

Environment and Natural Resources Trust Fund

Research Addendum for Peer Review

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Project Title: Restoration Strategies: Ditched Peatland Scientific and Natural Areas

Project number: 69-C1+2

1. Abstract

Minnesota is home to unique boreal peatland systems called patterned peatlands. These peatlands form where water levels are near the surface and water flow through the system is slow, allowing for slower decomposition of plant tissues and thus an accumulation of peat. The hydrology of the peatland controls the accumulation of peat and resulting peatland landforms. Alterations of the hydrology can have profound impacts on the peat and landforms. Ditching within the ecologically significant Winter Road Peatland Scientific and Natural Area (SNA) appears to have affected the hydrology and habitat of this peatland.

A long-term monitoring network for peatland hydrology and habitat will be established to evaluate the effects of the existing ditch system. The network will consist of automated and “synoptic monitoring locations, where the term synoptic is used to describe monitoring locations where data must be gathered during site visits and which will all be visited within as short a period of time as possible to obtain a ‘snapshot’ of conditions within the study area as a whole. Automated stations, one in each of the three subwatersheds, will monitor groundwater levels, surface water levels in a nearby ditch, and precipitation amounts for that area. Three vegetation monitoring plots will be set up adjacent to each automated station.

Once detailed subwatershed boundaries are determined from available LiDAR data (Light Detecting and Ranging data – planned release date in July 2010), sites for an estimated seven additional vegetative monitoring plots with groundwater level monitoring and approximately eight surface water gaging sites will be chosen within the peatland. As much as possible, these synoptic vegetation, groundwater, streamflow monitoring sites will be co-located.

Flow, level, and vegetation data will be used to examine the functional relationship of ditches to their associated drainage systems, affected properties and habitat. The intent is to determine if ditch abandonment will improve the ecological health of this patterned peatland.

Background

In North America, peatlands are only found in Minnesota, Maine, Canada and Alaska, and to a very limited extent in Michigan, Wisconsin and New York (Haws, 2010). Minnesota, with its 6 million acres of peatlands, has the largest peatland area in the lower 48 United States. One of the largest and most unusual boreal peatland systems is found in the glacial lake beds of northern Minnesota and is called the patterned peatlands.

Patterned peatlands form in lowland areas where precipitation does not move rapidly through and off the system. This is generally caused by poor drainage from the site due to an impermeable substratum and/or flat or gentle slopes which results in a high water table (Wright et al. 1992). Peatlands only form where summer temperatures are low enough and precipitation is high enough to allow for less evaporation than precipitation. Because the water does not run through the system quickly, oxygen is depleted from the system and decomposition of plant tissues is slowed. This slow decomposition results in an accumulation of peat which consists of partially decomposed wood, stems, leaves and fruits (Wright et al., 1992). Therefore, the hydrology of the peatland tends to control the formation of and sustainability of the peatland.

In patterned peatlands, water tables are close to the ground (peat) surface. The water table receives recharge through mineral rich run-off from higher lands surrounding the peatlands and mineraltrophic ground water flowing through the upper layers of the peat. Water moves through the peatland, maintaining saturated conditions within the peat profile. The quantity of moving water and its chemistry, particularly mineral content and pH, varies throughout these peatlands. The peat thickness also varies throughout the peatland. The varied thickness of peat and gradients of water flow and chemistry allow for the formation of various plant communities. These plant communities take on different physical characteristics and form different peat landforms. These different peat landforms include: Raised Bogs, Water Tracks and Spring Fens, Spring-Fen Channels, Flarks, Strings, Featureless Water Tracks, Forested Fingers, Tree Islands, and Spring-Fen Forests (Wright et al. 1992).

Winter Road Lake Peatland is a typical patterned peatland found in the glacial lake bed of northern Minnesota in Lake of the Woods and Roseau Counties. It contains several different peat landforms including Strings, Flarks, Water Tracks, and a Raised Bog in addition to Winter Road Lake itself (Haws, 2010). Because of these landforms, Winter Road Lake Peatland was identified as one of the 18 most significant peatland sites in Minnesota by the "Task Force on Peatlands of Special Interest", whose recommendations were published in 1984 (MN DNR, 1984). The Winter Road Lake Peatland, along with 17 other peatlands, was designated as a Scientific and Natural Area (SNA) through legislation that was passed and signed into law as MS 84.035 and MS 84.036 in 1991.

