

SOILS AND FOREST INFORMATION FOR 1972  
DOCK IMPACT STUDY IN WATERTON LAKES  
NATIONAL PARK, ALBERTA

by

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TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION .....	1
SOILS .....	2
Results and Soil Descriptions .....	2
Interpretation of Results .....	7
Conclusions .....	7
FOREST .....	8
Wishbone Fan .....	8
Crypt Landing Fan .....	9
Bertha Bay Fan .....	12
Knight's Lake .....	12
Conclusions .....	17
APPENDIX .....	18
Table 1. Characteristics of Trees Sampled on Crypt Landing Fan; Waterton Lakes National Park, 1972 .....	11
Table 2. Characteristics of Trees Sampled on Bertha Bay Fan, Waterton Lakes National Park, 1972 .....	14
Table 3. Characteristics of Trees Sampled Around Knight's Lake; Waterton Lake National Park, 1972 .....	15
Table 4. Summary Sheet for Dock Impact; Waterton Lakes National Park, 1972.....-	16

TABLE OF CONTENTS (Cont.)

	<u>Page</u>
Figure 1. Soil Map Adjacent to Knight's Lake .....	6
Figure 2. Sample Plot Locations and Related Features on Crypt Landing Fan .....	10
Figure 3. Sample Plot Locations and Related Features on Bertha Bay Fan .....	13

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INTRODUCTION

A request was received from Mr. W. Turner, consultant to the Canadian Wildlife Service, for soils and forest information to be used in their Dock Impact study in Waterton Lakes National Park. This report provides the soil and forest information for the areas outlined for the Dock Impact study (i.e. four alluvial fans adjacent to Waterton Lake and the shore areas surrounding Knight's Lake). The soils data are from Coen and Holland, Report No. 1\*\*. Additional data were gathered in July, 1972, to provide an assessment of forest vegetation on the same areas.

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\* Soil Research Technician, Northern Forest Research Centre, Canadian Forestry Service, Environment Canada, Edmonton, Alberta.

\*\* Report No. 1, Land and Soil Resources and Interpretations Waterton Lakes National Park, G.M. Coen, Soil Research Institute, Canada Department of Agriculture and W. D. Holland, Canadian Forestry Service, Environment Canada, Edmonton, Alberta, March 1973.

## SOILS

The soil characteristics on the alluvial fans proved to be similar to those found earlier on Boundary Cabin fan. (See Preliminary Report, NOR-Y-17; Soil and Vegetation Characteristics of Boundary Cabin Fan., Waterton Lakes National Park - Glacier National Park; G. M. Coen, W. D. Holland, and John (Magy, 1972). The soil on these alluvial fan areas is mostly a loose, coarse textured Cumulic Regosol. The main matrix of the profile is a loose, structureless sandy loam with variable layers of gravelly coarse sand.

The soils bordering Knight's Lake vary from the other areas examined and should be looked at separately for management purposes. (See Figure 1). The soils surrounding the lake are predominantly formed on alluvial materials. A notable exception is the active sand dunes and loessal area that occurs along the southwest corner of the lake. Soil information in this area was condensed from preliminary field notes from the soil survey in progress within the park. (Soil Survey of Waterton Lakes National Park: G. M. Coen and W. D. Holland, 1973).

### Results and Soil Descriptions

The following brief description of map unit 27 from Boundary Cabin fan applies as well to Wishbone, Crypt Landing and Bertha Bay alluvial fans.

<u>Horizon</u>	<u>Thickness in inches</u>	<u>Characteristics</u>
L-H	1½" - 2"	Leaves, needles, rotted wood, charcoal, mycelia, pH 5.2.
C <sub>1</sub>	0 - 1"	Very friable, structureless brown loam, 10% coarse fragments.
C <sub>2</sub>	1 - 7"	Loose, structureless dark reddish brown sandy loam containing 50% coarse fragments, pH 6.6.
C <sub>3</sub>	7 - 15"	Loose, structureless dark reddish brown gravelly coarse sand with 20% coarse fragments, pH 6.8.
C <sub>4</sub>	15 - 18"	Very friable, structureless reddish brown silt loam, pH 6.6.
C <sub>5</sub>	18 - 35"	Very friable structureless reddish brown silt loam, pH 6.6.
C <sub>6</sub>	35 - 44"	Loose gravelly coarse sand with 60% coarse fragments, pH 6.8.

