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SOILS AND ASSOCIATED FEATURES OF BLAKISTON FAN, WATERTON LAKES NATIONAL PARK.

Northern Forest Research Centre
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PRELIMINARY REPORT NO. 3

SOILS AND ASSOCIATED FEATURES OF BLAKISTON FAN WATERTON LAKES NATIONAL PARK

BY

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Waterton, July 1972

INTRODUCTION

During the course of a soil survey of Waterton Lakes National Park, a request was received from Mr. Gordon Roach, Chief Engineer, for a detailed examination and description of the soil on a part of the Blakiston fan that is being considered for the installation of a sewage disposal lagoon for the townsite of Waterton. This report is written to satisfy the above request.

GENERAL DESCRIPTION OF THE AREA

The majority of the soils (map Unit No. 21) on Blakiston Creek fan are coarse textured and contain a very high percentage (80 to 90%) of coarse fragments. The exception is a small amount of silt loam on the eastern and northern fringe of the fan; i.e. the picnic area near the Dardanelles waterway. The coarse fragments are mostly gravel and cobble sized, red and green argillites, sandstones and limestones. Many of these fragments are lime coated. The apex of the fan (i.e. the area close to where the highway bridge crosses Blakiston Creek) contains the coarser soil and greatest abundance of cobble-sized fragments. From this point, the fan drops down in an easterly direction towards Waterton Lake. The slope of the fan is approximately 2 per cent. The toe of the fan (the easterly and lower portion near Waterton Lake) has a sandy loam surficial deposit above the gravels (see Figure 4). This overlay reaches a thickness of greater than fifty inches near the fan margins. Shallow (one to two feet deep) meander scars of abandoned creek channels are very evident over the landscape of this alluvial fan. There are no soil layers or horizons that will impede water permeability. There is not enough rainfall to keep these soils moist for very long and because the water storage capacity of these soils is low, they are subject to droughty periods. In the early spring and during other wet times, there may be very short periods when the water table rises to within three feet of the surface. Low areas of the fan with high water table conditions have been indicated on the soil map and are located in forested areas close to Waterton and Knight's Lake. Seepage of water from Blakiston Creek through the fan has been observed at a number of places on the lower parts near the lakes.

Geologically speaking, Blakiston fan appears to be aggrading slightly. Because of this condition, the present creek channel can overflow its banks occasionally and flood certain adjacent areas. It is also possible that the creek will change the position of its channel from time to time. High water conditions in Waterton Lake (i.e. see the 1964 flood records) can flood some of the lower land areas on the toe of this fan.

Erosion is probably active during some years when extensive flooding occurs, and may take the form of deposition and/or removal of surface soil materials. Observation of areas where the vegetation has been disturbed indicate that the soil on this fan has a high risk or potential for water erosion. This high erosion potential is further verified by observing the loose, open, non-coherent characteristics of the soil materials.

Grassy vegetation is characteristic of a large portion of the fan (Figure 2). In this area there are few, if any, trees, even Populus tremuloides (trembling aspen). The shrubs and herbs of the grassy part of the fan appear to suffer from drought for significant periods of the year. Strong, prevailing winds from the south follow the Waterton Valley and most certainly add to the droughtiness of these soils. There is nearly 100 per cent coverage of a vegetative association characterized by Festuca idahoensis (bluebunch fescue), Festuca scabrella (rough fescue), Danthonia parryii (parry oatgrass) and Lupinus sericeus (pursh's silky lupine). About 5 per cent of the area is covered by Potentilla fruiticosa (shrubby cinquefoil). Because of the droughtiness of the soil, vegetative growth is short and of relatively low volume. The limited vegetative growth plus shifting of material by running water does not allow significant profile development to take place, hence these soils are classified as Regosols (the Canadian System of Soil Classification, 1970), showing little evidence of soil horizonation (See Figure 1 and accompanying soil legend).

