratory (RSGAL) hosted a technical workshop on wetland mapping for the southern Minnesota NWI update project. This full day event was held on the University of Minnesota Campus and was attended by three staff from St. Mary's University Geospatial Services (GSS). GSS was selected under the Phase 3 grant to update the wetland inventory maps for southern Minnesota.
- RSGAL researchers conducted an extensive study of the effects of digital elevation model (DEM) preprocessing and mapping algorithm choice on the accuracy of wetlands maps in three physiographically different regions of Minnesota. The results of this study have been compiled and are being prepared for publication in a peer reviewed scientific journal and included in reports to LCCMR.
- RSGAL researchers continued studying optimal geospatial data types and mapping methods for wetlands in agriculture dominated portions of Minnesota. Current study sites are in the Swan Lake watershed near Mankato and the Big Stone watershed in western MN. Findings from this research will be incorporated into NWI mapping methods.
- Publications
  - Knight, J.F., B. Tolcser, J. Corcoran, and L. Rampi. The effects of data selection and thematic detail on the accuracy of high spatial resolution wetland classifications. *Photogrammetric Engineering and Remote Sensing*. In press.
  - Jiang, Z., Shekhar, S., Mohan, P., Knight, J.F., Corcoran, J. Learning spatial decision tree for geographical classification: a summary of results. ACM SIGSPATIAL GIS 2012. In press.
  - Corcoran, J.M. and Knight, J.F. Influence of Multi-Platform, Multi-Frequency, and Multi-Temporal Remote Sensing Data on the Performance and Accuracy of Decision Tree Classification of Wetlands. *Remote Sensing*. In review.
  - Rampi, L. and Knight, J.F. Using lidar and high resolution imagery for wetland mapping in Minnesota. *Remote Sensing*. To be submitted in spring 2013.
  - Knight, J.F., Kloiber, S.M., Corcoran, J.M., Rampi, L.P. Effects of digital elevation model preprocessing and topographic derivations on wetland mapping accuracy. Journal TBD. To be submitted in summer 2014.
- Presentations
  - Corcoran, J.M.; Knight, J.F.; 2012. The influence of multi-platform, multi-frequency, and multi-temporal remote sensing and field reference data quality on the accuracy of decision tree classification of wetlands. Minnesota GIS/LIS Consortium, St. Cloud, MN, October 7, 2012.

Results Status as of July 2013:
The University of Minnesota delivered updated wetland map data for all the pilot areas along with a complete wetland mapping protocol document for southern Minnesota. Additionally, the University of Minnesota hosted a wetland mapping methods workshop with the mapping vendor for southern Minnesota and other project stakeholders. Lian Rampi (University of Minnesota) presented at the Society of Wetland Scientists annual meeting in Duluth Minnesota on June 6, 2013 based on the methods assessment work performed for this project.

- Publications
    - Knight, J.F., B. Tolcser, J. Corcoran, and L. Rampi. 2013. The effects of data selection and thematic detail on the accuracy of high spatial resolution wetland classifications. Photogrammetric Engineering and Remote Sensing, 79(7): 613-623.
    - Corcoran, J.M, J.F. Knight, A.L. Gallant. 2013. Influence of multi-source and multi-temporal remotely sensed and ancillary data on the accuracy of random forest classification of wetlands in northern Minnesota. Remote Sensing, 5(7): 3212-3228.
- Presentations
    - Rampi, L.P., Knight J.F. Wetland mapping in Minnesota: an object based approach to integrate lidar and multispectral imagery. Society of Wetland Scientists, Duluth, MN, June 6, 2013.
    - Rampi, L.P., Knight J.F. Wetland mapping in Minnesota: an object based approach to integrate lidar and multispectral imagery. International Lidar Mapping Forum, Denver, CO, February 12, 2013.

Results Status as of January 2014:
All method assessment tasks are complete.

Final Report Summary:
Researchers at the University of Minnesota conducted an extensive study of the effects of digital elevation model (DEM) preprocessing and mapping methods on the accuracy of wetlands maps in three different physiographic regions of Minnesota. This research covered two study sites in agricultural areas including the Minnesota River Headwaters (Big Stone County) and Swan Lake (Nicollet County) as well as a comparison site from northern Minnesota (St. Louis and Carlton Counties). The results of this effort were compiled and submitted for publication in in several peer-reviewed scientific journals along with results from the earlier phase of the NWI update project. Three hard copies and one electronic copy of these publications have been submitted with the final report to LCCMR. There have also been numerous presentations at professional conferences.

