The Boundary Water Canoe Area Wilderness
Campsite and Portage/Trail
Monitoring Manual

Jim Hinds
Norma Malinowski
Robert Kari
The United States Forest Service

Luke Lukas
Vermillion Community Collage
Ely, Minnesota

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Table of Contents

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The BWCA Wilderness Campsite and Portage/Trail Monitoring Report

Introduction

The human values of preserving natural environments will expand dramatically in the future as surrounding lands become increasingly modified by people. However, these values are contingent on the effectiveness and success of our managing these irreplaceable resources.

The United States Forest Service recognizes the need for effective visitor management and resource protection programs to balance visitation with its associated visitor impacts. The recurring question, "Are We Loving our Wilderness to Death?" increasingly challenges managers to develop and implement policies, strategies, and actions that permit the use of these areas without compromising their ecological and aesthetic integrity. Furthermore, managers are frequently forced to engage in this balancing act under close scrutiny of the public, competing interest groups and the courts.

Marion (1991) states, as with other prominent and critical issues managers can no longer afford a wait-and-see attitude on subjective impressions of deterioration in resource conditions. Managers require scientifically valid research and monitoring data. Such data should describe the nature and severity of impacts and the relationship of controlling visitor use and biophysical factors. Research has revealed that relationships are complex and not always intuitively obvious. A reliable information base is essential to managers seeking to develop and implement effective visitor and resource management programs.

The final subsection of Section 2 of the Wilderness Act of 1964 defines wilderness.
A wilderness, in contrast with those areas where man and his works dominate the landscape, is thereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor and does not remain.
In spite of lofty goals to preserve land in an untrammeled state, wilderness lands are "subject to human controls and manipulations that hamper the free play of natural forces. " (Hendee, 1990 p. 108) Management must be constantly on watch for excessive or progressive cumulative impacts on wilderness areas.
On account of those potential impacts, management agencies have developed extensive management plans to address the problems. The management plans protect and perpetuate the natural ecosystems found within the wilderness areas and provide opportunities for a primitive and unconfined recreation experience, present and future. This duel purpose does not come without compromise. Recreational use, no matter how primitive, impacts the resource. If impacts continued unchallenged, there will be no future opportunities.

In order to provide recreational opportunities and to protect the resources, standards and guidelines have been established to manage wilderness areas. This type of management is explicitly referred to in the Wilderness Act of 1964:
Wilderness areas…. shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness.

Management guidelines and standards are to be used to reduce negative impacts to wilderness areas. The management must be carried out within a certain prescribed framework. This

framework may include rationing decisions, permit fee charges, regulations, methods to control overuse, and methods to restore areas which have been used too much.

The purpose of this manual is to establish specific procedures which measure existing conditions of campsites and trails. The manual will guide the manager through the process of establishing the impact parameters and implementing a monitoring program to determine if visitor impacts do exist. The campsites contained within the Boundary Waters Canoe Area Wilderness (BWCAW) are the focus of this monitoring program.

The campsite impacts in the BWCAW are best managed through prevention. Prevention can be implemented if management can identify the current situation, establish standards, monitor the campsites, and then act as necessary to prevent further degradation. Campsites are usually the focal points in a BWCAW experience. They receive concentrated use and are quite often the most heavily impacted areas in this wilderness. The procedures for monitoring portages will also be included in this monitoring program procedural manual.

Some resource impacts because of camping and traveling through the BWCAW include: loss of vegetation, damage to trees, exposure of tree roots, soil compaction, erosion, loss of organic matter, shoreline disturbance, littering, and threats to human health (Marion 1991) The United States Forest Service is mandated to manage areas such as the BWCAW in a manner which mitigates impacts.

Although numerous reasons for developing a program are described in the forth-coming pages, the actual value of these programs is entirely dependent upon the wilderness managers who initiate and manage them. Programs developed with little regard to data quality assurance or operated in isolation from resource protection decision making will be short-lived. Marion (1991) states programs that provide managers with reliable information that is necessary to develop and evaluate resource protection policies, strategies, and actions can be of significant value. Only through the implementation of objective management frameworks which integrate defensible monitoring programs can we hope to provide legitimate answers to the question "are we loving our wilderness to death?"

Forest Service Legislative Mandates

This section reviews legislative mandates management policies and guidelines, and resource protection objectives. The purpose of this review is to describe legislative and management intent regarding the balancing of visitor use with resource protection objectives and the need for impact monitoring. This review is included both to justify the intention of a campsite monitoring program and to enlist the support for sustaining the program over time.

In addition to the Wilderness Act of 1964, federal agencies incorporate other plans for establishing standards and guidelines in wilderness areas.

The National Environment Policy Act (NEPA, P.L. 91-190) was enacted in 1969. Under NEPA guidelines, federal agencies must assess the environmental and social impacts of alternative management actions before any actions can be implemented. As stated in Hendee, Lucas and Stankey's book "Wilderness Management," "NEPA requires that environmental impacts be

considered through the analysis of a proposed action and its alternatives, and that the public be allowed to comment on the actions under consideration." (p.197) All of the alternatives must be considered. The process begins with an Environmental Assessment. If this assessment finds that there will be no significant impact, then a statement of "no significant impact " is issued and the action can proceed. If the action will result in significant impact, then an Environmental Impact Statement (EIS) must be prepared. The EIS must precede the proposed action or actions.

Wilderness Management direction in the National Forests is derived from the Multiple Use Sustained Yield Act of 1960 (16 U.S.C. 528 TO 531. P.L. 86 – 517, Section 1. June 12th, 1960, 74 Stat. 215) This act codified the policy that " national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes." The act supplemented the Organic Administration Act of 1897. The Secretary of Agriculture is directed to "develop and administer the renewable resources of the national forests for multiple use and sustained yield." In order to sustain outdoor recreation in the wilderness of the national forests, standards which define specific limits must be identified and maintained. This process must be preceded by a system to monitor the impacts imposed upon wilderness areas by recreactionists.

The Forest and Rangeland Renewable Resources Research Act of 1978 (16 U.S.C. 581 to 581i notes, 1600 note, 1641 to 1647. P.L. 95-307, Section 1, June 30th 1978, 92 Stat. 353) authorizes the Secretary of Agriculture to implement a comprehensive program of forest and range resources research and the disclosure of findings of such research. This act makes it possible to establish a monitoring system to measure standards of wilderness recreation areas.

The Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1600 note, 1600 to 1606, 1607 to 1614. P.L. 93-378, Section 2, August 17th, 1974, 88 Stat. 476 as amended). Authorized the Secretary of Agriculture to prepare an assessment of the supply and demand of the nation's forests and rangelands; and to develop a management program that considers alternative management directions and the roll of the national forests. This act was amended by the National Forest Management act of 1976 (16 U.S.C. 472a, 476 notes, 500, 513 notes, 514 note, 515, 516, 518, 528 note, 576b, 1600, 1601, 1602, 1604, 1606, 1608 to 1614. P.L. 94-588, Section 14, October 22, 1976, 90 Stat. 2949 as amended).

Through the concerted effort of various United States Forest Service researchers, management concepts were developed to implement the federal legislative mandates.

The National Forest Management Act requires land and resource management planning units within the national forest system and additional regulations of timber harvesting on national forests. The major provisions of the act require public participation in the planning process; regulations for the preparation and revision of management plans; resource management guidelines for controversial management activities, such as wilderness management; and an economic analysis of management alternatives. The management concept, Limits of Acceptable Change (LAC), meets the requirement set forth in this act.

Monitoring Program Objectives

The overall goal of the BWCAW campsite impact monitoring program is to provide wilderness decision makers with reliable yet cost-effective data on the condition of campsites over time. Specifically, the monitoring program seeks to:

1. Obtain quantifiable measurements for managerially relevant campsites impact parameters using scientifically valid procedures.

2. Provide current and reliable information for resource decision making, including data analysis capabilities providing input to visitor impact management frameworks based on indicators and standards.

3. Maintain flexibility in the design and application of monitoring procedures to accommodate changing management needs and constraints.

4. Emphasize data accuracy and precision through the development and documentation of standardized monitoring procedures, quality assurance protocols, and field training programs. (Marion, 1991)

Monitoring Program Capabilities

Marion (1991) states, effective management of visitor impacts requires objective and current information from inventory, monitoring and research efforts. Management informational needs include documentation of where impacts are occurring, the types and severity of impacts, how impacts relate to amount and type of visitor use, how impacts relate to influential biophysical factors, and the effectiveness of management strategies and actions implemented to minimize resource impacts.

Scientists and managers have developed numerous monitoring systems to document and evaluate resource impacts resulting from visitor use. These management oriented programs provide a standard approach for collecting and analyzing site-specific information on the nature and severity of visitor impacts over time.

Capabilities of Visitor Impact Monitoring Systems According to Marion (1991) are as follows

- Identify and quantify site-specific resource impacts.

- Summarize impacts be environmental or use related factors to detect and evaluate relationships.

- Aid in setting and monitoring management standards for resource conditions.

- Evaluate deterioration in resource conditions to suggest potential causes and effective management actions.

- Identify and assign priorities to maintenance needs.

When implemented properly and with periodic reassessments, these programs can produce a data base that has significant benefits for the wilderness manager. A monitoring program provides an objective record of changes occurring visitor areas, even though individual managers may come and go. A monitoring program can help in detecting and evaluating trends by comparing data from the past and present assessments. Deteriorating conditions can be detected before severe or

irreversible impacts occur, allowing time to implement corrective actions. Relationships between specific impacts and use related or biophysical information suggest appropriate management actions. A monitoring program also helps in evaluating the success or failure of resource protection measures (Marion, 1991).

