

WATERSHED HEALTH, RIPARIAN, AND SOILS (WS); SOILS

Monitoring Question

Are the effects of Superior National Forest management, including prescriptions, resulting in significant changes to the productivity of the land?

Monitoring Conducted

1. Soil Protection

Desired Condition. FWD. D-WS-12; and 36 CFR 219.12k2. Soils recover from natural disturbance events and absorb the effects of human disturbances without reducing productivity and function. Soils contribute to ecosystem sustainability. Soil-hydrologic function & productivity is protected, preserving the ability to serve as a filter for good water quality & regulation of nutrient cycling. Soil exposure is minimized. There is minimal compaction, displacement, & puddling. Severely burned conditions resulting from mgt-ignited fire occur infrequently AND O-WS-10. During all management actions involving soil disturbance: Maintain adequate ground cover and soil organic layers, both during and after treatment, to minimize erosion and allow water to infiltrate the soil. Minimize soil displacement, nutrient loss, and effects of severe burning. Restore and re-vegetate disturbed areas. Provide for the maintenance of physical, chemical and biological properties of the forest floor (soil organic matter, Surface O layer), that makes soil productive.

Project Level Monitoring

During 2006, a variety of monitoring activities was scheduled to take place to determine effects of management activities on soils. Soils would be monitored for ruts, compaction, presence of organic layer or disturbance/removal of the organic layer, rills, and gullies on treated acres. Some areas affected by management activities would also be assessed prior to treatment activity to provide a comparison between pre and post treatment conditions. However, limited monitoring was done during 2006 on routine activities because wildfires were occurring and soil personnel were not available. Instead, resources were devoted to monitoring wildfires and a prescribed burn in the Boundary Waters Canoe Area Wilderness (BWCAW), a review of ELT 18 from a productivity standpoint, pretreatment monitoring of biomass harvest units, participation in the development of Minnesota Forest Resource Council (MFRC) Biomass Harvest guidelines, Burned Area Emergency Response implementation for the Cavity Lake wildfire, and soil restoration projects.

BWCAW Prescribed Burn and Wildfires.

During 2006, fire effects to soils were monitored within the Trout Lake prescribed burn and within the Cavity Lake, Redeye, and Alpine wildfires. The presence and depth of organic layer (duff) was monitored. This is a measure of productivity outlined in the Forest Service Eastern Region Soil Quality Standards (FSH 2509.18, Chapter 2), the 2004 Forest Plan (guidelines GW-10, 11) and the MFRC Voluntary Guidelines.

Ecological Land Type 18

Ecological Land Type (ELT) 18 is defined as areas of dense bouldery till on very shallow material underlain by bedrock which are vulnerable to management activities such as logging and prescribed fire. Moreover, use of equipment on ELT 18 is difficult. The Superior National Forest (SNF) contains many acres of ELT 18. The 2004 Forest Plan designates these sites as generally “off limits” to treatment activity.

Monitoring on several units within the Echo Trail and Dunka project areas was initiated prior to harvest (pre-treatment monitoring) to determine organic layer depth and the site’s suitability for timber harvest. In addition, monitoring within the Tomahawk and Echo Trail project areas was conducted to determine whether ELT 18s were more productive than originally documented. Information gathered included 3-4 site index measurements for several tree species and a collection of stocking survey information from a nearby ELT 18 stand that had

been treated prior to passage of the 2004 Forest Plan. ELT 18 areas were reviewed after most of the Ecological Classification System (ECS) inventory and mapping was completed.

Biomass Sites

Interest in the use of biomass for energy has grown considerably. In 2006, the SNF collaborated with the Institute for Agriculture and Trade Policy to research and monitor biomass harvest from the Old Root, Pitcha, and Upper Caribou sites. Biomass from these sites was used to supply energy to the Laurentian Energy Authority (a joint effort by Virginia and Hibbing Public Utilities) where their biomass-fueled electric generators produce steam and electricity. (<http://www.forestrycenter.org/biomassproject.cfm>).

