GEAC

GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS

Natural Resource Conservation
Prairie and Northern Region

Environmental Assessment Report 91-1/PNR

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Winnipeg, Manitoba
R3B 3E8

March 1991

1.0 Introduction

A number of similar projects or activities commonly recur within Prairie and Northern Region. The majority of these projects require environmental assessments. This results in repetition of information gathering and inconsistency in dealing with similar situations. The preparation of class screenings for frequently repeated projects will reduce repetition and increase efficiency and effectiveness.

This report presents a set of guidelines on different topics that may be used in the preparation of class screenings. Portions of these guidelines may also be utilized in the preperation of environmental screening reports in other topic areas. Each guideline is a compilation of available standards, regulations and mitigative measures which are considered to be the minimum measures to be applied. The mitigations in these guidelines are by no means complete. All projects require site-specific evaluation and mitigations.

Each project utilizing a class screening will be registered separately. Those projects will utilize a complete and approved class screening to which site or project-specific evaluation and mitigations will be added.

A number of other aids are available for the preparation of environmental screening. This report is meant to supplement other publications or guidelines which may be used in preparing environmental screenings.

Inaccurate or dated information should be reported to the Regional Environmental Assessment Coordinator to aid in future revisions of this guide.

2.0 Screening Format

The following format is suggested for preparing environmental screenings.

FORMAT FOR PRELIMINARY AND FULL SCREENING

1. PROJECT DESCRIPTION

A summarized description of the project or activity as outlined in the application for registration form which includes:

- proposal and justification of the project
- site description (including location and U.T.M.)
- nature of work
- work plan
- work schedule (space/time)
- project components
- alternatives
- agencies involved and their responsibilities
- contractual arrangements
- cost of project
- future activities programmed
- information deficiencies

The project description should include maps, design plans and photographs.

2. NATURAL AND CULTURAL RESOURCES

Resources associated with the project will be described and the park zoning identified. The Park Conservation Plan, Resource Description and Analysis, biophysical and other publications should be utilized (referenced) to obtain resource information.

3. ENVIRONMENTAL EFFECTS

All environmental effects including cumulative impacts, are to be addressed. Approval of a project will be based on the evaluation of environmental effects. Each environmental effect will be categorized as:

1. insignificant or mitigable with known technology
2. unknown
3. significant

Environmental effects should be discussed under the following headings:

3.1 **Preservation**

3.1.1 **Cumulative Impacts:**

3.1.2 **Wildlife**: habitat use and change, migration routes, carrying capacities, trauma, rare and endangered species.

3.1.3 **Vegetation**: extent of vegetation damage, loss and change, habitat change, effects on wildlife, effects on land and erosion; rare, endangered, exotic species; aesthetics.

3.1.4 **Landform** (Geomorphology, Geology, Soils): erosion, compaction, organic change; features of special interest, aesthetics.

3.1.5 **Aquatic Resources**: fisheries (habitat change/loss, populations affected, time boundaries for spawning and incubation), aquatic vegetation, hydraulic changes (flow rates, surface water changes, water quality, feature of special interest).

3.1.6 **Trans-boundary Influences**: wildlife, water, vegetation, exotic species.

3.2 **Pollution**

Land, water, atmosphere (air), toxic chemical compounds in land, water, air, hazardous wastes, human wastes, natural pollutants. Consider water tables, watersheds, prevailing winds, temperature changes, micro-climates, soil texture, subterranean faults.

3.3 **Cultural Features**

3.3.1 **Aesthetics**: long-and short-term visual, sound and odour effects on park visitors and residents.

3.3.2 **Public Facilities and Services Affected**: access, roads, trails, utilities, parking, recreational activities, etc.

3.3.3 **Public Safety**: short and long term effects from traffic, road/trail designs, excavation sites, blasting, presence or introduction of natural or structural hazards.

3.3.4 **Historical Resources**: known or potential values.

3.3.5 **Archaeological Resources**: known or potential values.

3.3.6 **Socio-economic Impacts**: lifestyles, property values, employment, special interest groups, quality of life.

4. MITIGATIONS

Mitigative measures should address each point identified in the Environmental Effects portion of the screening. The Mitigative Measures should be organized to correlate with the development or construction schedule of the project.

(Example)

4.0 MITIGATIONS

Design
4.1 ...text...

Pre. Construction
4.2 ...text...
4.3 ...text...
4.4 ...text...

Construction
4.5 ...text...
4.6 ...text...
4.7 ...text...
4.8 ...text...

Landscaping

Not Applicable

Longterm (Maintenance)
4.9 ...text...

Cumulative Effects
4.10 ...text...

Etc.

5. SURVEILLANCE REQUIREMENTS

Surveillance required for the project will be identified. A forecast of PY and $ required for surveillance must be outlined.

6. MONITORING

A monitoring strategy and plan may be required for some projects. If monitoring is required a plan will be included in the environmental screening. Monitoring plans include objectives, methodology, implementation, scheduling, responsibilities and a forecast of PY and $ requirements.

The requirement for monitoring may not be evident until well into the project implementation phase. In this case a monitoring plan must be approved by the Superintendent as an attachment to the original environmental screening.

3.0 Checklist of Environmental Parameters Subject to Impact

The following checklist of environmental parameters subject to impact is presented for reference when evaluating site-specific factors and when preparing environmental screening reports.

A. ATMOSPHERE

1. Microclimate

1.1 Temperature
- (a) Daily ranges - maximum and minimum

1.2 Humidity
- (a) Dewpoint temperature
- (b) Specific humidity

1.3 Winds
- (a) Velocity (average)
- (b) Average direction of flow
- (c) Range of velocities
- (d) Airflow and turbulence

1.4 Insolation and Radiation
- (a) Intensity of solar radiation received at ground level

1.5 Feature of Special Interest

2. Air Quality

2.1 Chemical Composition
- (a) Hazardous toxicants
- (b) Odours

2.2 Particulate Loading
- (a) Dust
- (b) Other particulates

2.3 Feature of Special Interest

B. LAND

1. Soils

1.1 Susceptibility to Erosion

1.2 Drainage Properties
- (a) Permeability
- (b) Porosity

1.3 Compaction

1.4 Organic Content

1.5 Chemical Composition
(a) pH
(b) Nutrients
(c) Salinity
(d) Hazardous toxicants

1.6 Feature of Special Interest

2. Permafrost

2.1 Distribution Profile

2.2 Depth Profile
(a) Thickness
(b) Active layer
(c) Duration

2.3 Surface Conditions
(a) Vegetation
(b) Drainage

2.4 Feature of Special Interest

C. **WATER**

1. Ground

1.1 Quantity
(a) Volume of ground water available
(b) Depth to water table

1.2 Quality
(a) Chemical composition
(b) pH
(c) Dissolved solids
(d) Toxic compounds
(e) Fecal coliforms
(f) Salinity

1.3 Feature of Special Interest

2. Surface Water

2.1 Quantity
(a) Drainage pattern
- spatial distribution
- lag time
(b) Flow velocity
(c) Depth
(d) Area of surface
(e) Circulation

2.2 Quality
(a) Chemical Composition
- BOD (Biochemical Oxygen Demand)
- pH
- DO (Dissolved Oxygen)
- Dissolved solids
- nutrients
- toxic compounds
- fecal coliforms
- salinity

(b) Temperature
(c) Suspended solids
(d) Turbidity

2.3 Drainage Pattern

2.4 Feature of Special Interest

D. SPECIES AND POPULATIONS

1. Flora

1.1 Terrestrial
(a) Community structure and composition
- number and type of strata
- composition of each strata
- extent of community
- rare and endangered species
- exotic species introduction
- utilization by wildlife

(b) Natural revegetation
- species availability
- seed dispersal distances
- growth rates of species (soil nutrients, moisture)

1.2 Aquatic
(a) Community structure and composition
- plant composition of benthic and littoral zones
- abundance of each plant species in each zone
- extent of community
- rare and endangered species
- exotic species
- utilization by fauna
- plant structure and composition of limnetic zone

(b) Natural revegetation
- species availability
- dispersal opportunities
- growth rates and requirements (water temperature, nutrients)

1.3 Species of Special Interest

2. Fauna

2.1 Terrestrial

(a) Composition, distribution, abundance, productivity
- population distribution, regional and provincial
- population density
- habitat distribution, regional and provincial
- trans-boundary movements
- reproductive rate and success
- sex and age structure
- mobility of species
- carrying capacity of area

(b) Ecological role
- as predator including browsing
- as prey
- as competitor for food
- as competitor for space

(c) Special use areas, seasonal or continuous
- for reproduction
- for feeding
- for resting
- for migration routes

(d) Population health
- disease and parasite load
- environmental pollutant uptake and load (pesticides and herbicides)

(e) Access to species
- control of access
- location of roads and other transportation routes near populations
- condition of transportation routes
- tolerance of species to disturbance
- response to human presence and activity
- presence of people and their wastes
- duration, frequency and intensity of noise
- timing and extent of disturbances

2.2 Aquatic

(a) Composition, distribution, abundance, productivity
- population size, local and regional
- population distribution, regional, provincial
- reproductive rate and success
- habitat type distribution, regional and provincial
- mobility of species
- sex and age structure
- individual growth rates

(b) Ecological role
- as predator
- as prey
- as competitor for food
- as competitor for space

(c) Special requirements
- for reproduction
- for feeding
- for resting
- for migration

(d) Population health
- disease and parasite load
- environmental pollutant uptake and load (pesticides and herbicides)

(e) Access to species
- control of access
- location of transportation routes near populations
- publicity regarding region and species

(f) Tolerance of species to disturbance
- turbidity
- flow rates
- turbulence, falls
- chemical contaminants
- temperature
- water depth
- siltation

2.3 Species of special interest

E. CULTURAL FEATURES

1. Social

1.1 Visitor Experience
(a) Natural or historical appearance of landscape
(b) Sounds
- removal of natural sounds
- addition of unnatural sounds

(c) Odours
(d) Number of other visitors present
- adequacy of facilities
- loss of sense of solitude

1.2 Public Safety
(a) Road design and location
(b) Trail design and location
(c) Facility design and location
(d) Presence of natural hazards
(e) Presence of incompatible wildlife or potential habitat

1.3 Lifestyle of Aboriginals, Residents of Park/Site Vicinity
- (a) Conflict with traditional occupation
  - hunting
  - logging
  - fishing
  - trapping
- (b) Access to residence
  - traffic routing
  - road maintenance
- (c) Number of visitors present
- (d) Business opportunities
  - existing
  - potential

2. Historical

2.1 Known Value
- (a) Research value
- (b) Interpretive/educational value

2.2 Potential Value
- (a) Aborininal religious and cultural value
- (b) Research value
- (c) Interpretive/educational value

2.3 Feature of Special Interest
- (a) Internationally acclaimed
- (b) Nationally unique

3. Archaeological

3.1 Known Value
- (a) Aboriginal religious and cultural value
- (b) Research value
- (c) Interpretive/educational value

3.2 Potential Value
- (a) Research value
- (b) Interpretive/educational value

3.3 Feature of Special Interest
- (a) Internationally acclaimed
- (b) Nationally unique

GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS:

A. PRIVIES

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Prairie and Northern Region

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3.0 Site Location

3.1 Considerations

Surface drainage and surficial deposits must be considered when choosing a privy location. These factors will determine the rate of percolation and hence, effect decomposition, leaching and ground water drainage.

Surface drainage and surficial deposits may be variable over short distances. Thus, site-specific evaluation is required to determine the appropriate locations for privies.

The following information is provided to help in the determination of privy locations.

3.1.1 Surficial Deposit Characteristics

Table 1. Surficial deposit percolation characteristics.

Soil Type	Percolation Rate (min/cm)	Suitability
Gravel, coarse sand	< 0.5	not suitable
Coarse to medium sand	0.5 - 2	suitable
Fine sand, loamy* sand	2 - 6	most suitable
Sandy loam, loam	13 - 24	suitable
Clay	>24	not suitable

(adapted from Reed, et al 1984)

* Loamy - fine earth fraction is at least 35% clay by weight, particles greater than 2mm are less than 35% by volume (Canada Soil Survey Committee 1978).

3.1.2 Surface Drainage Characteristics

Surface drainage is influenced by topography, soil types, precipitation intensity, snow accumulation and other factors. These factors should be evaluated when choosing the appropriate location for any privy.

Cryosolic and organic soils are associated with poor drainage and the development of ground ice. Privies should not be located in areas suspected to be influenced by permafrost or in areas close to organic soil complexes.

Organic Soils:

Organic soils are derived primarily from organic materials and are often termed peat, muck or bog soils. Excessive water is important for development, therefore, organic soils are associated with poor or very poorly drained conditions.

Cryosolic Soils:

Cryosolic soils occupy much of northern Canada where permafrost remains close to the surface. Its occurrence is strongly influenced by terrain and aspect, and is associated with both mineral and organic deposits. It is indicated by patterned ground features such as sorted and nonsorted nets, circles, stripes and hummocks. Cryosolic soils indicate the presence of permafrost within 2 metres of the surface.

(Goode 1986)
(Canada Soil Survey Committee 1978)

Sources which provide further information on locations and classification of different soils are, the Park Resource Description and Analysis, Canadian Soil Survey maps and The Canadian System of Soil Classification text (Canada Soil Survey Committee 1978).

4.0 Regulation Standards

The mitigations presented in this section represents the most stringent legislative regulation within Prairie and Northern Region. Adopting these regulations, as the minimal acceptable in this region, is in keeping with environmental assessment principles.

Mitigations in this section should be considered as the minimal standard for this region.

Mitigations

4.1 Determine ground water table.

4.2 Privies must be a minimum of 30 metres away from the high water level of lakes or rivers.

4.3 The bottom of a pit privy must be above the ground water table by at least:
a) 2 metres in clay
b) 8 metres in other materials (sand, gravel, etc.)

4.4 Privies must be at least 15 metres from a drilled water well.

4.5 Privies must be at least 30 metres from a natural spring or seep. In practice, pit privies should not be located in the vicinity of any springs or seeps.

4.6 Privies must be at least 6 metres from any building.

4.7 Only vaulted privies are permitted at a facility with plumbing (a piped water system).

5.0 Privy Design Mitigations

The U.S Forest Service has developed, design criteria that have been proven to reduce or eliminate many of the negative environmental effects associated with present privy designs. The new design will minimize odours, increase cleanliness and eliminate affects to amphibians, mammals and birds. The reduction in odours and increase in cleanliness should result in more people using privy facilities rather then the surrounding vegetation cover.

The new design criteria has been incorporated into a pre-fabricated vaulted (pump out) privy which is now available commercially. A new design for pit and fly-out privies, that will incorporate these new criteria, will be available from Prairie and Northern Region office in the summer of 1991.

The following design mitigations include the criteria developed by the U.S. Forest Service.

Design Mitigations

5.0.1 Design and installation will provide a tight seal between the structure and the vaulted portion. This seal will be as close to air tight as possible. This is necessary to increase the air flow through the venting system and minimize or eliminate odours.

5.0.2 For pit or fly-out privies, flashing or heavy screening will be used around the bottom of the structure and the ground. The purpose of this barrier is to prevent small mammal access. The material will be attached to the structures wall and will extend out a minimum of 0.5 metres onto the ground. The material will be secured to the ground and buried.

5.0.3 No vents will be present inside the facility portion of the privy (above the floor).

5.0.4 Lighting in the building compartment (plexi-glass material) should be designed to offer enough light for the user, but not lit in such a way that the user can see down the toilet riser. Screening must not be used.

5.0.5 An inlet vent (30cm by 25cm) will be located at the top portion of the pit or vault space (below the floor). This vent will be screened to prevent any access by small mammals, birds and amphibians.

5.0.6 The vent will be located on the side of the structure facing into the prevailing wind.

5.0.7 A 30cm exhaust vent will run from the top of the pit or vault space, through the structure and out of the roof. The exhaust vent will extend at least one metre above the highest point of the structure.

5.0.8 The exhaust vent discharge will be protected by a wide-mesh screening. This will prevent access by birds and small mammals.

5.0.9 The structure (portion people use) should be well-sealed. This will increase ventilation through the toilet hole and out the exhaust stack, thereby reducing odours.

5.0.10 The inside of the structure will be painted white.

5.0.11 A toilet riser will be used, a bench and seat contructed of wood will not be used.

5.0.12 The outside of the structure will be painted a colour that will blend with the surrounding landscape (subject to 5.1.11).

5.1 **Privy Types**

Pit Privies

Pit privies are outdoor washroom facilities which make use of a hole dug in the ground. Once the hole is mostly filled it is covered with dirt and the privy structure is moved to a new hole.

Considerations

Existing privies which are accessible by vehicle should be replaced with a vaulted privy system.

In backcountry locations with high visitor use, fly-out privies are strongly recommended (see section 5.2).