Like many of the peatlands of Minnesota, Winter Road Peatland is impacted by many drainage ditches, primarily installed in the early 1900's. There are approximately 31 miles of ditches within the peatland SNA and Watershed Protection Area (WPA). Haws (2010) stated that "There is evidence that the ditches have altered the hydrology of the peatlands, at least within 30 meters. The "strings" of Winter Road Lake Peatland have more woody vegetation (willow, etc.) than would typically be expected ... This is seen in various locations within the SNA and may be due to drier than expected ridges.." The installation of drainage ditches can increase the spring runoff amount and change the timing of peak surface water flows. Ditches also steepen the hydraulic gradient of the ground water immediately surrounding the ditches and this can decrease the local water table elevation, resulting in habitat changes around the ditch which can mimic dryer areas (Wright et al. 1992).

The site specific management plan for this SNA suggests that ditch abandonment may help improve this peatland. However, there is no in-depth information for this peatland relative to its

hydrologic gradient, vegetation and habitat (Haws, 2010). Information needs to be collected on the existing ecosystem to evaluate potential effectiveness of ditch abandonment, to evaluate which ditches can/should be abandoned and to determine how the ditches should best be abandoned.

2. Hypothesis

Drainage ditches installed in the 1930s have altered the hydrology of Winter Road Lake Peatland resulting in changes to the vegetation composition and patterns in the peatland. This project is the first step towards restoring the area to more natural ecological conditions. The hypothesis of this proposal is that to design and implement an effective restoration project for Winter Road Lake Peatland, a basic water budget needs to be developed for the peatland, and understanding of current vegetation differences relative to existing ditches and hydrologic characteristics must be gained and a pre and post restoration monitoring system must be established.

3. Methodology

Hydrologic and vegetative monitoring will be established for the Winter Road Peatland SNA and Watershed Protection Area (WPA). Monitoring of tributaries of these rivers will be required: the Winter Road River, the Warroad River and the West Branch Warroad River.

INTERNAL SUBWATERSHED ESTABLISHMENT

The intent is to distribute monitoring efforts approximately equally among the three watersheds within the Winter Road Lake Peatland. Once the subwatershed boundaries are accurately determined (figure 1 shows approximate boundaries), it will be possible to know with greater certainty which subwatershed each monitoring location is located. Accuracy of the subwatershed delineation also determines the proportional area contributing to each of the three tributaries. Delineation of internal watershed boundaries and establishment of conceptual water budgets for subwatersheds will be completed by the end of July 2011 using available LiDAR data. Ability to access the chosen sites will also be an important factor in selecting monitoring station locations.

AUTOMATED GROUND WATER, SURFACE WATER AND PRECIPITATION MEASUREMENT SITES:

Three automated data collection sites will be established at each of three surface water gaging stations. Equipment deployed will consist of a precipitation gage, a surface water (ditch) gage, an acoustic velocity meter, and several water table wells and/or piezometers with transducers and loggers for data collection. Well and piezometer placement relative to peat depths will be determined after the conditions at each chosen site are determined. The elevation of the measuring points for all wells and piezometers will be surveyed and referenced to NGVD (1929). Design details for water table well and piezometer construction are included as Attachment A. These design details have been approved for other sites for Health Department variances from the Minnesota Well Code.

Figure 1 is a conceptual map of all monitoring points. Figure 2 is conceptual drawing of potential well placement within a vegetative transect. The wells will be placed as appropriate to monitor horizontal and vertical groundwater flow near the ditch. Data shall be collected electronically and will be available at <http://www.dnr.state.mn.us/waters/csg/index.html>.

GROUND WATER SYNOPTIC MEASUREMENT SITES:

Four groundwater level monitoring locations will be established along the length of each vegetation monitoring transect (10 sites). Well/piezometer locations and construction details will be as described above. Final piezometer locations shall be established based on vegetation transect dimensions. Depth to water level data will be collected during vegetation monitoring and synoptic surface water monitoring. Data will be provided in an electronic format (spreadsheet).

SURFACE WATER MEASUREMENT SITES:

Automated surface water measurement sites will be established to coincide with automated ground water measurement sites.

- An acoustic velocity meter will be installed in the ditch nearest to the wells at each automated station.
- Data loggers and water level sensors shall meet approved standards including the accuracy of stage measurements to +/- 0.005 feet over the expected range for each gage site. Data loggers shall be programmed to record levels and flows every 15 minutes.
- Each gaging station shall be surveyed and referenced to NGVD (1929), and where applicable a reference staff gage shall be installed.

Synoptic surface water measurement sites will be established to evaluate surface water flow in locations outside of the automated gaging stations. These sites will be used to tie in surface water runoff values throughout the peatland with the automated gaging stations.