The above profile is typical of the three fans except that the bands of silty material were less noticeable. From experience with similar soils elsewhere, it is anticipated that cation exchange will be low and that levels of major nutrients such as nitrogen and phosphorus will also be low. Field pH measurements indicate that the mineral soil is nearly neutral, being only slightly acidic. Infiltration tests were in the range of 14 to 22 inches of water per hour on the Boundary Cabin fan and are expected to be approximately the same for these three areas.

Brief descriptions of the soils bordering Knight's Lake are given in the legend accompanying a soil map of the area. (See Figure 1).

LEGEND FOR (FIGURE 1) SOIL MAP ADJACENT TO KNIGHT'S LAKE

Map Unit	Classification	Texture (< 2 mm)	Coarse Fragments (> 2 mm)	Drainage	Vegetation	Parent Material
1	Orthic Dark Brown and Black Chernozems (mainly esker area)	Gravelly sandy loam	Abundant gravel cobbles and boulders	Rapidly drained	Fescue, Oatgrass	Outwash
8	Orthic Dark Brown Chernozem (shallow to lime)	Very fine sandy loam to silt loam	Occasional gravels, no cobbles or boulders	Well drained	Fescue, Oatgrass	Outwash
15	Cumulic and Orthic Regosols (slightly elevated areas on river flood plains)	Silt loam	Occasional cobbles and boulders	Moderately well drained	Willow, Balsam Poplar	Alluvium
17	Orthic Dark Brown Chernozem (weak Bm developments)	Gravelly sandy loam	Many cobbles and boulders	Rapidly drained	Fescue, Oatgrass	Alluvium
19	Orthic and Rego Black Chernozems	Sandy loam to loam	Few cobbles; many gravels	Moderately well drained	Fescue, Aspen	Alluvium
20	Orthic Regosol (very recent alluvium; annual flooding)	Gravelly loamy coarse sand and sand	Abundant cobbles and boulders	Well drained (except for spring flooding)	Unvegetated	Alluvium
21	Orthic Regosol (braided channels)	Gravelly coarse sandy loam	Many gravels, cobbles and boulders	Rapidly drained	Fescue, Oatgrass	Alluvium
25	Cumulic and Orthic Regosols (found on areas commonly disturbed by runoff)	Sandy loam	Few gravels and cobbles	Well drained	Aspen, Fescue	Alluvium
26	Rego Dark Brown Chernozem	Sandy loam	Coarse fragments found at depths > 30"	Well drained	Timothy, Bromegrass	Alluvium
29	Gleyed Regosol (found on down slope margins of fans)	Sandy loam	Few gravels; cobbles and boulders not found	Imperfectly drained	Balsam Poplar, Black Cottonwood	Alluvium
31	Orthic Humic Gleysol (saturated except for brief periods in the fall)	Loam	Very few coarse fragments	Very poorly drained	Sedges	Alluvium

LEGEND FOR (FIGURE 1) SOIL MAP ADJACENT TO KNIGHT'S LAKE (Cont.)

Map Unit	Classification	Texture (< 2 mm)	Coarse Fragments (> 2 mm)	Drainage	Vegetation	Parent Material
32	Orthic Humic Gleysol (saturated for significant periods in the spring and summer)	Very fine sandy loam to loam	Very few coarse fragments	Poorly drained	Willow, Alder	Alluvium
36	Orthic Gray Luvisols and Dark Gray Luvisols	Sandy loam to loam	Few coarse fragments	Well drained	Lodgepole Pine, White Spruce, Aspen	Alluvium
42	Rego Dark Brown Chernozem (> 40" to gravel)	Loam to silt loam	Few cobbles	Well drained	Fescue, Oatgrass and Aspen	Alluvium
50	Orthic Dark Brown and Black Chernozems (some drumlin landforms)	Loam	Many cobbles and gravels	Well drained	Fescue, Oatgrass	Glacial Till
53	Orthic Humic Gleysol (seepage areas and depressions)	Loam	Variable coarse fragments	Poorly and very poorly drained	Spruce, Willow	Glacial Till
57	Orthic Gray Luvisol (high lime stable till)	Loam and clay loam	Many cobbles and boulders	Well drained	Lodgepole Pine	Glacial Till
58	Dark Gray Luvisol (many pedons show abundant earthworm activity)	Loam	Few coarse fragments	Well and moderately well drained	Aspen	Glacial Till
170	Orthic Regosol	Loamy sand to sand	Nil	Rapidly drained	Western Snowberry, Aspen	Aeolian Sand
171	Cumulic Regosol	Loamy sand	Nil	Rapidly drained	Fescue, Oatgrass	Aeolian Sand
190	Silvo-Fibrisol	Not applicable	Not applicable	Very poorly drained	Sedges, Willows	Organic