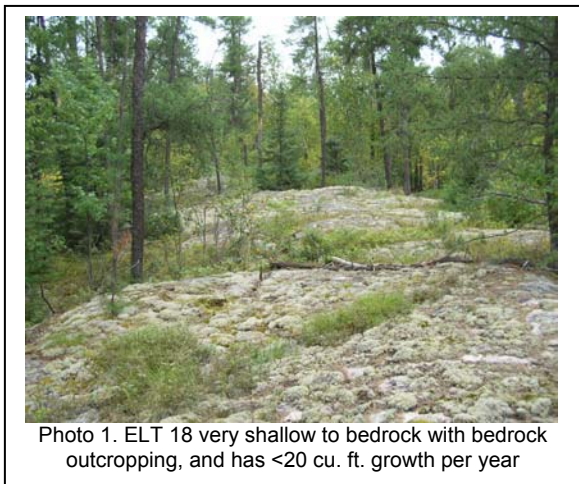


Photo 1. ELT 18 very shallow to bedrock with bedrock outcropping, and has <20 cu. ft. growth per year

These activities were completed to determine the most practical and feasible way to use equipment to optimize harvest without disturbance to sensitive ELTs.

Photo 1 displays a site visited to assess the soil productivity of a very shallow to bedrock site that has limited nutrient status. Photo 2 displays balsam fir ladder fuels that were scheduled for removal at the Pitcha site.

Biomass treatment at Pitcha removed ladder fuels (balsam fir) in a red pine stand whereas at Caribou it removed ladder fuels in a decaying aspen stand that had been previously harvested. Soil scientist Mike Demchik from the University of Wisconsin Steven's Point conducted pre-treatment soil monitoring which involved hand-felling and measuring biomass at the Upper Caribou site. Post-treatment monitoring was scheduled to occur during summer 2007. No treatment occurred on the Old Root site.

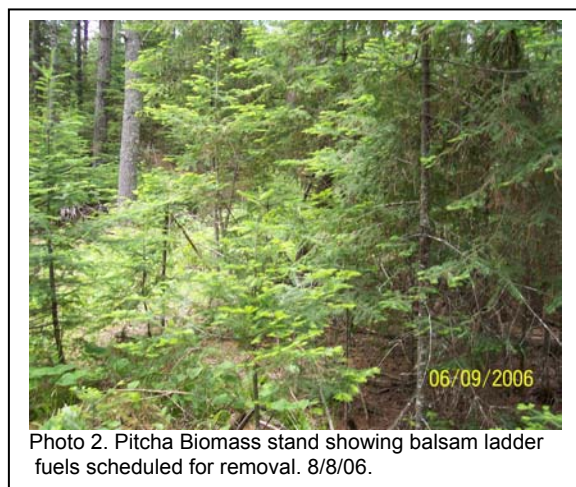


Photo 2. Pitcha Biomass stand showing balsam ladder fuels scheduled for removal. 8/8/06.

Minnesota Forest Resource Council Biomass Guidelines

Mandated by the Minnesota Legislature, the MFRC and the Minnesota Department of Natural Resources (MN DNR) developed "best management practices" for sustainable managed woody biomass by assembling a twelve member interdisciplinary team which included the SNF Soil Scientist as a participant from April 2006 to June 2007. The guidelines focus on sustainable harvest of biomass while protecting the soil, water and habitat essential to a healthy and sustainable ecosystem. Soil features addressed were compaction, organic layer (forest floor duff) retention and other relevant factors. The guidelines are to be published in October 2007. Training to implement monitoring on the biomass guidelines is scheduled to commence in the Spring of 2008.

Minnesota Forest Resource Council Voluntary Forest Harvest Guidelines

Annual monitoring of the voluntary guidelines occurs statewide. Four sites within the Billy Dump project were monitored on the SNF during 2006. Factors monitored include rutting, compaction, erosion, presence of organic layer, and use of water bars.