RESULT/ACTIVITY 3: Data Acquisition

Description: Creating a high quality update of the NWI requires having high quality data. This component will include acquisition of imagery along with field verification data for the next anticipated mapping phase in southern Minnesota. We will acquire high-resolution, spring leaf-off, multi-spectral aerial photography for 36 counties (although specifications could change based on recommendations from Result 2). The imagery

will be used as a base for updating the NWI maps for southern Minnesota. Data acquisition will also include a field-based assessment of wetland type for 400 to 500 sites chosen using a stratified random selection process. The field data will be used to assess the accuracy of the final wetland maps. To maintain the independence of the field data, the field data acquisition will be managed by University of Minnesota, Remote Sensing and Geospatial Analysis Laboratory and not shared with the mapping contractor.

Summary Budget Information for Result/Activity 3: **ENRTF Budget: $563,218**
Amount Spent: $563,218
Balance: $ 0

Deliverable/Outcome	Completion Date	Budget
1. High-resolution, spring leaf-off, multi-spectral digital aerial imagery	6/30/14	$475,218
2. Field data acquisition	06/30/13	$88,000

Result Completion Date: *2014*

Result Status as of January 2011:

- A Request for Proposals was developed and advertised. A vendor was selected to acquire high-resolution, leaf-off imagery for southern Minnesota this coming spring.
- An interagency agreement was developed between DNR and MnGeo to establish a partnership to better manage the spring aerial imagery acquisition project for southern MN.
- A contract between the DNR and the UMN was developed and signed covering the acquisition of field validation data for the southern agricultural region of Minnesota. Acquisition of field data will take place this summer.

Result Status as of July 2011:

- Acquisition of aerial photography was completed for 35 out of 36 counties. Imagery acquisition was conducted between April 12, 2011 and May 16, 2011. However, due to weather issues, the acquisition for Meeker County will be delayed until spring 2012.
- Preliminary image processing has been completed for all of the acquired images including aero-triangulation and seam line edits. Processing of the ortho-rectified imagery is ongoing. Delivery of both stereo and ortho-rectified imagery is on schedule for later this summer.
- The UMN has hired and trained field staff for collecting validation data.
- Acquisition of field data for southern MN was initiated in May 2011. However, these efforts were temporarily suspended during the State government shutdown from July 1 to July 21, 2011.

Result Status as of January 2012:

- Draft imagery for 35 out of 36 counties in southern Minnesota was provided by the aerial photography vendor (Surdex, Inc.). Imagery for Meeker County will be acquired in spring 2012.
- A detailed review of the draft imagery was conducted by DNR, MnGeo, and other project partners. All comments were addressed by the vendor (Surdex).
- Final imagery was delivered for 35 counties. The acceptance of the data is pending the results of the horizontal accuracy assessment, which is being conducted by MnDOT.
- UMN completed the field data acquisition and delivered the data to the DNR for 2703 sites (1722 upland and 981 wetland sites). DNR will be reviewing these data.

Results Status as of July 2012:

- Imagery data that was delivered by Surdex for 35 counties in southern MN has passed the quality control assessment. The data have been accepted and posted to the MnGeo web service for public access.
- Imagery acquisition for last remaining county in the acquisition area was delayed to spring 2013 due to weather issues this past spring.
- The DNR and MnGeo have been conducting outreach campaign to reach potential partners for next imagery acquisition phase. A series of informational meeting were held as a part of this effort in Fergus Falls, Bemidji, & Brainerd.

Result Status as of January 2013

- There were no additional actions related to result two (data acquisition) in this reporting period. All field data has already been acquired and the one remaining county of imagery data that needs to be acquired will be acquired this spring.

Results Status as of July 2013:

The remaining imagery for southern Minnesota was acquired and the processing is about 90% complete. Final processing and quality assessment will be performed in FY14. This is the only outstanding deliverable for this project. We anticipate that the project should be 100% complete by October of 2014.