1  
5  
1



FIGURE 1 : SOIL MAP ADJACENT TO KNIGHT'S LAKE

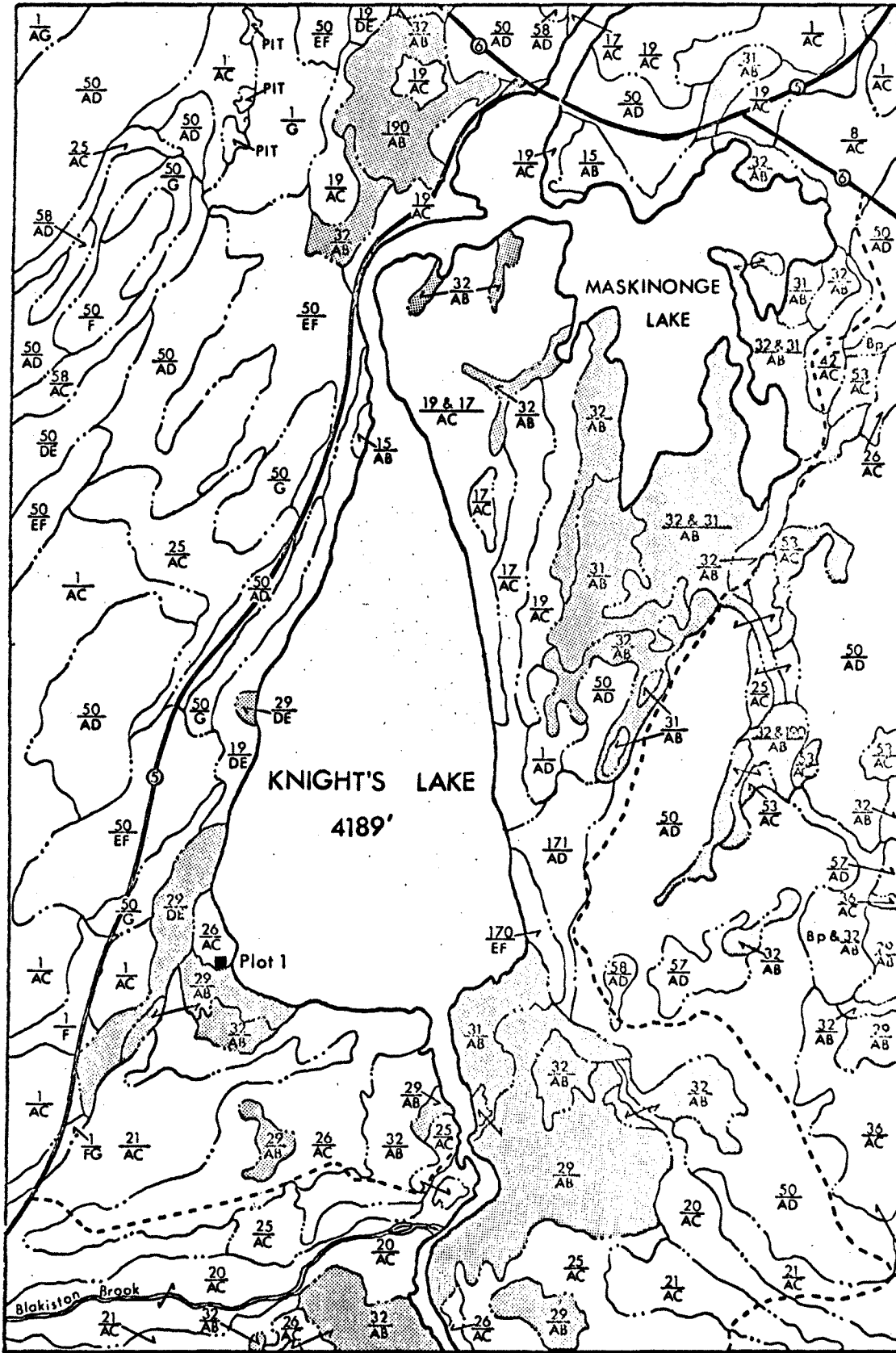
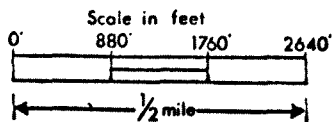
WATERTON LAKES NATIONAL PARK