The monitoring program which is being described did not arise on its own. It is deeply rooted in the research of many researchers and managers. The basis is described in the next section.

Management Concepts

Carrying Capacity

Many management concepts preceded the development of LAC. These management concepts asked the question how much use is too much. The concept of carrying capacity led the way. The early elements of carrying capacity as stated by Stankey and McCool (1984) were:

(1) recreationists sought multiple satisfactions from recreation engagements, and depending upon these, encounters with others might add, detract, or be neutral in their effect on those experiences;
(2) the satisfaction visitors report is a function of more then use level—the type, frequency, and location of encounters are important intervening variables;
(3) Clearly stated objectives are essential to identifying carrying capacities;
(4) The emphasis in management needs is to be on outputs-the experimental and environmental conditions desired – not on input such as use levels (page 455).

Detrimental use of the recreational resource was a concern of managers as early as 1942. The recreational land manager in 1942 coped with the problem of regulating use within a "recreational saturation point" (Stankey, McCool, 1984). It became apparent many backcountry areas would suffer or be totally destroyed unless some sort of control was imposed on the increasing number of recreationists utilizing the nation's forests and lakes. Unconstrained use was impacting the qualities of primitive recreation opportunities such as those found in the Boundary Waters Canoe Area Wilderness (BWCAW) of Northeastern Minnesota.

Robert Lucas (1964) enlarged on the carrying capacity concept in his BWCAW study. He found that the type of use was more critical then the amount of use. These results pointed to the need to investigate the relationships between the encounters in the Wilderness and the primitive recreation settings. Lucas found that different types of users sought out different experiences, and these experiences required different settings and opportunities.

Frissell and Stankey (1972), took this concept one step further. They used a Wilderness purism scale to show different relationships between visitors with differing value systems. In the end it became quite apparent that management should examine changes in environmental and social conditions, not just how many people visit or use an area.

David Lime (1977) presents six basic principles that relate to the carrying capacity of recreation sites. These principles are proposed to help managers develop management objectives, such as, the control of impacts on recreational sites. In his article, Lime defines carrying capacity as a management concept, to establish a method a manager can use to observe recreation sites and plan for the use of those sites. Lime's six principals are as follows:

1. "Managers must determine the amount and character of use an area can sustain over a specified time period, without causing unacceptable change to the physical environment or to the experience of the user.
2. Carrying capacity can be defined only in the light of management objectives for the area in question.
3. Obtaining attitudes and preferences of recreation users and non-users can help administrators set objectives and may suggest needed changes in current policies.
4. A full range of recreation opportunities within a region to satisfy the diversity of recreation taste is desirable.
5. The character and amount of change permitted to occur to the resource resulting from recreation use must relate directly to management objectives.
6. There are many techniques to manage an area for its carrying capacity; The techniques selected, should depend on the management objectives for the area."

Lime concludes by stating that the manager is still left with the final decision concerning carrying capacity. There is no "magic formula".

Various concepts have been suggested and tried in order to answer the question, how much is too much? Men like Aldo Leopold (1949) addressed the question. In his book A SAND COUNTY ALMANAC he said, "the greater the exodus, the smaller per capita share of peace, solitude, wildlife and scenery." If we prevented masses of people from going to the wilderness then the quality could be preserved, but only for a few. Then how do we manage use. The concept of carrying capacity will not settle this problem. Leopold thought that we must educate the visitor. In his words "to promote perception." This could be undertaken through interpretation and education. It would help people to understand the implications that negative impacts have on the resource.

These methods are all viable, yet do not provide the protection a wilderness area needs. The resource will still be degraded if management does not have a grasp on how much use is detrimental. Limits of Acceptable Change - (LAC) provides management with a tool in determining the answer to that important question.

Limits of Acceptable Change

Limits of Acceptable Change (LAC) is a management framework for establishing acceptable and appropriate resource and social conditions in recreation settings (Stankey et. al., 1985). The LAC process allows managers to define particular wilderness conditions and then to take actions to maintain or achieve those conditions (Stankey et. al., 1985) NFMA, Section 219.18a states that the forest plan providing direction for wilderness management will: " provide for limiting and distributing visitor use of specific portions in accord with periodic estimates of the maximum levels of use that allow natural processes to operate freely and that do not impair the values for which wilderness areas were created" (Federal Register, 1982). According to Stankey et.al., the LAC process consists of four major components:

(1.) The specification of acceptable and achievable resource and social conditions, defined by a series of measurable parameters;
(2.) An analysis of the relationship between existing conditions and those judged acceptable;
(3.) Identification of management actions necessary to achieve these conditions;

(4.) A program of monitoring and evaluation of management effectiveness. (page 3)

Nine steps account for the final result of measurable objectives that define the wilderness conditions.

1. Identify area concerns and issues
2. Define and describe opportunity classes
3. Select indicators of resource and social conditions
4. Inventory resource and social conditions
5. Specify standards for resource social conditions
6. Identify alternative opportunity class allocations
7. Identify management objectives for each alternative
8. Evaluation and selection of an alternative
9. Implement actions and monitor conditions

(Stankey et.al. 1985)

Limits of acceptable change has become policy in most wilderness areas managed by the United States Forest Service.

THE BWCAW MANAGEMENT PLAN AND LIMITS OF ACCEPTABLE CHANGE

The BWCA Wilderness management plan utilizes the LAC concept. The process began with an environmental impact statement (EIS). The EIS describes alternatives for managing the BWCAW. The Forest Service requires that all wilderness have a Wilderness Management Plan and Implementation Schedule. The selective alternative for managing the Boundary Waters Canoe Area Wilderness is found in the management plan. The management plan and implementation schedule sets forth standards and establishes a requirement that those standards be monitored every five years.

The BWCAW Management Plan defines and describes four management areas or opportunity classes: 5.1 Pristine; 5.2A Primitive; 5.2B Semi-Primitive, Non-Motorized; and 5.3 Semi-Primitive, Motorized.

The Plan includes indicators for campsites conditions, portage conditions, and trail conditions. They include but are not limited to the following:

1) Mineral Soil Exposed
2) Tree Roots Exposed
3) Erosion Level
4) Portage/Hiking Tread Minimums (USDA, 1993)

The management plan also lists specific standards which include:

1) A General Description
2) Ecological Conditions
3) Prevalence and Duration of Impact
4) Visibility of Impacts
5) Social Conditions (U.S.D.A., 1993)

Various management actions might be undertaken to mitigate a problem. These actions can range from relocation of a fire grate to the relocation of a campsite. The need for management action stems from a specific condition exceeding the standards established for the condition.

LAC step nine establishes the need for implementing management actions and for monitoring conditions. Priorities for monitoring should consider situations where rates of resource change are considered to be the greatest: the quality of the data available is the poorest; and there have been unanticipated changes in factors such as access or adjacent land uses (Stankey, et.al., 1985)

If monitoring shows that conditions remain better than standards, then current management actions can be maintained until monitoring shows that standards are being exceeded. Managers need to be aware of the different types of monitoring programs which exist. It is also important that the monitoring program be cost efficient as well as effective.

MONITORING SYSTEMS

Marion (1991) lists three general monitoring systems:

1) Photo-graphic systems 2) condition class systems and 3) Multi-parameter systems. The following allows the reader a brief summary of these systems.

PHOTOPOINTS

This method involves the taking of photos from a fixed point. The point is located and the photography is duplicated by the next monitor. All locations are referenced in terms of distance and direction from recognized landmarks. These reference points and the photo-points must be noted on a sketch of the area and on a map. The person monitoring the site must also record the camera make and model, focal length of the lens, height of the camera above the ground, film type and filter type (Hammitt and Cole, 1987)

QUADRANT PHOTOGRAPHY

Brewer and Berrier (1984) utilize the quadrapod, which is a device which can set a camera at a given distance above the ground. A series of replicable quadrants are laid out and using the quadrapod, photos are taken of each quadrant. Analysts can utilize these pictures in the lab without going into the field.

CONDITION CLASS SYSTEM

This system is made up of a series of conditions by which a campsite is classified. Frissell (1979) includes the following classes (Hammitt and Cole, 1987)

1. Ground vegetation flattened but not permanently injured. Minimal physical change except for possibly a simple rock fireplace.
2. Ground vegetation worn away around the fireplace or center of activity.
3. Ground vegetation lost on most of the sight but humus and litter still present in all but a few areas.
4. Bare mineral soil widespread. Tree roots exposed on the surface.
5. Soil erosion obvious. Trees reduced in vigor or dead.

In this system, which Frissel developed in Minnesota's BWCAW, each campsite is assigned to whichever class fits it best.

MULTIPLE PARAMETER RATING SYSTEM

This system collects information on a number of separate impact parameters (Hammitt and Cole, 1987). Information is collected on the amount of vegetation loss, the amount of exposed mineral soil, soil compaction, the amount of campsite development and many other parameters. Each parameter is assigned a rating, and these ratings are totaled to give a cumulative score. Cole (1987) developed this system based on the work of Parsons and MacLeod. This system contains much more information than the Class Condition System. According to Hammitt and Cole (1987), it also retains the flexibility to change parameters without having to reexamine every site.

The system to be followed in this manual will be based upon multi-parameter system with a few alterations. Marion (1991) has developed a new multi-parameter system based upon measurements. According to Marion the system is fast and efficient. He states that it takes two workers 10 to 15 minutes to assess a typical campsite. This system begins with a condition class assessment, the site is photographed, and its size is measured. Marion also utilizes three slightly different approaches depending upon how lightly or severely a site is impacted. This system will be applied to the campsites and portages within the Boundary Waters Canoe Area Wilderness .

