Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2014 Work Plan

Date of Report: January 20, 2014

Date of Next Status Update Report: January 2015

Date of Work Plan Approval:

Project Completion Date: June 30, 2016

Does this submission include an amendment request? _No_

PROJECT TITLE: Restoring Forest Inventory Data

Project Manager: Alan R. Ek

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Location: Statewide

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

Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05d

Appropriation Language:
$100,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to obtain and restore statewide forest inventories of 1935, 1953, and 1966 to link with more recent data to improve understanding of historical forest trends and enhance long-term ecological monitoring.

I. PROJECT TITLE: Restoring Forest Inventory Data

II. PROJECT STATEMENT:

Long-term forest plot datasets have proven invaluable for understanding the changing conditions and ecology across Minnesota's 17.3 million acres of forestland. Major forest conditions, e.g., forest type and age class distributions, have changed dramatically in the last century. One dataset that has contributed enormously to our understanding of change is the statewide forest inventories reported on in 1935, 1953, 1962, 1977, 1990, 2003, 2008 and 2013. These data are from the USDA Forest Service Forest Inventory and Analysis (FIA) program and represent high quality data collection methods for their time and thousands of field plot observations for each survey. Unfortunately, only the data from 1977 to the present is available in detail; the earlier plot records have been lost. We propose to locate and restore and/or reconstruct the earlier data down to a level useful for ecoregion to local change analysis and thereby reestablish linkage to the 1977 and more recent data. We may also be able to locate the original field data in archives. With that data we will gain 40+ years of detailed forest dynamics—invaluable to climate, environment and habitat change understanding.

Additional datasets exist beyond FIA that can also be effective to extend our capability to assess and analyze long term forest change. An example is the 400 forest plot inventory on the University's 3,500 acre Cloquet Forestry Center—measured 7 times from 1959 to 2000 and with an 8th measurement scheduled for 2014. Other research or simply long-term monitoring datasets exist on a smaller scale than FIA but may have important utility regionally. This project will seek out those offering the most promise for restoration and understanding environmental change.

Research hypothesis: We recognize the increasing value of large, long-term and intensive forest inventory datasets for examining a wide range of ecological, habitat and economic issues. We anticipate that today's search, database management, scanning, digitizing, interpolation, extrapolation and imputation methodologies are sufficient to complete databases with gaps or missing data such that truly useful detail can be restored and linked to the more recent records. Further, we anticipate that informed searching of published records, internal agency reports and data archive sites can provide sufficient information and perhaps original data to allow nearly complete and highly useful dataset restoration

III. PROJECT STATUS UPDATES:

Project Status as of January 15, 2015:

Project Status as of June 30, 2015:

Project Status as of January 15, 2016:

Project Status as of June 30, 2016:

Overall Project Outcomes and Results: June 30, 2016

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Collect, assemble and recover information on and details of the 1935, 1953 and 1966 statewide forest inventories.

Description: The 1935, 1953 and 1962 FIA data are available only in summary reports on a statewide and sometimes regions and counties. We have sought further documentation describing these data and also interviewed individuals who designed and/or executed these surveys, including past and present survey project leaders. Here we extend those efforts further to restore the subject datasets. The attached graphic suggests the geographic extent of the project.

We anticipate documentation and actual summary and field plot records exist in various federal, state, university, industry and individual survey crew or supporting scientist files in various formats. Operationally, we will further develop our contact list from currently employed and retired individuals likely to be familiar with these data. Subsequently, we will contact them to narrow the search. Questions for these contacts will seek their knowledge of the documentation of these survey designs, the location of plot records and related data and maps, and the names of other contacts who might be helpful. We will also explore library and publication archives, federal archives in Washington, D.C. and Kansas City, MO and existing research compilations, electronic and otherwise, to identify promising leads and/or key portions of the FIA records. Once located, these data would be processed per the activity steps described below to make them useable and readily available.

If we are unable to locate the full datasets in the form of detailed plot records, then various statistical approaches would be used to impute existing data to provide useful plot, survey line, section, township, county or survey unit results and associated map characterizations. Note there are 4-6 survey units in Minnesota depending upon the year of the survey.