- Eight such sites in and around the Winter Road Lake WPA will be selected based on internal watershed boundaries and practicality of access. The stations shall be as evenly divided between the three internal watersheds as possible.
- Synoptic measurement events for 2012 and 2013 will be timed to catch peak spring runoff and fall low water conditions for a total of four measurement events over 2 years. The goal is to complete all measurements within two days in order to have a snapshot of conditions over the peatland.
- Wading measurements with hand held velocity meters will be used and must have a minimum of 25 – 30 samples of velocity depth and distance within the transect. High flow measurements must be with approved equipment and follow standard USGS procedures for the equipment used. The computation of discharge must follow standard USGS procedures. Flow measurements during ice conditions must comply with standard USGS procedures for the equipment used.

Rating Curve / Stage - Discharge Relation: A minimum of 15 pairs of flow and stage measurements must be used to develop the initial stage discharge relation and follow standard procedures for development. In order to maintain the stage - discharge relation, flow measurements must be made on a 4-6 week basis or as needed to capture high flow events and winter base flow conditions throughout the life of the project. Discharge computation shall follow standard USGS procedures including the use of datum corrections and shift adjustments during the open water season. During winter / ice conditions flow measurements must be taken on at least a monthly basis to assist with the estimate of the winter daily flow record. All aspects of the surface water-monitoring program shall conform to "Measurement and Computation of Streamflow" USGS Water Supply Paper #2175.

VEGETATION SURVEYS:

Vegetation surveys will be conducted along ten transects. Three will be located adjacent to the three automated groundwater/surface water sites. The remaining seven transect locations will be chosen to maximize the capture of vegetative/ditch hydrology differences in each subwatershed insofar as site access allows. If possible, these seven remaining sites will be co-located with the synoptic surface water monitoring sites.

Transects will be sampled to capture the greatest species diversity and richness; one sampling to occur in the early summer (by the end of June) and one in the late summer (by the end of August). Transects will be sampled twice per year, at the same time of the year, for the two years of this project. There will be a total of four sampling events throughout the project.

- Data will be collected, verified and submitted electronically by the contractor.

Transects will extend perpendicular to and in both directions from the ditch ending in the peatland beyond the area considered to be affected by the ditch. Transect lengths will be determined as each site is chosen and will be the length necessary to encompass the ditch impact zone. Transects will likely be a minimum of 50m long.

Along each transect, a point intercept protocol will be followed to count and measure all vascular plants. Each transect will have a grass/sedge type sample plot approximately every 5 m, with approximate dimensions of 1m by 1m. The distance between, number of, and size of plots will be dependent upon the length of each transect. These sampling plots will be established on the initial site visit and remain the same throughout the project. Each plot will be identified with a unique identifying code and its location marked with 18-24 inch long hollow steel posts to allow for re-evaluation. Standard DNR relevé sampling methods will be followed (MNDNR 2007). Vegetation statistical analysis will be done by measuring the presence/absence of indicator species and conducting an analysis of variance based upon distance from the ditch and/or wells.

Nested bryophyte mini-plots will be established within the grass/sedge type plots. The size and location of these plots will be established at the initial site visit to maximize bryophyte species counts. Each plot will remain in the same location and be the same size throughout the project, location measured from the steel posts of the larger plots. A small sample of each visibly different bryophyte species will be collected and shipped to the subcontractor, Jan Janssens, for species identification. All bryophyte species found will be vouchered. Vegetation statistical

analysis will be done by measuring the presence/absence of indicator species and conducting an analysis of variance based upon distance from the ditch and/or wells.

POTENTIAL DITCH ABANDONMENT, RESTORATION AND WETLAND BANKING

Based on results of the hydrologic and vegetation surveys the potential to improve the hydrology and habitat conditions of the SNA will be assessed. The lateral effect of the ditches on the hydrology and plant communities will determine the extent to which ditch abandonment and restoration strategies will be effective and whether or not there is any potential for wetland mitigation credits. Ditch abandonment methods found in the literature (Armstrong, et al. 2009) will be assessed for potential use in the SNA as well as recommended strategies for re-establishment of indigenous peatland plants (Quinty and Rochefort 2003). A preliminary assessment of the SNA's wetland banking potential and required regulatory procedures will be conducted according to state and federal wetland rules (Minnesota Board of Water and Soil Resources 2009).