Marion's system has been selected for use because it includes measurement scales, not just condition class estimates. It gathers many types of information concerning a site, not just limited amounts. According to Marion's research, this system is accurate and precise. The measurements can be replicated and the system is easy to work. Finally this system is cost efficient. The procedure will be initiated utilizing a small sampling of sites and will later be expanded until all the campsites, both user developed and agency developed will be measured.

SELECTION OF MONITORING INDICATORS

Using the multi-parameter approach requires the selection of field parameters. The following are the suggested indicators. This list will be adapted to the procedure.

Inventory Indicators (Marion, 1991)
Site number/name
Inventory personnel
Assessment date
Management Zone (5.1; 5.2a; 5.2b; 5.3)
USGS Quadrangle
Elevation
Water source
Type of site development (user, agency)
Amount of site use
Inter-site visibility
Tree canopy cover
Soil type
Distance from lake or trail
Tent-site capacity
Tree species
Vegetation type
Landform type
Site facilities (fire grate, latrines)
Facitity condition
User-built facilities

Latrine Suitability

a. Distance to water
b. Drainage (location of latrine)
c. Soil composition (ELT)

Referance photographs

Impact indicators

1. The recreation site area
2. Vegetation cover loss
3. Vegetation composition change
4. Soil compaction

a. Organic litter loss
b. Exposure of mineral soil
c. Soil erosion

5. Tree damage

a. tree stumps
b. tree root exposure

6. Resource impacts caused by camping activities

a. Human waste
b. Trail development (access trails and social trails)

7. Shoreline disturbance
8. Campsite condition classes
9. BWCAW trails and portages

a. Trail width
b. Trail erosion
c. Problem spots (muddy sections, trail braiding, trail widening)

The following is a literature review of the many processes used to measure inventory and impact indicators. The actual processes described may be altered or omitted in the monitoring system.

THE RECREATION SITE AREA:

This indicator addresses the physical disturbed area used in the activity of camping. The BWCAW Management Plan addresses the indicators that are considered critical to the health of a campsite. They include erosion, exposed mineral soil, and the number of trees with exposed roots. Standards are set forth for each management area within the BWCAW, the areas are as follows:

Management Area 5.1

- Campsites will not be constructed. Maintenance will occur on user built sites only when necessary to protect the biophysical resource.
- User built campsites will be monitored on a rotation basis, every five years, for compliance with the standards for limits of acceptable change indicators
- If, through monitoring, impacts exceed limits of acceptable change standards, sites will be rehabilitated.
- The BWCAW LAC standards for this area are: Allowable amount of mineral soil exposed – 0 to 250 square feet.
- Number of trees on site with exposed roots – none to 25%.

- Erosion level – None to erosion level 2 (erosion either on the campsite, access trails, or at the shoreline resulting in the loss of soil which is not pronounced, gravel on site, or obvious loss of soil at the landing or along the shoreline.)

These standards apply only to those sites that were previously designated by the USFS and are still used. No degradation will be allowed on new user – developed sites.

Management Areas 5.2a, 5.2b, and 5.3

- Campsites will be monitored on a rotation basis, every five years, for compliance with the standards for limits of acceptable change indicators. If ongoing monitoring shows that limits of acceptable change standards are being exceeded, the appropriate management action will be implemented, i.e.: education, rehabilitation, closure, quota adjustments.
- Campsites will be maintained according to the level of use they receive.
- Rehabilitation or closure of a campsite will occur when it is determined the site has exceeded the limits of acceptable change standards. The site will be restored to an acceptable condition.

Standards for 5.2a, 5.2b, 5.3, management areas are:

- Allowable amount of mineral soil exposed – 800 square feet.
- Number of trees on site with exposed roots – 50% of total trees.
- Erosion level 2 – Campsites with erosion either on the campsite, gravel on the site, or obvious loss of soil at the landing or along the shoreline.

The Management Plan states that the campsite area will be measured in square feet for the total area impacted be recreational use. The perimeter of the site will be defined by determining the point at which the density and composition of the vegetation becomes equal to that of the surrounding area. Islands of undisturbed vegetation will also be measured and recorded. Areas of impact beyond the perimeter should also be measured and recorded, such as tent pads.

Marion (1991) states that "precision may be more important then accuracy for these parameters." Utilizing a class condition type of assessment may not provide the USFS with the amount of precision necessary to determine the allowable amount of mineral soil exposed on a site. One evaluator may estimate a different amount or percentage of mineral soil then another. This is not the precision that the LAC process demands.

Marion (1991) also states that there may be problems with estimating the boundary lines of a site. The site boundary is the point where the vegetation begins to dwindle. This he says may be dependent on the following factors: vegetation cover, vegetation composition, vegetation height, topography, and organic litter. There are many measurement techniques that may be used. Marion recommends a variable radial transect method.

This method is more accurate because the evaluator can match the number and direction of transects to the unique shape of the recreation site. Utilizing the radial transect method an evaluator will flag the boundary of a campsite with survey pins and flagging tape. This procedure will define a polygon whose area approximates the size of the recreation site.

The radial transect method also allows replication of the process when the site is re-monitored. Marion (1991) reports that when the site is re-measured, the center point and transect endpoints are relocated using the data recorded from the last measurement. The method is also easily transferable to a dBase computer program.

A carefully, implemented measurement method will produce data with less error. The measurement technique must be practiced. However, it is impossible to eliminate all error. Therefore, error estimates should be calculated into each procedure.

A detailed description of the radial transect method will be presented in the Monitoring Procedural Manual.

Soil Compaction, Organic Litter Loss, Exposure of Mineral Soil, and Erosion

Ground cover is impacted by recreational use either directly or indirectly. The trampling of vegetation directly impacts vegetation, indirectly this results in soil compaction. Where trampling is heavy, plants are killed outright. Compaction decreases the plant's ability to penetrate the soil. It inhibits the germination, emergence and establishment of new plants, and the percolation of moisture. Runoff increases as the surface becomes impacted, for water no longer infiltrates into the upper layers of soil. On slopping sites, sheet erosion may be severe and plant and tree roots are exposed. Erosion may be accelerated by more visitor use.

The amount of previous use will determine the soil's capacity for further compaction. Most compaction occurs during the first two years of site occupancy, and little change is observed with additional use (Merriam et. al. 1973)

Studies conducted by Cole and Hammitt (1987) show that use-impact relationship is neither direct or linear. The initial use causes most of the impact. Additional use causes less and less additional impact. The finding that vegetation loss is so severe even on little used sites demonstrates the susceptibility of ground cover to impact.

In impact zones, recreational uses affect vegetation in three ways: trampling, removal of stems, and mutilation. On shady forest sites, ground cover declines rapidly, especially during the first stages of use. Broad leaf species and tree seedlings have little or no resistance to trampling and are quickly eliminated.

Tree Damage, Stumps and Root Exposure

Tree conditions are a primary concern to the Management Plan. Indicators which could be evaluated are: tree damage, such as scarring by mutilation, tree stumps, trees removed for firewood, trees used in user development, and tree root exposure due to soil impaction.

The major impacts to trees are caused be visitor actions, such as hacking trees with axes and pealing of bark. Recreational – caused loss of trees, according to Cole and Hammitt (1987) occur where soil is thin, as it is in the BWCA Wilderness area. Merriam and Peterson (1983) report that just after five years of use 15% of the tree cover on a handful of BWCA Wilderness campsites was destroyed, and after 14 years 40% of the trees were dead. According to their study, thin soils and pronounced erosion along with detrimental use killed these trees. Trees and large saplings are often mutilated, with birch and aspen being utilized by the aspiring, jackknife artist. Hot

lanterns fastened to the trees also scald and kill sections of cambium. Evergreen species with persistent lower branches are less often mutilated (Merriam et. al. 1973).

Exposure of tree roots is another common problem along trails and in campsites in this wilderness area. Marion (1984) found that 84% of the trees in campsites which he surveyed were suffering from tree root exposure. Once the roots are exposed the tree becomes susceptible to mechanical and chemical damage. This exposure also makes the tree more prone to wind damage.

The most serious problem as a result of all these impacts is the lack of tree regeneration. There is no regeneration to replace the trees that have died. The saplings that do survive are cut down into firewood or tent poles.

Resource Impacts Caused by Use and Camping Activity

These impacts include littering of areas and trash disposal in the campsite area. Littering may be the result of improper behavior, thoughtless actions or just plane carelessness

The presence of human waste is a threat to the resource and to human health. The improper disposal of human waste may be do to ignorance and a lack of knowledge. It may also be do to haste and an uncaring attitude. Large parties may also be responsible for the increase in human waste. Concentrated use of one campsite may lead to more depositing of human waste on the site. Human waste may also cause an increase in bacterial counts in the water in the BWCA Wilderness lakes. The presence of human waste can best be determined by counting pieces of toilet tissue. Fecal matter will probably not be found with the tissue. Weathering action and wild animals account for the disturbance and or disappearance of fecal matter. This also is another potential health hazard.

Latrine Suitability

The BWCA Wilderness Management Plan provides for visitor latrines in all management areas except one 5.1. Adequate sanitary facilities are of the utmost importance in the BWCA wilderness. Human waste is a normal product of life and as such must be addressed seriously by wilderness managers. Wilderness latrines should be placed in well drained soils at a recommended depth of three to five feet. This is a problem in the BWCA Wilderness. The soils are very thin and bedrock is near the surface. The latrines must be placed at least 150 feet from any water source. The drainage from the area in which the latrine is located should not drain toward the water source. The soil composition of the area is another important criteria in the placement of the latrine. The soil yields moisture to bodies of water. Inadequate soils will not filter out contaminates.

A study by King and Mace (1974) in the BWCA Wilderness found that coliform bacteria populations at canoe campsites were significantly higher than at control points. They established that there was a relationship between level of use for a campsite and coliform bacteria density.