LEGEND

- Highway ..... —————
- Secondary Road ..... - - - - -
- Soil Boundary ..... — · — · —
- Sample Plot ..... □
- Height in feet A.S.L. .... 4189
- Poorly Drained Soil ..... [shaded box]
- Map Unit Symbol .....  $\frac{50}{AD}$
- Soil Symbol ..... 50
- Topography Symbol ..... AD ▲
- Beaver Pond ..... Bp

TOPOGRAPHY CLASSES

▲ Symbol	% Slope
A.....	0-5
B.....	5-2
C.....	2-5
D.....	5-9
E.....	9-15
F.....	15-30
G.....	30-60
H.....	60+



### Interpretation of Results

Wishbone, Crypt Landing, and Bertha Bay alluvial fans:

The soil is loose and porous. Drainage is extremely rapid and water retention is sufficiently low that droughty periods likely occur. These sites are of relatively low productivity for tree growth, probably because of low nutrient levels, poor moisture regimes; short growing season, and large evaporation losses from the high amount of wind blowing down the valley.

### Conclusions

1. Use of the soil on this fan will probably not create serious changes in soil physical characteristics such as compaction. Thus, physical soil changes in themselves are not thought to be a serious hazard at this site.
2. Infiltration rates are substantially higher than rainfall intensities that are likely to occur. Measurements in the present picnic area indicate that compaction does not appear to change these rates, so human activity will probably not result in accelerated erosion, except that concomitant with vegetation loss.
3. The soil has excessive percolation rates and low water-holding capacity. Thus, it will act as a poor biological and nutrient filter and if used in such a way that this soil receives more than minor amounts of sewage, the effluent could move into the lake water very quickly and contribute to a pollution problem.

4. The soil provides little impediment to irrigation. If fertilization is to be practiced, care should be taken to avoid the application of excessive rates of fertilizer because of the small amount of nutrient holding capacity this soil is likely to exhibit. This soil can be managed and modified with some success but it must be done with care.
5. Present picnic use of part of the area is assumed to be relatively light in intensity. Nevertheless, such use has resulted in tree root exposure and considerable loss of trees and ground vegetation. The sandy, coarse texture of this soil does not compact, but it is easily kicked about and shifted once the lower vegetation becomes worn.
6. Figure 1 indicates the pattern of poorly drained soils surrounding Knight's Lake. These soils may limit access route construction, or increase the cost of access. They could also pose a pollution risk unless precautions are taken.

#### FOREST

Unlike the soils, these areas were extremely variable in species composition and will be described separately. Plots of various sizes were located at selected points on these areas to describe the variation in vegetation and the impact from visitor use.

A summary of tree plot data is given in Tables 1 to 4. Figures 2 and 3 give diagrammatic sketches of plot locations for each area.

#### Wishbone Fan:

This fan rises from the water's edge with a gentle slope of 5 to 10%

in a southerly direction. The fan is very open and grassy with a sparse forest covering. The major portion of the forest vegetation occurs on the upper half of the fan and along an intermittent creek which descends from Vimy peak. The dominant conifer is Douglas fir which is found in small clumps throughout the fan. Other species found in minor quantities are lodgepole pine, balsam poplar, trembling aspen, white spruce, limber pine, and birch. Forest plots were not established on this fan because the trees present were inadequate for meaningful measurements.

The trees are of low height and diameter class for their age, thus indicating a low productivity and thriftiness as compared to other places in the park. The upper half of the fan has very good trembling aspen regeneration and should be producing a good aspen stand within fifty years.

Crypt Landing Fan:

This fan rises from the lake shore with a gentle slope of 2% in an easterly direction for approximately 200 feet then abruptly changes to a 37% slope on glacial till. The slopes average 7% running northeast and southwest from the picnic site immediately opposite the dock. This area is well forested mainly consisting of Douglas fir and birch. The trees measured on the fan are approximately 119 years old and range in height from 58 to 65 feet. Plot 1 (See Figure 2 and Table 1) was located in the picnic area and shows 55% root exposure and no regeneration above  $\frac{1}{2}$  inch in height. At plot 2 (See Figure 2) immediately southwest of the picnic area the regeneration shows a great improvement in both quantity and height of seedlings and in some cases is overstocked. Some of the regeneration