Result Status as of January 2013

The remaining imagery for southern Minnesota was acquired and processing is complete. The final quality assessment found the data to meet the requirements. The data was delivered to the State and is posted on the MnGeo web service for public access 2014. All data acquisition tasks are complete.

Results Status as of July 2013:

All data acquisition tasks are complete.

Results Status as of January 2014:

All data acquisition tasks are complete.

Final Report Summary:
Accomplishments for this project include acquiring high-resolution, spring, leaf-off, digital aerial imagery for 23,900 square miles of southern Minnesota as well as acquiring field validation data for southern Minnesota.

V. TOTAL ENRTF PROJECT BUDGET:

Personnel: $ 135,000 (DNR Project Manager – 0.65 FTE unclassified employee)
Contracts: $ 955,000 (Details in Attachment A)
Equipment/Tools/Supplies: $ 1,500 (batteries and accessories for GPS units, spray paint for accuracy assessment targets, etc.)
Acquisition (Fee Title or Permanent Easements): $ NA
Travel: $ 6,000 ($4,000 for in-state travel for business meetings, field work, and training. $2,000 for out-state travel for the DNR project manager to attend a professional symposium/workshop regarding current technology for mapping wetlands – American Society of Photogrammetry and Remote Sensing)
Additional Budget Items: $ 500 (printing field manuals, procedures documents, reports, and maps)

TOTAL ENRTF PROJECT BUDGET: $1,100,000

Explanation of Capital Expenditures Greater Than $3,500: None

VI. PROJECT STRATEGY:

A. Project Partners: Joe Knight, Ph.D., of the University of Minnesota, Remote Sensing and Geospatial Analysis Laboratory will receive a total of $180,000; $100,000 for Result 2 (methods evaluation) and $80,000 for Result 3 (field data acquisition).

Other partners providing in-kind services for this project include the Minnesota Pollution Control Agency, the Minnesota Board of Water and Soil Resources, the U.S. Fish and Wildlife Service, and the Minnesota Dept. of Administration's Geographic Information Office.

B. Project Impact and Long-term Strategy: This is the second phase of a multi-phase project to update the National Wetlands Inventory (NWI) for the entire state of Minnesota. The NWI provides critical baseline data that inform many wetland management actions and policies. We anticipate submitting proposals every other year for four additional phases (ie. 2012, 2014, 2016, and 2018). The estimated total budget for the project is $7.5 million. With this project phase, we will have received $1.65 million (about 22%) from ENTRF. Upon completion of this project phase, we will have completed 100% of the methods evaluation, 50% of imagery and field validation data acquisition for the state, and 10% of the updated wetland maps for the state.

C. Other Funds Proposed to be Spent During the Project Period: The DNR and its partners listed above will provide approximately $20,000 of in-kind staff time in support of this project (but not tracked for reporting purposes). In addition, approximately $154,000 in Department Operations and Division Support charges accruing to this project will be covered by Division general funds or other eligible Division funds.

Based on experience from phase one of this project, we also anticipate being able to find matching funds from local, state, and federal agencies for imagery acquisition. Any savings in the ENRTF budget that result from this will be redirected toward updating NWI maps for additional areas and/or acquisition of additional field data to validate the updated maps.

D. Spending HIstory: The ENTRF provided $550,000 for the first phase of this project. The first phase included: 1) developing mapping standards designed to ensure that the final product meets the needs of end users; 2) acquiring high-resolution, leaf-off, color infrared aerial imagery for northeastern and east-central Minnesota; and 3) evaluating imagery sources and mapping technologies to identify the most cost-effective, reliable inventory procedures for pilot study sites in northeastern and east-central Minnesota.

Matching funds for imagery acquisitions included: 1) National Geospatial Intelligence Agency (via U.S. Geological Survey) - $25,000, 2) St. Louis County Planning Department - $24,999, 3) Minnesota Pollution Control Agency - $111,373, 4) National Oceanographic Atmospheric Administration (via DNR Coastal Zone Program) - $24,227, and 5) DNR - $181,065. We anticipate that the Metropolitan Council will contribute about half of the cost (about $70,000) for acquiring imagery for the 13-county, east-central Minnesota project area (the Metropolitan Council will cover the costs for the seven-county region that corresponds to their statutory authority).