Shoreline Disturbance

The BWCA Wilderness Management Plan mandates that shoreline disturbance be measured. This is an area where vegetation is lost due to the use of the area for the landing of water vessels. A measurement in linear feet is required for each area of disturbance. The Plan also calls for

remarks noting the presence of ledgerock instead of soil. Lakeshores are fragile areas and are quite susceptible to ecological damage.

Shoreline activities such as swimming, washing dishes, cleaning fish, and boat landings will cause other negative impacts to the area, such as erosion, and even health threats from harmful bacteria and bottom sediment disturbance. Water – related impacts can lead to more serious human health problems than can vegetative or soil impacts.

Campsite Condition Classes

In some systems, monitoring begins with a site classification. Marion (1991) defines conditions in five classes:

Class 1: The recreation site is barely recognizable. There is only a slight loss of vegetation and minimal disturbance of organic litter.

Class 2: The site is obvious; vegetation is lost, and organic litter is pulverized ion primary use areas.

Class 3: Vegetation cover is lost, and organic litter is pulverized on most of the site. There is some exposed mineral soil in the primary use area.

Class 4: There is nearly a complete loss of vegetation cover on the recreation site. No organic litter and exposed mineral soil is widespread.

Class 5: Soil erosion is obvious. Tree roots are exposed because of severe erosion.

BWCA Wilderness Trails and Portages

Initial impacts on trails and portages are the results of intentional felling of trees, the removal of brush and ground vegetation, surface flattening, soil compaction, and drainage alteration.

Two Impact Problems are trail widening – difficult trails (muddy or rocky), continuous or braided and erosion or trampling. Tramping causes compaction of the soil, reduces infiltration rates, removes vegetation, and channels water.

The primary cause of erosion is running water from intercepted streams, snowmelt, springs, and even intense perception. This will continue until water bars or some other drainage control devices are installed to divert water off the trail.

Soil erosion is greatest where high rainfall, steep slopes, or the lack of tree roots exist by which to stabilize the soil. The thinness of soil affects its capacity to handle quantities of water. The soil is thin in areas where soil formation is slow (cold climates or alpine or tundra surfaces).

The BWCAW Management Plan establishes specific objectives for trail conditions.

<u>Management area 5.1 does not maintain or allow the development of trails or portages.</u>

<u>BWCAW Management Plan standards for hicking trails and portages in areas 5.2a, 5.2b, and 5.3:</u>

- Tread width of trails generally will be no greater than 1 ½ feet. The treadway may be clear of obstructions such as deadfalls and boulders.
- Trails will be maintained in a manner as to appear part of the environment and not an intrusion.
- The clearing width will generally be between four and six feet wide, total.
- Portage treads will be 1 ½ feet walking width.
- Portage clearings will be generally not more then four feet, in area 5.2a, to a maximum of ten feet in area 5.3.

Environmental situations that result in trail deterioration include highly erosive soils, locations with seasonally high water tables or in places where trail design is inadequate (Hammitt and Cole, 1987).

There are a variety of trail measurement techniques. The following are a sample:

1. Small sample of trail segments
2. Rapid surveys of a large sample of trail segments.
3. Complete censuses of trail problems and conditions.

Trails could be surveyed, problem areas would be noted and measurements of these areas then would be taken. These measurements would consist of: landing area erosion; muddy trail sections; trail erosion; trail width, braided trails, multiple trails; and the presence or absence of rutting, stepping, surface deterioration, gullying, lateral erosion, bad drainage, esthetic intrusions, vandalism, and litter (Hammitt and Cole, 1987). If sample points might be needed they would be distributed in a random or systematic fashion along the trail or portage.

The most common problem to be measured is soil erosion. This could be accomplished by successively measuring the cross-sectional area between the trail tread and a taut line stretched between two fixed points on each side of the trail. This should be done far enough apart to allow for trail widening.

This measurement can be accomplished by taking a series of vertical measurements of the distance between the line and trail tread at fixed intervals along the tape. The above mentioned procedure would provide detail information concerning trail conditions. Time and limited funding, however do make the implementation of cross sectional sample points prohibitive.

Conclusion

This proposal is intended to provide the necessary background and justification to aid in its continuance over time with changes in wilderness personnel and priorities. It is recommended that this monitoring program be utilized to implement the BWCA Wilderness Management Plan.

A comprehensive campsite/portage impact monitoring manual will also be developed as part of the program. This manual will provide comprehensive documentation for the operation of the campsite monitoring program, including information on the following topics: description of field forms, assessment procedures, database management, and report production.

In conclusion the value and longevity of the campsite/portage monitoring program will be dependent largely upon its integration with and responsiveness to wilderness management and

decision making. A failure to cultivate and maintain organizational support will ultimately lead to its termination or result in a program that is operated in isolation by a particular ranger district. Achieving and maintaining a broad base of support for the monitoring effort should be the primary objective of those involved with the managing monitoring program.

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Appendix A

Mgmt Area_____
LTA_____
Travel Zone_____

BWCAW Recreation Site Monitoring Form

1. Ranger District (2, 5, 6, 7) _____
2. Name of Lake _____
3. Lake Number _____
4. Recreation Site Number _____
5. Latitude and Longitude _____, _____
6. Site Designation (D = Designated U = Undesignated) _____
7. Site Location (I = Island P = Peninsula NSEW = Shore) _____
8. Inventoried By: _____
9. Date: ____/____/_____
10. Locate and label the site on the map
11. Shoreline Disturbance (Linear feet) _____
12. Number of landing sites: _____
13. Area Soil Erosion Level/ Access trail Soil Erosion
    ____ _____ _____ (Level 1, 2, 3) _____ _____
    ____ _____ _____ _____ _____
    ____ _____ _____ _____ _____
14. number of other recreation sites visible: _____
15. Number of 8x10 tent pads: _____

16. Determine recreation site boundary use measurements from site center to perimeters:
17. Condition class (0, 1, 2, 3, 4, 5) _____
18. Site soil exposure: (Geometric area measurement) _____
19. Site soil type: (Use estimated percentages and code) record modifier then texture
____% _____
____% _____
____% _____

Texture: Bedrock – B Sand/gravel – S Clay - C Loam – L Modifiers: Cobble/Stony/Boulders – O Shallow to bedrock <40" deep – R Steep slope gradient > 18% - X Not applicable – NA

20. Site soil area/erosion: (level 1, level 2, level 3) Area ___ L ___ _____%
L ___ _____%
L ___ _____%
21. Surrounding forest community ____ RP ____ WP ____B___A____ JP ____ BF____ WC___BS____WS__ M (Use Estimated percentages)
22. Tree canopy cover: (Use estimated percentage) _____
23. Sapling tree inventory _____ RP____WP___B____A____ JP____BF___ WC BS____WS__ M___ (Count all 1" to 5" DBH)
24. Larger tree inventory _____RP____WP___B____A____ JP____BF___ WC____BS____ WS____M (Count all greater than 5" (DBH)
25. Tree damage: None to Slight ____Moderate_____ Severe_____
26. Root exposure: None to Slight____ Moderate____ Severe_____
27. Number of tree stumps: _____
28. Number of trails: _____
29. Number of firesights: _____
30. Human waste: (N=none, S=some, M=much) _____
31. Latrine distance to water: (Designated sites) _____
32. Location of latrine site drainage: R = ridge top, S = side slope, _____ D=drainage/depression, O=other
33. Soil composition near latrine (Modifier first, then texture) _____

Texture: Bedrock – B Sand/Gravel – S Clay – C Loam – L
Modifiers: Cobble/Stony/Boulders – O Shallow to bedrock <40" deep – R
Steep Slope gradient > 18% - X Not applicable – NA

Site Center Point References

1.
2.
3.

TRANSECT DATA

	Azimuth	Distance in Feet
Site Photo		
1._____		
2._____		
3._____		
4._____		

5._____
6._____
7._____
8._____
9._____
10._____
11._____
12._____
13._____
14._____
15._____
16._____
17._____
18._____
19._____
20._____

Island/Satellite Site Data
(Include azimuth and distance to center of island or satellite.)

Site Area From Transect _____

+ Satellite Area _____

- Island Area _____

Total Site Area _____Sq Ft

Comments:

Boundary Waters Canoe Area Wilderness Area
Site Monitoring Manual
Description of Procedures

Staff Training Schedule
Two days of training will be all that is necessary. The first day will consist of a reading and discussion of the techniques and steps found in this training manual. The objectives, data uses and the need for accurate information will be emphasized. A U.S.F.S. soil scientist and a forester will present information regarding the soil types which may be encountered and the species of trees to be identified.

The first day will also include a demonstration of the assessment procedure and a discussion followed by questions and answers. The various pieces of equipment will be fully explained and demonstrated to the monitors. The individuals will be instructed in how to utilize the various monitoring programs and what to do if there is a computer failure.

On the second day, the staff, in small groups will apply their knowledge to a common group of sites. Evaluations of the site will be reviewed by the entire group, and differences in the evaluations will be discussed and resolved by referring to the manual. The equipment will be tested and the staff will also be evaluated on their use of the necessary equipment.

Procedural Definitions
For the purposes of this manual a site is defined as an area accessed by water or land, containing vegetation and soil impacts caused by overnight/day time visitor use. A portage is defined as a pathway linking two bodies of water, or an access point with a body of water. A trail is a pathway utilized for recreational hiking within the boundaries of the BWCA Wilderness Area. For each site monitoring begins with inventory parameters.