Landscape Level Monitoring

Monitoring Forest-wide management treatments throughout the decade at a broad scale will provide a more comprehensive view of activities that may have an impact on nutrient sensitive sites. This will provide data on the spatial distribution of acres treated for each Land Type Association (LTA) across the SNF. One advantage of landscape scale monitoring is the ability to evaluate how the nutrient sensitive sites have been treated (Final Environmental Impact Statement, 2004 Forest Plan, pp. 3.6-13 to 3.6-15). Some measures of success in these areas include increased abundance of conifer plant communities on ELTs 7,8,9,11,16, 17 and increased use of partial harvests.

Since a large portion of shallow to bedrock sites deemed nutrient sensitive are located near the BWCAW, it is important to monitor how these sites are treated in a spatial context. This will help clarify the relationship between landscape scale monitoring and site monitoring of Forest Plan Guidelines G-WS- 8 through 11. This monitoring will be accomplished in year 5 of Forest Plan implementation when more information is available for completing this analysis. The method of this analysis will be developed during 2007 and beyond.

2. Restoration of Soils

***Desired Condition D-WS-3.** Watersheds and soils are maintained or restored in a way that allow for the conservation of the genetic integrity of native species. Physical properties of soil are maintained and enhanced. Watershed and habitat restoration projects are natural appearing and favor the use of native materials or naturalized species to the extent practical AND **O-WS-9.** Protect, and where appropriate, restore the soil resource. Improve and protect watershed conditions to provide the soil productivity necessary to support ecological functions. Protect and restore areas where soils are adversely impaired and contributing to an overall decline in watershed condition, soil productivity, soil quality, and soil function. Do this by using management practices, inventory and monitoring results, and findings from the inventory of ecological units. During all management actions involving soil disturbance, minimize soil displacement, nutrient loss, and effects of severe burning.*

The SNF has completed watershed improvement projects for several decades at sites that have eroded, some due to lake level changes, some due to natural erosion and others due to human impacts. Watershed improvement projects include filling abandoned wells, reworking trails to be placed on more appropriate ELTs, restoring plant communities appropriate for riparian areas and other rehabilitation. Water bars and other design features are used to control erosion, and sites are monitored to ensure restoration to an appropriate vegetation condition. The SNF relies on a Forest-wide Watershed Inventory Needs list that recognizes areas in need of restoration. Many projects have been completed with Recreation, Road Maintenance and Soil program sponsorship.

The Soil and Watershed programs have taken a proactive approach to completing complex projects that achieve desired conditions on the SNF. A highlight of 2006 was the accomplishment of the Birch Lake Centennial Projects completed in collaboration with the Tribal 1854 Authority, Timber Bay Lodge, MN DNR, MN Power, Friends of the MN Conservation Corp, and the South St. Louis County Soil and Water Conservation District (SWCD). The Centennial Projects delivered unique and integrated benefits, including watershed improvement, recreation site improvement, restoration of riparian habitat, enhancement of fish and mussel habitat, and protection of heritage resources along the shoreline. See Photos 3 and 4.



Photo 3. Birch Lake Site #3 in early stages of repair



Photo 4. Birch Lake Site #3 with restoration complete but needs a season of vegetation growth.

Evaluation and Conclusions

Soil Protection

BWCAW Prescribed Burn and Wildfires

Preliminary prescribed fire monitoring suggests overall good retention of organic matter, although ELTs with shallow material and in high elevation landscape positions burned more severely than ELTs with deeper materials in mid and side slope landscape positions. In contrast, it was observed from limited monitoring (4-5 transects) that drier conditions and more severe burning on the Alpine wildfire occurred on ELTs 17 and 18 than was observed on prescribed burns areas.

Where fuel loads are high and during extreme drought soil moisture conditions, wildfires are likely to severely impact soil resources. BAER soil specialist reports indicated that in the Alpine wildfire (2005), 32% of the area was unburned, 54% was lightly burned and 12% was moderately burned. In the Cavity wildfire (July 2006), the forest floor was consumed in up to 20% of the area. These areas tended to be small size and discontinuous. Areas larger than 30 ft in diameter were unusual and were areas subject to high intensity fire with long resident times. Several campsites were monitored to determine the feasibility of replacing latrines at shallow to bedrock sites which indicated that latrines could be replaced where soil was deep enough.