VII. DISSEMINATION:

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

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

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

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

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Publications

Corcoran, J.M, Knight, J.F., B. Brisco, S. Kaya, A. Cull, and Murhnaghan, K. (2011) The integration of optical, topographic, and radar data for wetland mapping in northern Minnesota. Canadian Journal of Remote Sensing, 27(5): 564-582.

Corcoran, J.M., Knight, J.F., and Gallant, A.L. (2013) Influence of Multi-Source and Multi-Temporal Remotely Sensed and Ancillary Data on the Accuracy of Random Forest Classification of Wetlands in Northern Minnesota. Remote Sensing, 5(7): 3212-3238.

Knight, J.F., B. Tolcser, J. Corcoran, and Rampi, L. (2013) The effects of data selection and thematic detail on the accuracy of high spatial resolution wetland classifications. Photogrammetric Engineering and Remote Sensing, 79(7): 613-623.

Rampi, L.P., Knight, J.F., and Pelletier, K.C. (2014) Wetland mapping in the Upper Midwest United States: An object-based approach integrating lidar and imagery data. Photogrammetric Engineering and Remote Sensing. 80(5): 439-449.

Rampi, L.P., Knight, J.F., and Lenhart, C.F. (2014) Comparison of flow direction algorithms in the application of the CTI for mapping wetlands in Minnesota. Wetlands, 34(3): 515-525.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than January 2011, July 2011, January 2012, July 2012, January 2013, July 2013, and January 2014. A final work program report and associated products will be submitted between July 31, 2014 and August 31, 2014 as requested by the LCCMR.

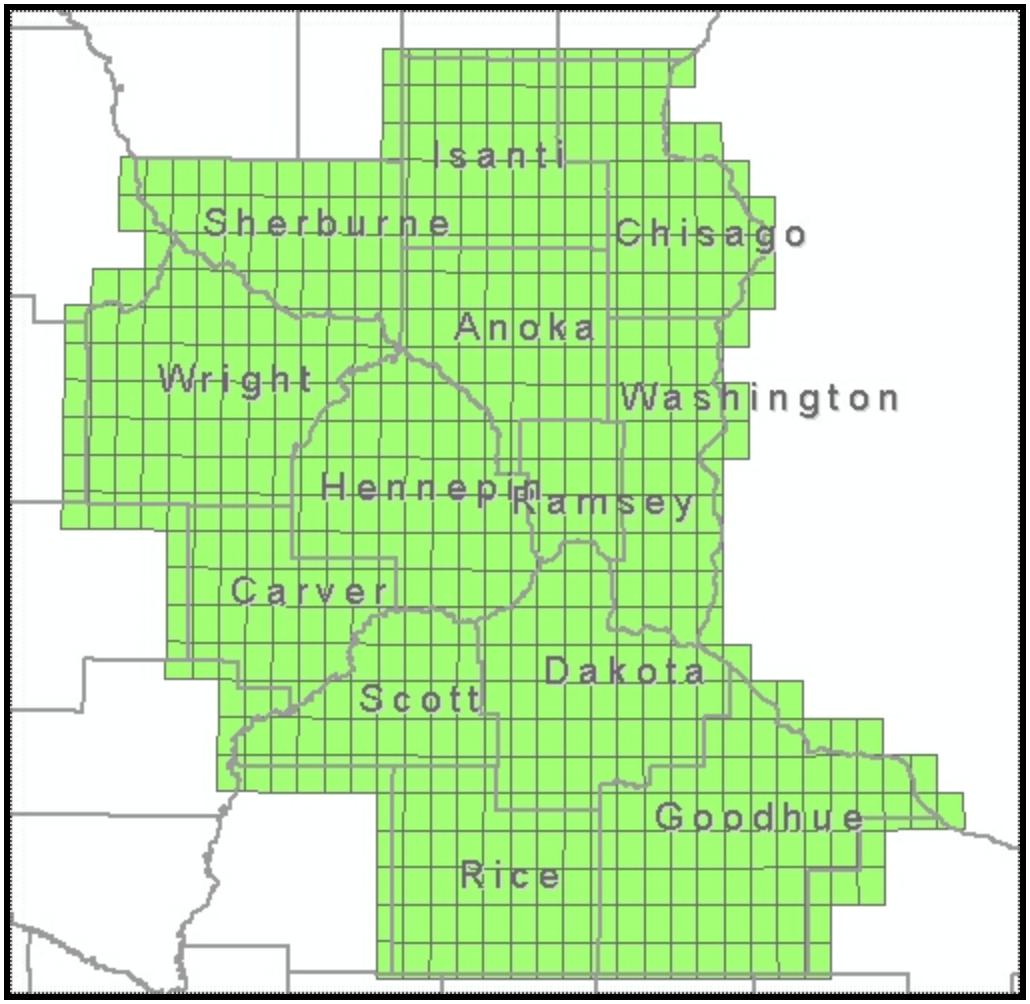


Figure 1: The focus of the first update of NWI will be the 13 counties Metropolitan Area.