The priority in restoration will be the 1962 and then 1935 datasets. It is possible the 1962 plot data still exists in punch card or electronic format or in a form that can be scanned and digitized. Even though the 1935 plot data and some tree data was summarized and transferred to IBM cards, it is less likely that these would still be readable or even found. The 1953 Survey was compiled from inventories conducted by federal, state, county and industry entities and is perhaps the most problematic for reconstruction at the plot level.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 85,830
Amount Spent: $ 0
Balance: $85,830

Activity Completion Date: March 2016

Outcome	Completion Date	Budget
1. Collection and synthesis of documentation, summaries, maps and field data records from individuals, agencies, and federal archives for the subject inventories.	January 2015	$ 22,000
2. Digitization, processing, and recovery of data down to survey unit, county, township and plot levels; verification of restoration by comparison with published summary reports.	January 2016	$60,000
3. Database formatted to link for analysis with datasets for 1977 to present and reporting.	March 2016	$4,830

Activity Status as of January 15, 2015:

Activity Status as of June 30, 2015:

Activity Status as of January 15, 2016:

Activity Status as of June 30, 2016:

Final Report Summary: June 30, 2016

ACTIVITY 2: Identify and restore additional long-term forest plot datasets.
Description: Seek out and recover additional long-term datasets that have potential for understanding forest change. Key criteria are that these datasets (a) describe ecologically important conditions over a large area, (b) have detail for meaningful change analysis, and (3) describe timeframes in excess of 30 years. These datasets will focus on naturally occurring forest conditions, though some portion may have a history of management treatments.

These datasets will include the eighth remeasurement of the permanent forest inventory / research plots on the University of Minnesota's Cloquet Forestry Center permanent plot database, to be conducted in the summer of 2014 with funds obtained from the University's Office of the Vice President of Research. Earlier measurements of these 400 plots were taken in 1959, 1964, 1969, 1976, 1982, 1990, 2000. Note the initial project proposal included an activity that sought funding for the 2014 measurement of the Cloquet dataset. This measurement activity has now been deleted from the work plan as it is no longer needed. However, we have included that dataset to be treated under this revised activity.

Additionally, we will seek out and attempt to recover additional long-term datasets that have potential for understanding forest change. Key criteria are that these datasets (a) describe ecologically important conditions over a large area, (b) have detail for meaningful change analysis, and (3) describe timeframes in excess of 30 years. These datasets will focus on naturally occurring forest conditions, though some portion may have a history of management treatments. We anticipate such datasets exist in various federal, state, university, industry and individual files in various formats.

Operationally, we will develop a contact list from currently employed and retired individuals likely to be familiar with such datasets. Subsequently, we will contact them to narrow the search. We will also explore library and publication archives and existing research compilations, electronic and otherwise, to identify promising datasets that suggest they include long-term records. Once located, these datasets would be processed per the activity steps described below to make them useable and readily available.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 14,170
Amount Spent: $ 0
Balance: $14,170

Activity Completion Date: March 2016

Outcome	Completion Date	Budget
1. Identification and **c**ollection of documentation and existing field data for the subject inventories.	October 2015	$ 4,000
2. Digitization, processing, and restoration of data with recompilation to compare and verify against official reports.	March2016	$ 8,000
3. Databases and data formatted for forest change analysis and reporting consistent with USDA Forest Service FIA and MN DNR data specifications.	June 2016	$2,170

Activity Status as of January 15, 2015:

Activity Status as of June 30, 2015:

Activity Status as of January 15, 2016:

Activity Status as of June 30, 2016:

Final Report Summary: June 30, 2016

V. DISSEMINATION:

Description: The project plans to provide restored databases in electronic formats together with data descriptions for other users. These results and dataset restoration methodology will also be described in paper and electronic reports to be made available to ecologists, inventory specialists, and resource analysts through publications and web access (via the Department of Forest Resources and the Forest Resources Interagency Information Cooperative websites). Additionally, we are planning on technical journal articles and webinars to describe the datasets and restoration methodology for potential use by those in other regions. The data is intended to in convenient data formats including those compatible with current statewide forest inventory data. These datasets will be employed as soon as they become available for examination of long-term forest change, specifically for their implications for climate change (resilience, adaptation), for understanding long-term carbon sequestration in forests statewide, and for habitat change, e.g., for ruffed grouse, moose and forest health and biodiversity implications as well. We anticipate our own (other) projects in these subject areas will provide the funding for using these data further. We also see these data as an important and publicly available datasets to be made available for applications by others within and beyond the University and Minnesota on funding they may have available.