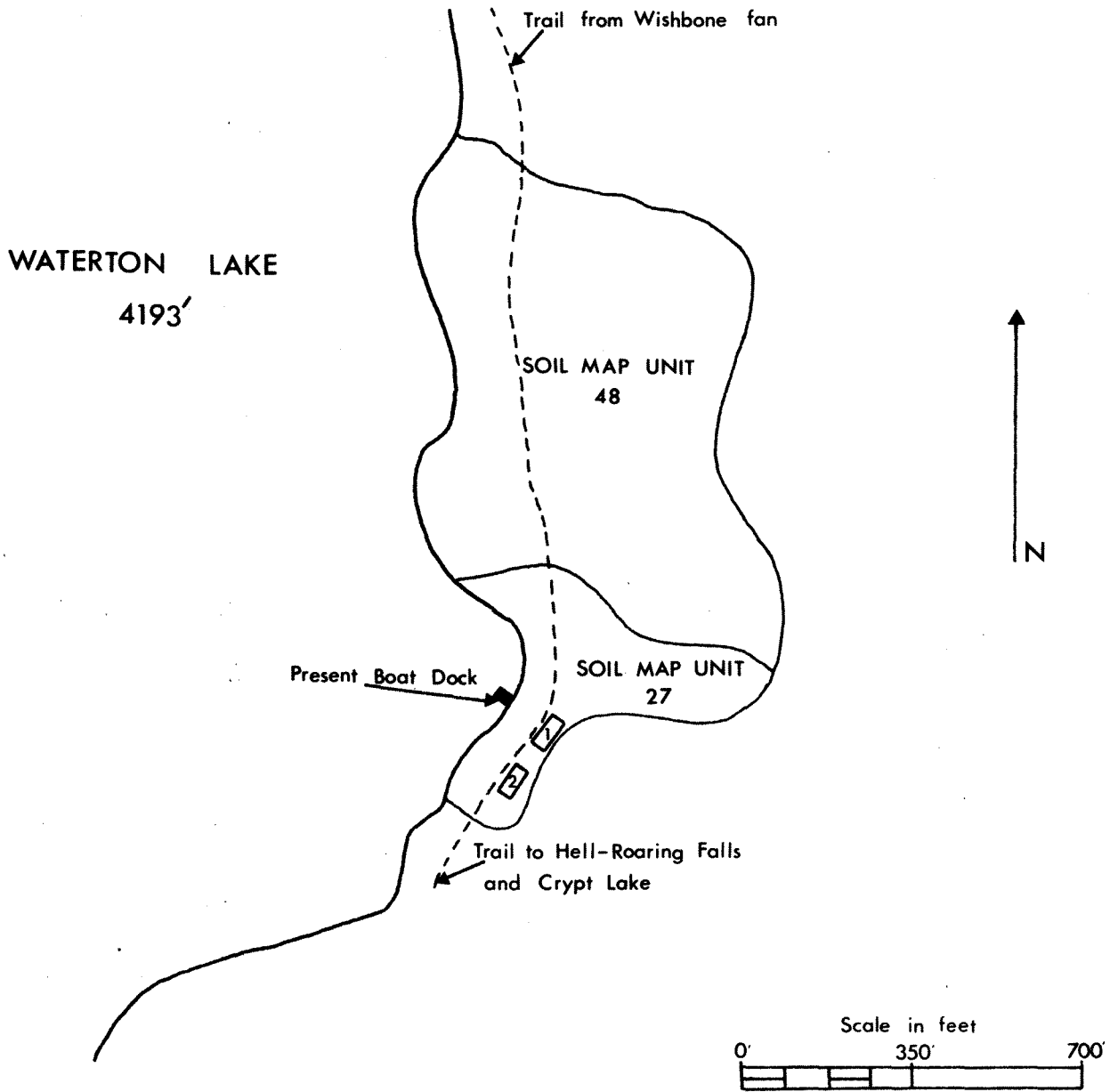


TABLE 1. CHARACTERISTICS OF TREES SAMPLED ON CRYPT LANDING FAN;  
WATERTON LAKES NATIONAL PARK, 1972

Plot	Tree	Species	D.B.H. (o.b.) in inches	S.D. (o.b.) in inches	Total Ht. in feet	Age at one foot	Total Age	Radial Growth Last in inches			Vigor	Crown Development	Crown Class
								10 yrs.	20 yrs.	30 yrs.			
1	1	Df	14.3	17.3	62	74	80	.99	2.38	3.65	Good	Good & even	Dom.
	2	Df	16.3	19.7	67	116	123	.82	1.22	1.94	Fair	Fair	Dom.
	3	Df	13.0	16.0	60	114	121	.63	1.22	1.70	Good	Fair, one-sided	Dom.
	4	Df	14.0	16.2	67	107	114	.25	.50	.75	Fair	Fair, one-sided	Dom.
	5.	Df	13.0	15.5	68	104	111	.60	1.13	2.00	Good	Fair	Dom.
	* 6	Df	27.7	31.5	89	119	126	.95	1.97	3.03	Good	Good & even	Dom.
2	1	Df	20.0	22.3	77	128	135	.32	.80	1.27	Good	Good & even	Dom.
	2	Df	14.0	18.3	58	107	114	.58	1.35	2.80	Good	Good & even	Dom.
	3	Df	16.2	20.9	57	109	116	.37	.87	1.42	Good	Good & even	Dom.
	4	Df	9.1	10.6	41	126	133	.33	.98	1.40	Fair	Good & even	Co.-Dom.
	5	Df	10.2	12.8	57	94	101	.45	1.10	1.89	Good	Good & even	Dom.

\* Sampled outside of plot area.

shows signs of gall aphid infestation and some have died from natural thinning. The trees in this area still show a low height and diameter class for their age. Visitors to the area have stripped the bark from the birch trees and the Douglas fir show numerous axe scars.

Bertha Bay Fan:

This fan has a southeast aspect and the slope average is 5 to 7%. The main species on this fan is Douglas fir with minor quantities of lodgepole pine, balsam poplar and birch. Two forest plots were established (See Figure 3 and Table 2) the trees measured averaged 100 to 103 years old and ranged in height from 51 to 61 feet. The most prevalent defect was leaning trees resulting from exposure to high winds that blow across the fan from the south. It was also noted that regeneration was poor.

Knight's Lake:

The major portion of the forest vegetation occurs along the west and southwest shores of the lake and consists entirely of hardwoods. There are some hardwoods along the east shore of the lake but are few in number and show signs of becoming decadent. The trembling aspen measured in Plot 1 (See Figure 1 and Table 3) at the old Camp-Tee-La-Daw site averaged 74 years old and 39 feet in height. Slope from shore at this site is 2 to 3% in a westerly direction. The balsam poplar along the east shore were chosen at random and averaged 65 years old and 35 feet in height and showed 50% rot.

