2011 Project Abstract
For the Period Ending June 30, 2013

PROJECT TITLE: Strengthening Natural Resource Management with LiDAR Training
PROJECT MANAGER: Leslie Everett
AFFILIATION: U of MN
MAILING ADDRESS: Water Resources Center, 173 McNeal Hall, 1985 Buford Ave
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WEBSITE: http://wrc.umn.edu
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2011, First Special Session, Chp. 2, Art.3, Sec. 2, Subd. 03k

APPROPRIATION AMOUNT: $180,000

Overall Project Outcome and Results

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

- The **goal** of the project was to enable natural resource managers with GIS skills to effectively use LiDAR data in restoring, protecting, and managing natural resources.
- The **methods** used were to develop six teaching modules focused on major application areas, deliver the modules as hands-on workshops in computer laboratories around the state, and then enhance the modules for web-based self-learning. An additional set of four webinars was delivered, recorded, and posted to the web to supplement the workshop modules. An on-line user Forum was established to provide answers to questions about using LiDAR data and its applications.
- The **module subjects** are Basics of LiDAR, Terrain Analysis, Hydrology Applications, Engineering Applications, Wetland Mapping, and Forestry Applications. The on-line materials for the modules include lectures and exercises in Powerpoint slide, text, and video formats
- The **module workshops** were delivered in 34 sessions at eight locations across the state, with a total attendance of 558, (226 individuals in one or more modules).
- **Post-workshop surveys** enabled workshop presenters to make adjustments to the workshop materials and presentations as the workshops progressed.
- The **webinars** addressed the use of hydrology tools recently developed in Minnesota, hydrology applications in the Red River Basin, and LiDAR for non-technical managers and staff. Total webinar participation was 437.
- The **user Forum** currently has 24 topic areas and 121 posts answering questions from technicians employing LiDAR data.

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

Project Results Use and Dissemination

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

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

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2011 Work Plan

Date of Status Update: 8/05/2013

Date of Next Status Update: Final Report

Date of Work Plan Approval: 6/23/2011

Project Completion Date: 6/30/2014   **Is this an amendment request?** _Yes____

Project Title: Strengthening Natural Resource Management with LiDAR Training

Project Manager: Leslie Everett

Affiliation: U of MN

Address: Water Resources Center, 173 McNeal Hall, 1985 Buford Ave

City: St Paul   **State:** MN   **Zipcode:** 55108

Telephone Number: (612) 625-6751

Email Address: evere003@umn.edu

Web Address: http://wrc.umn.edu

Location:

Counties Impacted: Statewide

Ecological Section Impacted: Lake Agassiz Aspen Parklands (223N), Minnesota and Northeast Iowa Morainal (222M), North Central Glaciated Plains (251B), Northern Minnesota and Ontario Peatlands (212M), Northern Minnesota Drift and lake Plains (212N), Northern Superior Uplands (212L), Paleozoic Plateau (222L), Red River Valley (251A), Southern Superior Uplands (212J), Western Superior Uplands (212K)

Total ENRTF Project Budget:	**ENRTF Appropriation $:**	180,000
	Amount Spent $:	**180,000**
	Balance $:	0

Legal Citation: M.L. 2011, First Special Session, Chp. 2, Art.3, Sec. 2, Subd. 03k

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

I. PROJECT TITLE: Strengthening Natural Resource Management with LiDAR Training

II. PROJECT SUMMARY: The State of Minnesota is completing acquisition of high resolution digital elevation data using LiDAR (Light Detection and Ranging). The data have many applications in natural resource management and protection. For Minnesota examples see: http://www.mngeo.state.mn.us/chouse/elevation/uses/lidar_uses_waterquality.html . Most natural resource managers have not had experience using high resolution digital elevation data. This training project will enable them to effectively employ the data in appropriate applications. Specific training modules will be developed to address: 1. basic LiDAR data management, 2. terrain analysis and soil conservation, 3. natural resource engineering, 4. hydrologic applications, 5. wetland mapping, and 6. forestry and ecological applications. The modules will be delivered in hands-on computer workshops across the state and on the web. The outcome will be natural resource managers who can effectively employ these new data sets in precision conservation and other applications in natural resource evaluation, management, and protection.