Activity Status as of January 15, 2015:

Activity Status as of June 30, 2015:

Activity Status as of January 15, 2016:

Activity Status as of June 30, 2016:

Final Report Summary: June 30, 2016

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Explanation
Personnel:	$ 96,800	**Research Support:** Research Associate John Zobel @ 25% time for one year to assist project team in developing statistical approaches for restoring data sets, notably to address gaps in data, as necessary. Total: $17,000. Research Fellow David Wilson@ 65% time for two years to assist project team in the collection and synthesis of the subject long-term forest inventory plot datasets. Total $79,800.
Travel Expenses in MN:	$1200	To dataset and or archive sites outstate
Other: Travel expenses beyond MN	$2,000	To federal archives in Washington D.C. and Kansas City, MO.
TOTAL ENRTF BUDGET:	**$100,000**	

Explanation of Use of Classified Staff: NA

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.6

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: NA

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
	$	$	
State	$		
University of Minnesota In-kind Services During Project Period: Project manager (Ek) will contribute 1% time to the project; other University co-PI (Burk) will contribute 1% time to working with project employees.	$6,594	$0	Project manager faculty time providing project research leadership
University of Minnesota Unrecovered indirect costs @ 52% of modified total direct cost base of $100,000	$52,000	$0	
TOTAL OTHER FUNDS:	**$58,594**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners: The University of Minnesota will receive the funding and also contribute substantial faculty time and effort to the project. Project team members (PIs) are from the University's Department of Forest Resources and include Professors Alan Ek and Thomas Burk, Research Associate John Zobel and Research Fellow David Wilson. A key cooperator is the USDA Forest Service Northern Research Station Forest Inventory and Analysis unit in St. Paul and related Federal Archive sites (in Washington, D.C. and Kansas City, MO), plus the MN DNR Division of Forestry and other individuals that have been involved with collection of MN FIA and other data in the past.

B. Project Impact and Long-term Strategy: A two-year project length is needed to be able to identify, locate and restore existing datasets. This includes the development of statistical imputation methodology as needed, and to digitize and make the datasets available for improving the analysis of forest change for ecological, habitat and economic interests.

C. Spending History: The project manager and his research teams have been been using long-term forest datasets in research for several decades. However, we have only recently sought to improve on the data available through the restoration of "lost" forest inventory records. However, no ENRTF anf MRRF funds have been in used in those efforts.

Funding Source	M.L. 2008 or FY09	M.L. 2009 or FY10	M.L. 2010 or FY11	M.L. 2011 or FY12-13	M.L. 2013 or FY14

VIII. ACQUISITION/RESTORATION LIST: NA

IX. VISUAL ELEMENT or MAP(S): To be developed from the datasets restored in the course of this project

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: NA

XI. RESEARCH ADDENDUM:

XII. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than January 15, 2015, June 30, 2015, January 15, 2016, and June 30, 2016. A final report and associated products will be submitted between June 30 and August 15, 2014.

Environment and Natural Resources Trust Fund

M.L. 2014 Project Budget

Project Title: Restoring Forest Inventory Data
Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05d
Project Manager: Alan R. Ek
Organization: University of Minnesota
M.L. 2014 ENRTF Appropriation: $ 100,000.
Project Length and Completion Date: 2 years, June 30, 2016
Date of Report: January 20, 2014

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Collect, assemble and recover information…***			***Identify and restore additional…datasets***				
Personnel (Wages and Benefits)	$83,130	$0	$83,130	$13,670	$0	$13,670	$96,800	$96,800
John Zobel, Research Associate: $17,000. (66.4% salary, 33.6% benefits); 25% FTE for one year. Work: To assist project team in developing statistical approaches for restoring data sets, notably to address gaps in data, as necessary.								
David Wilson, Research Fellow: $79,800. (66.4% salary, 33.6% benefits); 65% FTE for two years. Work: to assist project team in the collection and synthesis of the subject long-term forest inventory plot datasets.								
Travel expenses in Minnesota *Mileage, lodging and meals to locate and collect restorable datasets in Minnesota*	$700	$0	$700	$500	$0	$500	$1,200	$1,200
Other *Air fare, lodging, and meals to locate and collect restorable datasets from federal archives in Washington, DC and Kansas City, MO.*	$2,000	$0	$2,000	$0	$0	$0	$2,000	$2,000
COLUMN TOTAL	**$85,830**	**$0**	**$85,830**	**$14,170**	**$0**	**$14,170**	**$100,000**	**$100,000**

GRAPHIC: History of Statewide Forest Inventories in Minnesota from 1935 to 2013.