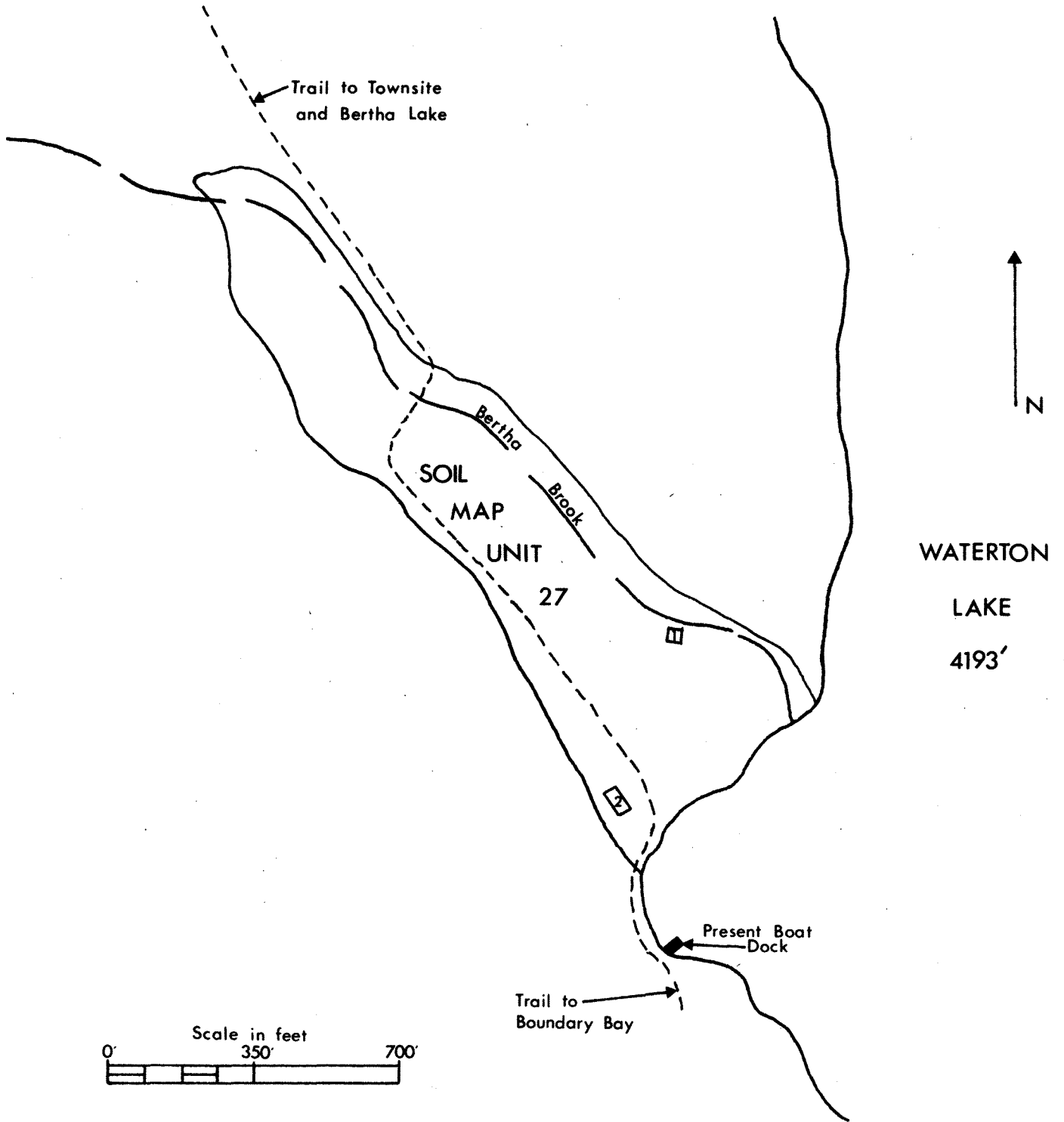




TABLE 2. CHARACTERISTICS OF TREES SAMPLED ON BERTHA BAY FAN,  
WATERTON LAKES NATIONAL PARK, 1972

Plot No.	Tree No.	Species	D.B.H. (o.b.) in inches	S.D. (o.b.) in inches	Total Ht. in feet	Age at one foot	Total Age	Radial Growth Last in inches			Vigor	Crown Development	Crown Class
								10 yrs.	20 yrs.	30 yrs.			
1	1	Df	8.6	10.6	40	87	94	.18	.30	.50	Fair	One-sided	Co.Dom
	2	Df	12.2	13.5	63	97	104	.55	1.00	1.35	Good	Even	Dom.
	3	Df	11.3	14.2	57	96	103	.35	.50	.80	Fair	Even	Dom.
	4	Df	8.8	10.6	42	98	105	.24	.50	.78	Good	Even	Co.Dom
	5	Df	9.8	11.2	53	96	103	.28	.55	.85	Good	One-sided	Dom.
2	1	Lp	10.2	10.8	56	75	80	.55	1.10	1.56	Good	Even	Dom.
	2	Lp	13.4	14.2	63	90	95	.20	.40	.65	Fair	Uneven	Dom.
	3	Df	16.2	17.9	57	Rotten	-	-	-	-	Fair	Uneven	Dom.
	4	Df	11.6	13.3	55	100	107	.58	1.10	1.35	Good	Even	Dom.
	5	Lp	14.4	16.3	71	108	113	.42	1.00	1.56	Fair	Uneven	Dom.
	6	Lp	10.4	11.3	67	97	102	.25	.60	.90	Fair	Uneven	Dom.