SOIL DESCRIPTIONS

The following pit was described August 7, 1971 at a point approximately 2/10 of a mile east and 100 yards north of the stables eat of the cemetarh:

Soil Pit No. 1, map unit No. 21

Horizon	Depth	Description
Ah	0-5"	Dark brown (7.5 YR 3/2, moist), gravelly sandy loam; single grain; very friable; plentiful fine roots; estimated coarse fragments 50 per cent; gradual wavy boundary; pH 7.6.
Ck	5-30"	Grayish loam (10 YR 5/2, dry) gravelly coarse sandy loam; single grain; loose; few fine and medium roots; weak efferesence with hydrochloric acid (mainly from lime coatings on the finer gravel); coarse

		fragments estimated at 90 percent wavy boundary; pH 7.6.
Ck_2	30-35"	Grayish brown gravelly sandy loam; single grain; loose; few to no roots; weak efferesence; coarse fragments estimated at 90 percent, pH 7.7.

A second pit was excavated near the gravel dump and was described as follows:

Soil Pit No. 2, Map Unit No. 21

Horizon	Depth	Description
C	0-12"	Brown (10 YR 4/3, moist) sandy loam; single grain; loose; many roots; abrupt wavy horizon boundary.
IIC_1	12-24"	Dark grayish brown (5 YR 4/2, moist) gravelly sand; single grain; loose and non-coherent; some efferesence when HCl was applied to lime coatings on the undersides of cobbles and stones in position; diffuse wavy horizon boundary; coarse fragments estimated about 90 per cent.
IIC_2	24-112"	Very similar to the horizon immediately above except for an even higher percentage of coarse fragments; water table encountered at 112 inches from the surface on July 21, 1972.

The above profile is very weakly stratified. No fine textured strata were encountered anywhere in the profile.

SOIL SUMMARY

Parent Material:	coarse textured alluvial fan.
Landform:	low angle alluvial fan.
Slope:	2 per cent and relatively uniform throughout the area.
Elevation:	from lake level at approximately 4190 feet above sea level to 4300 feet above sea level at the apex of the fan.
Relief:	less than 10 feet from bottom of old creek channels to general fan level.
Aspect:	slope directions are north, east, and south.
Estimated drainage:	very well drained except at toe of fan where some areas have a permanent water table.
Water table:	probably seldom, if ever, within three feet of the soil surface of the grassy part of the fan.
Water infiltration rate:	around five inches per hour.
Water Percolation rate:	most test sites are about three to four minutes per inch (See Figure 5).
Resistance to erosion:	low when the vegetation has been removed. Low, even when vegetated, if the volume of water is large.
Compactability:	very low.
Shrink-swell potential:	extremely low.
Ease of revegetation:	difficult.
Chemical characteristics:	cation exchange capacity is very low; probably less than four millie-quivalents per 100 grams of soil (i.e. the fine earth fraction which is less than 2 m.m. in diameter size). The calcium carbonate ($CaCO_3$) equivalent is about 10 per cent. The pH is about

7.7. There is about one pound per acre of available nitrogen, 12 pounds per acre of available phosphorus and 252 pounds of potasium. The above values were determined from soil samples taken from the first pit described.

PARTICLE SIZE DISTRIBUTION

The following were done on the fine earth fraction of the soil (those particles that are 2 millimeters or less in diameter).

Soil Horizon	Thickness in inches	Mechanical Analysis (Soil pit No. 1)		
		% Sand 2 to 0.05 m.m.	% Silt 0.05 to 0.002 m.m.	% Clay <0.002 m.m.
Ah	5	59	32	9
Ck_1	25	74	22	4
Ck_2	5+	79	17	4

MOISTURE CHARACTERISTICS

of the fine earth fraction of soil pit No. 1

Soil Horizon	Thickness in inches	1/3 bar percentage (Field Capacity)	15 bar percentage (Wilting Point)	Moisture Available for plant growth.	
				Percent	Inches of water per foot of soil
Ah	5	19	9	10	0.9
Ck_1	25	--	-	--	---
Ck_2	5+	5	3	2	<0.1

The table indicates this soil has very little capacity to store moisture for plant use.