Vaulted Privies

Vaulted privies are outdoor washroom facilities which have an impermeable holding tank that is pumped out regularly.

Considerations
Vaulted pump-out privies should be used in all high visitor use areas that are accessible by vehicle.

Other Privy Options

Alternatives privies such as desiccating and incinerator types with propane or wind powered systems should be considered for locations where traditional privies are not appropriate.

Site Mitigations

5.1.1 Site selection will take surficial deposits, surface drainage and grade into account (see section 3, Site Location).

5.1.2 * The privy will be located in the normal prevailing wind path. This is of utmost importance to the exhaust system and its capability to eliminate odours.

5.1.3 * The work site must be identified in the environmental screening and physically delineated in the field.

5.1.4 * A site for the storage of excavated material must be identified in the screening and physically marked out.

5.1.5 * The method of pit excavation (hand, backhoe) will be identified. Impacts to flora and fauna and access area must be considered.

5.1.6 The regional archaeologist will be contacted as early as practicable in advance of excavation. Notification and plans should be provided at the Project Definition Stage.

5.1.7 If any paleontological, historical or archaeological artefacts or features are encountered during excavation, all work will stop. The Surveillance Officer or Park Warden will be informed immediately. Work will not re-commence until the Surveillance Officer gives direct instruction to do so.

5.1.8 Upon report of a possible find the Surveillance Officer will notify the Superintendent and regional archaeologist. The Surveillance Officer will not give permission to commence work until instructed to due so by the Superintendent, under guidance from the regional archaeologist .

5.1.9 * A portion of the back fill will be used to provide drainage of surface water away from the pit area.

5.1.10 * In areas where porcupines have or may become a problem, the following materials will not be used in the construction of any privy.

a) Plywood
b) Paint
c) Linseed oil
d) Any resin-based coating

* - Indicates Site-specific Evaluation and Mitigations Required.

Solid woods particularly cedar have been successfully used in areas with porcupine problems.

If plywood or wood preservatives are used they should be protected by non-painted sheet metal. The metal should cover all wood from the ground to a height of 1 - 1.5 metres up the walls. The metal should cover all sides of the structure. (Refer to National Management Directive 2.4.1 regarding wood preservatives).

5.1.11 If at all possible privies will be constructed prior to transporting to the field. This will include painting, application of wood preservatives and sheet metal.

5.2 Fly-Out Barrel Pit Privy

A fly out barrel pit privy makes use of a sliding privy structure which allows access to two 45 gal. barrels. Fecal waste is collected in 45 gal. barrels in the pit portion of the privy. At the end of the season when the material has become more solid with cold temperatures, the barrels are flown out by helicopter. The barrels and waste are disposed of in a land-fill site.

Due to the expense of helicopter time this type of privy is only suitable for the following situations:

a) backcountry areas with high visitor use,
b) areas of extreme climate, physical geography and sensitivity.

The volume of potential waste generated at the site must be considered and the appropriate number of units installed.

Design Mitigations

The currently used design for this type of privy is attached as a reference (see appendix 8.1). A new design incorporating criteria to reduce or eliminate negative environmental concerns will be available from Prairie and Northern Region office in the summer of 1991.

The following mitigations are specific to fly-out privies and are required in addition to those outlined in section 5.0 and 5.1.

5.2.1 The barrels must be made of metal.

5.2.2 The barrels must not have contained toxic substances.

5.2.3 * The barrels will have holes in them to allow for the dissipation of liquids. If the location is a very sensitive one, then holes may not be appropriate.

Waste Management Mitigations

5.2.4 The barrels should only be transported in the fall or spring. This will guarantee that the waste in the barrel is solid (frozen or semi frozen) and will not spill, blow or drip when in transport (see section 8.1, design for helicopter sling).

5.3.5 * The volume of waste may be of a quantity warranting a change of barrels more than once per year. If this is the case then holes will not be drilled in the barrel. The volume will be monitored closely and transport will only be permitted with sealed barrels. This will eliminate spilling and dripping waste from the barrels when transported in a non frozen state.

5.2.6 The public will be cleared from the immediate area when barrels are being changed.

5.2.7 A lid must be firmly fitted to seal the top of the barrel, prior to transportation.

5.2.8 Monitoring the content level of the barrels is essential. Over filling of the barrel will lead to problems flying and handling the waste. An extra barrel can be flown in if necessary for extra waste. Alternatively, extra waste can be shovelled into the new barrels. The waste build up will be monitored more closely for the next flight.

5.2.9 The pit must be cleaned with a shovel each time the barrels are changed.

5.2.10 No material that is in the pit will be stored or deposited anywhere at the facility. All waste must be deposited of as per 5.2.13.

5.2.11 Barrels used must be rinsed and cleaned prior to flying them into the privy site.

5.2.12 Barrels are used only once. Once emptied, they are to be buried in the landfill.

* - Indicates Site-specific Evaluation and Mitigations Required.

5.2.13 Fecal matter will be disposed of at a sewage treatment facility. It should be dumped into the system, prior to the screening area. This will separate and restrict plastic and other garbage from entering the treatment facility. Barrels of fecal waste transported by truck required a permit under the Transport of Hazardeous Goods Act.

If this is not possible, the barrels will be disposed of in a land fill. They will be buried with a minimum of 2 metres of soil covering them. The hole will have been dug prior to transporting the barrels. The barrels will be burried immediately after they arrive at the landfill.

- Barrels can be deposited (or emptied) in a primary cell of a sewage lagoon only if;

a) no garbage is present in the barrels (likely present in a high use are),
b) the barrel is made of metal,
c) the lid is taken off the barrel and
d) only a limited number are used each year.

6.0 Use of Lime

Considerations

The lime used for outhouses is Calcium Oxide. When Calcium Oxide is mixed with water it forms a strong alkali-Calcium Hydroxide.

- Lime powder is can be dangerous if it comes in contact with mucous membranes.

- The use of lime greatly reduces biological activity necessary for the breakdown of fecal mater. In the past, use of lime was promoted because it reduces odours.

-The incorporation of mitigative measures to increase ventilation flow will eliminate odours without the use of lime. This in turn will enhances biological degradation of fecal material.

Mitigations

6.1 Lime powder should not be used (as long as the new privy designs are used).

6.2 No enzyme materials will be used.

7.0 References

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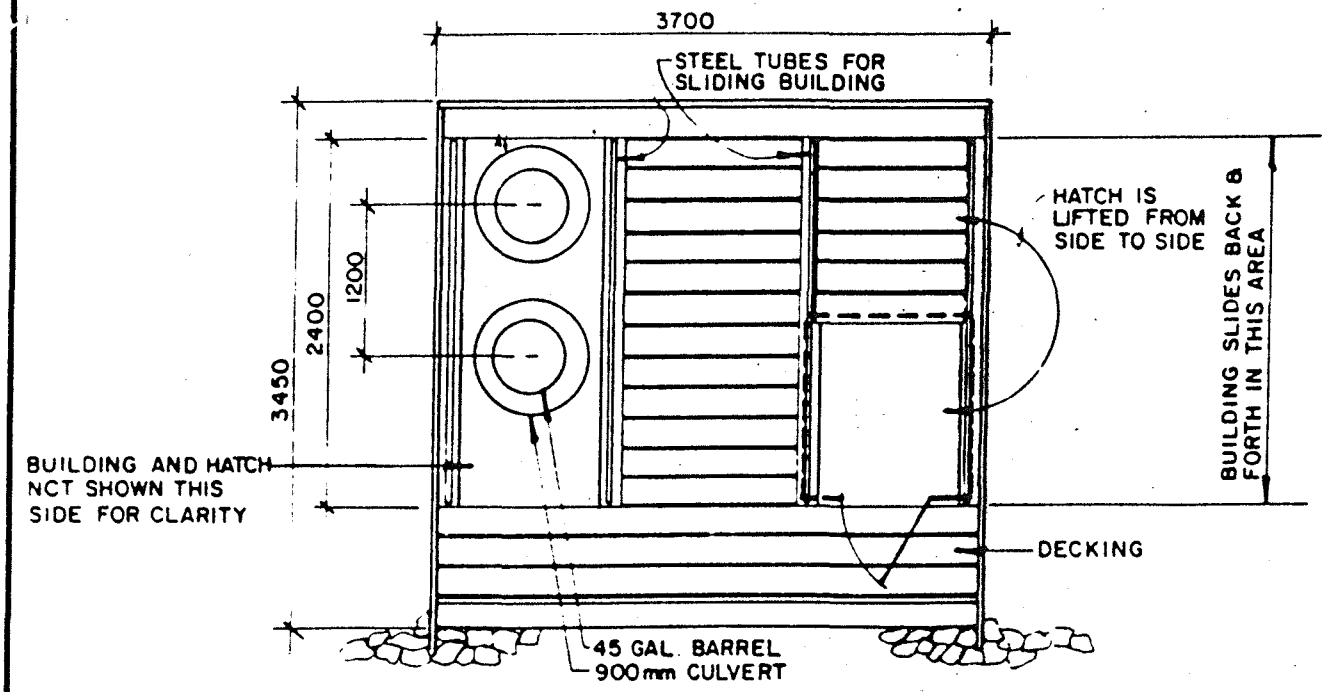
Reed, S., W. Ryan, J. Cameron and J.R. Bouzoun. 1984. On-site Utility Services for Remote Military Facilities in Cold Regions. U.S. Army Cold Regions Research and Engineering Laboratory. Hanover, New Hampshire, 03755.

8.0 Appendices

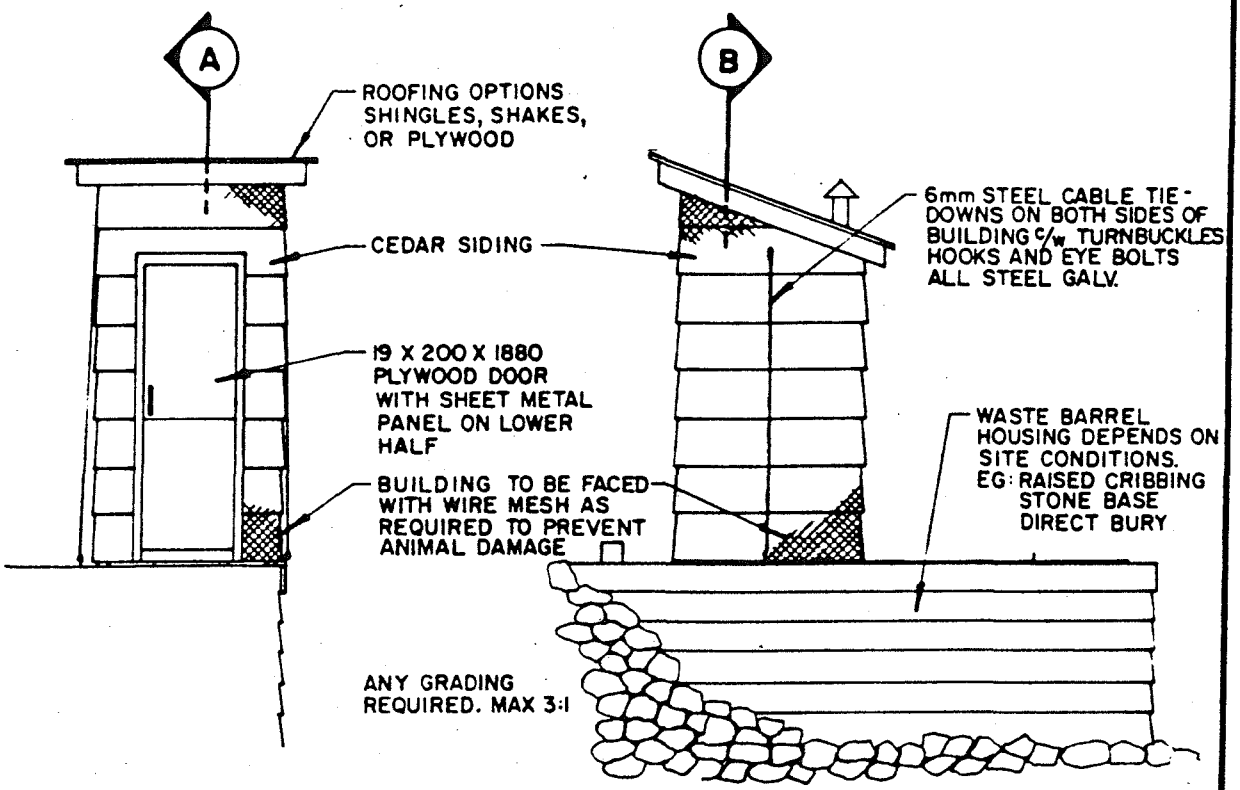
Appendix:

8.1 Design for fly out Barrel Pit Privies.

Appendix 8.1
Design for Fly out Barrel Pit Privies.