TABLE 3. CHARACTERISTICS OF TREES SAMPLED AROUND KNIGHT'S LAKE; WATERTON LAKE NATIONAL PARK, 1972

Plot No.	Tree No.	Species	D.B.H. (o.b.) in inches	S.D. (o.b.) in inches	Total Ht. in feet	Age at one foot	Total Age	Radial Growth Last in inches			Vigor	Crown Development	Crown Class
								10 yrs.	20 yrs.	30 yrs.			
1	1	WA	9.4	10.2	38	67	73	.52	.83	1.10	Fair	Fair	Dom.
	2	WA	8.4	9.3	45	Rotten	-	-	-	-	Good	Good	Dom.
	3	WA	9.0	9.7	43	68	74	.55	.92	1.50	Good	Good	Dom.
	4	WA	9.2	10.0	44	71	77	.58	1.26	1.80	Good	Fair	Dom.
	5	WA	9.7	11.9	39	Rotten	-	-	-	-	Good	Good	Dom.
	6	WA	8.8	9.9	43	66	72	.59	1.19	1.85	Good	Fair	Dom.
	3A	WA	9.7	10.8	32	Rotten	-	-	-	-	Good	Fair	Co.- Dom.
	5A	WA	7.1	7.5	31	68	74	.40	1.15	1.70	Fair	Fair	Co.- Dom.
2*	1	Pb	18.6	20.9	33	Rotten	-	-	-	-	Poor	Poor	Dom.
	2	Pb	13.8	16.3	35	Rotten	-	-	-	-	Fair	Poor	Dom.
	3	Pb	6.7	7.9	28	67	73	.50	1.13	2.00	Good	Good	Dom.
	4	Pb	8.6	9.11	42	51	57	.65	1.10	1.85	Good	Good	Dom.

\* Trees sampled at random along east shore of lake.

Plot No.	Location	Species Distr. in %	Average Plot Ht. in feet	Average Tree Age on Plot	No. of Trees per acre	Total Volume in cu. ft./acre	Present Mean Annual Increment (MAI)	MAI at 100 yrs.	Site Index	Tree Defects							Vigor			Dead Trees	Wind-fall	Re-generation	Plot Size	Remarks	
										Dead & Broken Tops & Dying Trees	Forks	Scars	One-sided Crowns	Leans Down and Crooks	Centre Rot		Root Exposure	Poor	Fair						Good
															Total Trees Bored	Trees with Evident Centre Rot									
1	Crypt Landing	*Df-88.9% Pb.Sp.-11.1%	64.8	118.0	180	3,588.7	34	34	60	11.1%	N11	N11	22.2%	55.5%	6	N11	55.5%	11.1%	44.4%	44.5%	10.0%	Assume Removed	Very Poor	1/20 acre	Impact of human activity is concentrated on a small area because adjacent land is very steep.
2	Crypt Landing	Pb.Sp.-42.8% Df-35.7% wS-21.5%	58.0	119.9	280	2,218.5	18.5	18.5	50	N11	14.3%	7.1%	7.1%	21.4%	5	N11	N11	N11	50.0%	50.0%	N11	Light	Very Good Over-stocked in Places	1/20 acre	Understory of white spruce.
1	Bertha Bay	Df-100.0%	51.0	103.3	880	6,069.4	58.7	58.7	50	4.5%	9.0%	N11	40.9%	54.5%	6	N11	N11	18.2%	31.8%	50.0%	18.5%	Medium	Very Poor	1/40 acre	
2	Bertha Bay	Lp-53.8% Df-46.2%	61.5	100.0	260	3,659.2	36.6	36.6	60	23.0%	7.7%	N11	23.0%	15.4%	6	2	N11	46.1%	38.5%	15.4%	18.8%	Light	Poor	1/20 acre	
1	Knight's Lake	wa-100.0%	39.3	74	740	4,008.8	54.2			2.7%	N11	10.8%	N11	21.6%	8	3	N11	8.1%	43.3%	51.4%	17.8%	Light	Good	1/20 acre	Thick understory of lush shrubs, herbs and grass.

Note: See C.F.S. Report NOR-Y-17 for information on Boundary Cabin Fan.

\* See Appendix.

Trees close to the east shore are occasionally inundated by water and are also damaged by wave action and floating driftwood. This would account for the high amount of rot found in these trees. Slopes along the east shore vary from 15 to 30% at the water's edge.

### Conclusions

1. Concentration of human activity in small intensely used forested or unforested area usually decreases vegetative regeneration of the area. Damaged trees and vegetation also occur. In very high intensity use areas, such as around picnic tables, etc., there may be complete loss of vegetation.
2. Table 4 gives a summary of all forest measurements taken for the Dock Impact study.
3. This report indicates the amount of environmental variability that may be encountered on small areas of land. The vegetation plots are more variable than the soil. The author wishes to point out the need for on-site investigations.

APPENDIX

Key for Species

Df	-	Douglas fir
wS	-	White spruce
lp	-	Lodgepole pine
Pb	-	Balsam poplar
wA	-	Trembling Aspen