INTERPRETATION

1. The water table encountered at 112 inches from the surface on July 21, 1972 is assumed to be in hydraulic connection with the Waterton Lakes system. Undesirable materials which pass through the soil material to the water table will thus eventually end up in the lakes. The soil materials in the vicinity of the proposed lagoon are porous and coarse textured, allowing rapid percolation of water. Sewage may be expected to contaminate the water in the saturated zone below the water table unless preventive measures are taken. Thus, care is necessary on these soils if pollution of the Waterton Lakes system is to be avoided. Even if the measures taken are effective in reducing the organic matter and pathogenic organism content, care must still be exercised if nutrient pollution (elements such as nitrogen, phosphorus, potassium, etc.) of the lakes is to be avoided. The very low cation retaining capacity of these soils means that they will not be effective filters for nutrient ions.

2. The low amount of available nitrogen and relatively low amounts of available phosphorus, plus the very low water-holding capacity of these soils suggest that establishment of effective grass cover for erosion control (i.e. on a back-slope area) and trees for screening will require the addition of fertilizers and irrigation, and possibly the addition of topsoil. These soils are quite susceptible to erosion when the Ah horizon is removed, so prompt establishment of erosion control measures is desirable.

3. Because of the geographic location of the Blakiston fan, it is conspicuously in public view from several points in the Park (See Figure 3). In our view, the soils and subsurface materials of this area do not readily lend themselves to management that will improve the aesthetic values of the area.

4. The grassy area of the fan is part of the general winter-grazing area of the Park. Any reduction in the area of this range would probably be detrimental to animals using the range and would, in addition, place more grazing pressure on the remaining range. If an installation such as a sewage lagoon is undertaken in such a way as to occupy ten acres, with a buffer zone of another twenty acres around it, it is possible that the impact on animal life may be over as much as one hundred acres.

Note: Figure 1 shows the distribution and position of Map Units 29 and 30 which have water tables at or near the soil surface for significant portions of the year.

CONCLUSION

1. The threat of pollution from establishment of a sewage disposal lagoon on this material is a real danger to be considered and avoided, if possible.

2. An examination of the soil maps currently being prepared for the Park, does not reveal any convenient alternatives for the location of such a lagoon near the townsite.

3. The Blakiston fan and the soils developed on it are not particularly unique. Similar soils and fans are common to this region.

LEGEND FOR (FIGURE 1) SOILS MAP OF BLAKISTON FAN

MAP UNIT	CLASSIFICATION	TEXTURE (<2m.m.)	COARSE FRAGMENTS (>2mm)	DRAINAGE	VEGETATION	PARENT MATERIAL
20	Regosol (very little profile development)	Coarse textured	Abundant cobbles and boulders	Poorly drained	Unvegetated	Alluvium
21	Regosol (very little profile development)	Coarse textured	Many gravels, cobbles and boulders	Excessively drained	Mainly fescue grasses	Alluvium
25	Regosol (very little profile development)	Coarse textured	Few gravels and cobbles	Well drained	Grasses and clumps of trembling aspen	Alluvium
26	Dark Brown Chernozem (Profile development indicates little disturbance)	Coarse textured	Coarse fragments found at depths >30"	Well drained	Grasses	Alluvium
29	Gleyed Cumulic Regosol (soils frequently flooded or eroded)	Coarse textured	Few gravels; cobbles and boulders not found	Imperfectly drained	Balsam Poplar	Alluvium
30	Orthic Humic Gleysol (soils saturated for significant portion of year)	Coarse to medium textured	Very few coarse fragments	Poorly drained	Willows, mountain alder, sedges	Alluvium
1	Orthic Dark Brown chernozem	Coarse textured	Abundant gravel, cobbles and boulders	Well drained	Mainly fescue grasses	Outwash
4	Lithic Dark Brown chernozem (<20 inches to Rock)	Coarse textured	Abundant gravel and boulders	Well drained	Mainly fescue grasses	Outwash
23	Cumulic and Orthic Regosol	Coarse textured	Abundant gravels and boulders below 20". Above there is few coarse fragments	Well drained	Mainly grasses with some trembling aspen	Alluvium