Background/Justification: High resolution digital elevation data via LiDAR will be available for most of the state by February 2012 and likely for all of the state by February 2013. Precision, efficacy and cost efficiency of natural resource management will be greatly increased by use of these data. Examples include wetland and restorable wetland mapping, siting and installation of soil and water conservation structures, mapping and prediction of soil erosion, hydrologic modeling for water quality and quantity, plant community mapping by terrain characteristics, forest and biomass volume estimates, geologic mapping, and many other applications. Integration of LiDAR data with Minnesota's rich set of other data layers (soil survey, geological atlas, wetlands inventories, biological surveys, etc.) will add precision to their interpretation and use. For example, the current soil survey provides slope classes. LiDAR data allow calculation of precise slope, slope length, and aspect anywhere in the field, enabling prediction of soil erosion and areas of concentrated flow, as well as rapid pre-design of management practices and structures. Other examples include rapid identification of depressional areas in landscapes suitable for wetland restoration or hydrologic storage, and identification of specific micro-terrain where rare species may be located and mapped. However, in order to fully utilize this new tool, natural resource managers require training and information on how to import, process, and employ the very large LiDAR data sets, using the computer software applications currently and potentially available to them. We have surveyed a subset of resource managers to determine their training and information requirements, and designed this project to meet those needs.

III. PROJECT STATUS UPDATES:

Project Status as of January 2012:
Project activities began in August 2011 when notice of funding was given. Workshop modules have been partially completed in preparation for workshop delivery beginning in March 2012 (more details listed under Activity 1 Project Status below). Workshops have been scheduled through May, with more to be added. The workshop information and registration website is operational at: http://tsp.umn.edu/lidar

Project Status as of July 2012:
Preparation of workshop presentations and computer laboratory exercises was completed in this period, and 22 workshops were delivered across the state. Details are listed in the next section. Training materials were posted, along with module descriptions, workshop schedules, and registration information at http://tsp.umn.edu/lidar . We continue to refine training presentations and materials in response to survey responses from participants following each workshop.

Project Status as of January 2013:
Twelve training workshops were delivered in the second half of 2012, bringing the total to 34 with 558 total participants (226 unique individuals, since many attended multiple modules).
On-line training materials are being supplemented to enhance independent review and study.

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In response to workshop participant survey feedback, an on-line user forum was developed where LiDAR user questions and expert answers are being posted. See: http://www.mngeo.state.mn.us/chouse/elevation/lidar.html#education

Amendment Request (08/05/2013):
We are requesting an amendment to re-allocate funding among activities to reflect changes in costs to perform the activities. In particular we are extending the paid time of one professional staff person so that he can produce lecture and exercise videos to the on-line teaching modules to enhance the post-project on-line learner experience. We would like to reduce the funding allocation to the supplies and travel expense categories since we found that we have been able to reduce the workshop handout production costs, do most of the collaborative training preparation electronically, and combine trips to workshops.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Prepare Training Modules and Website

Description: Six training modules will be developed for natural resource managers using GIS and CAD (Computer Aided Design) applications: 1. basic LiDAR data management, 2. terrain analysis and soil conservation, 3. engineering, 4. hydrologic applications, 5. wetland mapping, and 6. forestry and ecological applications. Modules will be tested with target audiences and refined for wider delivery. Components of the training modules as well as reference information will be prepared for and maintained on the Web for open use. The host sites will initially be at the University of Minnesota, with links from MnGeo, MnDNR, BWSR, and NRCS. Interagency coordination will be provided through the State Digital Elevation Committee.

Summary Budget Information for Activity 1:	**ENRTF Budget:** ~~$ 84,814~~
	$ 88,721
	Amount Spent: $ 88,721
	Balance: $ 0

Activity Completion Date:

Outcome	Completion Date	Budget
1. Six training modules ready for delivery in workshops	January 2012	$ 81,814
2. Training and reference information for application of LiDAR data in natural resource management available on the Web to all users	March 2012, initial versions	~~$ 3,000~~ $ 6,907

Activity Status as of January 2012:
Basics of LiDAR Module - Lecture materials for the full-day "Basic LiDAR Training" course are 80% complete with peer review sessions in planning stages. One class exercise of three is complete. Training datasets for each exercise have been selected, downloaded, and are being processed to determine best-use methods for training. Fellow GIS specialists, past training instructors, and other peers are currently being consulted with to ensure final content is appropriate to the target-audience.
Terrain Analysis Module – Lecture materials for the half-day "Terrain Analysis Training" course are 90% complete with one peer review session planned. Class exercises are written, awaiting a review and addition of recent topics/methods. Estimated completion of exercises is 80%.
Hydrology Module – Lecture materials for the half-day "Hydrology Module" course are 80% complete with peer review sessions in planning stages. Exercise development is nearly complete, and lecture materials are being finalized.
Engineering Module –Two case studies are under development, where class participant s will bring LIDAR data into Civil 3D to create a design for a sediment basin and channels. The workshop will help

the participants evaluate the best/easiest ways to accomplish the data preparation and use, and ask class participants to provide feedback and insight into how they process LIDAR data in their offices. The module is 35% complete.