Attachment A: Final Budget Detail for 2010 Projects

Project Title: *Updating the National Weltand Inventory for Minnesota: Phase 2 (019-A3)*

Project Manager Name: *Steve Kloiber*

Trust Fund Appropriation: **$1,100,000**

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2010 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent**	**Balance** *(7/31/14)*	**Result 2 Budget:**	**Amount Spent**	**Balance** *(7/31/14)*	**Result 3 Budget:**	**Amount Spent**	**Balance** *(7/31/14)*	**TOTAL BUDGET**	**TOTAL BALANCE**
BUDGET ITEM	*Updating Wetland Maps*			*Methods Evaluation*			*Data Acquisition*				
PERSONNEL: wages and benefits *(Steve Kloiber 65%FTE - unclassified)*	$52,080	$52,080	$0	$26,040	$26,040	$0	$52,080	$52,080	$0	$130,200	$0
MIS Direct Support (Craig Perrault/Hal Watson - 87 hrs)	$5,520	$5,520	$0							$5,520	$0
Contracts											
Professional/technical *(Ducks Unlimited, selected by RFP, Wetland Mapping)*	$288,886	$288,886	$0							$288,886	$0
Professional/technical *(Univ. of MN, Methods Evaluation)*				$100,000	$100,000	$0				$100,000	$0
Professional/technical *(Univ. of MN, Field Data Acq.)*							$80,000	$80,000	$0	$80,000	$0
Professional/technical *(Surdex, selected by RFP, Aerial Imagery)*							$428,873	$428,873	$0	$428,873	$0
Printing *(procedures, reports, & maps)*	$0		$0							$0	$0
Supplies *(field supplies, batteries, GPS accessories, spray paint)*	$643	$643	$0				$758	$758	$0	$1,401	$0
Travel expenses in Minnesota *(mileage, per diem, lodging, etc.)*	$1,506	$1,506	$0				$1,506	$1,506	$0	$3,012	$0
Travel outside Minnesota *(conference/training, see note in workplan)*	$0		$0				$0		$0	$0	$0
Other (Service Level Agreement with DNR Resource Assessment Office in Grand Rapids, MN for support on wetland mapping including data processing, field recon., and QA/QC)	$62,107	$62,107	$0							$62,107	$0
COLUMN TOTAL	**$410,742.10**	**$410,742**	**$0.00**	**$126,040**	**$126,040**	**$0**	**$563,218**	**$563,218**	**$0**	**$1,100,000**	**$0**

Selected news websites with stories about the updated NWI data

HometownSource.com
brought to you by ECM Publishers, Inc.

New wetland map data available

By **Site Editor** on January 6, 2014 at 4:05 pm

St. Paul, MN – The Department of Natural Resources has released updated wetland map data for 13 counties in east-central Minnesota, encompassing the Twin Cities metropolitan area.

The wetlands were originally mapped by the U.S. Fish and Wildlife Service in the late 1970s and early 1980s as part of the National Wetlands Inventory (NWI).