PLAN



FRONT ELEVATION

SIDE ELEVATION

project: PIT PRIVY - Helicopter Waste Removal

drawing: Plan and Elevations

Environnement Canada / Environment Canada
Parcs / Parks

scale: N·T·S

All dimensions in millimetres unless noted

sheet no: 1 of 3

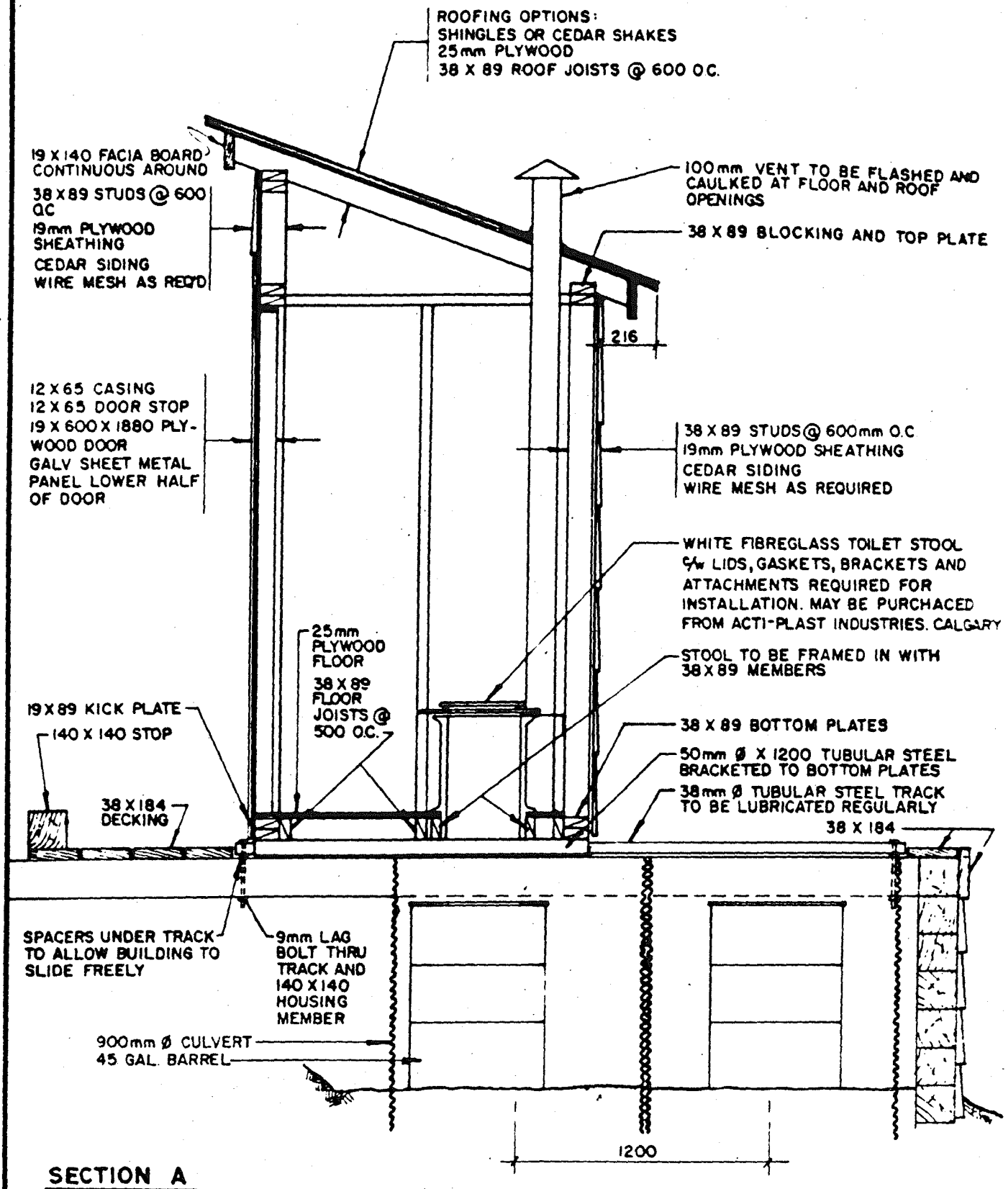
plot type: 4·3

reference: 4·63

drawn by: A·SEWALL

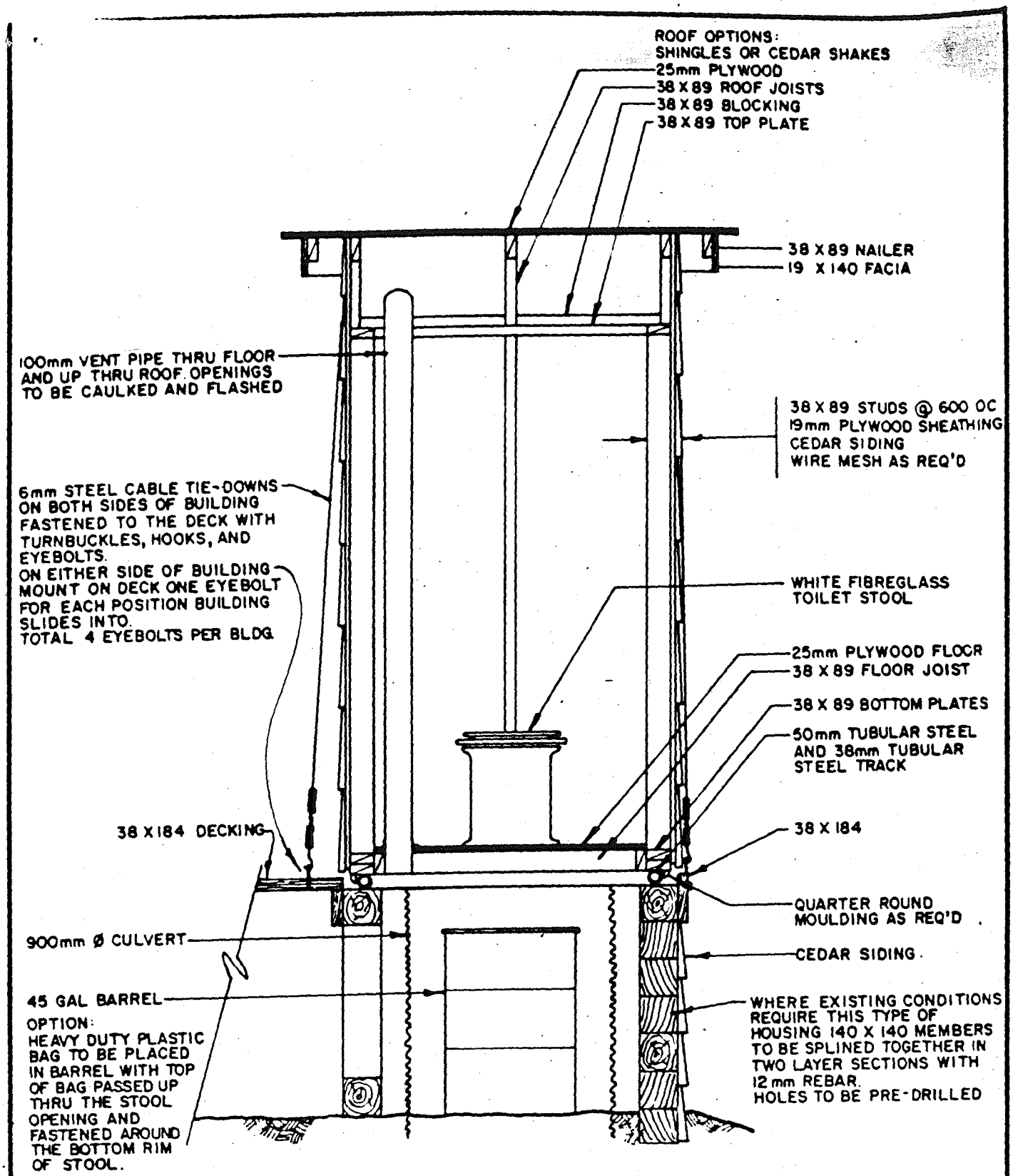
date: AUG 1986

Engineering & Architecture



SECTION A

project: PIT PRIVY – Helicopter Waste Removal		Environnement Canada Parcs / Environment Canada Parks	
drawing: SECTION - A		scale: 1:20	sheet no: 2 of 3
ref. no.: 4.3	reference: 4.63		
	drawn by: A. SEWALL	date: AUG. 1990	Engineering & Architect...



SECTION - B

project: PIT PRIVY - Helicopter Waste Removal

drawing: Section - B

Environnement Canada / Parcs — Environment Canada / Parks

scale: 1:20

All dimensions in millimetres unless noted

sheet no: 3 of 3

file no: 4·3

reference: 4 · 63

drawn by: A. SEWALL

date: AUG · 1986

Engineering & Architecture

GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS:

B. ROAD DUST CONTROL

Natural Resource Conservation
Prairie and Northern Region

Environmental Assessment Report 91 - 1B/PNR

by:
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March 1991

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1.0 INTRODUCTION

The use of oil and chemicals to control dust on unpaved roads is an environmental issue. Environmental effects from the use and run off of these products versus their effectiveness and the necessity of their use, is a major conern.

The prevention of deleterious effects from chemical runoff and associated effect on natural resources are of the utmost importance in national parks.

This report compiles available environmental information on a number of dust control agents. Included are mitigative measures and considerations associated with the application of dust control agent.

This report is to be used as a guide when preparing a class screening report, on the use of dust control agents and their application at the park level.

2.0 USE OF THIS GUIDELINE

This report is not an environmental screening. It is a list of environmental standards and information that will be used in preparing class screening reports.

Mitigative measures are provided. These are considered to be the minimal measures to avoid and reduce possible environmental effects. These mitigative measures do not address site specific concerns. Site specific mitigations must be included in all screenings. A screening format and a checklist of environmental parameters subject to impact are presented in the first section (EA91-1/PNR) of this report and should be used for reference purposes.

3.0 PRODUCT INFORMATION

Product information presented is meant to be used as a general indication of environmental suitability.

Most producers are not required to provide specific composition or toxicology information on their products. There are few environmental impact studies published in journals on these products. Thus, the environmental effects presented are based on limited information and this must be taken into account by the user.

3.1 Hydrocarbon base

This is a large group of oil-based products. The main component in these products is either asphalt or non-refined crude oil.

3.1.1 Hydrocarbons in general

Studies have indicated that as much as 99% of road oils are lost to evaporation, adhesion to vehicles, dust transport, biodegradation and runoff. The proportion of oil lost to each of these factors could not be determined (Yee, et al 1980).

The effects of heavy metals in used oils may be more important than the oil itself (Yee, et al 1980). An additional concern is that oils used on road surfaces can contain up to a maximum of 5 ppm of PCB's by liquid weight (Sec 5(2) PCB Interm Order of the Canadian Environmental Protection Act, Sec 35, Febuary 23,1989).

3.1.2

PRODUCT: S.S.1 (trade name)

COMPOSITION: 57% Asphalt - distillation of crude oil
? % Emulsifier - wood resin
1 % Fuel oil - diesel

TOXICITY: No information is available from the producer.

Volatile material is given off (Environmental Protection 1989).

Hydrocarbons act as a herbicide (stomata affected) on ornamental vegetation (Forestry Canada 1989).

APPLICATION: S.S.1 is usually diluted 5:1 with water for the control of dust and applied three times per year in most locations. The typical rate of spread is 2.26 l/m^2 (0.5 gal/yd^2). It is sprayed onto the road surface as an aqueous solution.

This product is in a continuous aqueous solution. The supplier states that once the aqueous solution evaporates, no runoff is possible. However, no literature can be provided to back this statement up.

STORAGE: The supplier delivers this product and the purchaser carries out the application. This product is stored in tanks and must be used up prior to freezing.

ROAD: The road surface should be graded prior to application.

RESULTS: This product keeps the dust down. It is effective in areas with low speed limits, however three applications per year are required on heavily used areas.

PRODUCERS:

Pounder Emulsions
Box 5734 Station L
21st- 103 Ave
Edmonton, Alberta
403-467-2214

Head Office
Pounder Emulsions
806 50th Street west
Saskatoon, Sask.
306-934-1500

Koch Material Company
7404-30th Street. S.W.
Calgary, Alberta.
T2C 1M8
403-234-5000

SUPPLIER: Supplied by producers.

Prepared March 1990.

3.2 Non-Hydrocarbon Base

3.2.1 PRODUCT: CALCIUM LIGNOSULFONATE

This is a by-product of the pulp industry. It is composed of spent sulfite liquors of wood sugars and lignin. The lignins are water solubilized by Calcium based pulping liquors to form Calcium based lignosulfonates.

Calcium Lignosulfonate is produced by two different companies in the western United States. Georgia-Pacific supplies the product from soft wood process. This product is available in British Columbia, Alberta and Saskatchewan. Flambeau Paper supplies the product from a hard wood process. This product is available in Manitoba and Ontario.

COMPOSITION: By Volume (Flambeau Paper)

<1 %	Calcium Sulfate
4.4%	Calcium (approximate)
2.4%	Sodium (approximate)
5 %	Sulfur (approximate)
30 %	Sugars (approximate)
55 %	Calcium lignosulfonate (approximate)

(Flambeau Paper Corp. 1988)

By Volume (Georgia-Pacific)

80.0%	Calcium lignin sulfonate
8.5%	Methoxyl
7.2%	Reducing sugars (glucose)
4.9%	Calcium (soluble)
0.2%	Sodium
1.5-2.0%	Insolubles ($CaSo_4.2H_2O$)
4.5	pH

Physical Properties (Georgia-Pacific)

28	Bulk density (powder), lb/ft^3
100	Powder size (100 mesh), %
1.25	Specific gravity (liquid), 25°/15°
290	Ingition temperature, C°
8100	Heat of combustion, BTU/lb solids

(Georgia-Pacific Corp. 1989)

Analysis of one sample (Flambeau paper)

61.08%	Solids
8.68 %	Methoxyl (solid)
5.08 %	Ksolids
1:2	Ration max/min
1.21 %	Phenolic OH (solids)
0.36 %	Chloride (solids)
0.30 %	Sulfate as sulfur (solids)
3.63 %	Calcium (solids)
0.31 %	Sodium (solids)
0.11 %	Potassium (solids)
7.68 %	Ash (solids)
1.06 %	Acetic acid
0.0 %	Formic acid
4.93 %	Total sulfur as sulfur (solids)
4.63 %	Sulfonic sulfur as sulfur (solids)
5.91 %	Gluconate (solids)
29.12%	Reducing sugars (solids)
33.10%	Reducing sugars, post hydrolysis (solids)

2.3 % remaining material is likely aldonic acids other than gluconate, sugar sulfonic acids, or non-hydrolyzable polysaccharides.

(Chem-Lig International, Inc. 1988)

IMPACTS:

Water: No data available. A three year study is in progress, preliminary results are not available. This study is being carried out with Flambeau Paper's product.

Fish: #LC_{50} 4,250 ppm (96hr) for juvenile Rainbow Trout. (Hann R.W. and PA. Jensen 1977).

B.O.D: No data available.

#LC_{50} is the lethal concentration which is fatal to 50% of the test population.

Soil: Calcium Lignosulfonate (Flambeau Paper product) will not sufficiently bind with road bed material if the proportion of clay in the road bed is not approximately 15% (Tomczak 1990). Georia-Pacific states that the fines content in the road bed does not effect the binding capability of its product. If binding does not occur, this dust control agent will run off. Sulfur and Sodium are both present in this product. The effects of run off have not been published and are not available to date.

Possible effects of runoff of this dust control agent are:

Sulfur added to the soil is acted on by bacteria. The bacteria changes the sulfur into sulphate. When water reacts with sulphate, sulfuric acid is produced. This will increase the acid level of the soil. A number of factors will influence the final acidity in the soil. Calcium is present in this product and may be available to buffer any acid produced. The repeated addition of sulfur can result in damage or death to vegetation in three to four years (Forestry Canada 1989).

Sodium can break down soil and seal it off, creating surface pooling and increased runoff.

Dioxin: Calcium Lignosulfonate (Flambeau Paper's product) has been tested for the presence of dioxin. The test results indicate no presence of dioxin at the detection level of 0.300 NG/GM. The parameters tested for, were 2,3,7,8-TCDD (metaTrace 1988).

pH: Flambeau's product can be purchased with a pH of 6-7.5. Most of the product lines are available with a pH of 3-5. If this product is used it should be purchased by the name of "Flamsperse N.S." with a pH of 6-7.5.

Georgia-Pacific's product comes in a pH of 4.5.

Vegetation: Data not available.

Wildlife: No information is available for wildlife.

Both Georgia-Pacific's and Flambeau's products have been approved by the Food & Drug Administration for use as feed ingredients for domestic animals. It has been approved to replace 11% of liquid or 4% of dry feed.

Aesthetics: This product will run off if it does not bind with the road bed material. Riding Mountain National Park has found a great deal of runoff after application to be red and brown in colour.

APPLICATION: The supplier will transport and spread this dust control agent with their own equipment and personnel.

This product requires a total quantity of 2 l/m^3 of road. The product is diluted to a 25% to 50% solution. For the best binding results, the road surface must be wetted down prior to application. A water truck should run directly in front of the applications truck.

ROAD: Grading the road is required prior to application of this dust control product.

RESULTS: An average of 15% clay content is required in the road bed material for this product (Flambeau Paper's product) to be effective. Road beds with less or more fines decreases the effectiveness of this product and reduces its binding capability (Tomczak, 1990).

Georgia-Pacific states that the percent of fines in the road bed is not a determining factor to their product's effectiveness.

Riding Mountain National Park (General Works and Warden Service) has tried this product (Flambeau Paper) and has recommended against its use.

PRODUCER: Flambeau Paper Corporation
Park Falls
Wisconsin, 54552
U.S.A.
715-762-5235

Georgia Pacific Resins, Inc.
1754 Thorne Road
Tacoma, Washington
98421
206-733-4410

SUPPLIER: Machenzie and Feimann Ltd.
12835-146 Street
Edmonton, Alberta
T5L 2H6
403-451-9222

Prepared March 1990.

3.2.2 PRODUCT: **CALCIUM CHLORIDE**

IMPACTS:

Water: Prevent entry into water *

Fish: #TL50 10,650 mg/L (96hr) Sunfish *
TL50 13,400 mg/L (96hr) Mosquito Fish *
(Waite 1990).

B.O.D: No information.

Corrosive: Slightly *

Soil: There is concern of ion exchange if Sodium has been applied in the past (road salting). Calcium will displace Sodium and may cause high levels of Sodium in road side soil and water. Sodium binds with soil and reduces permeability. This is very detrimental to the associated vegetation (Forestry Canada 1989).

Vegetation: Chloride is accumulated in leaves. Damage is visible as early colour change. Repeated use of Chloride (salt) for control of road ice will cause eventual death of trees in four to five years. Coniferous trees are affected more quickly than deciduous trees (Forestry Canada 1989).

Calcium Chloride is applied as a road stabilizer at a much lower concentration then as a de-icer. Thus, the effects of Chloride on vegetation will take longer to manifest.

The concentration of Calcium Chloride applied that will result in negative impacts is dependent on surface drainage, soil types, runoff rates and road bed condition.

* - From $CaCl_2$ facts sheet provided by Canadian Parks Service, Natural Resources Branch, Ottawa.

- TL_{50} the concentration in mg/L in water at which 50% of the test population will show abnormal behavior (including death).

Wildlife: Moose and White-tailed deer are not attracted to Calcium Chloride if applied as an aqueous solution (Fraser and Reardon 1980).

Attraction may occur if used on areas previously treated with Sodium Chloride sand mixture. This is a result of ion exchange and accompanying Sodium release (Damas and Smith 1982).

Aesthetics: Road side vegetation effected by Chloride will eventually turn brown and die.

APPLICATION: This product is applied in an aqueous solution. The best results are obtained if this product is applied on a damp road bed. This maximizes absorption and minimizes runoff. The supplier provides application. The application rate is 1.51 L/m^2.

STORAGE: Storage is not required as suppliers usually transport and apply this dust control agent.

ROAD: Limited preparation work would be required by the Park. This product works best with between 5%-10% fines in the road bed.

RESULTS: Riding Mountain National Park has had poor results due to the lack of fines and clay in the road bed material.

PRODUCER: General Chemical Canada Ltd.
230-10711 Canibie Rd.
Richmond B.C.
1-800-668-0433
604-936-7272

SUPPLIER: Same as producer.

Edmonton, Alberta
Doug Maynes
403-464-6836

Bill Hackman
Brandon, Manitoba.
204-727-7605

Prepared March 1990.

3.2.3 PRODUCT: **MAGNESIUM CHLORIDE**

IMPACTS:

Water: Prevent entry into water.

Fish: No information.

B.O.D: No information.

Corrosive: Slightly *.