Wetland Mapping Module – The first of three exercises is complete.

Forestry Module - Drafts of the first two of five sub-modules have been prepared, and the remaining three sub-modules have been outlined and data collected. The first sub-module is nearing completion, with written instruction, video, and data complete. An overview presentation on LiDAR applications in forestry was developed and presented in a one-hour webinar on January 17th and is available on-line. (See more detail under "Dissemination" below.)

Activity Status as of July 2012: Six training modules, as described above in the project summary, were completed, including lectures and computer laboratory exercises for students for all modules. An overview presentation on LiDAR applications in forestry was developed and presented in a one-hour webinar on January 17th and is available on-line. (See more detail under "Dissemination" below.) The lecture and exercise materials were posted on the project website: http://tsp.umn.edu/lidar

Activity Status as of January 2013**:**
The training materials posted on the web are being augmented to facilitate independent review and study by previous workshop participants and others. They include short videos as well as written materials.
In response to workshop participant survey feedback, an on-line user forum was developed where LiDAR user questions and expert answers are being posted. See:
http://www.mngeo.state.mn.us/chouse/elevation/lidar.html#education
In the final six months of the project, we will be enhancing the web-based training materials to make them, as much as possible, independent study and reference modules. By the end of the project they will be transitioned over to the MnGeo LiDAR website for long term maintenance.

Final Report Summary:

ACTIVITY 2: Deliver hands-on training workshops

Description: Each of the six training modules will be delivered through day-long hands-on workshops at computer laboratories selected to best serve the target audience around the state. We will deliver approximately seven basic data management module workshops and an average of five workshops for each of the five application modules, depending on specific audience demand, with an average of 15 participants per workshop. Pre and post-workshop surveys of participants will assist in adjustment of training format and content.

Summary Budget Information for Activity 2:	**ENRTF Budget:**	$ ~~95,186~~
		$ 91,279
	Amount Spent:	$ 74,219
	Balance:	$ 20,967

Activity Completion Date:

Outcome	Completion Date	Budget
Natural resource managers who have received hands-on training in use of LiDAR for resource management activities: 480 participant-training-days.	June 2013	$ ~~95,186~~ $ 91,279

Activity Status as of January 2012:
No project activities were planned for this activity for this period.

Activity Status as of July 2012:

All six training modules were delivered in workshops at computer laboratories. Locations included Winona, East Grand Forks, Brainerd, Duluth/ Cloquet, St. Paul/Minneapolis. The Basics, Terrain Analysis, and Hydrologic Applications workshops were delivered at all of these locations, while the Wetland Mapping, Forestry, and Engineering workshops were delivered at a subset of the locations. The following table presents the number of sessions and total number of participants for each of the modules as of July 1, 2012. More workshops are scheduled.

Module	# Sessions	# Participants
Basics	7	137
Terrain Analysis	6	102
Hydrology	5	98
Wetland Mapping	1	19
Forestry	2	19
Engineering	1	15
TOTAL	**22**	**390**

A post-workshop survey was emailed to each participant following each workshop and results were assembled to provide feedback to workshop presenters as they progressed from workshop to workshop. Adjustments were made to the workshop materials and presentations in response to this feedback.

The workshops were advertised multiple times through agencies and other organizations (for example, Minnesota Association of Soil and Water Conservation Districts). Training module descriptions, workshop schedules, and training materials are posted at http://tsp.umn.edu/lidar

Activity Status as of January 2013**:**

The final 12 regularly scheduled training workshops were delivered in this period, bringing the total to 34 and total attendance to 558 (226 unique individuals because of multiple modules attended by most participants). Additional sites included Mankato, Morris, and St. Cloud. The updated total project session and participant numbers are in the following table.

Module	# Sessions	# Participants
Basics	10	186
Terrain Analysis	9	140
Hydrology	7	135
Wetland Mapping	4	55
Forestry	2	19
Engineering	2	23
TOTAL	**34**	**558**

Final Report Summary:

V. DISSEMINATION:

Description: Two deliverables address dissemination as listed in the activity descriptions above:
1. Training workshops
2. Web posting of training modules (URL to be assigned when modules are posted.)