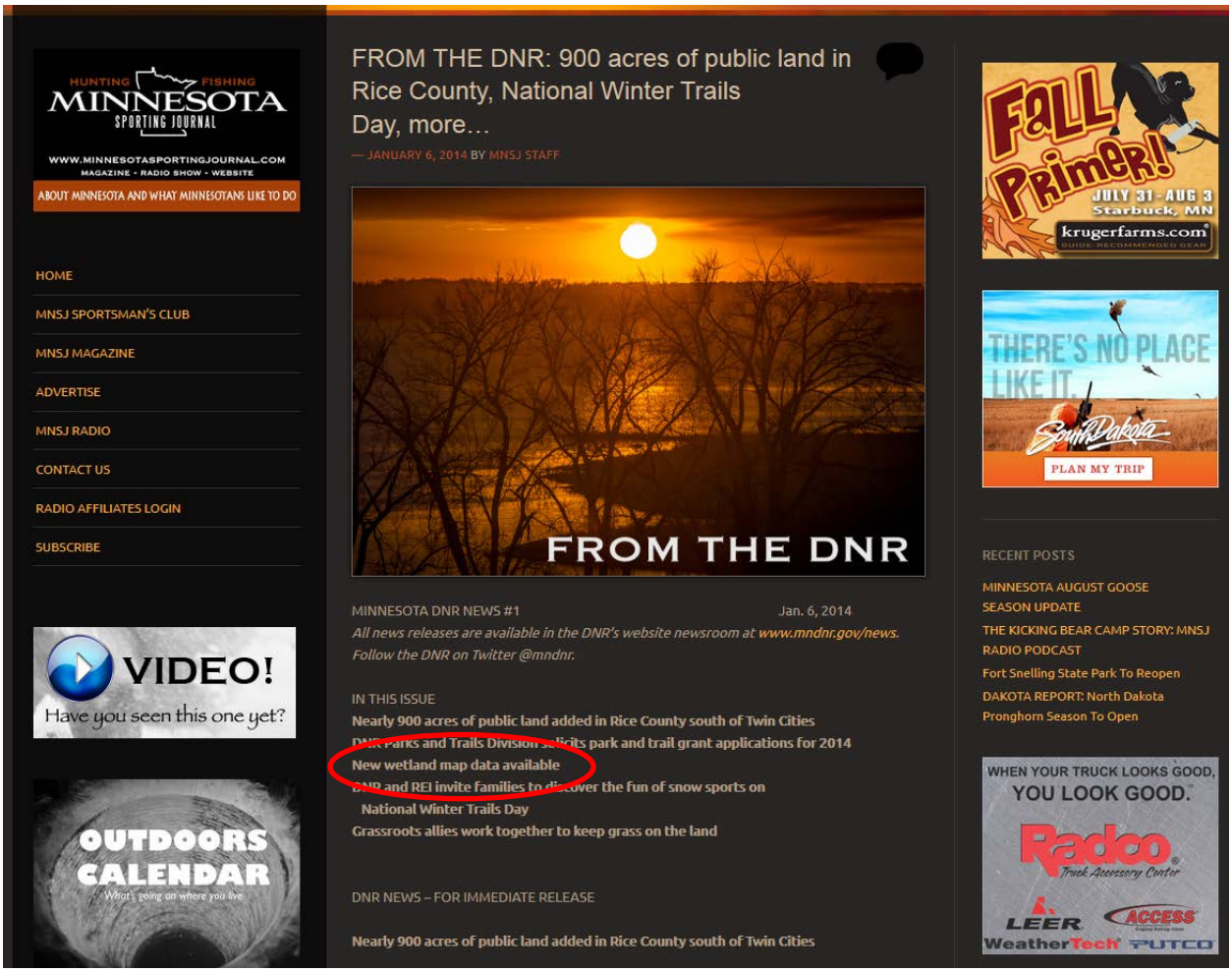
Although still widely used for land use planning, wetland permit screening and natural resource management, the original maps have grown increasingly out-of-date due to landscape alterations over the years. The newly-released map data is the first time the NWI has been updated in Minnesota.

The data are available through an interactive mapping application on the DNR's website at: www.dnr.state.mn.us/eco/wetlands/map.html. The data can also be downloaded, free of charge, for use in geographic information system applications through the DNR's data deli at: http://deli.dnr.state.mn.us/.

The new maps reflect the latest technology in remote sensing and mapping including high-resolution aerial imagery and Light Detection and Ranging (LiDAR) data.

"The original NWI maps were quite good considering the imagery and mapping methods of the time, but the new maps are much more accurate, capture more detail and provide more information than the original maps," said Steve Kloiber, the DNR manager of the NWI update project.

Besides showing the location, size and type of each wetland, the updated map data include information on the wetland's landscape position and hydrologic characteristics, which can be useful in assessing the benefits provided, such as water quality improvement, flood storage, and fish and wildlife habitat.