Materials Needed
Peep style Compass
Topographic Maps
Tape Measure, 100 foot (marked in tenths)
Electronic Measuring Devise
Two surveyor range poles
Survey Pins (25)
Steel Rebar (5 inch pieces)
Camera 35mm SLR, 35 mm lens (preferably wide angle) ASA 200 film, Tripod, photo log
Hammer
Palm top computer, printer, monitoring program, and accessories
Clipboard, Monitoring forms, pencils, procedural manual

Initial Procedure
Upon arrival to the campsite to be assessed, the assessor will photograph the landing site, approximately five to ten yards from the shore. Use a 35mm camera with a wide angle lens. Record the film speed, the lens focal length, camera make and model, and approximate distance from the shore.

A campsite number has to be assigned to each photo. Use utmost care to record all photos in a photo log. Also label the film containers with site numbers. (The latrines are numbered with the site number. Photograph the latrines if necessary to document the site.)

The gathering of data will be accomplished with the use of a palm top computer and a monitoring program inserted in the computer. The program will lead the monitoring individual through the series of steps necessary to gather all pertinent information. The program runs on MS DOS. If there is a malfunction of the hardware or software, you will be expected to continue to gather data on the forms provided to you. (See the program instructions in Appendix B)

You are also expected to print a hardcopy of the data and double check your figures as soon as it is practical to do so.

Categorized Monitoring Procedures

1. Ranger District
Ranger districts containing BWCA Wilderness are the Gunflint District. Kawishwi District, La Croix District, Tofte District. They are coded as follows:
2 = Gunflint
5 = Kawishwi
6 = La Croix
7 = Tofte

2. Name of Lake
Enter the name of lake the site is located on.

3. Lake Number
A number has been assigned to each BWCAW lake. Check your lake number book for the appropriate number.

4. Recreation Site Number:
Each designated site has been given an identifying site number on each lake. Each lake has its own set of sites, for example Moose Lake has five, numbered one through five. Each site latrine has a site number printed upon it, use this number.

5. Latitude and Longitude:
Latitude and Longitude can be determined from a U.S.G.S. map. This indicator is necessary for relocating undesignated sites. Latitude and Longitude will be provided by a G.I.S. system for previously designated and numbered sites. G.P.S. may also be available.

6. Site Designation
Designated BWCAW campsites in all management areas other than 5.1 have firegrates and latrines. Undesignated site or user established sites do not have fire grates of latrines. Sites are not designated in management area 5.1. This management area provides a pristine wilderness experience where human presence is minimal. Because of this you will have to determine if a site exists. Base this determination upon vegetative impacts.

Code as follows: D = Designated U = Undesignated.

7. Site Location:
Peninsula and Island sites receive more impact because of their locations. Peninsulas are defined as having a maximum distance across of 25 feet. If more then 25 feet treat as a site location on the lake. Site locations must be indicated by their location on a body of water, for example, east side of Clearwater Lake.

Code Locations as Follows:
I = Island
P = Peninsula
N = North side of lake or river
S = South side of lake or river
E = East side of lake or river

W = West side of lake or river

8. Inventoried By
Please do not forget to legibly write your name on this line.

9. Date
The date the site is monitored is extremely important. Always date the form in the following manner:
August 18, 1995 must be coded as – 08/18/95

10. Locate and Label the Campsites on a U.S.G.S. map.
Simply inter the site number monitored and circle it to keep track of the sites you have monitored.

11. Shoreline Disturbance:
Shoreline disturbance is defined as any area of shoreline that is altered due to human use, (not always included within site area.)

Measure the disturbed area in linear feet. Do not include ledge-rock landings, unless it is clear that soil has been eroded to expose bedrock. Ledge-rock landings usually exhibit few impacts. If campsites have more then one area of shoreline disturbance, note and record multiple disturbances in linear feet. (See Photo Figure 1)

12. Number of Landing Sites:
Count the number of **evident** landing sites. These are areas where visitors have landed with canoes or boats resulting in disturbance of soil/vegetation. (See Photo Fig. 2)

13. Landing Area Information
a. Area Category:
The landing area as defined by Marion (1991) is the area of human disturbance extending from the average water level up to the trail assessing the site. Measure the area/areas used by canoe and boat landings. Utilize the geometric figure method. If the landing area is part of the site do not measure it, list it as N/A. If this area is not included in the site area enter it.

b. Soil Category:
Record the modifier code first if applicable, than the soil texture code. Enter both on the same line. Modifiers describe the type of soil conditions which exist on the site. For example: a site strewn with large rocks would be described as a cobbly area. Determine if there is some soil on top of bedrock, use code R, if less than 40" deep. If there is a steep slope which may contribute to site erosion, record it as X. If none of the modifiers apply to the situation then leave blank. (See Fig. 3)

Use the Following Modifier Code:
O = Cobble/Stone/Boulders
R = Shallow Soil to Bedrock (<40" deep)
X = Steep Slope Gradient (<18%)
If there is no modifier leave blank

Use the Following Texture Codes:
B = Bedrock (exposed)

C = Clay
S = Sand/Gravel
L = Loam
Use only one texture code
(See the texture description in Appendix B)

The completed information should look like this for a cobbly area of loam textured soil with a steep gradient of more than 18%: OXL If the entire area is composed of this material then it would be entered in the program as 100%-OXL. (See Fig. 3)

c. Erosion Category:
Estimate the amount of active erosion at the landing. Look for ground litter which has been moved by water action. Look at the amount of soil which has been removed by erosion. Is the soil being eroded at the present? If the area has been stabilized through management rehabilitation, consider the erosion as inactive and categorize at level 1. Enter the level of erosion in the erosion level space. (See Fig. 4)

Code as Follows:
Level 1: No erosion at the shoreline and negligible erosion on the access trail(s). The surface organic material is more or less in tact on trails, the shoreline is essentially in tact or has been stabilized.

Level 2: Erosion either on the access trail(s) or at the shoreline resulting in the loss of soils which is not pronounced. The upper surface of roots may be exposed.

Level 3: Erosion which has become pronounced, resulting in access trails becoming gullied; with the exposure of lighter colored subsurface soils or gravel; or obvious loss of soil at the landing or along the shoreline. Total root exposure is common.

d. Access Trail Soil and Erosion Category
Access trails are trails leading from the landing area to the main portion of the campsite. Determine the soil modifier and soil texture of the access trail, use the above codes described in Sec. 13b. (See photo Fig. 3) Record this in the appropriate area. If access trails do not exist or have no erosion use N/A. Determine the level of erosion which may be accruing on the trial. Use the above codes for level of erosion in Sec. 13c. (See Photo Fig. 4)

14. Number of Other Recreation Sites Visible:
Record the number of campsites which are visible from this site. The visible site may be across the lake. Therefore it may only be visible if it is occupied. Reference a map as needed.

15. Number of 8X10 Tent Pads:
Count the number of 8X10 tent pads. Include pads found in satellite areas. Include rock-free areas where an 8X10 foot tent has been comfortably located in the past. (See Photo Fig. 5)

16. Recreation SDite Boundary Measurement
(See Photo and Diagrams Fig. 6)

Marion (1991) states that, the first step is to establish the sites' boundaries and measure its size. The following procedures describe the use of **Variable Radial Transect Method** for determining the size of sites. This is accomplished by measuring the lengths of linear transects radiating from a permanently defined centerpoint to the site boundary.

Step 1 Identify Site Boundaries and Flag Transect Endpoints: Walk the boundary and place flagged wired pins at locations which, when connected with straight lines, will define a polygon who's area approximates the site area. Use as few pins as necessary, typical sites can be adequately flagged with 10-15 pins. Look both directions along site boundaries as you place the flags and try to balance areas of the site which fall outside the lines of offsite (undisturbed) areas which fall inside the lines. Pins do not have to be placed on site boundaries, as demonstrated in the diagram following these procedures. Project site boundaries straight across areas where trails enter the site. Identify site boundaries by pronounced changes in vegetation cover, vegetation height/disturbance, vegetation composition, surface organic litter, and topography (refer to photographs following these procedures). Many sites with dense forest overstories will have very little vegetation and it will be necessary to identify boundaries by examining changes in organic litter, ie leaves which are untrampled and intact vs. leaves which are pulverized or absent. In defining the site boundaries be careful to include only those areas which appear to have been disturbed by human trampling. Natural factors such as dense shade and flooding can create areas lacking vegetation cover. Do not include these areas if they appear "natural" to you. When in doubt, it is also helpful to speculate on which areas typical visitors might use based on factors such as slope and rockiness. **Bedrock in high use areas should be included within site boundaries.**

Step 2 Select and Reference Site CenterPoint. Select a site center-point which is preferably: a) visible from all the site boundary pins, b) close to and easily referenced by distinctive permanent features such as larger trees or boulders, and c) at a spot permitting the burial of the centerpoint rebar. Embed a temporary stake through the eyelet on the tape measure at the center-point location. Reference the centerpoint to at least three relatively permanent and distinctive features. Try to select reference features in three opposing directions as this will enable future workers to triangulate the centerpoint location. For each feature, take a compass bearing (nearest degree) and measure the distance (nearest 1/10 foot) from the centerpoint to the center of trees or the highest point of boulders. Also measure the approximate diameter of reference trees at 4.5 feet above ground (DBH). Be extremely careful in taking these bearings and measurements as they are critical to relocating the center-point in the future. Record this information on the back of the form.