4. Results and Deliverables:

a. Evaluate existing hydrologic conditions

- Establish internal watershed boundaries and conceptual water budgets using available LiDAR data. Product will be a map of the watershed boundaries.
- Install and maintain three (3) automated precipitation, groundwater and ditch gaging stations with satellite telemetry. Each station will have 7 wells, 1 acoustic velocity meter and one precipitation gage per site all manifolded together into one data logger
- Install at least 4 wells along the transect of each vegetation monitoring plot not co-located with the automated gaging stations for synoptic groundwater level measurements.
- Conduct annual synoptic surface water flow measurements at eight (8) sites four (4) times during project. Once in spring, once in late summer/fall of each year of the project
- Compile collected hydrologic data and report the results with a determination of the peatland water budget. Report will be produced containing all collected data and preliminary analysis of restoration methods

b. Evaluate vegetation to determine effects of altered hydrologic conditions due to ditches

- Plot-based quantitative vegetation and bryophyte sampling and synoptic groundwater level measurements conducted at ten (10) sites to coincide with the synoptic and automated groundwater level measurements
- Compile collected vegetation data and report the results. Report will be produced containing all data collected and preliminary habitat analysis

c. Develop recommendations for restoring peatland hydrology and vegetation

- Review ditch plans, conduct ditch profiling as needed, review potential hydrologic and restoration methods

- Analyze results from a & b, research and make preliminary recommendations for habitat improvements in an interim report
- Analyze final results, research and make final recommendations for habitat improvements in a final report
- Prepare preliminary information and analysis necessary for potential ditch abandonment, wetland banking, permitting and other regulatory processes in a report

5. Timetable

	2011		2012			2013		
Project	Summer July - Sept	Fall Oct - Dec	Winter Jan - Mar	Spring Apr - June	Summer July - Sept	Fall Oct - Dec	Winter Jan - Mar	Spring Apr - June
Field Work								
Installation of automated gaging stations, synoptic wells and establishment of vegetative and bryophyte transects	09/30/2011							
Automated gaging station measurements and maintenance	continuous	continuous	continuous	continuous	continuous	continuous	continuous	continuous
Synoptic surface water flow measurement		Oct		Peak runoff		Oct		Peak runoff
Complete Vegetation and bryophyte transect sampling and well measurement	9/30/2011			6/15/2012	8/30/2012			6/15/2013
Reports								
Map of watershed boundaries	8/30/2011							
Interim report –Preliminary hydrologic and vegetation data, peatland water budget, & analysis of habitat restoration methods							1/3/2013	
Final report – Complete hydrologic and vegetation data, peatland water budget, & preliminary recommendations for habitat restoration								6/30/2013
Preliminary report – Info for potential ditch abandonment								6/30/2013

6. Budget –

2011-2012 Detailed Project Budget: Proposal# 069-C1+2 - Restoration Strategies; Ditched Peatland Scientific and Natural Areas	
IV. TOTAL TRUST FUND REQUEST BUDGET 2 years	
BUDGET ITEM <i>(See list of Eligible & Non-Eligible Costs, p. 13)</i>	AMOUNT
Personnel: Hydrologist 3-processing of LiDAR data and determination of internal watershed boundaries.	\$ 5,040
Personnel: Hydrologist 3-planning and installation of synoptic ground water wells.	\$1,800
Personnel: Hydrologist 3-data compilation and report writing.	\$12,600
Personnel: Hydrologist 3-project management.	\$3,600
Personnel: Hydrologist 3-Results analysis, research, and preliminary recommendations regarding ditch abandonment and habitat improvement.	\$2,880
Personnel: Four (4) Hydrologist 1-Construct and install three (3) automated surface water, ground water and precipitation gaging sites. Includes ditch cross section elevation measurement at gaging site.	\$11,760
Personnel: Two (2) Hydrologist 1- Maintain three (3) automated surface water, ground water and precipitation gaging sites and take 8 synoptic surface water velocity measurements with ditch cross section elevations.	\$33,600
Subtotal - Personnel	\$71,280
Contracts: Vegetation Data Collection and Compilation. One contractor will collect vegetative data. Vegetative collection will include moss and separate contractor will identify and compile moss data.	\$12,200
NRRI contract: Review and analysis of data to determine potential restoration methods including ditch blocking and vegetation establishment/management. Conduct preliminary analysis to determine the potential for wetland mitigation credits.	\$29,180
Subtotal - Contracts	\$41,380
Equipment/Tools/Supplies: Design Analysis Water Log Series Equipment (includes data collection platform, antenna, cables, lightening protection, 7 pressure transducers with cable and a Mounting Panel). Three Stations for automatically collecting ground water and surface water data @ \$15055 each.	\$45,165
Equipment/Tools/Supplies: Sontek Uplooker Acoustic Velocity Meters. Three meters, one for each station, to measure ditch flow @ \$8000 each.	\$24,000
Equipment/Tools/Supplies: 20 Watt Solar Panel and Regulator. Three solar power stations, one for each automatic data collection station, to provide power @ \$330 each.	\$990
Equipment/Tools/Supplies: Marine Battery. Three battery power supply, one for each automatic data collection station @ \$110 each	\$330