Link to the story is highlighted. The full story from the website is shown below.

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Besides showing the location, size and type of each wetland, the updated map data include information on the wetland's landscape position and hydrologic characteristics, which can be useful in assessing the benefits provided, such as water quality improvement, flood storage, and fish and wildlife habitat.

The release of the wetland map data for east-central Minnesota marks completion of the first phase of a statewide update of the NWI. New, high resolution aerial imagery has been acquired for the entire state and wetland mapping is currently underway for the southern third of the state and a portion of northeast Minnesota.

The DNR is planning to complete the entire state by 2020. The NWI update project is being funded by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources.
The trust fund is a permanent fund constitutionally established by Minnesotans to assist in the protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources.

Minnesota: New wetland map data available

January 12, 2014 on 7:32 pm | In Midwest, Minnesota, Mobile APPS, News, USA | No Comments

The Department of Natural Resources has released updated wetland map data for 13 counties in east-central Minnesota, encompassing the Twin Cities metropolitan area. The wetlands were originally mapped by the U.S. Fish and Wildlife Service in the late 1970s and early 1980s as part of the National Wetlands Inventory (NWI).

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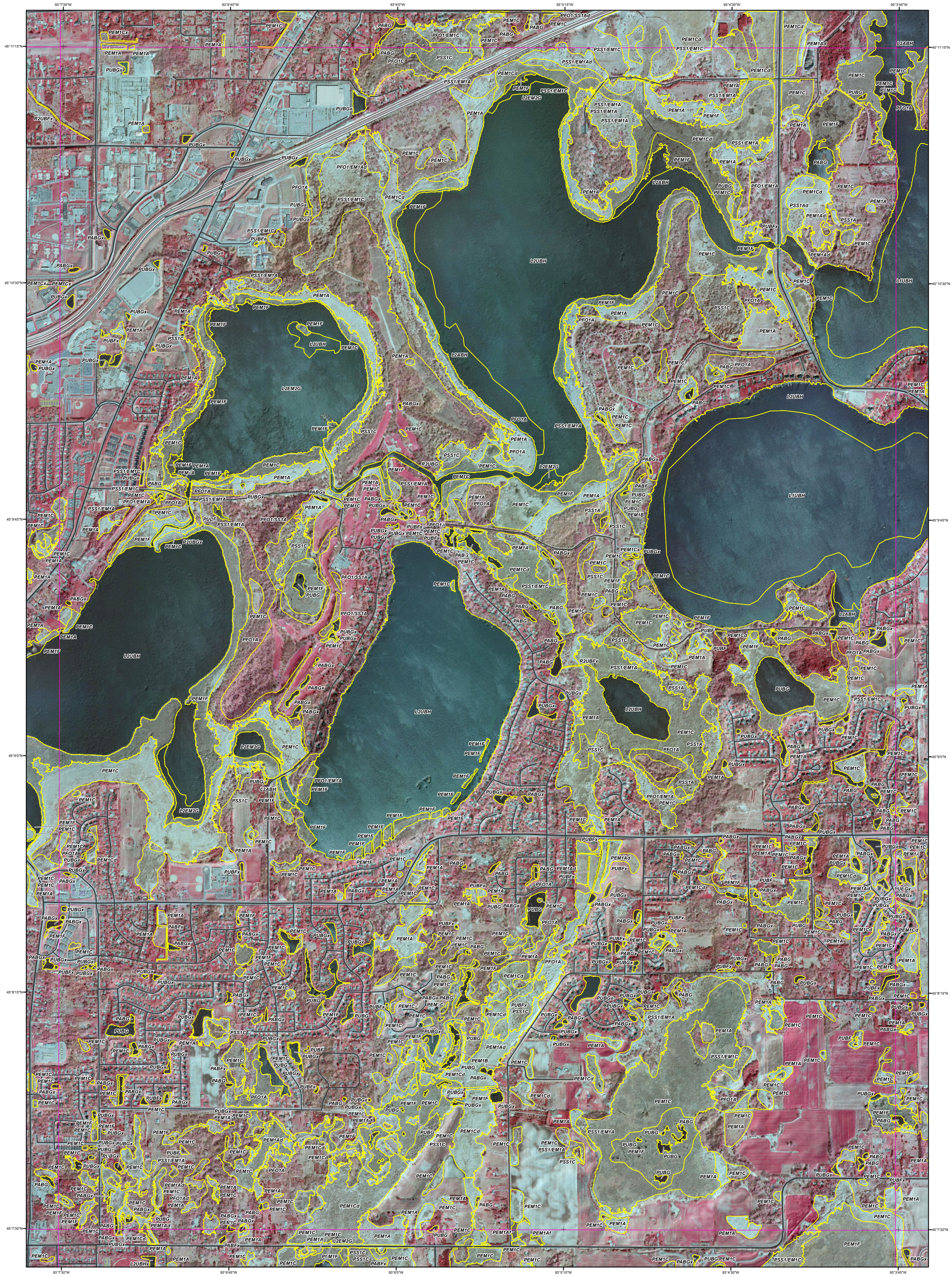
From LCCMR's Facebook page