Examples:
1) Red Maple, 3.2 ft (DBH), 23.2 ft. at 195 degrees (largest tree on site)
2) Boulder, 1719 ft at 312 degrees (distance and bearing to highest point)
3) Sycamore, 1.4 ft (DBH), 2915 ft at 78 degrees (only sycamore in area)

Hints
Marion (1991) recommends locating the center-point about five feet from the firegrate. Use caution in doing so. The steel in the firegrate may affect the compass azimuths and may possibly create a problem when trying to relocate the pin with a magnetic pin locater. Utilizing a 5 inch piece of rebar, drive this into the ground at the selected centerpoint. Make sure that this rebar is under at least 4 inches of soil. (See photo Fig. 6)

Take a photograph of the centerpoint, with range pole in position, that shows the center-point in relation to nearby landmarks which you referenced. Record the photo description in the photo log. If the site absolutely lacks a second or third reference point, use the one feature available and note the absence in the comment section on the back of the Monitoring Form.

Options: Some sites may lack the necessary permanent reference features enabling the centerpoint to be accurately relocated. If only one or two permanent reference features are available, use these to take additional photographs from several angles. If permanent features are unavailable simply proceed with the remaining steps without permanently referencing the centerpoint. This option will introduce more error in comparisons with future measurements, particularly if the site boundaries are not pronounced. Note your actions regarding use of these options in the Comments Section.

Step 3 Record Transect Azimuths and Lengths: Standing directly over the center-point, identify and record the compass bearing (azimuth) of each site boundary pin working in a clockwise fashion (in the exact order you would encounter them if you were walking the site boundary). Be careful not to miss any pins hidden behind vegetation or trees. Be extremely careful in identifying the correct compass bearings to these pins as error in these bearings will bias current and future measurements of site size. Next, anchor the end of your tape to the centerpoint stake, (or use electronic distance measuring device) measure and record the length of each transect (nearest 1/10 foot) starting with the same boundary pin and in the same clockwise order as before. Be absolutely curtain that the appropriate pin distances are recorded adjacent to their respective compass bearings. Leave boundary pins in place until you finish all other site measurements.

Step 4 Measure Island and Satellite Areas. Identify any undisturbed "islands" of vegetation inside site boundaries (often due to clumps of trees or shrubs) and disturbed "satellite" use areas outside site boundaries (often due to tent sites or cooking sites). Use site boundary definitions for determining boundaries of these areas. Use the **Geographic Figure Method** to determine the areas of these islands and satellites (refer to the diagram following these procedures). This method involves superimposing one or more imaginary geometric figures (rectangles, circles or right triangles) on island or satellite boundaries and measuring appropriate dimensions to calculate their areas. Record the types of figures used and their dimensions on the back of the form; the sizes of these areas should be computed in the office with a calculator. Also, record the compass bearing and distance **from the site centerpoint to the center of each island or satellite area.**

Site Remeasurement – Relocate the centerpoint using centerpoint references, photos, and a magnetic pin locator. Reestablish site boundary pins using the transect data compass bearings and distances. Reassess boundary pin locations based on the following procedures:

1) Keep the same transect length if that length still seems appropriate, ie, there is no compelling reason to alter the initial boundary determination.
2) Record a new transect length if the prior length is inappropriate, ie, there is compelling evidence, that the present boundary does not coincide with the pin and the pin should be relocated either closer to or further from the centerpoint along the prescribed compass bearing.
3) Repeat steps one and three from above to establish additional transects where necessary to accommodate any changes in the shape of site boundaries. Also repeat step 4.

These additional procedures are designed to eliminate much of the measurement error, associated with different individuals making subjective judgements on those sites or portions of sites where boundaries are not pronounced. These procedures may only be used for sites whose centerpoints can be relocated. (Marion 1991)

Use of Peephole Compass: Hold the compass level with the viewfinder close to your eye. The top of the white floating scale should be centered in the viewfinder. With your compass on top of the range pole, align the object with the black vertical line in the viewfinder. Allow the compass scale to come to rest and read the azimuth to the nearest degree. Practice and periodically compare your readings with those of your partners.

17. Condition Class
Record the conditions class based upon the following assessment:
Condition Class Definitions (Marion 1991)

Class O: Recreation site barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. Often an old site that has not seen resent use.

Class 1: The campsite is barely distinguishable; there is only a slight loss of vegetation cover and/or a minimal disturbance of organic litter.

Class 2: The campsite is obvious; vegetation cover is lost; and/or organic litter is pulverized.

Class 3: Campsite is obvious; vegetation is lost and the organic litter is pulverized; there is some bare or mineral soil exposed in primary use areas.

Class 4: Campsite is obvious; there is nearly a complete loss of vegetation cover and organic litter; exposed soil throughout the site.

Class 5: Campsite is obvious; soil erosion is pronounced; gullying and exposed tree roots present because of the erosion. (Page 36) (See photo Fig. 7)

18. Soil Exposure:
Measure the exposed mineral soil on the campsite. Use the geometric measurement method. Soil exposure is ground with little or no vegetation or organic cover. The exposed soil must be within the campsite boundaries. Dark organic soil which generally covers mineral soil will also be assessed exposed soil. Patches of organic litter sparsely covering an area will also be assessed as exposed soil.
(Refer to photographs following the procedures. Fig. 8)

19. Site Soil Type
Identify the predominate modifier and texture of the soil which makes up the main portion of the site. Soil types may vary across the site. Estimate the percentage of that type of soil.

Use the Modifier and Texture Codes from 13

20. Site Soil Area/Erosion:

Soil erosion is defined as the loss of soil due to water and wind actions. Recreational activities can provide the impact that may increase the rate at which erosion occurs. The potential for soil erosion is the greatest on bare mineral soil. Most campsites may only be on level one, but take the whole site into consideration. Look at the site and determine if active erosion is occurring. Measure the area which is being eroded, using the Geometric Figure Method. Enter the area in the first space provided.

Sheet erosion is fairly common. This occurs when water moves across broad expanses of ground, picking up soil and other organic material as it moves. Gully erosion occurs when water is concentrated in channels. Erosion is likely to be more severe on steep slopes where water tends to be channeled and in climates with infrequent and intense rainfall. (Hammett and Cole, 1987) Soils which are silt/fine sand combinations are more erodible then soils high in organic matter. Look at the soil and its content.

A percentage of each level of erosion must be estimated for the area. For example if 50% is terribly eroded and is washing into the lake then list L - 3 – 50%. If the remaining 50% has loss of surface organics then list L – 2 – 50%. If the entire site is level 1 erosion (inactive) enter O in site soil erosion. (See Fig. 4)

Code as Follows:
Level 1: Campsites that have negligible erosion on the campsite. The surface organic material is more or less in tact, or has been stabilized.
Level 2: Campsites with erosion, resulting in the loss of soils which is not pronounced. The upper surface of roots may be exposed.
Level 3: Erosion which has become pronounced, resulting in gullies with the exposure of lighter subsurface soils or gravel on the site; or obvious loss of soil. Total root exposure is common.

21. Surrounding Forest Community:
Identify the surrounding forest **within or near the site boundaries.** The objective is to try to characterize the vegetation that was present at the site before it was constructed. Denote each species by estimating the percentage of that species in the space before the initial of the species. For example, a red pine forest with no other species present would be listed as 100% RP. If the over-story consisted of red pine and white pine evenly, then list it as follows: 50% RP, 50% WP. You estimate the percentage **each** species represents.

Code as Follows:
RP = Red Pine
WP = White Pine
B = Birch
BF = Balsam Fir
A = Aspen
JP = Jack Pine
WS = White Spruce
BS = Black Spruce
WC = White Cedar
M = Maple

22. Tree Canopy Cover

This parameter requires an estimate of tree canopy cover. How much cover is over the campsite? Simply, stand within the site boundary and look up. How much tree canopy covers the site? Use an estimated percent. If tree canopies cover the entire site, enter 100%. (See Photo Fig. 9)

23. Sapling Tree Inventory

Count the total number of trees between 1 and 5 inches (DBH) in diameter at 4 ½ feet above ground, within the site boundary, delineated by the survey pins (**do Not Include Islands of Vegetation).** Record that sum in the space provided next to the appropriate species identifier. For example, ten balsam fir trees under 5" (DBH) would be listed as 10 BF.

Use species codes from 21

24. Larger Tree Inventory

Count the total number of trees within 5 inches (DBH) in diameter at 4 ½ inches above the ground, within the site boundary delineated by the survey pins **(Do not include islands of vegetation.)** Record that sum in the space provided next to the appropriate species identifier. For example, ten birch trees over 5 inches (DBH) would be listed as 10 B.

Use species codes from 21

25. Tree Damage:

Using the coding system listed below determine the amount of damage to each tree, greater then 1 inch (DBH) within or on the site boundary. (Refer to photographs following the procedures) **Do not include trees within undisturbed "islands".** Only count trees as damaged within the campsite or satellite or on the boundary. Trees with multiple stems will be counted as one tree. Do not count tree stumps. Take into account tree size. For example, damage for a small tree would be considerably less in size then for damage for a large tree (Marion, 1991, pg. 41) Omit damage that is not human caused, for example, lightening strikes. (See Photos Fig. 10)

Code as follows

None/Slight – No or slight damage, such as broken limbs, superficial scars, perhaps one nail in the tree.

Moderate – Numerous small scars and/or nails or one moderate scar.

Sever – Numerous trunk scars, large and penetrating, complete girdling of tree bark.

26. Root Exposure

Limit the assessment of root exposure to trees found within or on the boundaries of the site. Omit trees with exposed roots due to natural causes. Include roots in disturbed "satellite" sites. Count the trees with exposed roots. Record the count next to the proper category. (See Photos Fig. 11)

During reassessment include all trees within or on the site boundaries identified in the last measurement period.

Code as Follows:

None/Sight = No or slight root exposure, exposure such as found in off-site adjacent areas.

Moderate = Top half of roots exposed, more than one foot from the base of tree.

Severe =Three/Quarters or more of major roots exposed more then one foot from the base of the tree; look for obvious soil erosion.