Equipment/Tools/Supplies: Hoffman Steel Enclosure. Protection for automatic data collection equipment at each of three stations. \$1900 each		\$5,700
Equipment/Tools/Supplies: Texas Electronic Rain Gage. Three gages, one at each station. Measures precipitation for ground water recharge measurements and surface water discharge measurements. \$220 each		\$660
Equipment/Tools/Supplies: Glvanized pipe, conduit, wire and cement to install automated gaging stations. \$750 each		\$2,250
Equipment/Tools/Supplies: Schedule 40 PVC Riser pipe with 6 inch stainless steel 10-slot well points for 40 synoptic wells in each of 10 vegetation plots @ \$95/well		\$3,800
Subtotal - Equipment		\$82,895
Acquisition (Fee Title or Permanent Easements): NA		NA
Travel: Hydrologist 3 & Natural Resources Senior round trip Bemidji to SNA, mileage, lodging, meals		\$647
Travel: Four (4) Hydrologist 1 round trip St. Paul to SNA, mileage, lodging, meals for automated stream/observation well equipment installation		\$1,118
Travel: Hydrologist 1 round trip St. Paul to SNA, mileage, lodging, meals for 8 Synoptic surface water measurements, 40 ground water measurements & maintenance of 3 automated stations		\$2,680
Subtotal - travel		\$4,445
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND \$ REQUEST		\$200,000
V. OTHER FUNDS		
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period:	\$ -	
Other State \$ Being Applied to Project During Project Period:	\$4,033	Accounting expenses not being reimbursed
In-kind Services During Project Period: DNR Expenses for monitoring hydrologist 1 hired to backfill classified positions.	\$8,000	confirmed
In-Kind Personnel: Natural Resource Senior-data compilation and report writing. Done in both years of project.	\$7,200	time not being reimbursed
In-Kind Personnel: Natural Resource Senior-Results analysis, research, and recommendations regarding ditch abandonment and habitat improvement. Done in both years of project	\$3,600	time not being reimbursed
In-Kind Personnel: Staff time replacement costs for four (4) hydrologist 1, one (1) hydrologist 3	\$71,280	
Remaining \$ from Current ENRTF Appropriation (if applicable):	\$ -	
Funding History:	\$ -	

7. Credentials –

Project Manager: Michele Walker

Michele Walker is a hydrogeologist (Geoscientist license #30096) in the Groundwater Unit with Minnesota DNR Division of Waters. Her program responsibilities are to provide technical analyses of the nature, distribution, appropriation and sustainability of groundwater in the northwestern counties, which include Minnesota's portion of the Red River Valley and extensive peatlands.

Michele has an MS degree in Soil Science from the University of Idaho and a BS degree in Geology from Bemidji State University. She has worked for both the Minnesota DNR and Minnesota Department of Agriculture as a hydrogeologist since 1991 and has published several peer-reviewed papers in scientific journals including the Journal of Environmental Quality and Environmental Science and Technology.

As a hydrogeologist with the State, she has worked on both groundwater quantity and groundwater quality issues. Her current position involves working on groundwater quantity concerns as they relate to water supply in the northwestern region of the State. She evaluates water supply plans for many cities in northwestern Minnesota and evaluates surface water and groundwater interaction as it relates to ground water appropriation.

In previous positions with the State, she has performed hydrologic work to protect ground- and surface water from agricultural contamination. This has included reviewing and evaluating environmental investigations and remediation at agricultural chemical cleanup sites; coordinating the work of consultants, responsible parties and other interested people; and working on innovative cleanup approaches to agricultural contamination.

Peter Buessler

Peter Buessler is the DNR NW Regional Manager for the Division of Ecological Resources. This position directs, supervises, and coordinates multiple division programs designed to 1) collect and link ecological information to resource decisions by department disciplines, resource agencies, local units of government, private citizens, and conservation organizations; and 2) manage aquatic and terrestrial habitat.