Soil: Magnesium is a very similar element to Calcium and will displace Sodium in soil. However, Magnesium Chloride is slightly less soluble than Calcium Chloride *. There is concern of ion exchange if Sodium has been applied in the past (road salting). Magnesium will displace Sodium and may cause elevated levels of Sodium in road side soil and water. Sodium binds with soil and reduces permeability. This is very detrimental to the associated vegetation (Forestry Canada 1989).

Vegetation: Chloride is picked up and accumulated in leaves. Damage is visible as early colour change. Repeated use of Chloride in the salt form will cause eventual death of trees in four to five years. Coniferous trees are affected more quickly than deciduous trees (Forestry Canada 1989).

Magnesium Chloride is applied as a road stabilizer at a much lower concentration than salt de-icer. Thus, the effects of Chloride on vegetation will take longer to manifest themselves.

Wildlife: The attraction of ungulates to Magnesium Chloride is unknown.

Attraction will occur if used on areas previously treated with Sodium Chloride sand mixture. This is a result of ion exchange and accompanying Sodium release (Damas and Smith 1982).

* - Information provided by Canadian Parks Service, Natural Resources Branch, Ottawa.

Aesthetics: Road side vegetation effected by Chloride will eventually turn brown and die.

PRODUCER: Information not available.

SUPPLIERS: Information not available.

Prepared March 1990.

3.3 PRODUCT: **WATER**

IMPACTS:

Fish: Impacts associated with withdrawal of water from natural water bodies.

Other: Impacts associated with vehicle access to rivers.

APPLICATION: Water is sprayed onto the road surface. This method of dust control is most commonly used during road construction.

ROAD: No preparation is required.

RESULTS: Dust is controlled for a short period of time. The effectiveness is dependent upon temperature and weather conditions.

3.4 PRODUCT: **THE USE OF NOTHING**

Not using a dust control product is strongly recommended for roads with limited traffic use.

IMPACTS:

Vegetation: Dust plugs up stomata pores in the leaves of plants. Precipitation will wash most of the dust off the leaves. The effects of dust are not long lasting if precipitation is regular (Forestry Canada 1989).

Aesthetics: Dust may cover vegetation along the road side. While this may not be aesthetically pleasing, the direct and cumulative effect on park resources is less and therefore preferred.

Public Safety: Visibility reduction resulting from traffic on roads not treated with a dust control product may pose a public safety concern.

4.0 APPLICATION OF AGENTS

Considerations

The use of any product to control dust must be justified (need verses potential environmental effect). The long-term environmental effect and costs of chemical agents should be considered and compared with those of asphalting. The alternative of not using dust control on roads that have limited use is strongly recommended.

Mitigation:

4.1 Contractor's terms of reference or specifications will reflect all the mitigative measures outlined in this report.

4.2 The contract will not be considered completed, until the work site and any required clean up has passed final inspection by the project Surveillance Officer.

4.3 The contractor must provide a spill contingency plan for all fuels and chemicals. This plan must be reviewed and will be considered as part of the mitigative measures and specified on the Environmental Screening. As such it must be approved by the park superintendent as part of the Screening.

4.4 Material and hand tools as outlined in the contingency plan must be at the work site to contain and remove any chemical spill.

4.5 All spills (small and large) must be reported to the Surveillance Officer or the Warden Service immediately.

4.6 Prior to commencement of work by a contractor a meeting of all personnel working on the project and the Surveillance Officer is required. The meeting will include a review of the environmental screening and applicable National Park Act and regulations. This meeting should take approximately one hour.

4.7 Fuel supplies and refuelling can be a major source of water contamination. Therefore all fuel supplies must be located and used at least 200 metres from any water course. The quantity of fuel and number of storage locations must be minimized.

4.8 All equipment and vehicles will be restricted to the road surface and pullouts. Vehicles are not allowed off the road unless prior arrangements have been made and mitigative measures are in place.

4.9 All equipment and vehicles must be in good maintenance. A maintenance check of vehicles and equipment prior to entering the park is recommended. Repairs of equipment and vehicles will be restricted to the park compound area.

4.10 During road preparation, do not push soil and gravel loosened during grading into ditches or water bodies.

4.11 Do not apply any chemical dust control product if any precipitation is anticipated within three days.

4.12 Road surface must be damp prior to the application of agents. The use of a water truck to dampen the road surface may be required. This will maximize absorption and minimize runoff.

4.13 The application of any dust control product will be stopped if wind is blowing the product as a spray, mist or solid off the road surface which is to be treated.

4.14 Reduce application rates of dust control products near water bodies to prevent excessive runoff.

4.15 No dust control product will be applied on roads within 300 metres of a water body.

4.16 Alternative dust control measures such as paving road sections within 300 metres of a water course should be considered.

4.17 The application truck will not be parked within 300 metres of any water.

4.18 * The location for refilling equipment with chemicals must be designated in the environmental screening. This location must be delineated in the field. It is preferred that all the chemicals required for use are premixed and ready, prior to arriving in the park.

4.19 * If required, the location for withdrawal of water from water courses must be designated in the environmental screening. This must be delineated in the field.

4.20 * The withdrawal of water from water courses must be evaluated for possible effects on spawning, fish species in the area, waterflow and sediment entrainment.

4.21 * The withdrawal of water should be restricted to larger rivers and lakes.

* - Indicates Site-specific Evaluation and Mitigations Required.

4.22 The withdrawal of water shall not impair or reduce stream flow.

4.23 The water intake hose must be protected (screened) so as to prevent entry of streambed material, fish and other organisms.

4.24 * If off-road use is necessary for the uptake of water then site specific mitigations will be required.

4.25 The water intake hose must be long enough so that the vehicle will not be driven close to the banks of any water body.

4.26 Application in excess of rates of spread recommended by the manufacturer will not be permitted.

4.27 The application of the dust control product must be restricted to avoid over spraying.

4.28 Application should be concentrated to the centre and crown of the road surface.

4.29 Spillage and excessive usage must be prevented to minimize water quality impairment and impacts on vegetation.

* - Indicates Site-specific Evaluation and Mitigations Required.

5.0 MONITORING

A monitoring plan is required in order to determine the effectiveness of the dust control product and mitigative measures. Resource impacts must be monitored for short and long-term effects. This monitoring may be run in conjunciton with a de-icer monitoring program.

The monitoring plan should be specified in the environmental screening and should include; objectives, methodology, implementation, scheduling, responsibilities and a forecast of PY and $ requirments.

Environmental perameters to be monitored will depend on the product used. Resource Conservation staff (PNRO) as well as Forestry Canada, Inland Waters Directorate and Environment Protection can be contacted to provide information and services when preparing a monitoring plan.

6.0 REFERENCES

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GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS:

C. ICE CONTROL

Natural Resource Conservation
Prairie and Northern Region

Environmental Assessment Report 91 - 1C/PNR

by:
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R3B 3E8

March 1991

TABLE OF CONTENTS

1.0 INTRODUCTION

The use of salt for ice control on roadways in national parks is a commonly repeated maintenance function that requires environmental screening. It is impracticable for a screening to be prepared and submitted each time this function is to be repeated. This report has been prepared to help alleviate this conflict.

The purpose of this report is to provide an information base that can be used to produce a yearly road ice control plan and environmental screening.

Environmental information has been collected on a number of different de-icing agents. This information is presented to help in the selection of an ice control agent which is effective and posses the least potential for environmental impact. Mitigative measures associated with the storage and application of ice control agents are provided.

2.0 USE OF GUIDELINE

This report is not an environmental assessment screening. It is a list of environmental standards and information that will be used in preparing class screening reports.

Mitigative measures are provided. These are considered to be the minimal measures to avoid and reduce possible environmental effects. These mitigative measures do not address site specific concerns. Site specific mitigations must be included in all screenings. A screening format and a checklist of environmental parameters subject to impact are outlined in the first section (EA 91-1/PNR of this report and should be used for reference purposes.

3.0 PRODUCT INFORMATION

3.1 PRODUCT: **CALCIUM CHLORIDE**

IMPACTS:

Water: Prevent entry into water*

Fish: #TL_{50} 10,650 mg/L Sunfish*
TL_{50} 13,400 mg/L Mosquito Fish*
TL_{50} 5,000 mg/L (ppm) most fresh water fish (Waite 1990)

B.O.D: No information

Corrosive: Slightly*

Calcium is often mixed with Sodium Chloride for de-icing roads. An ion exchange will occur and Calcium will displace Sodium in the soil. The displaced Sodium will bind the soil and reduce permeability. This is very detrimental to the soil structure, nutritional balance and associated vegetation. (Forestry Canada 1989)

Vegetation: Chloride is picked up and accumulated in leaves. The uptake of Chloride by vegetation is greater when associated with Sodium than with Calcium. Damage is visible as early colour change in the following year. Repeated use of Chloride will cause eventual death of trees in four to five years. Coniferous trees are effected more quickly than deciduous trees (Forestry Canada 1989).

The concentration of Calcium Chloride that will result in negative effects is dependent on surface drainage, soil type, runoff rate, road bed condition and the cumulative effect of repeated use.

* - From $CaCl_2$ facts sheet provided by Canadian Parks Service, Natural Resources Branch, Ottawa.

- TL_{50} is the concentration in mg/L in water at which 50% of the test population will show abnormal behavior (including death).

Wildlife: In a selection study, moose and whitetailed deer showed no attraction to a pure aqueous solution of Calcium Chloride (Fraser and Reardon 1980).

Moose have been attracted where solid Calcium Chloride was spread on roads which had been treated with a Sodium Chloride mix the previous year. This is most likely the result of an ion exchange and accompanying Sodium release which will attract ungulates (Damas and Smith 1982)

APPLICATION: This product is applied in a solid form. A mixture with Sodium Chloride and a sand abrasive is usually used.

STORAGE: This product is usually stockpiled separately or in a mixture with abrasives. It is a very soluble product and, hence, leaching is a concern.

Calcium Chloride should be stored in an area away from sensitive vegetation, surface water and ground water. It should be contained in a shed or building which prevents precipitation from falling on it. An impermeable base and loading apron should be used.

EXPENSE: This product is more expensive than Sodium Chloride.

RESULTS: Calcium Chloride is effective as a de-icer to a temperature of -15°C to -18°C.

Prepared March 1990.

3.2 PRODUCT: **SODIUM CHLORIDE**

IMPACTS:

Water: Sodium is soluble in water. The repeated use of this product has resulted in pollution of groundwater, shallow aquifers and surface water in North America.

Fish: TL_{50} 5,000 mg/L (ppm) for most fresh water fish (Waite 1990).

B.O.D: Information not available at this time.

Soil: Sodium binds with the soil and reduces permeability. This is very detrimental to the soil structure, nutritional balance and associated vegetation (Forestry Canada 1989 1990).

Vegetation: Chloride is picked up and accumulated in leaves. The uptake of Chloride by vegetation is greater when associated with Sodium than with Calcium. Damage is visible as early colour change, the following year. Repeated use of Chloride will cause eventual death of trees in four to five years. Coniferous trees are effected more quickly then deciduous trees (Forestry Canada 1989).

Wildlife: Ungulates are attracted to Sodium. The application of Sodium Chloride in areas of ungulates will likely result in the use of the road, roadside soils and melt water pools as mineral licks (Fraser and Thomas 1982).

The attraction of wildlife to the road side has a strong potential for increasing wildlife mortality which also results in a public safety hazard.

APPLICATION: This product is applied in a crystalline form. It is used alone or in conjunction with Calcium Chloride and/or abrasives. Pre-wetting this salt will reduce the volume required.

When used by itself this product is effective to a temperature of -4°C.

STORAGE: This product is usually stockpiled separately or in a mixture with abrasives. It is a very soluble product and hence, leaching is a concern.

Sodium Chloride should be stored in an area away from sensitive vegetation, surface water and ground water. It should be contained in a shed or building which prevents precipitation from falling on it. An impermeable base and loading apron should be used.

EXPENSE: This product is inexpensive in comparison to other available ice control agents.

RESULTS: Sodium Chloride is effective to a temperature of -4°C.

Prepared March 1990.

3.3 PRODUCT: **CALCIUM MAGNESIUM ACETATE (CMA)**

IMPACTS: The Federal Highways Authority of the U.S.A has published an environmental impact study of this product (Manning 1990). Information provided on this study indicates no significant environmental impacts. This documentation has been ordered by Canadian Parks Service, Natural Resources Branch in Ottawa, for review.

Water: Conclusive information is not available at this time.

B.O.D. Acetate is organic and is decomposed by bacteria, reducing potential for biochemical oxygen demand (Pianca 1984).

Soil: Normal CMA solution has been reported to have the potential to remove significant amounts of Iron, Aluminium, Sodium, hydrolyzable othophosphate and Potassium from soil (Pianca 1984).

Vegetation: CMA, when compared to Sodium Chloride, has been reported to be less or equally damaging to vegetation (Pianca 1984).

APPLICATION CMA is applied in a solid form. In test studies CMA has been used effectively as a 10% mix with sand. It is applied at a ratio of 1.5 to 1.7 times the application rate of salts (Manning and Crowder 1988). It has been as effective as salt at temperatures of -9°C. Preliminary results indicate its effectiveness to be less than salt at -12°C (Perchanok 1990).

STORAGE: This product should be stored in a cool dry shed. An impermeable base and loading apron should be used.

EXPENSE: This product is supplied by Chevron for approximately $1,100. to $1,300. per Ton. The Ontario Ministry of Transportation is looking into producing CMA for $300. to $500. per Ton. They have estimated the real cost (production, corrosion, bridge damage etc.) of salt at approximately $400 per ton (Perchanok 1990).

RESULTS: Preliminary use indicates this product to be as effective as salt. There are indications that it may cause corrosion of steel in concrete bridges. Conflicting reports on the environmental effects of this product should be clarified prior to its use.

Prepared March 1990.

3.4 PRODUCT: **UREA**

COMPOSITION: This product is derived from the fertilizer industry and is composed of;

46% Nitrogen
0% Phosphate
0% Potassium
54% Carbon, Oxygen, Hydrogen

The formula for urea is NH_2CONH_2

IMPACTS:

Fish: Information is not available.

B.O.D: Information is not available.

Soil: An over application of Nitrogen will affect the nutrient balance of soil (Forestry Canada 1990).

Vegetation: An over-application of Nitrogen will affect the nutrient balance of vegetation. In addition it can delay dormancy and increase the susceptibility of trees to freezing. (Forestry Canada 1990).

The accumulation of Nitrogen along the roadside will increase growth of vegetation. This may result in additional or a more frequent cutting operation. It may also have an effect of the growth rate or prevalence of exotic species.

Wildlife: The induced vegetation growth along the roadside resulting from the addition of nitrogen may attract wildlife.

APPLICATION: Urea is most effective as an anti-icing agent. If applied prior to freezing rain or snow, it is effective in keeping a road surface free of ice to a temperature of -20°C (Armstrong 1990).

As a de-icer urea's effectiveness is variable. It is effective to a temperature of -5° to -6°C. On a sunny day it can be effective to -10°C. As a de-icer, urea is slow acting and the time from application to melting depends upon weather conditions (Armstrong 1990).

STORAGE: This product should be stored in a area away form sensitive vegetation, surface water and ground water. Urea can be purchased in one ton plastic bags or in bulk. It must be kept in a cool dry place, otherwise it will clump together. It should be contained in a shed or building protected from precipitation. An impermeable base and loading apron should be used.

EXPENSE: Expensive in comparison to the Chlorides.

RESULTS: Canadian International Airports use urea exclusively for ice control. Winnipeg International Airport has not experienced any Nitrogen damage to grasses with their spread rate (Armstrong 1990).

Prepared March 1990.

3.5 Choosing De-icers

Considerations

- Urea and CMA appear to be reasonable alternatives to the use of Chloride de-icers. However, little is known about the environmental effects of these products. The Chloride de-icers have a number of known detrimental effects. A lack of information and direction on the use and effects of de-icers exists.

- If a Chloride based de-icer is opted for, then Calcium Chloride should be used. Calcium Chloride poses less of an environmental effect than Sodium Chloride. Evidence indicates that the up take of Chloride by trees is less when associated with Calcium than with Sodium. Sodium will damage soil structure and poses more of an attraction to wildlife.

- The mixing of Calcium Chloride and Sodium Chloride should be avoided.

- Different application rates should be monitored for effectiveness. The minimum application rate which will produce an affective result should be used.

- If a salt-based de-icer is chosen then it should be mixed with an abrasive to reduce the quantity of salt required.

- Chemical de-icers must be restricted to portions of roads which are dangerous or steep.

- Abrasives should be used on corners and steep sections of roads whenever possible to avoid the use of chemicals.

- The storage of chemicals must prevent leaching and spillage.

4.0 USE OF CONTROL AGENT

Mitigations

Storage

4.1 * The storage site should be at a location with minimal possibility of impacts to groundwater, surface water, vegetation, soil and wildlife.

4.2 Ice control products must be stored in a dry shed to prevent leaching into the water table, and entry into surface runoff.