- **2013:** The figure below describes the location of the latest Forest Inventory and Analysis (FIA) field plots in Minnesota (6,139 plots, each consisting of four 1/24th acre subplots) and examples of data collected.

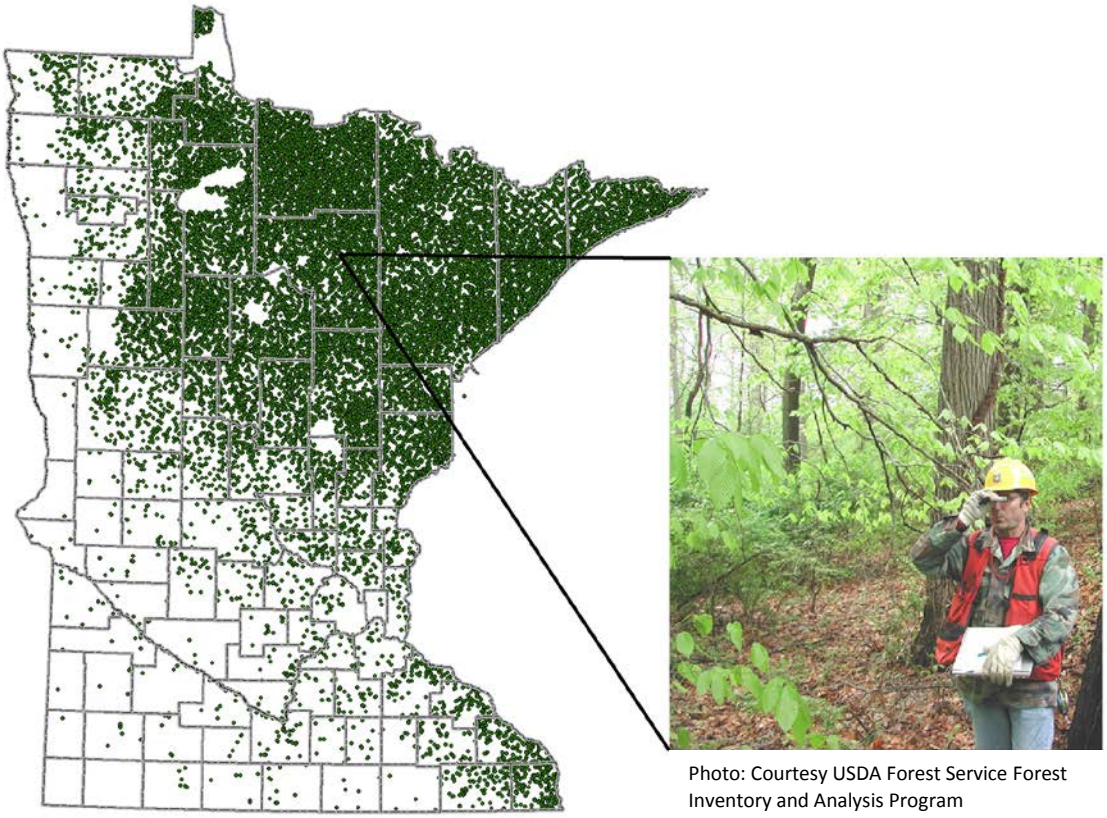

Photo: Courtesy USDA Forest Service Forest Inventory and Analysis Program

Figure 1: FIA plots in Minnesota in 2013. The plots were measured over a 5 year period (2009-2013) and provide estimates of forest area, ownership, cover type, stand tree and site description, numerous ecological descriptors, habitat indicators, and numerous other measures.

- **2008:** Same sample plot grid layout and measurement as 2013
- **2003:** Same sample plot grid layout and measurement as 2008
- **1999:** Same sample plot grid layout and measurement as 2003
- **1990:** Similar sample plot grid layout and measurement as 1999
- **1977:** Same sample plot grid layout and measurement as 2013
- **1966:** Data lost…
- **1953:** Data lost…
- **1935:** Data lost…

Project Activity: Locate, collect and restore the lost inventory data and compilations.
Results: Extension of forest and related ecological monitoring data and compilations for 40+ years, thus greatly strengthening historic detail on forest dynamics—invaluable to climate, environment and habitat change understanding.