Mr. Buessler has extensive experience collaborating with a wide range of internal and external stakeholders in addressing complicated and contentious natural resource issues. He will be providing administrative, fiscal and organizational support to this project. He has been manager (or sub-project manager) for several previous LCMR/LCCMR projects, including:

- 2007 Prairie Stewardship Assistance for Private Landowners
- 2005 Prairie Stewardship of Private Lands
- 2003 Forest & Prairie Stewardship on Public and Private Lands
- 2001, 2003, 2005 Habitat Corridors Partnership (sub)
- 2001 Forest & Prairie Stewardship of Private Lands (sub)

- 1999 Native Prairie Prescribed Burns
- 1999 Sustainable Woodlands and Prairies on Private Lands (sub)
- 1997 Prairie Grassland Landscapes
- 1995 Sustainable Grassland Conservation and Utilization
- 1991 Native Grass and Wildflower Seed (sub)

Mr. Buessler has served as NW Regional Manager for Ecological Resources since 2007, and has worked for the DNR since 1980. Other state experience includes:

- State Prairie Program Supervisor with the DNR Scientific and Natural Areas Program (1987-2007) Responsible for programs designed to improve native prairie conservation and management on public and private lands.
- Planner Principal, State; DNR Office of Planning (1985- 1987) Project leader for the development of interdisciplinary natural resource policies, resource management studies, and department-wide strategic planning.
- Natural Resources Specialist III, DNR Scientific and Natural Areas Program (1980 - 1985) Prepare management plans for SNAs and State Parks
- Field Biologist, DNR Wildlife Management Area Inventory Project (1980) Performed field habitat surveys of state Wildlife Management Areas.

Education: Graduated Summa cum laude from the University of Minnesota in 1979 with a BS degree in Field Biology

Becky Marty

Becky Marty is a plant ecologist with the Mn DNR Division of Ecological and Water Resources in Northwestern Minnesota. She is responsible for promoting conservation and providing technical guidance, analysis, and management recommendations regarding native plants, native plant communities, and high biodiversity sites throughout this 23 county area, including portions of the Red River Valley and extensive peatlands.

Previous pertinent positions include: Resource Manager at Itasca State Park for 13 years, Chief Naturalist for the state of North Carolina for four years, District Naturalist for the state of North Carolina for three years, and multiple consultant/contract ecologist positions with The Nature Conservancy of North Carolina and South Carolina, and with the state of North Carolina.

Becky has a MS degree in Resource Ecology from Duke University in Durham, North Carolina, and a BA in natural history from Carleton College in Northfield, Minnesota.

Becky has extensive experience managing and teaching about vegetation monitoring and native community restoration through a variety of initiatives. Some examples include:

- recovering and re-sampling historic vegetation monitoring plots;
- creating, maintaining and analyzing the effects of management and development, including pipeline and powerline pathways, trail impacts, road management, erosion control, tree planting, and sand-dune restoration;
- designing and evaluating the results of large-scale restoration projects using such tools as fire, goats, and manual labor; and
- administering the natural and cultural resource program of Itasca State Park.

She has built and engaged in multiple collaboratives to promote conservation, education, and sustainable use. Examples include bringing together research teams to; re-sampling long-term vegetation monitoring projects that range up to 75 years old, evaluate the effectiveness of bio-controls on invasive plant species, and evaluate the effectiveness of pheromones to mitigate insect outbreaks. She has also built and engaged in teams to create regional environmental education centers, provide outreach education particularly about native plant communities and how to manage them, and co-design and implement natural history curriculums into the state education standards.

Kurt Johnson

Kurt Johnson is a Research Fellow at the University of Minnesota Duluth Natural Resources Research Institute. He heads the Peat Resources & Applied Wetland Rehabilitation Research Group within the Minerals Division. He has conducted applied research on projects related to Minnesota's peatlands for the past 25 years. His projects include peatland and wetland restoration, *Sphagnum* moss regeneration and growth, peatland resource assessment, peatland development for commercial horticultural peat harvesting including environmental review and permitting, and most recently wetland mitigation research; specifically the potential for wetland mitigation in abandoned gravel pits. He was the project manager for the 1997 LCMR funded project "Peatland Restoration". Kurt has an MS degree in Environmental Biology from the University of Minnesota Duluth and a BS degree in Soils from North Dakota State University.

- 8. Dissemination and Use** – Hydrologic data collected will be available on an on-going basis at: <http://www.dnr.state.mn.us/waters/csg/index.html> . Final reports from the project will be available on the MNDNR website. This proposal will contribute development, implementation and monitoring of improved peatland management practices. Public land administrators, regulators and Watershed Districts will have access to the reports and data.