4.3 Loading area at the storage facility should have an impervious apron (asphalt).

Application

4.4 * The application of ice control products should be limited to hazardous locations on main travel routes, ie. intersections, steep hills, dangerous corners.

4.5 Although bridges are a high ice hazard area, ice control products should not be applied within 300 metres of water. Abrasive material (sand), rather than chemicals should be used on bridges.

4.6 Spreading equipment should be kept in good calibration so that it spreads only the prescribed amount of ice control product.

4.7 Calibration of equipment should only be done, or supervised by fully trained personnel.

4.8 The proportion of ice control product in an abrasive mix should be kept to the minimum amount required for effective ice control.

4.9 Early snow removal on hazardous portions of roads should be part of a planned strategy. This will reduce the hazard and decrease the volume of chemicals required for de-icing.

4.10 The application of control agents and abrasives should be restricted to the travelled surface of the road.

4.11 Sand is not to be broadcasted into water bodies while working on bridges or roads adjacent to water bodies.

* - Indicates Site-specific Evaluation and Mitigations Required.

Clean-up or Removal of Snow

4.12 Storage areas and road surfaces where salt and sand has accumulated, must be cleaned up immediately following spring melting.

4.13 * Accumulated snow that may be contaminated with ice control agents should only be disposed of at approved dump sites.

4.14 * Dump sites for snow should be located so as to minimize the possibility of impacts to groundwater, surface water, wildlife and aquatic communities. Possible areas for dump sites include old gravel pits with a deep groundwater table.

4.15 Snow containing salt and/or sand will under no circumstances be dumped or allowed to melt and run off into watercourses or marshy areas.

4.16 Snow is not to be pushed into water bodies during snow removal.

4.17 Following snow plowing operations, snow banks along the roadside should be cleared back with a wing blade well beyond the road shoulder. This will reduce the time required for melting and will minimize spring saturation and erosion of the roadbed.

4.18 When winging back with a grader blade, caution should be used to prevent damaging young trees and other vegetation.

Monitoring

4.19 Portions of road, treated with a de-icing agent will be monitored for vegetation damage. Vegetation inspection should be carried out in the late spring and late summer. Forestry Canada should be contacted when developing a monitoring program.

4.20 Any standing bodies of water (marsh, pools, etc.) near an ice controlled portion of road should be monitored for salinity. Sampling should take place once after melt off and once in mid-summer.

4.21 * Different application rates could be tested to determine the optimal level for effectiveness and the least associated impact.

4.22 * The monitoring and testing programs should be reflected in the park's vegetation management plan.

* - Indicates Site-specific Evaluation and Mitigations Required.

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GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS

E. TREE TRANSPLANTING

Natural Resource Conservation
Prairie and Northern Region

Environmental Assessment Report 91- 1E/PNR

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March 1991

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Introduction

Trees are transplanted within national parks for landscaping and to clear right-of-ways, and by residences in some parks. The majority of tree transplanting projects are small and their occurrence is common. This type of project lends itself to the preparation of a class screening.

This guideline follows the same format as that of a standard screening. It may therefore be used as a basis for preparing a site-specific or class screening report.

Use of This Guideline

This report is not an environmental screening. It is a list of environmental standards and information that will be used in preparing class screening reports.

Mitigative measures are provided. These are considered to be the minimal measures to avoid and reduce possible environmental effects. These mitigative measures do not address site specific concerns. Site specific mitigations must be included in all screenings. A screening format and a checklist of environmental parameters subject to impact are presented in the first section (EA 91-1/PNR) of this report and should be used for reference purposes.

1.0 PROJECT DESCRIPTION

This project makes use of right-of-ways as a source of trees for transplanting in high visitor use area. There are three objectives. The first objective is to replace trees that have been cleared from campgrounds and other high visitor use areas. The second objective is to limit the possibility of introducing exotic genetic variance, and insects and diseases (nursery stock), by utilizing trees growing on right-of-ways with in the park. (ie. using right-of-ways as a natural or in-house nursery).

1.0.1 Area Affected

Trees will only be taken from road, railway and utility (powerline etc.) right-of-ways. Trees will be transplanted in previously disturbed high visitor use areas.

1.0.2 Zoning and Present Use

This project will be carried out in zone IV, Outdoor Recreation and zone V, Park Services, as defined by the National Park Zoning System (Environment Canada 1979).

Zone IV can accommodate a broad range of activities and related facilities. Outdoor recreation facilities, campgrounds, picnic areas and trailheads are found in this zone. Motorized access is permitted in zone IV.

Zone V contains a concentration of visitor services and support facilities with motorized access.

1.0.3 Site Description

Tree supply areas should be identified and the number of suitable trees of different species type in each supply area determined. Identified areas will be evaluated as to their biophysical characteristics and resources. The supply areas are along right-of-ways and are therefore located on disturbed lands. The degree of disturbance and its influence should be evaluated. Has it provided increased forage areas, increased or decreased flora and fauna populations, provided a rutting or birthing area.

1.0.4 Nature of Work

This activity involves the use of a hand shovel, backhoe or tree spade to extract trees to be transplanted. Trees will be extracted and transplanted when dormant. The type of equipment used will depend of the size and number of trees to be transplanted. (projects should be limited to only a few large trees and perhaps up to one hundred small [one metre

tall trees). A hole will be excavated for the tree to be transplanted into. The project will require a limited amount of machinery activity, fertilizer, mulch and soil. All holes will be filled in and covered to match the surrounding area.

If this guideline is used to produce a park-specific class screening, a upper limit should be set on the number and size of trees to be transplanted per project.

1.0.5 Time Considerations

The project must be timed to avoid disturbing fauna utilizing critical seasonal habitat.

The most effective time of year to transplant deciduous and coniferous trees is in the spring prior to green-up. Transplanting in the spring abates stress related to a change in climatic (and micro-climatic) regimes. When trees are transplanted or extracted in the fall rather than in the spring, they experience more stress due to desiccation. This additional stress will reduce the probability of a successful transplant (Forestry Canada 1990).

1.0.6 Information Gaps

- Past and present use of the project area should be summarized.

- The project's financial and person-year requirements must be outlined (not required for small projects of only a few trees).

- Person-year and finances required from environmental assessment personnel for the preparation, surveillance and monitoring of the project will be specified (required for all projects).

- Refer to the format for screenings and the checklist of impacts (presented in the first section (EA 91-1/PNR) of this report).

- Any possible gaps in information related to the project must be outlined.

2.0 NATURAL AND CULTURAL RESOURCES

Resources associated with the project will be described and the park zoning identified. The Park Conservation Plan, Resource Description and Analysis, biophysical and other publicatons should be utilized (referenced) to obtain resource information.

3.0. ENVIRONMENTAL EFFECTS

All environmental effects including cumulative impacts, are to be addressed. Approval of a project will be based on the evaluation of environmental effects. Each environmental effect will be categorized as;

1. insignificant or mitigable with known technology,
2. unknown,
3. significant

Environmental effects should be discussed under the following headings:

3.1 Preservation

3.1.1 Wildlife

- Project sites must be evaluated and any critical annual and seasonal fauna habitat identified (ie. nesting birds).

- Fauna which use critical habitat must be identified. All possible affects on the identified fauna must be explored.

- Look at: habitat use and change, migration routes, carrying capacities, trauma, rare and endangered species.

3.1.2 Vegetation

- Any trees effected by insects or disease should not be transplanted in areas which are not affected by the same insects or disease. An inspection for insects and diseases should be conducted in the project area.

- Look at: extent of vegetation damage, loss and change, habitat change, effects on wildlife, effects on landform and erosion, rare and endangered species, exotic species, aesthetics.

- This guideline is primarily concerned with small projects which make use of trees taken from within a park. If trees are supplied by a nursery they must be certified disease and insect free and their genetic background must be known (ie. source of seeds) and evaluated.

3.1.3 **Landform** (Geomorphology, Geology, Soils)

- Look at: erosion, compaction, organic change, soils, feature of special interest, aesthetics.

3.1.4 **Aquatic Resources**

- Look at: fisheries (habitat change/loss, populations affected, time boundaries for spawning and incubation), aquatic vegetation, hydraulic changes (flow rates, surface water changes, water quality, feature of special interest).

3.1.5 **Trans-Boundary Influences**

- Will the project have any affect on the distribution of insect and diseases?

3.2 **Pollution**

- Look at: land, water, atmosphere (air), toxic chemical compounds in land, water, air, hazardous wastes, human wastes, natural pollutants. Consider water tables, watersheds, prevailing winds, temperature changes, micro-climates, soil texture, subterranean faults.

3.3 **Cultural Features**

3.3.1 **Aesthetics**

- Look at: long and short term visual, sound and odour effects on park visitors and residents.

3.3.2 **Public Facilities and Services Affected**

- Look at: access, roads, trails, utilities, parking, recreational activities, etc.

3.3.3 **Public Safety**

- Look at: short and long term effects from traffic, road/trail designs, excavation sites, blasting, presence or introduction of natural or structural hazards.

3.3.4 **Historical Resources**

- Look at known or potential resources.

3.3.5 **Archaeological Resources**

- Look at known or potential resources.

3.3.6 **Socio-economic Impacts**

- Look at: lifestyles, property values, employment, special interest groups, quality of life).

4.0 MITIGATIONS

4.1 Wildlife

4.1.1 Projects must be timed so as to avoid disturbing wildlife utilizing critical seasonal habitat.

4.2 Vegetation

The methods used in transplanting are critical to the success and the eventual survival of the trees (vegetation impacts) and aesthetics, as such they are mitigative measures.

General

- A permit is required from the Warden Service. The requirement for a permit should be stipulated in the screening.

4.2.1 Use only trees indigenous to the site into which they are to be transplanted. Trees should be extracted from an area similar to that of the transplanting site (aspect, soil, drainage).

4.2.2 All trees to be extracted for transplanting must be inspected for insects and diseases. Larger trees in the area should be cored with an increment borer to detect fungal stain and decay in the wood. Information on the assessment of tree diseases and insects is available from Forestry Canada (Ives and Wong 1988; and Hiratsuka 1987).

4.2.3 Trees and shrubs will only be extracted from within the right-of-way identified as the supply area.

4.2.4 The supply area must be physically delineated in the field.

4.2.5 Trees should only be dug up and transplanted in the spring, prior to green-up. Trees should be dug up after the ground has stared to dry out and prior to green-up. This will become an important consideration when selecting the supply location.

Movement - Shipment

4.2.6 Ensure minimum time lapse between digging and planting.

4.2.7 Keep roots moist and protected from sun, wind and freezing.

4.2.8 Access routes, type of vehicles used and number of trips permitted will be stipulated.

Extraction of Trees

4.2.9 Use trees and shrubs with strong fibrous root systems free of insects, diseases and defects.

4.2.10 Trees less than 1.5 m in height may be dug with a shovel. Trees larger than 1.5 m should be extracted with a tree spade. If a tree spade is not available, medium size trees (up to about 2.5 m can be dug with a backhoe.

4.2.11 All trees must be dug with a root ball. The root ball must include 75% of the fibrous and feeder root system. Generally the root ball should be as wide and deep as the periphery of the trees branches (ie. drip line).

4.2.12 The root ball must be supported and protected. The use of a burlap bag is most often used for this purpose.

Excavation for Planting

4.2.13 Shrub beds: excavate a planting hole to a minimum depth of 50cm.

Individual shrub: excavate a planting hole to a minimum depth of 50 cm deep and 50 cm wide.

Small trees: excavate a planting hole 60 cm deeper and a diameter 30 cm greater than the root spread or root ball.

Large tree: excavate a planting hole at least 20 cm deeper and a diameter 75 cm greater than the root spread or root ball.

4.2.14 Loosen bottom of planting hole to a depth of 15 - 20 cm. Cover the bottom of each excavation with a minimum of 15 cm of topsoil mixture.

4.2.15 Insure the removal of all water in the excavated hole prior to planting.

4.2.16 Protect the bottom of the excavation from freezing.

Planting

4.2.17 Insure that no air spaces occur in planting soil around the transplanted tree (ie. tamp planting soil around root system in 15 cm layers to eliminate air voids). When the hole is 2/3 full, fill the hole with water. After water has completely penetrated into the soil complete backfilling.

4.2.18 Build a saucer (dam) with sides at least 10 cm deep around the outer edge of the hole (drip line), using topsoil. This will assist with maintenance watering.

Fertilizer

4.2.19 Soil should be tested to determine fertilizer requirements. For small projects the surface of the planting saucer should be dressed with organic 10-6-4 fertilizer at a rate of 12 kg/100 m^2 for shrub beds or 50kg/100 m^2 for trees. Mix fertilizer thoroughly with top layer of planting soil and water in well.

Tree Support

4.2.20 All transplanted trees (small and large) require support. Trees should be supported using wire (with watering hose around portion in contact with tree trunk) and secured to the ground by stakes or posts. Trees should be supported for a minimum of two years.

Watering

4.2.21 Transplanted trees should be watered once per week for the first four weeks and then sufficiently thereafter (accounting for rain fall) to maintain optimum growing conditions. Ensure adequate moisture in root zone at freeze-up.

Rehabilitation

4.2.22 The number and size of filled-in holes from the extraction of trees associated with a project of this scale is very small. It is recommended that the filled-in holes not be re-seeded, unless a certified indigenous seed mix is provided. This will reduce the likelihood of the introduction of exotic vegetation.

4.2.23 The use and access of vehicles will be specified and minimized. This will reduce the possibility of vegetation and terrain degradation and hence the requirement for rehabilitation.

4.3 Landform

4.3.1 Tree supply sites must be chosen in an areas with good surface drainage. This will help insure the area is dry in the spring prior to green-up, and allow for tree spades to be used off-road on the right-of-ways.

4.3.2 Equipment to be used must be identified in the screening. The use of all equipment and the areas in which they may be used must be approved and by the Warden Service.

4.3.3 Equipment will not be permitted in any area other than on the designated right-of-ways and supply sites.

4.3.4 All holes left after extracting trees or shrubs must be filled in. The holes must be filled in with material similar to that extracted and must be made to visually blend into the surrounding area. Material excavated at the transplant location should be used for this purpose.

4.4 Aquatic Resources

4.4.1 The extraction of trees will not be permitted within 300 metres of any water course.

4.4.2 Water used for watering transplanted trees will not be taken from any water course. The park's watering truck or private watering hose must be used. This should not pose any inconvenience as the transplanting areas will all be in high visitor use areas, which usually have some sort of water supply.

4.4.3 If the transplant area is close to a water body the use of fertilizers will not be permitted.

4.5 Trans-boundary Influences

Trans-boundary influences will only be applicable if tree stock from commercial nurseries are used for transplanting.

4.6 Pollution

4.6.1 Refuelling of equipment and vehicles will not be permitted at the tree supply and planting areas.

4.6.2 Equipment will not be serviced at the tree supply and planting areas.

4.6.3 The use of herbicides will not be permitted.

4.7 Aesthetics

4.7.1 Trees must be inspected two years after transplanting. All trees that are dead must be removed. If a large number of trees are in poor shape the transplanting program should be reviewed and changed.

4.8 Public Facilities and Services

4.8.1 The timing of the project should be such that it does not conflict with any public facility use. However, timing concerns related to wildlife and transplanting requirements should over-ride short term interruption of public facilities.

4.9 Public Safety

4.9.1 If equipment such as tree spades are used then traffic control flag persons may be required.

4.10 Historical and Archaeological Resources

4.10.1 The Regional Archaeologist or Historical Services must be informed if the project is in the vicinity of known or potential resources. The presence of any historical or archaeological resources must be identified and protective mitigative measures stipulated.

4.10.2 If any paleontological, historical or archaeological artefacts or features are encountered, all work will stop. The Surveillance Officer or Warden Service will be informed immediately. Work will not re-commence until the Surveillance Officer gives direct instructions to do so.

4.11 Socio-economic

4.11.1 The use of trees growing within the park will reduce the cost associated with using nursery stock. At the same time the National Parks Act and regulations will be met, which prohibit the introduction of exotic species, insects and diseases to the park.

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GUIDELINES FOR THE PREPARATION OF CLASS SCREENING REPORTS:

F. TREE CUTTING

Natural Resource Conservation
Prairie and Northern Region

Environmental Assessment Report 91 - 1F/PNR

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March 1991

Introduction

Periodically trees need to be cut down for management purposes in national parks. A number of parks have prepared screenings for various types of projects involving the cutting of trees.

This guideline follows standard screening format. It may therefore be used at individual parks as a basis for preparing site-specific or class screenings.

Use of This Guideline

This report is not an environmental screening. It is a list of environmental standards and information that will be used in preparing class screening reports.

Mitigative measures are provided. These are considered to be the minimal measures to avoid and reduce possible environmental effects. These mitigative measures do not address site specific concerns. Site specific mitigations must be included in all screenings. A screening format and a checklist of environmental parameters subject to impact are presented in the first section (EA 91-1/PNR) of this report.