Monitoring data of the Trout Lake prescribed burn (July 2006) revealed 1/8" to 3/8" organic matter remaining on the site. Ten percent of the area was not burned, 15% was lightly burned and 75% was moderately burned.

Conclusions reached from 2006 monitoring:

- (1) Weather conditions, ELT patterns, fuel loadings, landscape position, timber type, and other factors all influence the way a fire burns.
- (2) There is good overall retention of organic matter following prescribed burning.
- (3) Where fuel loads are high and during extreme drought soil moisture conditions, wildfires are likely to severely impact soil resources, especially on ridgetops and where shallow soils occur.
- (4) Remaining standing and downed burned trees provide nutrients and habitat for the site, and provide some soil erosion control.
- (5) Many established soil transect locations were not burned due to deferred burning of the burn unit or if the burn unit was ignited, the actual fire skipped the transect location.
- (6) Where pre-burn monitoring of soil transects did not occur, unburned islands or the adjacent unburned perimeter were monitored in order to represent pre-burn conditions.

(7) Campsites occurring on shallow to bedrock sites burned within the Cavity wildfire were visited to determine if latrines could be replaced.

The Ecological Classification System and Ecological Land Type 18

Tentative monitoring results showed that the ECS mapping units (ELT polygons on ECS maps) have a high degree of reliability.

Continued discussion, review and documentation will outline an approach to further understanding of ELT 18 and its limitations. Information being gathered includes 3-4 site index measurements for several tree species from ELT 18 sites proposed for treatment. In addition, a nearby similar stand in ELT 18 that has previously been treated (prior to the 2004 Forest Plan) is being evaluated for stocking survey information. To date, ELT 18 sites are normally not candidates for treatment activities.

Minnesota Forest Resource Council Voluntary Forest Harvest Guidelines

The SNF participates in the Statewide monitoring process. In 2006, four sites were monitored. Within one site, rutting from unauthorized ATV use on a road segment with active erosion was observed. This active erosion transported sediment to a wetland. Observations on other sites included: (a) no diversion or erosion control devices were used on any road segment although they were 50% or more re-vegetated (b) landings occupied 4.2% of the site and there was no erosion or rutting on skid trails (c) water diversion structures are recommended on long steep skid trails (d) slash was redistributed to provide nutrients on the site that had full tree skidding (e) water bars were recommended but not used on skid trails where there was erosion evident but no rutting and (f) on one site less than 2% of wetland harvest area was rutted, slash was redistributed, water bars were placed, and no rutting occurred in upland areas.

To put this in perspective as part of the statewide analysis, most sites were complying with the Voluntary Guidelines as follows: a) filter strip compliance where <5% of mineral soil exposed was 73%; b) 32% of skid trails/road segments with a gradient of more than 2% had appropriate water diversion and erosion control structures; c) roads and landings occupied no more than 3% of harvest area; and slash retained or redistributed occurred 75%. (“Monitoring the Implementation of the Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Minnesota. Report 2000. A Report by the Minnesota Department of Natural Resources, Michael J. Phillips, DNR Document MP-0201). The MFRC report on monitoring during 2005 and 2006 will be available during Spring 2008.

Effects of Vegetative Treatments on Forest Soils

During 2006, very little soil monitoring of vegetative treatments occurred. Instead, time and resources were devoted to the development of protocols for monitoring ELT 18, pretreatment monitoring on Biomass sites, the development of MFRC Biomass Guidelines, monitoring burned sites, and the development of landscape level monitoring protocols.