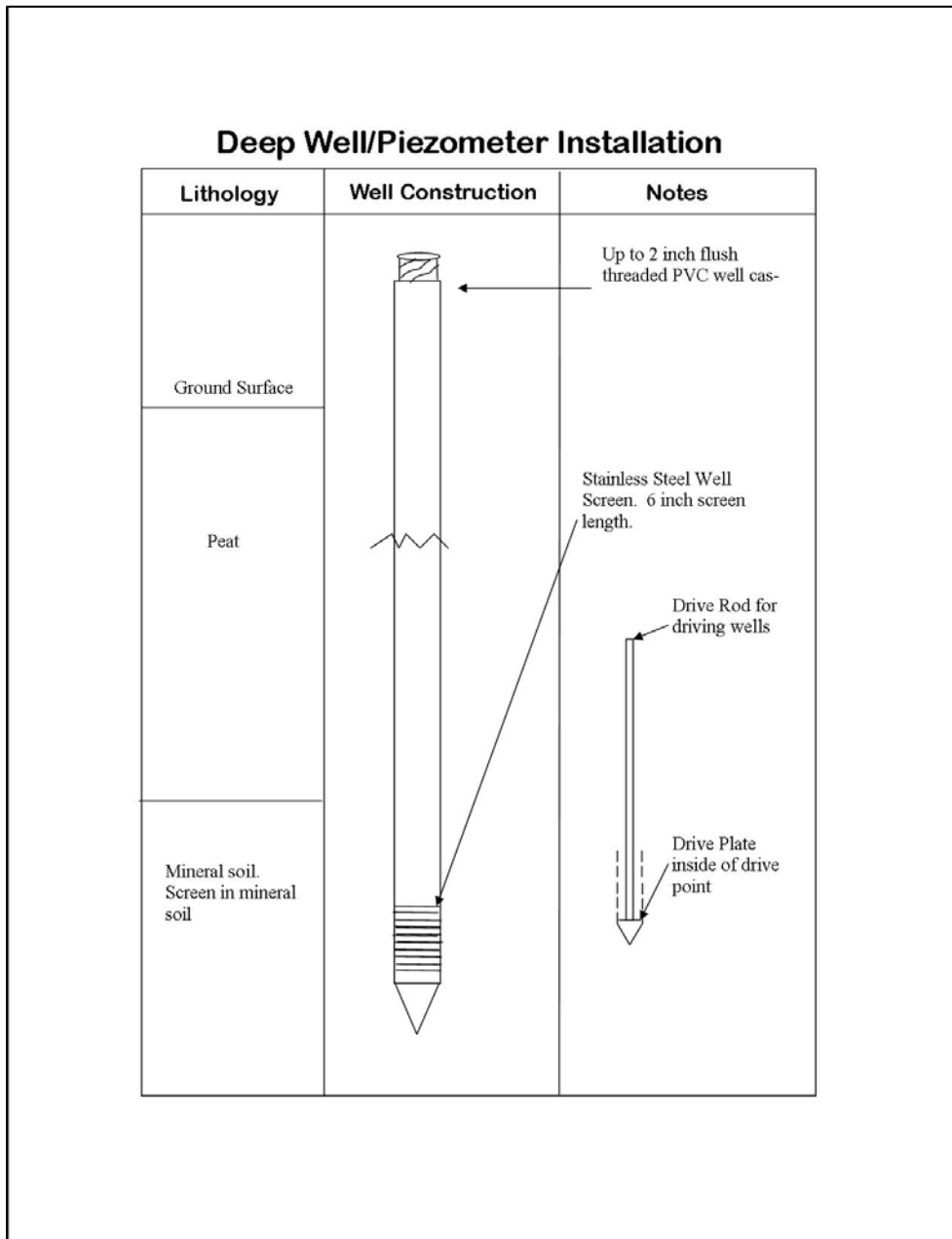
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Attachment A

Well/piezometer installation construction details

- a. No grout is to be used.
- b. No protective posts will be used. Wells are in wet areas where vehicles cannot go.
- c. Well depths will be determined by first pushing a ½ inch solid rod through the peat to the top of sand. Then the well pipe is installed by driving from inside the PVC casing with a drive-rod that contacts a driving plate inside of the stainless steel well screen. The driving rod extends out the top of the casing to provide contact with a driving apparatus that prevents any stress from being applied to the PVC. The screen may be driven into the mineral soil.
- d. Well depths will vary from 2- 20 feet and be dependent on peat depth and mineral soil type.
- e. Wells to be abandoned by pulling or jacking casing. Borehole will not be grouted.