1.0 PROJECT DESCRIPTION

This guideline relates to the cutting of trees to abate public safety hazards and for project developments.

Years of fire suppression has resulted in an aging tree stand, this is particularly true in and near high visitor use areas. As a result, insects and diseases in conjuntion with soil compaction and related hydrology changes are major factors in the structural weakening of trees. Trees that have been weakened are subject to failure and are susceptible to windfall.

Failure of trees can result in property damage, personal injury or possible death. Trees that have been assessed as being hazardous should be cut down as part of the parks public safety program (refer to assessment of tree hazard, appendix 6.1).

1.1 Site Description

Areas where trees will pose a hazard are found in zones IV, Outdoor Recreation and zone V, Park Services, as defined by the National Park Zoning System (Environment Canada 1979).

Zone V contains a concentration of visitor services and support facilities with motorized access. Visitor centres and some campgrounds are located in this zone.

Zone IV can accommodate a broad range of activities and related facilities. Outdoor recreation facilities, campgrounds, picnic areas and trailheads are found in this zone. Motorized access is permitted in zone IV.

Screenings (class or site-specific) require further site description information (more specific resource data, maps, site plans, photos).

1.2 Information Gaps

- The specific location of tree cutting (such as campgrounds and right-of-ways) must be specified.

- The required extent of cutting must be specified and justified (ie. number and species of trees).

- Past and present use of the project area should be summarized.

- Any plans to re-vegetate or transplant trees must be outlined at this point. Species and seed source information for transplant trees will be required.

- The project's financial and person-year requirements will be outlined.

- Person-year and finances required from environmental assessment personnel for the preparation, surveillance and monitoring of the project will be specified (required for all projects).

2.0 NATURAL AND CULTURAL RESOURCES

Resources associated with the project will be described and the park zoning identified. The Park Conservation Plan, Resource Description and Analysis, biophysical and other publications should be utilized (referenced) to obtain resource information.

3.0 ENVIRONMENTAL IMPACTS

All environmental effects including cumulative impacts, are to be addressed. Approval of a project will be based on the evaluation of environmental effects. Each environmental effect will be categorized as;

1. insignificant or mitigable with known technology,
2. unknown,
3. significant

Environmental effects should be discussed under the following headings:

3.1 Preservation

3.1.1 Wildlife

- The project area must be evaluated and any critical annual and seasonal habitat use by fauna identified.

- Fauna which use critical habitat must be identified. All possible affects on the identified fauna must be explored.

- The removal of trees will thin the forest canopy and may encourage more forage growth.

- Site-specific information and evaluation required.

3.1.2. Vegetation

- Any wood effected by insects or disease should not be transported to areas which are not affected by the same insects or disease. An inspection for insects and diseases should be conducted in the project area.

- The removal of trees should take into consideration effects on the understory communities and vegetation diversity.

- Site-specific information and evaluation required.

3.1.3 Landform

- Site-specific information and evaluation required.

3.1.4 **Aquatic Resources**

- Site-specific information and evaluation required.

3.1.5 **Trans-boundary Influences**

- Will the project have any affect on the distribution of insects and diseases?

3.2 Pollution

- Site-specific information and evaluation required.

3.3 Cultural Features

3.3.1 **Aesthetics**

The cutting of trees within campground areas will reduce cover and screening between campsites. This is seen as a negative effect (eg. loss of sound and visibility screening). Transplanting trees in sections of campgrounds and closing those sections for natural vegetation rehabilitation should be considered as a mitigation.

- Site-specific information and evaluations required.

3.3.2. **Public Facilities and Services Affected**

- Site-specific information and evaluations required.

3.3.3 **Public Safety**

- Site-specific information and evaluation required.

3.3.4 **Historical Resources**

- Site-specific information and evaluation required.

3.3.5 **Archaeological Resources**

- Site-specific information and evaluation required.

3.3.6 **Socio-economic Impacts**

- Site-specific information and evaluation required.

4.0 MITIGATIONS

4.1 Wildlife

4.1.1 * Cutting projects must be timed so as to avoid disturbing wildlife utilizing critical seasonal habitat (eg tree nesting birds).

4.2 Vegetation

4.2.1 A cutting permit is required for cutting down any tree. Permits are arranged through the Park Warden office.

4.2.2 Only those trees that are a hazard will be removed. Trees to be removed should be cored with an increment borer to detect fungal stain and decay in the wood. Information on tree hazards assessment (appendix 6.1), is attatched. Information on forest insects and diseases is available from Forestry Canada (Hiratsuka 1987; Ives and Wong 1988).

4.2.3 All felled trees that are accessible must be used for firewood within the park. This will discourage the need for firewood sources external to the park. This measure will help in controlling the spread of insects, diseases and exotic seed from entering the park.

4.2.4 All trees with DBH of 12 cm or greater will be hand felled (ie. chain saws). The felling of such trees by bladed equipment is prohibited.

4.2.5 All felled trees will be stumped as close to the ground as possible, and no stumps will exceed 15 cm in height. Stumps should be cut flush to the ground and covered with debris in a manner to mask them.

4.2.6 Care will be taken to minimize damage to surrounding trees.

4.2.7 Trees, branches and tree tops greater than 12 cm in diameter must be bucked up into 50cm (.5 metre) lengths for firewood.

4.2.8 Bucked wood must be dropped off at the nearest wood yard or used for a personal fireplace (as per permit).

4.2.9 Trees affected by insects and disease must only be used for firewood in the vicinity in which it was cut. This will reduce the possible affect of contributing to the movement of insects and diseases.

4.2.10 Woody stems, branches and tree tops less than 12 cm in diameter must be mulched or dropped off at a designated trade waste pit, or gravel pit (as per permit).

4.4.3 All trees and shrubs cut on streambanks or islands will be securely stacked on ground above the high water mark of the watercourse. This material should be removed from the island after freeze-up or by boat.

4.4.4 All slash inadvertently introduced to a watercourse during clearing will be removed.

4.5 Pollution

4.5.1 The use of any stump treatment and herbicides is strongly discouraged and must be in accordance with Management Directive 2.4.1 on the management of pesticides.

4.5.2 The storage of fuels, lubricants and chemicals will be prohibited within 300 metres of the high water mark of any watercourse.

4.5.3 The fuelling and servicing of equipment will be prohibited within 300 metres of the high water mark of any watercourse.

4.5.4 All fuel containers will be inspected daily for signs of leaks, and will be repaired or replaced immediately if faulty.

4.5.5 All spills (small and large) must be cleaned up or contained and reported to the EARP Surveillance Officer or the Warden Service immediately.

4.5.6 All equipment and saws must be inspected and maintained prior to the start of any project.

4.5.7 All saws must be maintained so as to minimize noise and exhaust.

4.6 Aesthetics

- If the tree removal is the only alternative and aesthetic impact is significant, tree transplanting may be required. Transplanting plans must be included as part of the tree cutting project and screening report.

4.7 Public Facilities and Services

4.7.1 When the cutting project is in an area of hiking, ski or equestrian trails, slash must be well removed from the trail area.

4.8 Public Safety

4.8.1 A skilled feller must cut the trees or be present to instruct, and supervise the felling project.

4.8.2 The public will be cleared from the area of tree felling. Barricades will be used in conjunction with a designated person to insure area security.

4.9 Historic Resources

4.9.1 The presence of any historic resources must be identified and protective mitigative measures stipulated. Historical services must be informed if the project is in the vicinity of known or potential resources.

4.9.2 If any historic resources are encountered, all work will stop. The Surveillance Officer or Warden Service will be informed immediately. Work will not re-commence until the Surveillance Officer gives instructions to do so.

4.10 Archaeological Resources

4.10.1 Most projects of this type should not affect any archaeological resources. Site-specific evaluation and mitigations may be required. The regional archaeologist must be informed if the project is in the vicinity of known or potential resources.

4.10.2 If any paleontological, historical or archaeological artefacts or features are encountered, all work will stop. The Surveillance Officer or Warden Service will be informed immediately. Work will not re-commence until the Surveillance Officer gives direct instructions to do so.

4.11 Socio-Economic

4.11.1 Tree felling should take place during low visitor use time periods. If possible felling will not take place during the high visitation season (June through September).

5.0 REFERENCES

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6.0 APPENDICES

Appendix 6.1 Assessment of Tree Hazards

Appendix 6.1
Assessment of Tree Hazard

PREFACE

This publication, prepared primarily for the Provincial Park System, introduces the concept of tree hazard and provides a uniform system by which potentially hazardous trees may be rated. Procedures for conducting tree-hazard control inspections and surveys are described and measures to reduce or abate hazards are suggested. Indicators of some common tree defects are described and illustrated.

The information on tree defects and forest pathology is consistent with known conditions in British Columbia. Procedural methodology may be suitable to other agencies concerned with the operation and management of forested recreation sites. However, prior to other agencies use of information contained in this publication on a program scale, consideration on a policy basis of such topics as areas of application, funding, liability, etc., would be advisable.

ACKNOWLEDGMENTS

Photographic and design contributions, organization assistance, and report assembly by Provincial Parks System and Canadian Forestry Service Staff are gratefully appreciated. Particular recognition is extended to M.B. Roberts, British Columbia Parks and Outdoor Recreation Division, and to A.L.S. Johnson and G. Reynolds, Canadian Forestry Service.

CONTENTS

INTRODUCTION

Trees are a prime environmental feature in most recreation sites. Like all living organisms, they develop defects (faults or areas of weakness) with age. This is an ongoing natural process which ultimately leads to the structural failure of portions of a tree or the entire tree.

On treed recreational sites, failures can result in property damage (Fig. 1), personal injury, or sometime death. Tree hazard control programs attempt to identify defective trees, assess the hazard posed by such trees, and implement measures designed to prevent accidents caused by their failures.

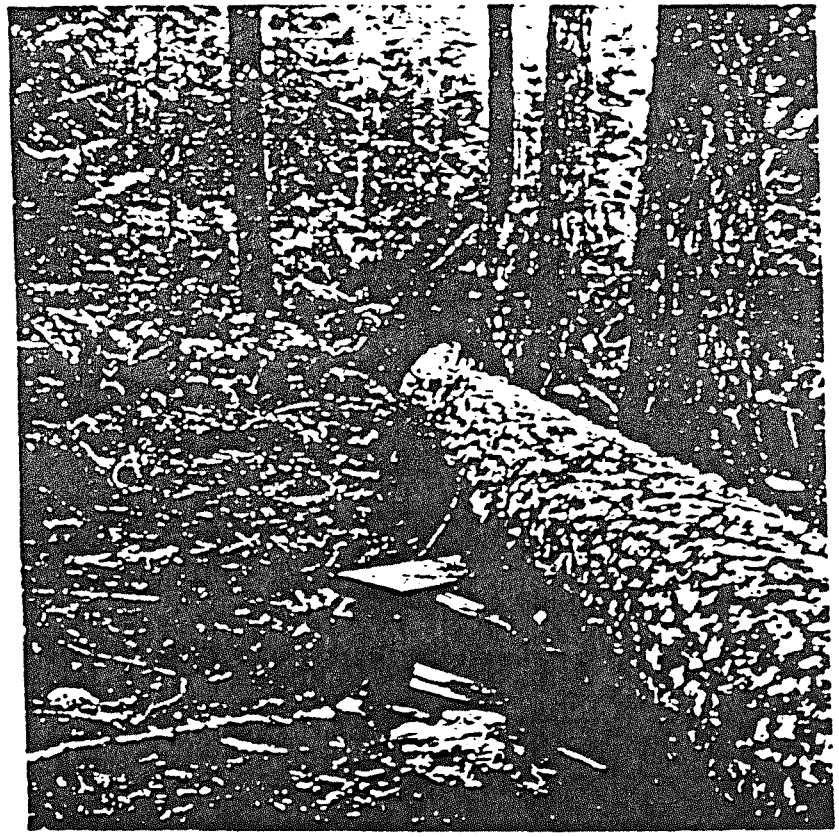


Fig. 1
Extensive decay in the roots caused this tree to fail without warning.

WHAT IS TREE HAZARD

A tree can be considered potentially hazardous if it is situated in an area frequented by people or is located adjacent to valuable facilities and has defects in roots, stem or branches that may cause a failure resulting in property damage, personal injury or death. The degree of hazard will vary with size of the tree, type and location of the defect, tree species and the nature of the target.

Recreational site managers must be aware of tree hazards and know how to recognize, evaluate and correct them. Conscientious and systematic hazard assessment and abatement will make recreation sites safer for the increasing number of visitors enjoying them each year and will minimize damage to park facilities and blockage of trails and roads.

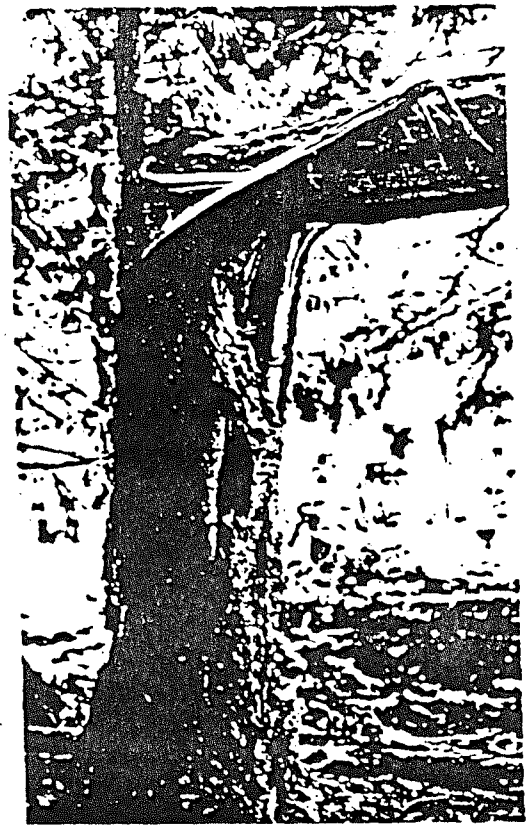


Fig. 2
Extensive heart rot caused this Douglas-fir to collapse.

RATING THE HAZARD

The objectives of tree hazard control are to provide a high level of public safety while retaining aesthetically pleasing surroundings and remaining within reasonable budgetary limits.

Any defective tree has the potential to fail at any time and, depending on its location, may cause damage. **However, by careful inspection of all developed areas, it should be possible to detect most defects and rate the likelihood of failure during normal site usage and weather conditions.** In some instances, defects are difficult to detect. Apparently sound trees growing adjacent to root rot centers must be critically examined below ground for evidence of the fungus (see descriptions of root rots). The extent of decay in the heartwood of some trees may become evident only after the stems are drilled.

When conducting an inspection, **all trees within a target area must be examined. However, only those trees with detectable defects are to be formally rated.** Failures in sound trees are rare and must be accepted as occurrences over which one has no control.

RATING SYSTEM

A standardized tree rating system is a fundamental requirement of any tree hazard control program. The Provincial Parks tree hazard rating system requires the evaluation of defective trees based on two elements: **failure potential and failure impact. Each element is quantified on a scale of 1 to 3; their total gives a numerical value of the degree of hazard. The objective of this rating is to evaluate trees with defects and decide whether there is a degree of hazard that requires abatement.** Adherence to this system will provide a uniform level of tree hazard evaluation and a basis on which expenditure of hazard abatement funds can be priorized. The system, because of the extreme variation in hazards, must be of a general nature. Knowledge, common sense and intuition are fundamental requirements for inspectors if this system is to be effective.

I. FAILURE POTENTIAL

This element considers the likelihood of failure under conditions prevailing during site usage. It is based primarily on an evaluation of the type of defect or defects and the tree species. The rating scale, 1 to 3, is as follows:

Value 1 - low potential for failure, some minor defects present

Value 2 - medium potential for failure

Value 3 - high potential for failure; dead trees, trees with serious defects, and those with multiple defects

Guidelines for evaluating failure potential are given in Tables 1 to 3.

II. FAILURE IMPACT

This element considers the consequences arising from a failure. It is based on an evaluation of the size of tree or parts thereof, probability of hitting a target, and the value of the target. The rating scale, 1 to 3, is as follows:

Value 1 - minimal damage; probability of hitting target low, tree or parts thereof that could fail are small, target of low value.

Value 2 - moderate damage; medium probability of hitting target, tree or parts that could fail are of sufficient size to cause moderate damage, target could sustain some damage or is of moderate value.

Value 3 - extensive damage; probability of hitting target high, tree or parts that could fail are of sufficient size to injure, kill or cause extensive property damage; targets include people and/or their property or high value public facilities.

III. HAZARD RATING

The hazard rating of a detective tree is derived by adding the value obtained for failure potential to the value obtained for the failure impact; for example:

FAILURE POTENTIAL RATING	+	FAILURE IMPACT RATING	=	HAZARD RATING
3	+	2	=	5

The value for the hazard rating should be entered on the Tree Hazard Site Inspection Record (Form 1).