27. Number of Dead Trees and Stumps

Count the number of dead trees and stumps within and on the site boundaries. **Include the trees and stumps within the "satellite areas". Do not include undisturbed "islands".** During reassessment include all dead trees or stumps within or on the site boundaries identified in the last measurement period. (See Photo Fig. 12)

28. Number of Trails:
A count of all trails leading away from the outer site boundaries. For trails that branch apart or merge together just beyond site boundaries, count the number of separate trails at a distance of ten feet from site boundaries. Do not count extremely faint trails that have untrampled tall herbs in their tread (Marion, 1991). **Count the trails leading to satellite areas.** Do not count access trails from the landing/landings.

29. Number of Fire-sites:
Count each firesite within the site boundaries. If present **do not include** the agency established fire-grate. Firesites can be identified by the presence of blackened rocks, charcoal or ashes. Do not include areas where ashes or charcoal have been discarded.

30. Human Waste:
Check the trails connected to the site. Observe obvious "toilet" areas. Count the number of human waste areas. These can be identified by the presence of toilet tissue and/or feces.

Use the Following Codes:
N = None
S = Some - 1-3 toilet areas
M = Much – 4 or more toilet areas

31. Latrine Distance to Water:
Locate the latrine. If there is no latrine use N/A. If a latrine is present, measure the distance, in feet, from the **latrine to the closest body of water.** Pace the distance.

32. Location of Latrine Site:
Locate the latrine according to topography. Is the latrine on top of a ridge or on a side slope. Is the site collecting, transporting, or dispersing water? This will aid management in determining the drainage of the latrine site.
Code as Follows:
R = Ridge-top (dispersing)
S = Side Slope (dispersing)
D = Drainage/Depression (transporting/ collecting)
O = Other (Note, for other location list in comment section)

33. Soil Composition At Latrine
Note the soil type at the latrine.
Use modifier and texture codes from 13

Comments:
Note anything that you felt was particularly difficult. Not anything that was out of the ordinary. Include recommendations and comments. These should be written on a piece of plane paper and

turned into your supervisor. Do not enter narrative into the program unless specifically requested to do so.

Campsite Photographs:
Take a photograph with lake name and site number on eraser board, record in the photo log. Select a vantage point at one of the boundary pins. **Preferably a point from which the entire site is visible.** Note the compass azimuth and distance from the centerpoint to the photo point and record it in the space provided on the monitoring form. Use ASA 200 color print film and a 35mm wide angle lens. Obtain photos which show as much of the site as possible. The photos will aid future workers in locating the site. Record the film type and ASA and photo description, site number, and focal length in the photo log. Date the backs of the photos with the same information and store the negatives. Staple the picture, the centerpoint location picture, and any others to a blank sheet of paper and attach to the monitoring form.
NOTE: Include the photo time on the transect log sheet. The time is automatically printed on the negative. This will aid in photo identification. (See Fig. 13)

Total Campsite Areas:
A computer program will calculate the site area based on the recorded transect measurements. Add the satellite areas and subtract the undisturbed islands to obtain total campsite area.

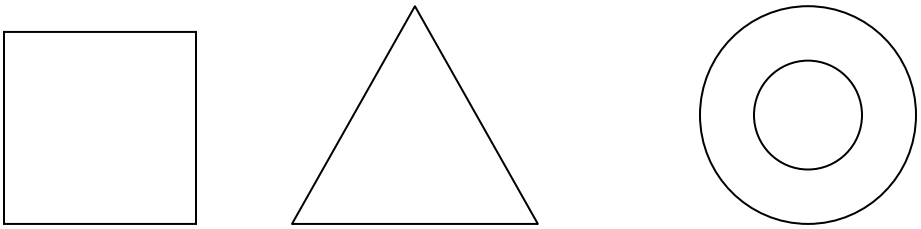
Geometric Figure Method

This method for determining the area of recreation sites, disturbed "satellite" sites, and interior undisturbed "island" sites is rapid and accurate if applied with proper judgement. Begin by carefully looking at the shape of the site, as if looking at it from an airplane. Mentally superimpose and arrange one or more simple geometric figures over the site boundary. Any combination and orientation of these figures is permissible; see the examples below. Measure the dimensions necessary for computing the area of each geometric figure. Complete the calculations in the office to avoid error.

Good judgement is necessary in making the measurements of each geometric figure. Boundaries do not have perfect shapes, you will have to mentally balance disturbed and undisturbed areas included and excluded from the geometric figures used. For example, in measuring an oval site with a rectangular figure, you would have to exclude some of the disturbed area along the side in order to balance out some of the undisturbed area included at the four corners. Be sure that when you are using this method that the opposite sides of rectangles are of the same length.

The computer program will aid in the computation of the area. Simply answer the questions.

$A = 1 \times w$ $A = 0.5 \times b \times h$ $A = 3.14 \times r \times r$



Appendix B

Portage /Trail Monitoring System

Procedural Definitions

A portage is defined as a pathway linking two bodies of water, or an access point with a body of water. A trail is a pathway utilized for recreational hiking within the boundaries of the BWCA Wilderness Area.

Material Needed

Topographic maps
Camera 35mm SLR, 35mm lens (preferably wide angle) ASA 200 film, tripod, photo log.
Palm top computer, printer, monitoring program, and accessories.
Clipboard, monitoring forms, pencils, and procedural manual

Initial Procedure
Upon arrival at the campsite to be assessed, the assessor will photograph the landing site, approximately five to ten yards from the shore. Use a 35mm camera with a wide angle lens. Record the film speed, the lens focal length, camera make and model, and approximate distance from the shore. A portage/trail number has to be assigned to each site photo. Use utmost care to record all photos in a photo log. Also label the containers with site numbers.

The gathering of data will be accomplished with the use of a palm top computer and a monitoring program inserted in the computer. The program will lead the monitoring individual through the series of steps necessary to gather all pertinent information. The program runs on MS DOS. If there is a malfunction of the hardware or software, you will be expected to continue data on the forms provided to you. (See the program instructions in Appendix B)

You are also expected to print a hardcopy of the data and double check your figures as soon as it is practical to do so.

Categorized Monitoring Procedures

1. Ranger Districts

Ranger districts containing BWCAW are the Gunflint District, Kawishwi District, La Croix District, Tofte District. They are coded as follows:
2 = Gunflint
5 = Kawishwi
6 = La Croix
7 = Tofte

2. Date:

The date the site is monitored is extremely important. Always date the form in the following manner:
August 18, 1995 must be coded as – 08/18/95

3. Inventoried By

Please do not forget to legibly write your name on this line.

4. Portage/Trail Number

A number has been assigned to each BWCAW portage and trail. Check your portage/trail number book for the appropriate number. Enter it in the appropriate space. Use extreme caution in determining numbers. Many portages and trails are composed of more than one part. Each part has been given its own number. For example: If one portage leaves Lake X and before it takes you to Lake Y, it branches to River R then the branch to the river has its own number and the

branch to Lake Y has a different number also. When entering this number into the monitoring program, you will be asked if the trail or portage contains more than one part. Enter the appropriate information.

5. General Site Description

Describe the location of the trail or portage. If necessary describe the portage by naming the lakes or streams the portage joins. Give the full name of the trail, if the trail is named.

Photograph the Landing/Access Site and any Problem Areas.
Problem areas might consist of trail widening because of muddiness, or severe erosion. Record the photo in your photo log.

6. Lake Name:

(Landing Location for portages only)
Record the lake name the landing is located on in this space. (When using the computer program enter PRT immediately after the lake name.) Use a trail name in this category if the monitoring is not to be done on a portage. If you are monitoring a trail then omit the landing area information and proceed as usual. (See Photo Fig. 14)

a. Landing Area:
The landing area as defined by Marion (1991) is the area of human disturbance extending from the average water level up to the trail accessing the site. Measure the area/areas used by canoe and boat landings. Utilize the geometric figure method. (The program will compute this for you) If the landing area is part of the site do not measure it and list it as N/A. If this area is not included in the site area than enter it.

b. Soil Category:
Record the modifier code first if applicable, than the soil texture code. Modifiers describe the type of soil conditions which exist on the site. For example: a shoreline strewn with rocks over loam soil would be described as a cobbly loam area. For example OL

Use the following modifier code:
O = Cobble/Stone/Boulder
R = Shallow soil to bedrock (< 40" deep)
X = Steep Slope Gradient (> 18%)
If there is no modifier leave blank

Use the following Texture codes:
B = Bedrock
C = Clay
S = Sand/Gravel
L = Loam
(See the texture description in appendix B)

Record the modifier first, then the texture code. Enter both codes on the same line. For example: An area consists mostly of bedrock covered with sand and gravel less then 40" deep. This would be coded as **RS** (See photos in Fig. 3)

c. Erosion Level:
Estimate the amount of active erosion at the landing. Look for ground litter which has been moved by water action. Look at the amount of soil which has been removed on account of erosion. Is the soil being eroded at the present? If the area has been stabilized through management rehabilitation, consider the erosion as inactive and categorize as level 1. Enter the level of erosion in the erosion level space. (See Fig. 4)

Code as follows:
Level 1: No erosion at the shoreline and negligible erosion on the access trail (s). The organic surface material is more or less in tact on trails, the shoreline is essentially in tact or has been stabilized.

Level 2: Erosion at the shoreline resulting in the loss of soils which is not pronounced. Roots have their upper surfaces exposed.

Level 3: Erosion which has become pronounced, resulting in gullies; with the exposure of lighter colored subsurface, soils or gravel; or obvious loss of soil at the landing or along the shoreline. Total root exposure is common. The shoreline is being significantly affected by erosion.