Status as of January 2012:
A one-hour webinar providing an overview of LiDAR applications in forestry was developed and delivered to about 50 forestry professionals on January 17, 2012 through the MN Sustainable Forests Education Cooperative. It can be viewed at http://sfec.cfans.umn.edu/ViewPastWebinars/index.htm

Status as of July 2012**:**
Workshops were delivered and training materials posted as described in Activity Status, Activity 2. See http://tsp.umn.edu/lidar

Status as of January 2013**:**
Workshops were delivered and training materials updated as described in Activity Status, Activity 2. See http://tsp.umn.edu/lidar .
In addition, a web-based user forum was initiated, where user questions and expert answers are posted. See http://www.mngeo.state.mn.us/chouse/elevation/lidar.html#education .
Online training materials and the online user forum were promoted to the target audience at the Water Resources Conference and the annual meetings of the MN Association of Watershed Districts and the MN Association of Soil and Water Conservation Districts. The forum was also announced through the Minnesota GIS/LIS Consortium.

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget:

Budget Category	$ Amount	Explanation
Personnel:	~~$154,676~~ $163,619	1 Faculty, wetland module development 3% time, 1 year, personnel fringe benefits 25% 1 Professional staff, forestry module dev. & delivery, 25% time, 1 year, personnel fringe benefits 25% 1 Instructor, engineer module dev & delivery, 139 hr, personnel fringe benefits 25% 1 Civil Svc staff, 3 modules dev. & delivery, 25% time, 22 months, personnel fringe benefits 28.6% 1 Professional staff, principal organizer, coordinate and assist with all modules, web, publications, and workshops, 66% time, 22 months, personnel fringe benefits 25% 1 Graduate student, wetland module, 25% time, 1 yr, personnel fringe benefits including tuition 43.5%
Services:	~~$6,800~~ $7,352	Design of training documents and web pages ($3,000) Video editing software, Camtasia ($200) Outstate training room rental, 12 workshops @$300 each
Supplies:	~~$5,400~~ $2,987	Workshop handouts for 480 participants @$10 Portable hard drives (>300GB) to store and take 6 large GIS training modules to computer training laboratories, 6 @$100
Travel Expenses in MN:	~~$13,124~~ $6,042	Mileage: 26 outstate workshops x 300 mi/wkshp x $0.5/mi or current UM mileage rate Mileage: 6 planning meetings x 2 people x 300 mi/person x $0.5/mi or current UM mileage rate Lodging/meals: 2 trainers x 26 outstate workshops x $116/trainer or current UM reimbursement rate Lodging/meals: 2 people x 6 planning meetings x $116/person or current UM reimbursement rate
TOTAL ENRTF BUDGET:	**$180,000**	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $3,500: N/A

Number of Full-time Equivalent (FTE) funded with this ENRTF appropriation: 2.3

B. Other Funds: No other cash funds available. A nominal pre-registration fee will be charged participants to pay for in-training food/beverages, avoiding training time lost to travel to restaurants, and assuring attendance by class registrants.

VII. PROJECT STRATEGY:

A. Project Partners:
Partners, UM:
Paul Bolstad, UM Dept. Forest Resources; $9,152 for 25% grad student assistant, 1 year
Joseph Knight, UM Dept. Forest Resources; $3,000 salary & fringe, 3% time, 1 year

Andrew Jenks, UM Dept. Forest Resources; $17,849 salary & fringe, 25% time, 1 year
Joel Nelson, UM Dept. Soil, Water & Climate; $37,330 salary & fringe, 25% time, 22 months
Ann Lewandowski, UM Water Resources Center; $78,114 salary & fringe, 66% time, 22 months
Ann Johnson, UM Dept Civil Engineering; $9,231 salary & fringe, 139 hours
Les Everett, UM Water Resources Center; project manager, time donated by WRC

Except for travel expenses for planning meetings and workshop delivery, non-UM partners (state and federal agency staff) will not receive funds from this project. They are:
Lea Holter and Sonia Jacobsen, NRCS
Karen Bonde, BWSR
Sean Vaughn, DNR