FORM 1 **TREE HAZARD SITE INSPECTION RECORD** Sheet _____ of _____

District: _____ Site: _____ Officer: _____ Date: _____

Tree	Sp.	dbh cm	Location	Description of defect	Failure Potential rating (1)	Description of target	Failure Impact rating (2)	Hazard rating (1 + 2)	Action Recommended	Action Completed: Date	Action Completed: Initials

CONDUCTING SITE INSPECTIONS

INSPECTION PERSONNEL

Trees should be examined annually by individuals knowledgeable in defect appraisals. These people should be familiar with signs and symptoms of diseases that cause defects, be able to recognize anatomical features associated with failures, and be aware of local weather and environmental conditions which may contribute to tree failures. By utilizing this publication, augmented by training workshops, field staff should become sufficiently knowledgeable to conduct inspections.

TIMING

Coniferous trees can be inspected at any time during the year when the ground is free from snow, but the best time is in the spring after the trees have been exposed to winter storms. Deciduous trees are best examined during leafing-out, when dead tops and branches are more easily seen. Special inspections should be made during the high use season after unusually heavy rainfalls and severe winds. Recreation personnel should always be alert to the development of serious hazards, regardless of the season.

If possible, select a bright day for the inspection. Observations of tree defects become more difficult and the dedication of the inspector tends to diminish as weather conditions deteriorate.

OFFICE PREPARATION

When planning a site inspection, the inspector should review all available information related to the area, including previous tree hazard inspection records. Past records are of value in alerting inspectors to trees with recorded hazard ratings and to site conditions that may contribute to tree hazards; for example, stand age, tree vigor, species composition, locations where water accumulates and the direction of prevailing strong winds. Using a site development map, select a tentative starting point and route to follow. Make a record of, and mark on the site map, the location of all trees that have a hazard rating. Complete the site description under the pertinent headings on the Tree Hazard Site Inspection Record (Form 1).

Assemble the materials and equipment needed for the site inspection as follows:

axe - with at least a 1 kg head, for sounding trees for hollows and decay
borer - hand increment borer and power borer for detecting fungal stain and decay in the wood
binoculars - for checking the trunk, tops and branches of tall trees
shovel or mattock - for checking the condition of roots
diameter tape - for taking tree diameters
tags and nails - for numbering defective trees
site development map - for plotting the inspection route and locations of trees with a hazard rating
tree hazard site inspection forms - for recording inspection data

FIELD PROCEDURES

The site examination must be done in a systematic manner to ensure that all trees within target areas are inspected. Determine if the starting point and inspection route chosen in the office is suitable; and modify, if necessary. Estimate the height of dominant trees around the targets; the height of the dominant trees is the distance back from the targets that must be examined (target area). Note landmarks that will serve as boundaries of the inspection area.

1. Proceed to the first tree (if it is too small to cause damage to the target or it is leaning away from the target, it need not be examined) and systematically inspect (Fig. 3):
   a) the ground around the base of the tree for fungus fruiting bodies (Figs. 19 and 21), root injuries and soil cracks or heaving indicating recent movement
   b) the butt of the tree for fruiting bodies (Fig. 4), wounds (Figs. 9 and 11), frost cracks (Fig. 5), etc., that indicate presence of decay
   c) the trunk for fruiting bodies (Fig. 37), wounds, cankers (Fig. 50), swellings (Fig. 53), etc.
   d) the top and branches for decline in vigor, broken top (Figs. 14 and 15), dead branches and other defects that indicate possible hazards. Use binoculars when examining tall trees.

   If defects are found in roots, butt or lower trunk, the tree should be bored on 3 sides (more if the tree is over 50 cm diameter), to determine the extent of fungal stain or decay.
2. If no defect indicators are found, proceed to next tree and repeat inspection. Keep in mind that only trees within a target area are inspected and only trees with defect indicators are rated.
3. If a defect (see Tables 1-3) is noted on a tree that is large enough to cause damage and may hit the target if it failed:
   a) tag the tree, keeping the tag as high and out-of-site as possible

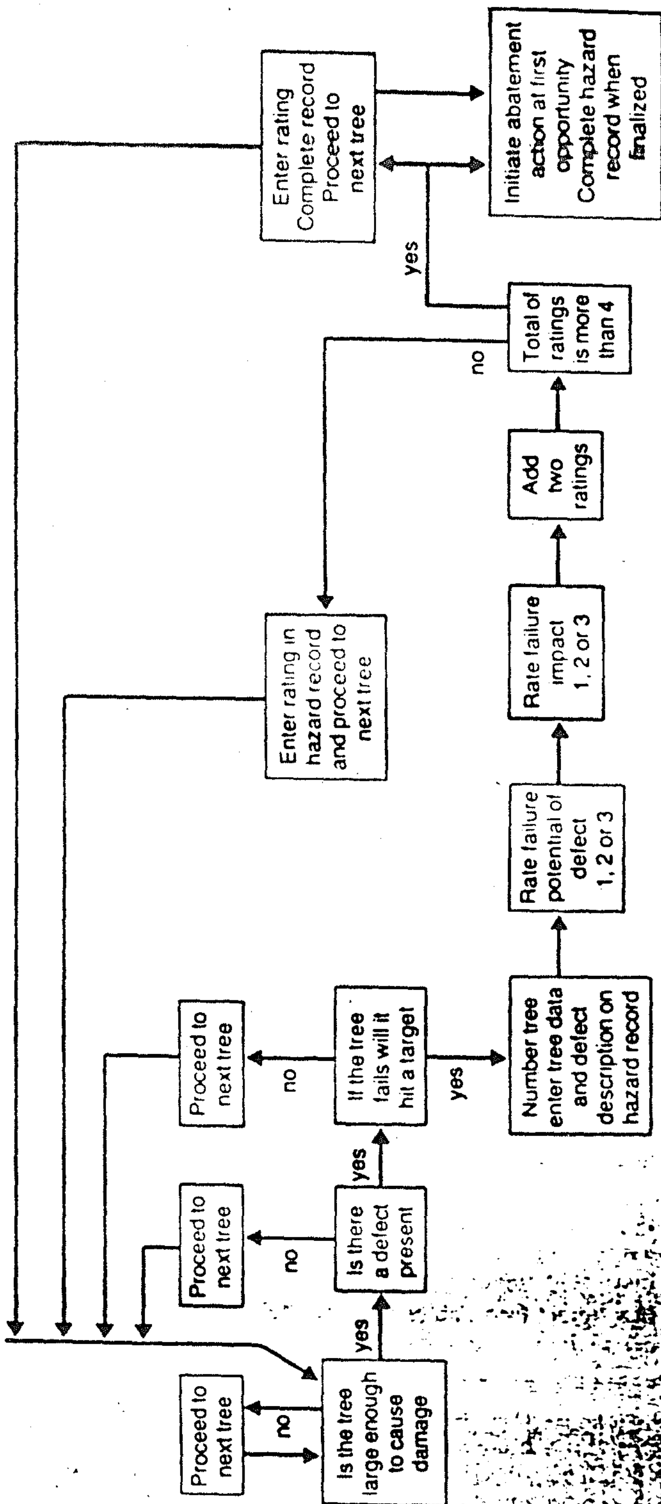


Fig. 3 Flow diagram of a procedure that may be followed for tree inspections

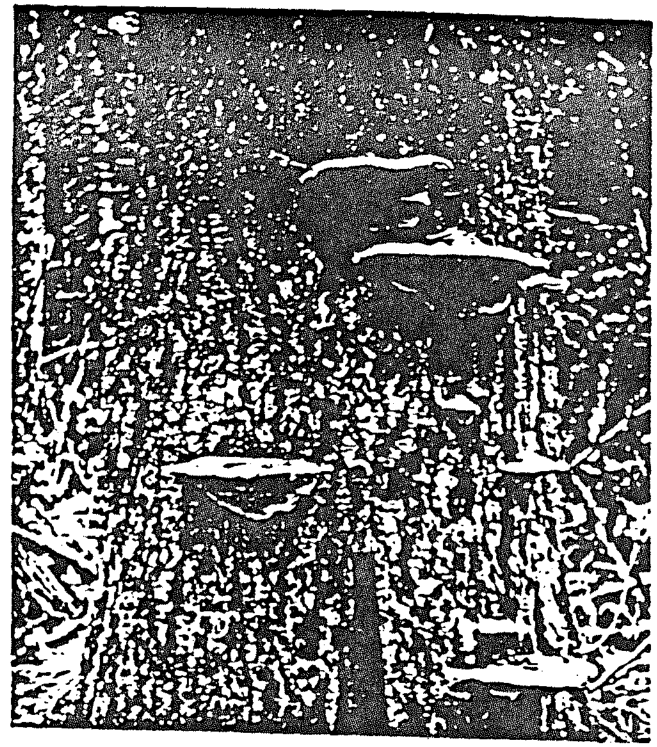


Fig. 4
Fruiting bodies on the butt of a tree indicate that the heartwood is in an advanced stage of decay and there is a high potential for failure.

b) record the tree number, species, d.b.h. and location on the inspection form and mark the location on the site map
c) record the description of the defect indicator
d) rate and record the **failure potential** (high - 3, moderate - 2, low - 1); use Tables 1-3 as guidelines
e) record description of the target
f) rate and record the **failure impact** (high - 3, moderate - 2, low - 1). In rating failure impact, keep in mind three factors:
  - is the size of the tree such that it would cause major, moderate or minor damage to the target if it failed
  - is the lean of the tree such that the probability of hitting the target is

high, moderate or low if the tree failed
- is the value of the target high (people, washrooms, picnic site eating enclosures, etc.), moderate (picnic tables, buildings of moderate value, etc.), or low (wood corals, fences, etc.)

g) add the values for the failure potential and failure impact to obtain the hazard rating and record

h) record the action required to abate the hazard, keeping in mind the requirements of the Tree Hazard Control Policy; namely, all dead trees must be removed if within a target area and all trees with a hazard rating of 5 or 6 must be considered for hazard abatement.

4. Continue systematic inspection until all trees within target areas have been examined. Be particularly careful that all trees with a previously recorded hazard rating are reinspected.
5. Carefully check all tree hazard site inspection forms to ensure that they are complete.
6. Summarize hazard abatement recommendations and submit to appropriate authority.
7. Undertake hazard abatement action and record date of action on Tree Hazard Site Inspection Record form.

INSPECTION RECORDS

Records of site inspections and any ensuing hazard abatement measures must be maintained (Form 1). These augment the information obtained from tree failure reports and, **most importantly, document inspection activities and abatement action. The care with which these records are completed and maintained may determine the outcome of any litigations arising fom tree failures.**

Table 1. Guidelines for evaluating the failure potential of specific defects

Conifer species except cedars

The following Table provides guidelines for making failure potential judgements; it is not a "magic formula" that provides definitive answers to hazard rating. Two extremes, low and high, are noted, corresponding to a **failure potential** of 1 and 3, respectively. Variations from these extremes **(failure potential 2)** will vary from tree to tree and can be judged only by the investigator on the site.

DEFECT	LOW FAILURE POTENTIAL	HIGH FAILURE POTENTIAL
Whole Tree Failure		Dead trees Leaning trees growing on sites with a high water table
Root and Butt Failure		
1. Soil		Cracks or heaving in soil around tree indicating recent movement
2. Roots	Few small roots severed or injured	Most of the roots on one or more sides of the tree severed or badly damaged
3. Wounds	Root and butt wounds less than 5 years old provided there is little advanced decay	Root and butt wounds more than 10 years old and with extensive advanced decay
4. Wounds	Scar with little wood injury	Scar with the wood deeply gouged, possibly fractured
5. Fruiting Bodies		Fruiting bodies on the butt of the tree (Fig. 4), or on the ground around the tree (Fig. 19)
6. Hollow Butt	Hollow butt if less than a quarter of the stem is affected	Hollow butt if a majority of the stem is decayed
7. Resin	Resin flow from the butt near the ground line (Fig. 27), with less than a half the circumference of the stem affected	Resin flow from the butt near the ground line (Fig. 27), with most of the circumference of the stem affected Mycelium fans below the bark (Fig. 28)
8. Mycelium	*Phellinus weirii* mycelium on the roots but no stain or decay in the butt	*Phellinus weirii* mycelium on the roots and red-brown stain and/or decay in the butt (Fig. 25)
9. Foliage		Thin chlorotic foliage (Fig. 22), indicates a tree is dying as a result of root rot
10. Frost Cracks	Frost cracks (Fig. 5), with little or no associated advanced decay	Frost cracks (Fig. 5), with extensive associated advanced decay (Fig. 6)

11. Dwarf Mistletoe	Young dwarf mistletoe swelling in butt	Dwarf mistletoe swellings in the butt, (Fig. 53), particularly if associated with advanced decay
12. Cankers	Butt cankers with bark still intact	Butt cankers with more than half the face of the canker dead (Fig. 50)

DEFECT	LOW FAILURE POTENTIAL	HIGH FAILURE POTENTIAL
Stem Failures		
1. Wounds	Scars less than 5 years old provided wood not deeply gouged	Scars more than 5 years old and with extensive associated advanced decay
2. Wounds	Scars with little wood injury	Scars with wood deeply gouged, possibly fractured
3. Fruiting Bodies	One or two small fruit bodies in the upper stem	Multiple fruiting bodies along length of stem (Fig. 37)
4. Dwarf Mistletoe	Dwarf mistletoe stem canker with the bark still intact	Dwarf mistletoe stem canker with more than a half the circumference dead (Fig. 53)
5. Forked Stems	Forked stems, one or both fork being of a small diameter	Large forked stems joined part way up the stem
6. Leaning Stem	Old lean, upper section of stem growing vertically	Recent lean: soil around tree cracked or heaving indicating recent movement
Top and Branches		
1. Dead Tops	Dead small tops and branches	Dead large tops and branches
2. Forked Tops	Small forked tops and crooks	Large forked tops
3. Broken Tops	Broken tops with adjacent branches healthy	Broken tops with adjacent branches unhealthy
4. Fruiting Bodies	One or two small fruiting bodies in top of stem	Numerous fruiting bodies in top of stem
5. Cankers	Top and branch cankers with the bark still intact	Top cankers where most of the canker face is dead
6. Dwarf Mistletoe	Small dwarf mistletoe branch and top swellings and witches' brooms	Large dwarf mistletoe, witches' brooms on branches (Fig. 51)

Table 2. Guidelines for evaluating the **failure potential** of specific defects

Cedar

The following Table provides guidelines for making **failure potential** judgements; it is not a "magic formula" that provides definitive answers to hazard rating. Two extremes, low and high, are noted, corresponding to a **failure potential** of 1 and 3, respectively. Variations from these extremes (**failure potential 2**) will vary from tree to tree and can be judged only by the investigator on the site.

DEFECT	LOW FAILURE POTENTIAL	HIGH FAILURE POTENTIAL
Whole Tree Failure		Dead trees Leaning trees growing on sites with a high water table
Root and Butt Failure		
1. Soil		Cracks or heaving in soil around tree indicating recent movement
2. Roots	Few small roots injured or severed	Most of the roots on one or more sides of the tree severed or badly injured
3. Wounds	Basal scars where the wood is not gouged	Basal scars where the wood is deeply gouged and possibly fractured
4. Hollow Butt	Hollow butt provided less than a half of the circumference of the stem is affected	Hollow butt with more than a half of the circumference of the stem affected and with significant advanced decay
5. Fruiting Bodies		Fruiting bodies on lower bole
Stem Failures		
1. Wounds	Scar with wood not deeply gouged	Scar with wood deeply gouged, possibly fractured
2. Fruiting Bodies	One or two small fruiting bodies in upper stem	Fruiting bodies along much of the stem
3. Forks	Forks and crooks	
4. Twin Stems	Small twin stems	Large twin stems joined part way up stem
5. Leaning Tree	Old lean, upper section of stem growing vertically	Recent lean, soil around tree cracked or heaving indicating recent movement
Top and Branches		
1. Dead Branches	Small dead branches	Large dead branches, especially if broken and lodged in other branches

2. Broken Tops	Broken top with adjacent branches healthy	Broken top with adjacent branches unhealthy
3. Spike Tops	Spike top not weakened by woodpeckers or decay	Spike top weakened by woodpeckers or decay
4. Multiple leaders	Small, volunteer tops	Heavy U-shaped branches formed when side branches turn up to become leaders

Table 3. Guidelines for evaluating the failure potential of specific defects

Deciduous Species

The following Table provides guidelines for making failure potential judgements; it is not a "magic formula" that provides definitive answers to hazard rating. Two extremes, low and high, are noted, corresponding to a failure potential of 1 and 3, respectively. Variations from these extremes (**failure potential 2**) will vary from tree to tree and can be judged only by the investigator on the site.