0 0.125 0.25 0.5 0.75 1 Miles

1:10,000

Roads

Wetland Boundary

Elevation Contour

Municipal Road

County Highway

Federal/State Highway

National Wetland Inventory

Centerville - SW

Circle Pines - NE	Centerville - NW	Centerville - NE
Circle Pines - SE	Centerville - SW	Centerville - SE
New Brighton - NE	White Bear Lake West - NW	White Bear Lake West - NE

R - Riverine
- 2 – Lower Perennial: RB – Rock Bottom; UB – Unconsolidated Bottom; AB – Aquatic Bed; RS – Rocky Shore; US - Unconsolidated Shore; EM – Emergent; 2 – Nonpersistent
- 3 – Upper Perennial: RB – Rock Bottom; UB – Unconsolidated Bottom; RS – Rocky Shore; US - Unconsolidated Shore
- 4 – Intermittent: SB – Streambed

L - Lacustrine
- 1 – Limnetic: UB – Unconsolidated Bottom
- 2 – Littoral: RB – Rock Bottom; UB – Unconsolidated Bottom; AB – Aquatic Bed; RS – Rocky Shore; US - Unconsolidated Shore; EM – Emergent; 2 – Nonpersistent

P - Palustrine: RB – Rock Bottom; UB – Unconsolidated Bottom; AB – Aquatic Bed; US – Unconsolidated Shore; ML – Moss-Lichen; EM – Emergent (1 – Persistent; 2 – Nonpersistent); SS – Scrub-Shrub (1 – Broad-Leaved Deciduous; 2 – Needle-Leaved Deciduous; 3 – Broad-Leaved Evergreen; 4 – Needle-Leaved Evergreen); FO – Forested (1 – Broad-Leaved Deciduous; 2 – Needle-Leaved Deciduous; 4 – Needle-Leaved Evergreen)

Water Regime
- A - Temporarily Flooded
- B - Saturated
- C - Seasonally Flooded
- F - Semipermantly Flooded
- H - Permanently Flooded
- K - Artificially Flooded

Special Modifiers
- b - beaver
- d - partly drained/ditched
- f - farmed
- h - diked/impounded
- q - bog
- x - excavated

Minnesota Department of Natural Resources

Environment and Natural Resources Trust Fund

N

Note: This map was created by the Minnesota Department of Natural Resources. Wetland data on this map were created through the Minnesota National Wetland Inventory (NWI) Update project which is primarily funded by grants from the Environment and Natural Resources Trust Fund as recommended by the Legislative and Citizen Commission on Minnesota Resources (LCCMR).

Wetlands on this map are classified according to Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). The wetland labels are a character code comprised of letters and numbers that indicate the system, subsystem, class, water regime, and any special modifiers.

The wetland information depicted in this map is developed using the best available remote sensing data including spring and summer aerial imagery as well as digital elevation models derived from LiDAR. Every reasonable effort has been made to follow industry standard practices for ensuring the accuracy of this data; however, there is an inherent uncertainty associated with mapping wetlands from remote sensing data. Detailed on the ground and historical analysis of specific sites may result in a different wetland representation and classification.

Federal, State, and local regulatory agencies with jurisdiction over wetlands may define wetlands in a different manner than this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of the proprietary jurisdiction of any Federal, State, or local government or to establish the geographic scope of the regulatory programs of government agencies. Persons engaging in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State, or local agencies concerning regulatory programs and proprietary jurisdictions that may affect such activities.