Standards and Guidelines

S&G Descriptor	Standard & Guideline Description	Compliance	Remarks
G-WS-8	Follow the limitations on management activities as specified in Table G WS-8.	Fair	Field monitoring needs to be implemented.
G-WS-9	During resource management activities, minimize adverse impacts to soil productivity by striving to have no more than 15 percent of a treatment area in a detrimentally compacted, eroded, rutted, displaced, or severely burned condition	Fair	Field monitoring needs to be implemented.
G-WS-10	When conducting prescribed burns on ELTs 7, 8, 9, 11, 12, 16, 17, & 18, minimize the loss of surface O layer. Provide for: a. Igniting burns only when the Canadian Fire Weather Index System Build Up Index (BUI) is 50 or less. b. Adjustment of ignition timing and firing patterns c. Taking into account vegetation type, topography, number of days since precipitation, wind, air temperature, humidity, and fuel loadings.	Fair to Good	Monitoring in prescribed burns and on wildfires occurring.
G-WS-11	On ELTs 7-9, 11, 12, & 16-18, management activities ...will be designed & conducted to minimize loss of surface O layer & duff layer.	Fair to Good	Monitoring in prescribed burns and on wildfires occurring

The Standards and Guidelines in the Forest Plan are steering management activities towards achieving desired conditions, but more intensive monitoring of nutrient sensitive sites at a landscape scale is properly warranted.

Necessary Follow-up Actions and Management Recommendations

Follow-up actions identified by the SNF Interdisciplinary Team:

- * More soil scientist's time needs to be dedicated to field monitoring and documentation of site visits.
- * There needs to be more focus on biomass harvest activities in the future during which issues on nutrient status of sites will arise.
- * Address current and future soil carbon sequestration on biomass harvest, fuel reduction, and other activities.
- * Encourage long term management on nutrient sensitive sites to maximize nutrients available—this ties to the “Activity Limits Code E and F” to be used with Table G-WS-8—Limits on Management Activities Designed to Safeguard Soil Productivity on Superior National Forest.
- * During the FY 2007 and beyond, field monitoring will occur at the project level on sites scheduled for prescribed burning, thinning, and clearcutting with reserves.

Collaborative Opportunities To Improve Efficiency And Quality Of Program

Partnerships

Contributions from the Tribal 1854 Authority, Timber Bay Lodge, MN DNR, MN Power, Friends of the MN Conservation Corp, and South St. Louis County SWCD helped the SNF complete the Birch Lake projects during 2006. These projects had been on the Watershed Improvement Needs List for a decade, waiting for the time when personnel and dollars were available to accomplish the needed treatments. The cooperative effort made all the difference in order to complete these projects.

The SNF is cooperating with the Natural Resources Conservation Service (NRCS) to validate both NRCS soil mapping units and SNF ECS mapping units. This process utilizes the field experience and administration skills of both agencies to analyze and portray mapped units in a usable format. Maps of the Virginia area containing both NRCS soil mapping units and SNF ECS mapping units will be posted on the NRCS website for use by the Agencies and the public.

As part of the MFRC biomass guideline development, research needs on biomass were organized and will be presented to MFRC. MFRC will provide direction and funding for research. Research on harvest equipment and techniques to obtain biomass will be completed on an ongoing basis as biomass demand continues to increase.

Summary Conclusions

- * Project level monitoring included: (a) assessing fire effects on the soil organic layer associated with prescribed fire and wildfire in the BWCAW (b) logging impacts to shallow ELT 18 sites particularly within the Echo Trail and Dunka project areas (c) effects of biomass removal from the Old Root, Pitcha, and Upper Caribou biomass harvest sites (d) compliance with Minnesota Forest Resource Council Voluntary Forest Harvest Guidelines, particularly 4 sites within the Billy Dump project.
- * Watershed restoration occurred as part of the Birch Lake Centennial Projects. These projects achieved watershed improvement, recreation site improvements, restoration of riparian habitat, and soil improvement in a unique and integrated manner.
- * Preliminary prescribed fire monitoring suggests overall good retention of organic matter.
- * Where fuel loads are high and during extreme drought soil moisture conditions, wildfires are likely to severely impact soil resources.
- * Tentative monitoring results showed that the Ecological Classification System mapping units (Ecological Land Type polygons) have a high degree of reliability.
- * MFRC Voluntary Guideline Monitoring on one site revealed rutting from unauthorized ATV use on a road segment with active erosion allowing sediment to reach a wetland.
- * Soil monitoring should also occur for other management activities such as timber harvest, ATV road use, site preparation, and long term vegetation composition on nutrient sensitive sites.