DEFECT	LOW FAILURE POTENTIAL	HIGH FAILURE POTENTIAL
Whole Tree Failure		Dead trees Leaning tree growing on site with a high water table
Root and Butt Failure		
1. Soil		Cracks or heaving in soil around tree indicating recent movement
2. Roots	A few small severed roots	Roots on one or more sides of the tree severed or badly injured
3. Wounds	Young small basal scars with little or no associated advanced decay	Basal scar with extensive associated advanced decay
4. Wounds	Scar with little or no wood injury	Scar with wood deeply gouged, possibly fractured
5. Fruiting Bodies		Fruiting bodies on lower bole
6. Butt Rot	Decay in butt confined to small, localized area	Decay extensive throughout the heartwood in the butt
7. Hollow Butt	Hollow in butt confined to a small section of stem	Hollow in butt affecting a major portion of the circumference of stem
8. Mycelium	Mycelium below the bark near the ground line confined to less than a half the circumference of the stem	Mycelium below the bark near the ground line affecting most of the circumference of the stem

9. Cankers	Butt cankers with the bark still intact	Butt cankers affecting a major portion of the circumference of the stem and with much of the canker tissue dead
Stem Failures		
1. Wounds	Young small scars with little or no associated decay	Large scars affecting major portion of circumference of stem and with extensive associated advanced decay
Wounds	Scar with little or no wood injury	Scar with wood deeply gouged
2. Heart Rot		Extensive heart rot, hollow stem
3. Fruiting Bodies	One or two small fruiting bodies in upper stem	Numerous fruiting bodies along length of stem
4. Burls	Burls or galls	
5. Leaning tree	Old lean, upper section of stem growing vertically	Recent lean, soil around tree cracked or heaving indicating recent movement
Top and Braches		
1. Dead Branches	Small dead branches	Large dead branches
2. Dead Top	Recent broken small top. Branches associated with top are healthy	Old broken top with extensive heart rot (Fig. 14). Branches associated with top unhealthy
3. Decay	Branches with little or no decay associated with crotch	Extensive decay in stem and lower portion of large branches
4. Branch Crotch	Sound crotch	Split crotch

AIDS IN TREE INSPECTIONS

1. Determining age of scars:
   Drill callus tissue on margin of wounds with increment borer and count rings added after injury occurred.
2. Ascertaining stain and decay in heartwood:
   Most wood decay fungi cause a discoloration of the wood in the early stages of the infection and a disintegration of the tissues in the later stages of infection. Stain or decay is readily seen in a stem increment core or in wood chips if a power borer is used to sample the stem. Adjacent sound trees can be cored to compare normal heartwood with suspected decay and stain.
3. Hollow butts:
   If the hollow in the butt of a tree is large, it frequently can be detected by striking the tree with the head of an axe. Boring with a hand or power borer is a more reliable method of detecting hollow butts.
4. Dwarf mistletoes:
   Most dwarf mistletoe species are confined to specific tree species and

to certain regions. For explanations, see dwarf mistletoes in the section "Causes of Tree Failures."

5. Trees may have a large part of their root system destroyed by fungi and not exhibit distress symptoms in their crowns. All trees on the margins of root rot centers should be examined for mycelium on the root collar and upper portions of the roots and should be drilled. Only trees showing decay or stain (Fig. 25) in the lower butt when drilled or with advanced decay in the major roots should be removed.

TREE HAZARD REDUCTION AND ABATEMENT

SITE SELECTION AND MANAGEMENT

Sites proposed for new campground and day-use development should be intensively inspected for hazard trees and abatement undertaken before facilities are installed. Old-growth stands usually contain many trees with hidden defects that will continue to present safety problems throughout the life of the installation. Therefore, where possible, these stands should not be considered for future campground and day-use development

In addition to rating and treating defective trees, site managers can manipulate site usage and reduce hazards. In areas subject to heavy snow and ice loads, recreation sites may be closed during the winter months or use areas may be confined to treeless, open sites. Those sites known to have a high water table during the wet season should have restricted access when the soil is saturated and the trees are most likely to be windthrown. In sites subject to wind from a constant direction, for example, those adjoining large clearings or next to lakeshores, defective trees should be removed from the windward side if they could cause damage if they failed.

PRIORITIES FOR HAZARD ABATEMENT

Except in unusual circumstances, first priority for hazard treatment must be assigned to dead trees and to those having a hazard rating of 6 and 5. It must be appreciated that some trees with minor defects will always be left because of low hazard ratings and aesthetics. These trees should be given particular attention in future site inspections as their failure potential will gradually increase with time and/or subsequent site development may change their failure impact.

ALTERNATIVES TO TREE REMOVAL

When contemplating hazard abatement action, consider the effects that removal of defective trees will have on surrounding site aesthetics. Whole tree removal is irreversible. Consider the feasibility of some alternative methods for alleviating the hazard. In certain circumstances, the following may be preferable to tree removal:

Altering the target - such as closing sites, relocating tables, fencing areas

Tree work - such as limb removal, topping, bracing and cabling, filling cavities

TREE REMOVAL

When it is necessary to remove a defective tree, felling should be done only by trained personnel. Poor felling, aside from the danger to the unskilled operator, can result in extensive damage to surrounding trees, making them unsightly and providing entrance courts for wood decay fungi, thereby compounding the hazard problem. If the number and condition of the felled trees warrants, arrangements should be made to recover the commercial values. Otherwise, attempt to find a use for felled trees on site; for example, firewood, protective barriers, educational features.

TREE FAILURES

In the following sections, types of tree failures are discussed in a generalized context of tree structure - **Root and Butt, Stem, and Top and Branches** - in relation to their relative contributions to tree hazard. Causes of failures are covered in considerable detail under two categories **"Non-pathological Causes of Tree Failures" and "Pathological Causes of Tree Failures."**

1. TYPES OF TREE FAILURES

A. Root and Butt

Root and butt defects account for the major portion of the hazard trees in recreation sites. Roots provide the structural support and anchorage for trees; consequently, defects in roots frequently result in whole-tree failures (Fig. 23). Cracks and heaving in the soil surrounding a tree indicate structural weakening in the root system

and a high potential for failure.

B. Stem Breakage

Most stem failure results from breakage caused by extensive heart rot (Fig. 2), or large fungus or dwarf mistletoe cankers (Figs. 50 and 53). Mechanical failures can be a problem in deciduous species because of their spreading form, and in conifers where twin stems are allowed to reach a large diameter (Figs. 7 and 8).

C. Top and Branch

Large limbs, often associated with dead and broken tops on conifers, frequently break and fall. Deciduous species, because of their open, wide-spreading branch pattern, are more subject to branch failures than are conifers. Branches with a V-shaped crotch are more subject to breakage than are those with a crotch approaching 90 degrees. Witches' brooms (Fig. 51), caused by dwarf mistletoe and rust infections, which overhang camping pads and picnic tables, will be a hazard only if they are allowed to reach large sizes. Snow accompanied with high winds frequently results in extensive top and branch breakage.

2. CAUSES OF TREE FAILURES

Non-pathological Causes of Tree Failures

TREE FORM AND SPECIES

Generally, deciduous species are more prone to mechanical failures than are coniferous species because of their wide spreading, often irregular branching pattern. Most failures will occur at the crotch of the branch and stem; this is particularly true where heart rot is present in the stem and extends into the branch. Unlike conifers, failures in deciduous trees are most common during the summer when they are in full leaf. Form defects in conifers are forking (multiple leaders) and crooks (deviations from a straight stem).

WEATHER

Wind, snow and ice acting on points of weakness in trees are the most common cause of failures. Many hazards are removed by these agents during the winter months when the majority of recreation sites are closed to visitors; however, permanent facilities may be damaged. At any time during the year, under extreme storm conditions, even sound trees may be broken or toppled by wind or lightning. Such events are unpredictable and must be accepted as risks that usually cannot be controlled in a meaningful manner.

Not all failures occur during windy periods. Fatal accidents have occurred during periods of still air. These failures have usually been associated with root, butt and stem rots, dead tops, or trees that have been weakened by previous storms.

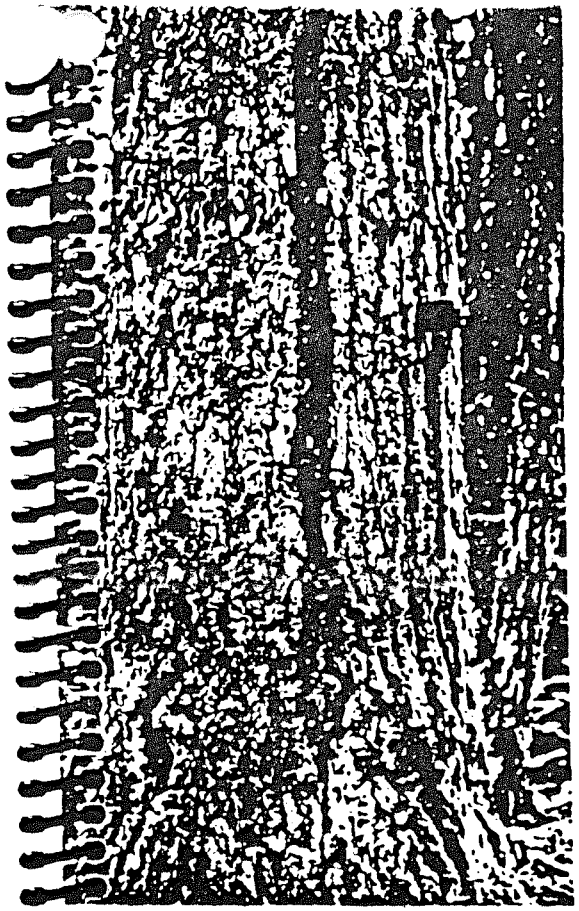


Fig. 6
Extensive heart rot that entered the stem through a frost crack

Fig. 5
← Frost crack in base of western hemlock

LIGHTNING AND FROST CRACKS (Figs. 5 and 6)

Lightning striking a tree may cause only minor damage or its death. In the former, the failure potential will be low. However, where splitting and cracking is extensive, the tree should be considered for removal if it could cause damage to a target. Wood decay fungi frequently become established in lightning wounds, further weakening the tree.

Frost cracks are characterized by black raised lines on the bark in the lower bole (Fig. 5). They do not indicate a high failure potential unless they are associated with advanced decay (Fig. 6).

FORKED STEMS (Figs. 7 and 8)

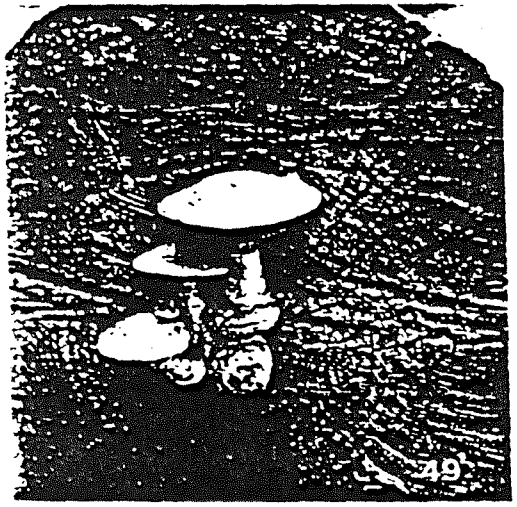
Where a forked stem is allowed to reach a large diameter (Figs. 7 and 8), the potential for splitting at the crotch is high (Fig. 8); the time of

Fig. 47
Fomes fomentarius fruiting body on birch.

Fig. 48
White spongy trunk rot caused by *Fomes fomentarius* in birch.

Fig. 49
Pholiota destruens fruiting body on black cottonwood

Fig. 50
Fungus stem canker.



broken tops indicates that heart rot is in an advanced stage and the fa .e potential is high. In deciduous species, heart rot frequently moves into the base of large branches, resulting in a high potential for failure at the branch crotch.

Dwarf Mistletoes (Figs. 51-55)

Dwarf mistletoes are parasitic flowering plants (Fig. 55) capable of survival only in living coniferous trees. With the exception of cedars, juniper and yew, all conifers in British Columbia are subject to attack. Infection of western hemlock is confined to the Coast, while infection of Douglas-fir is found only in the Interior.

Dwarf mistletoe infections are recognized by swellings on the main stem (Fig. 53) and branches (Fig. 51) and by witches' brooms (Fig. 51). Heavy infections may result in death of the tree or parts thereof (Fig. 54). Dead tissues, resulting from parasitic action of dwarf mistletoe, provide an entrance point for wood decay fungi (Fig. 52). Swellings affecting a major portion of the circumference of the stem and containing significant dead tissue have a high potential for breakage. Witches' brooms will become a hazard only if they are very large and heavy, causing the branch to break and fall on a target.

Cankers

Canker diseases, as detailed under Stem Diseases above, may occur frequently on branches, causing their death. The degree of hazard will be dependent on size and location of the affected branch.

TREE FAILURE REPORT

Tree failures are due to a wide variety of causes, varying with species, age and site conditions. Unfortunately, in British Columbia, very few records of failures and their causes have been kept. Therefore, data for developing a hazard rating system based on defects common to British Columbia and specific to areas within the province are unavailable.

Tree failures in recreation areas in the Pacific Northwest of the United States have been recorded systematically for the past 8 years. Together with selected input from Idaho and California, these data have been compiled in a report by the Forest Insect and Disease Management Division, United States Forest Service, Portland. The causes of failures appear to closely approximate those in British Columbia and have thus been used as a basis for the material presented on tree defects.

In order that a comparable bank of information specific to British Columbia conditions can be accumulated, failures in our developed areas

FORM 2

TREE FAILURE REPORT

Distnct: _____ Park: _____ Location: _____ Officer: _____

Time of Failure: _____ Site open for use: Yes ___ No ___

hour day month year

Tree and Stand

Tree species: _____

Approx. diameter (cm) _____

Approx. age _____

Stand age class: ___ overmature
___ mature
___ young growth
___ all aged

Class of Mechanical Failure

___ upper bole (top half)
___ lower bole
___ butt (bottom 2 metres)
___ branch
___ root, including uprooting

Tree Defect Leading to Failure

___ tree dead (snag)
___ dead top
___ root or butt rot
___ stem rot
___ wound-type _____
___ dwarf mistletoe canker
___ twin stems
___ cracks or splits
___ leaning
___ other _____
___ unknown _____ none

Contributing Factors

___ wind
___ snow
___ soil bank erosion
___ erosion (other)
___ lightning
___ soil saturation
___ shallow rooting
___ other _____
_____
___ unknown _____ none

Consequences

None: _____

Cleanup work only required: _____

Property damage: (describe giving approx. value): _____
_____
_____

Injuries (describe and note if medical attention was required): _____
_____
_____
_____

Comments: _____
_____
_____

Record only failures capable of inflicting damage or injury. Do not report the death of a tree or parts of a tree unless it fails. Trees, or parts thereof, removed prior to failure should not be reported.

and their probable causes should be recorded on the form opposite (Form 2) and submitted to Provincial Park System Headquarters. Form 2 is compatible with the United States Forest Service form and, as such, can be included in their data management system from which data for examination of individual species, sites and other information can be retrieved.

Information recorded on Form 2 is cumulative. It is anticipated that over the next 5 years sufficient data will be gathered to allow meaningful comparisons to be made. In this context, the form is a request for information and, as such, does not have the priority of Form 1, which is the basis of legal documentation in the system. However, please make an effort to utilize the Tree Failure Form as it will ultimately improve the tree hazard control program.

GLOSSARY

Abatement: diminishing or modifying the hazard to life and property created by defective trees.

Basal: see butt; usually considered the bottom 2 metres of the stem.

Bole: the trunk of a tree.

Bracing: strengthening or supporting a weakened or defective tree.

Burl: large woody growth, often spherical in shape, usually on the stem of a tree (Fig. 16).

Butt: the lower 2 metres of the stem of a tree.

Callus: the tissue that develops around a wound on the stem or root.

Canker: an area of dead tissue in a woody stem caused by fungi, bacteria or dwarf mistletoes. It is marked by sloughing of tissue that leaves an open wound surrounded by zones of callus (Fig. 50).

Canker face: the area of dead tissue in a canker (Fig. 50).

Chlorotic: yellowing of green foliage due to a disease or mineral deficiency.

Conk: the fruiting body or spore-producing structure of a wood decay fungus (see fruiting body); forms on the external surface of the host (Figs. 37, 41, 43).

Crown: the branch- and foliage-bearing portion of a tree.

Defect: a fault or point of weakness in a tree caused by non-pathological or pathological agents.

Entomological: pertaining to insects.

Forks: formed when two or more leaders develop following the death of the original leader.

Fruiting body: in the higher fungi, the reproductive structure that bears the spores; usually forms on the external surface of the host (see conk).

Fungi: a group of lower organisms that lack chlorophyll and therefore cannot produce their own food; must depend on a host to produce their food.