7a. Portage/Trail Distance

The distance between varying tread widths will be entered in the distance category.

Therefore begin measuring distance from where the trail leaves the landing area to where it meets with the next landing area. Record the tread width for the beginning portion of the trail/portage, the computer will ask for the distance, record beginning. Record the tread width changes and distances for the remainder of the trail and or portage.

7b. Portage /Trail Tread Width

Estimate the width of the tread of the trail or the portage. Record the width category. This is the portion of the trail that is walked on. Do not include the forest opening occupied by the trail or portage. In order to switch to a different tread category, the change in tread width must be a change for a distance farther than 10 feet. For example: You are walking on a portage with a tread width of feet. All of a sudden the tread becomes 3 feet wide. This change only lasts for a distance of 6 feet. Do not change categories in the program. If the change lasts for more then 10 feet and than enlarges again, change categories. Use the following categories to record the tread width:

1 – 1 foot to 1 ½ feet
2. – 1 ½ feet to 3 feet
3 – 3 feet to 4 feet
4 – 4 feet to 6 feet
5 – 6 feet to 10 feet
6 – more then 10 feet

(See Fig. 15)

The procedure which shall be used to determine varying tread widths along the trail or portage is as follows:

The portage/trail will be mapped by the monitor. Record the trail tread width as you walk along. Record the distance traveled for each category coded, as you travel the portage/trail.

Measuring tread width is a meaningful way of accessing trail or portage conditions. It provides an indicator of a variety of problems. This will be a rapid survey of the portage or trail tread. Keep track of the distance by pacing it and record the changes in the trail tread in the computer. The computer program will ask for a new distance, every time you change categories.

7c. Portage/Trail Problems:

If trail problems are encountered which affect less than a 10 foot segment of a trail, than use the appropriate code. Multiple entries are allowed if more than one problem is encountered. Do not begin a new segment. (Assuming the tread width is unchanged) If the problem area exceeds 10 feet in length, assuming the tread is changed, begin a new segment.

a. Mud Holes – These may range from minor puddles a few feet in diameter to lengths running hundreds of feet. If it is a minor mud puddle, do not record it as a trail problem. Common sense as to the nature and extent of the mud hole must be exercised by the monitoring individual.

b. Bog Areas – These are naturally wet areas. If portions of the trail are wet and soggy due to natural conditions, use this category.

c. Erosion (evidence of water movement) – Water digging and removing soil because of its movement. Water may be channeled onto a trail either naturally or because of some event. Gully erosion is typical.

d. Water Pooled on Trail – Pools of standing water on the portage or trail. For example: A low spot on the trail may fill with water after a heavy shower. Hikers travel through this area and walk around this spot creating a wider trail/portage tread.

e. Rutting – Gouges out into portions of the tread because of former periods of running water or compaction.

f. Down trees may cause individuals to walk around the obstacle creating wider treads.

g. Shortcutting – Portages or trails may be constructed with switchbacks to allow the traverse of steep slopes. Users may create portage/trail problems by shortcutting these switchbacks. This may create problems such as the aforementioned rutting.

h. Excessive Cobble Conditions – Rocky terrain with large rounded rocks may cause users to go around the area, creating wider treads.

i. Lack of Trail Definition – These areas may be over bare bedrock for undetermined distances. Because there is no trail definition users may take off in many directions causing one or more new trails to appear over short distances, after they leave the undistinguished area.

j. Resting Point – Users may widen a tread because a spot is a convenient spot to take a rest.

k. Scenic Point – A spot users stop at to see a beautiful scene. For example: A waterfall.

l. Other (This requires an extensive explanation – use narrative section) – Please elaborate using the narrative section of the computer program. Many other problems may occur that we are unable to document in code form.

The location of a problem area will also be recorded in the program. This distance will be in feet. The distance in feet will be paced. A pace consists of two steps. The average pace is between 5 and 6 feet. First determine the length of your pace in feet. Multiply the number of paces you count by the number of feet which make up your pace.

8. Lake Name:

(Landing Location for Portages only)
Record the lake name the second landing is located on in this space. **Remember portages and trails between two lakes, both lakes must be listed and the landing areas of both must be measured.**

a. Landing Areas:

The landing area as defined by Marion (1991) is the area of human disturbance extending from the average water level up to the trail accessing the site. Measure the area/areas used by canoe and boat landings. Utilize the geometric figure method. (The program will compute this for you) If the landing area is part of the site do not measure it and list it as N/A. If this area is not included in the site area, enter it.

b. Soil category:

Record the soil modifier first if applicable, than the soil texture code. Modifiers describe the type of soil conditions which exist on the site. For example: a shoreline strewn with large rocks over loam soil would be described as a cobbly loam area. For example OL

Use the following modifier code:
O = Cobble/Stones/Boulders
R = Shallow Soil to Bedrock (< 40" deep)
X = Steep Slope Gradient (>18%)
If there is no modifier leave blank

Use the following texture codes:
B = Bedrock
C = Clay
S = Sand/Gravel
L = Loam
(See the texture description in Appendix B)

Record the modifier first, then the texture code. Enter both codes on the same line. For example: An area consists mostly of bedrock covered with sand and gravel less then 40" deep. This would be codes as **RS** (See photos in Fig. 3)

c. Erosion Level:

Estimate the amount of active erosion at the landing. Look for ground litter which has been moved by water action. Look at the amount of soil which has been removed on account of erosion. Is the soil being eroded at the present? If the area has been stabilized through management rehabilitation, consider the erosion as inactive and categorize it as level 1. Enter the level of erosion in the erosion level space. (See Fig. 4)

Code as follows:
Level 1: No erosion at the shoreline and negligible erosion on access trail (s). The organic surface material is more or less in tact on trails. The shoreline is essentially in tact or has been stabilized.

Level 2: Erosion at the shoreline resulting in the loss of soils which is not pronounced. Roots have their upper surfaces exposed.

Level 3: Erosion which has become pronounced, resulting in gullies with the exposure of lighter colored subsurface soils or gravel; or obvious loss of soil at the landing or along the shoreline. Total root exposure is common. The shoreline is being significantly affected by erosion.

Mgmt Area ____
LTA_____
Travel Zone _____

Trail and Portage Monitoring Form

1. Ranger District (2, 5, 6, 7) _____
2. Date _____ _____ _____
3. Inventoried By: _____
4. Portage Number _ _ _ _ _ _ _ _
5. General Site Description (Describe location of trail or portage)
_____
6. Lake Name: (Landing Location) _____
a. Landing Area: (portages only) in sq. feet **_____**
Modifier and Soil Texture: (Use modifier first) _____
Cobble/Stony/Boulder = O

Shallow to Bedrock (<40" deep) = R
Steep Slope Gradient (.>18%)= X
Not applicable = N/A
Gravel/Sand = S, Bedrock = B, Clay = C, Loam = L
Area Erosion Level 1__ % Level 2____% Level 3____%

Code as follows:
Level 1: No erosion at the shoreline and negligible erosion on the access trail (s). The organic surface material is more or less intact.

Level 2: Erosion either on the access trail (s) or at the shoreline resulting in the loss of soils which is not pronounced. Roots have their upper surfaces exposed.

Level 3: Erosion which has become pronounced, resulting in access trails becoming gullied; the exposure of lighter colored subsurface soils or gravel on the site; or obvious loss of soil at the landing or along the shoreline. Total root exposure is common.

7a. Distance traveled – Same tread width (minimum varience in tread – 10 feet. If more record as new category)

The portage/trail will be mapped by the monitor. Record the trail tread width as you walk along. Record the distance traveled for each category coded.

When or where you encounter a major trail problem, stop and enter the nature of the problem and the distance along the portage/trail where the problem is located.

7b. Trail Tread Width	**Width**	**Distance**
Categories:	_____	_____
1. – 1 foot to 1 ½ feet	_____	_____
2. – 1 ½ feet to 3 feet	_____	_____
3. - 3 feet to 4 feet	_____	_____
4. – 4 feet to 6 feet	_____	_____
5. – 6 feet to 10 feet	_____	_____
6. – more then 10 feet	_____	_____

Note: You will have to utilize this form if problems are encountered with the computer or computer program. In order to use this form you will have to record many segments of distance and widths of a particular trail. There is not enough space provided on the front of the form. Turn it over and record your data on the blank side. Enter it in the computer when the computer problem is solved.

7c. Portage/Trail Problem	**Location on Trail**
a. Mud Hole	(Distance in feet from landing)
b. Bog Area	
c. Water erosion (running)	
d. Water pooled on trail	
e. Rutting	
f. Down trees	
g. Shortcutting	
h. Excessive cobble conditions	

i. Lack of trail definition
j. Resting point
k. Scenic point
l. Other (This requires an extensive explanation – Use narrative section)

8. Lake Name: (Landing location) _____
a. Landing Area (portages only) in sq. feet _____
Modifier and Soil Texture: (Use modifier first) _____
Cobble/Stony/Boulder = O
Shallow to Bedrock (<40" deep) = R
Steep Slope Gradient (>18%) = X
Not Applicable = N/A
Gravel/Sand = S, Bedrock = B, Clay = C, Loam = L
Area Erosion Level 1 ___% Level 2 ___% Level 3 ___%

Code as follows:
Level 1: No erosion at the shoreline and negligible erosion on the access trail (s). The organic surface material is more or less in tact.

Level 2: Erosion either on the access trail (s) or at the shoreline resulting in the loss of soils which is not pronounced. Roots have their upper surfaces exposed.

Level 3: Erosion which has become pronounced, resulting in access trails becoming gullied; The exposure of lighter colored subsurface soils or gravel on the site; or obvious loss of soil at the landing or along the shoreline. Total root exposure is common.