B. Project Impact and Long-term Strategy:

The State of Minnesota is procuring statewide coverage of high resolution digital elevation data via LiDAR. Precision, efficacy and cost efficiency of natural resource management will be greatly increased by use of these data. Examples include wetland and restorable wetland mapping, siting and installation of soil and water conservation structures, mapping and prediction of soil erosion, hydrologic modeling for water quality and quantity, plant community mapping by terrain characteristics, forest and biomass volume estimates, geologic mapping, and many other applications. However, to fully utilize this new tool, natural resource managers require training and information on how to import, process, and employ the very large LiDAR data sets, using the computer software applications currently and potentially available to them. Without this training, use of the LiDAR data at the local level will be limited and the potential benefits not fully exploited. Once the training project is completed, the training modules will be openly available on the LiDAR website of the Minnesota Geospatial Information Office and managed by the State Digital Elevation Committee, Subcommittee on Research and Education.

C. Spending History:

Funding Source	M.L. 2005 or FY 2006-07	M.L. 2007 or FY 2008	M.L. 2008 or FY 2009	M.L. 2009 or FY 2010	M.L. 2010 or FY 2011
No prior funding for training					
State funding for LiDAR data acquisition	300,000 NW	~650,000 SE		2,800,000 SW	2,800,000 Metro/Arrowhead

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. MAP(S): N/A

X. RESEARCH ADDENDUM: N/A

XI.   REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted not later than January 31, 2012; July 31, 2012; and January 31, 2013. A final report and associated products will be submitted between June 30 and August 1, 2013 as requested by the LCCMR.

Attachment A: Budget Detail for M.L. 2011 (FY 2012-13) Environment and Natural Resources Trust Fund Projects								
Project Title: Strengthening Natural Resource Management with LiDAR Training								
Legal Citation: *M.L. 2011, 1st Special Session, Chapter 2, Article 3, Subd. 03k*								
Project Manager: Leslie Everett								
M.L. 2011 (FY 2012-13) ENRTF Appropriation: $ 180,000								
Project Length and Completion Date: Two years, June 30, 2013								
Date of Update: August 5, 2013								
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	**Revised Activity 1 Budget 08/05/2013**	**Amount Spent**	**Balance**	**Revised Activity 2 Budget 08/05/2013**	**Amount Spent**	**Balance**	**REVISED TOTAL BUDGET 08/05/2013**	**TOTAL BALANCE**
BUDGET ITEM								
Personnel (Wages and Fringe Benefits) Total	81,591	81,591	0	82,028	82,028	0	163,619	0
1 Faculty, wetland module development 3% time, 1 year, personnel fringe benefits @ 25%, ($3000)								
1 Professional staff, forestry module dev. & delivery, 25% time, 1 year, personnel fringe benefits @ 25%, ($17,849)								
1 Instructor, engineer module dev & delivery, 139 hr, personnel fringe benefits @ 25%, ($9,231)								
1 Civil Svc staff, 3 modules dev. & delivery, 25% time, 22 months, personnel fringe benefits @ 28.6%, ($37,330)								
1 Professional staff, principal organizer, coordinate and assist with all modules, web, publications, and workshops, 66% time, 22 months, personnel fringe benefits @25%, ($78,114)								
1 Graduate student, wetland module, 25% time, 1 yr, personnel fringe benefits including tuition @43.5%, ($9,152)								
Services Total	3,817	3,817	0	3,535	3,535	0	7,352	0
Design of training documents and web pages ($3,000)								
Video editing software Camtasia, ($200)								
Outstate GIS computer laboratory training room rental, 12 workshops @$300 ($3600)								
Supplies	2,987	2,987	0				2,987	0
Workshop handouts for 480 participants @$10 ($4,800)								
300 GB or larger portable hard drives to store and take 6 large GIS training modules to computer training laboratories, 6 @$100 ($600)								
Travel expenses in Minnesota	326	326	0	5,716	5,716	0	6,042	0
Mileage: 26 outstate workshops x 300 mi/wkshp x $0.5/mi or current UM rate ($3,900)								
Mileage: 6 planning meetings x 2 people x 300 mi/person x $0.5/mi or current UM rate ($1,800)								
Lodging/meals: 2 trainers x 26 outstate workshops x $116/trainer or current UM location specific reimbursement rate ($6,032)								
Lodging/meals: 2 people x 6 planning meetings x $116/person or current UM location specific reimbursement rate ($1,392)								
COLUMN TOTAL	**$88,721**	**$88,721**	**0**	**$91,279**	**$91,279**	**$0**	180,000	$0