Attachment A cont.

Water Table Well Installation

Lithology	Well Construction	Notes
Ground Surface		2 inch PVC vented Cap
Peat		Enough PVC pipe for visible stick-up. At least 2 ft.
More Peat No confining layer is penetrated.		2 inch PVC coupling at ground surface
		PVC Screen
		2 inch PVC coupling
		Unslotted pvc for stability, use about 4 ft
		Unvented PVC cap

Figure 1: Possible Monitoring Points and Ditch Locations

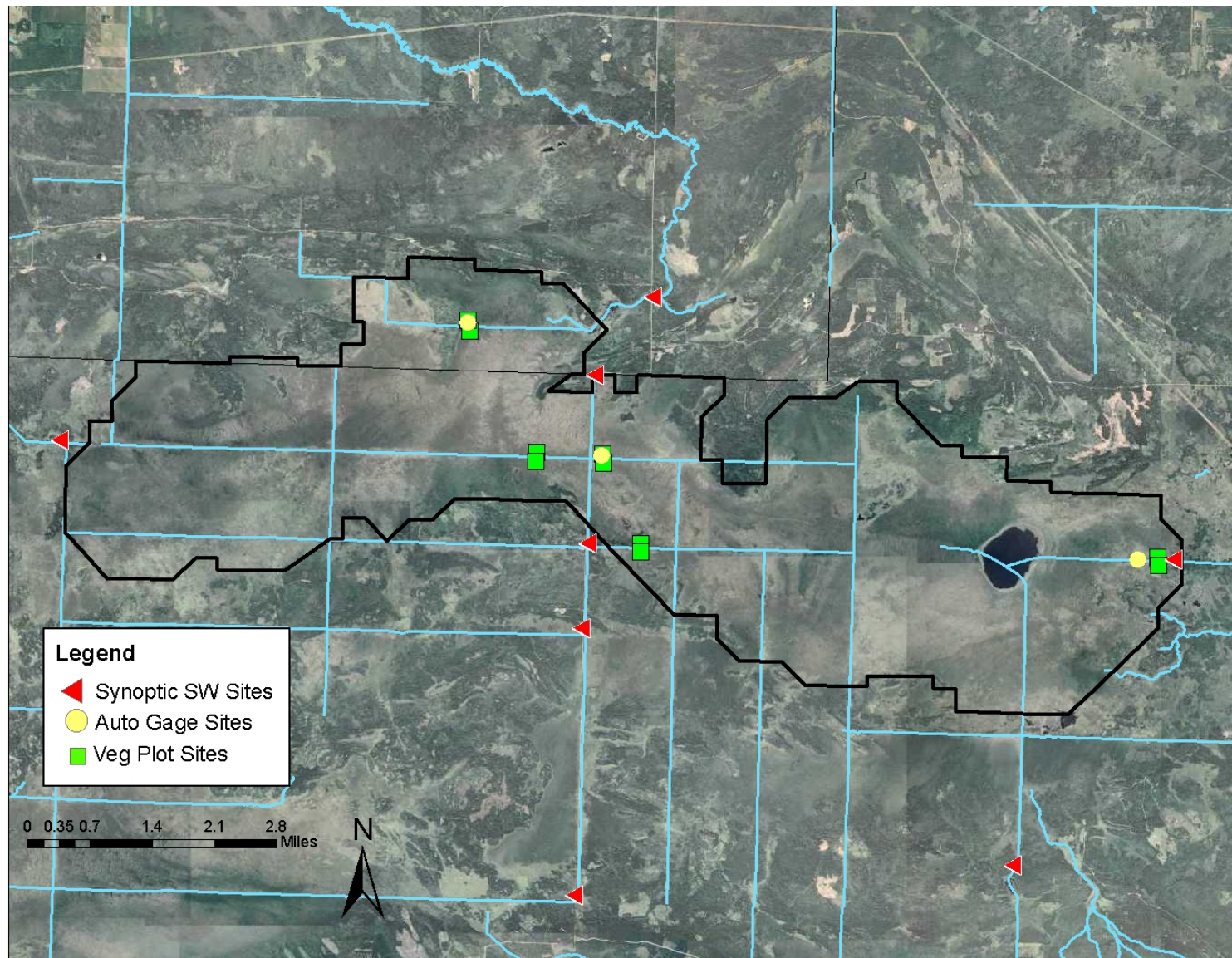


Figure 2. Possible Well/Piezometer Installation Layout in Vegetation Transect (not to scale).