R	Rock outcrop	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Figure 1: Soils on Blakiston Fan, Waterton

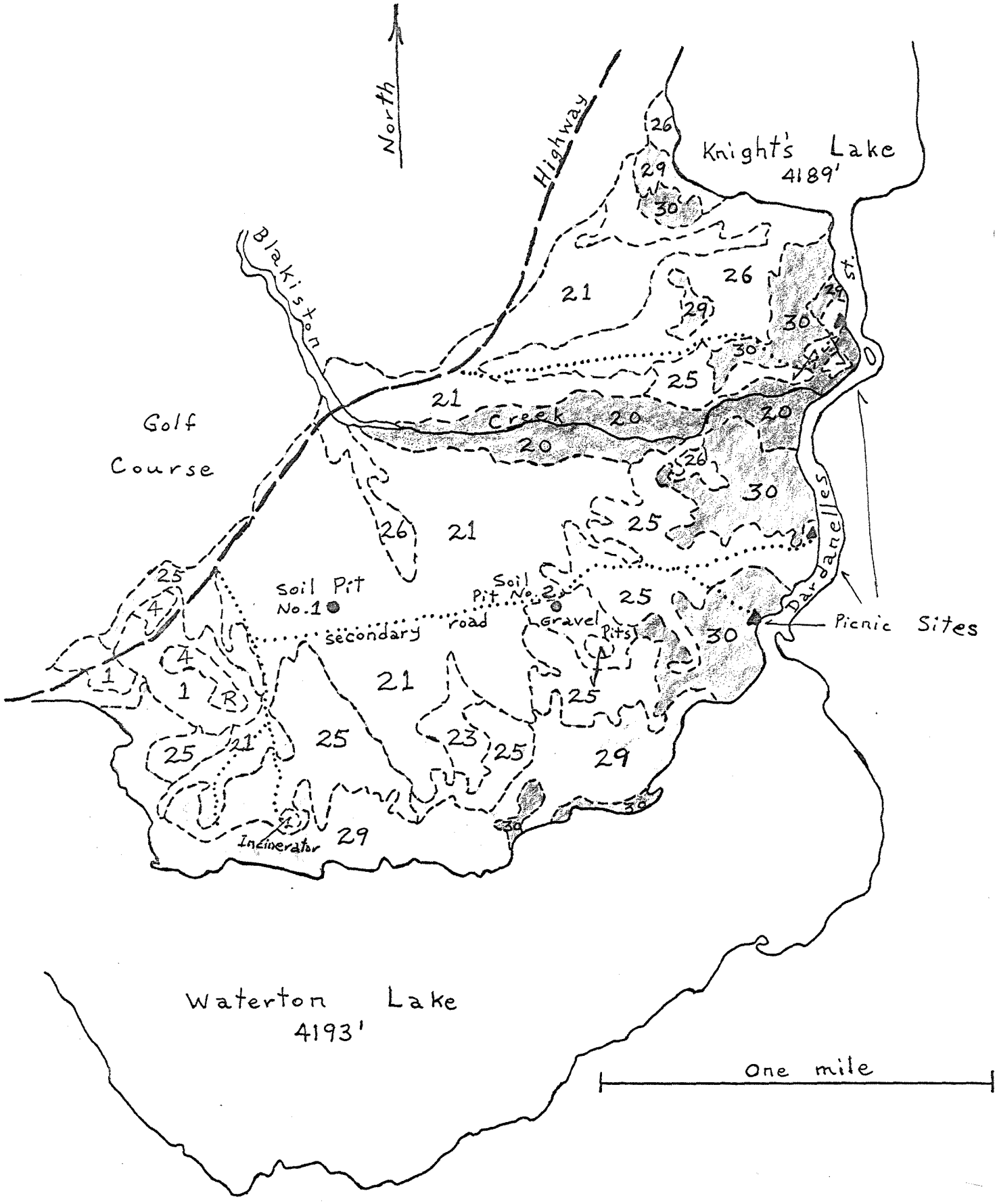


Figure 2: Vegetation Pattern on Blakiston Fan.

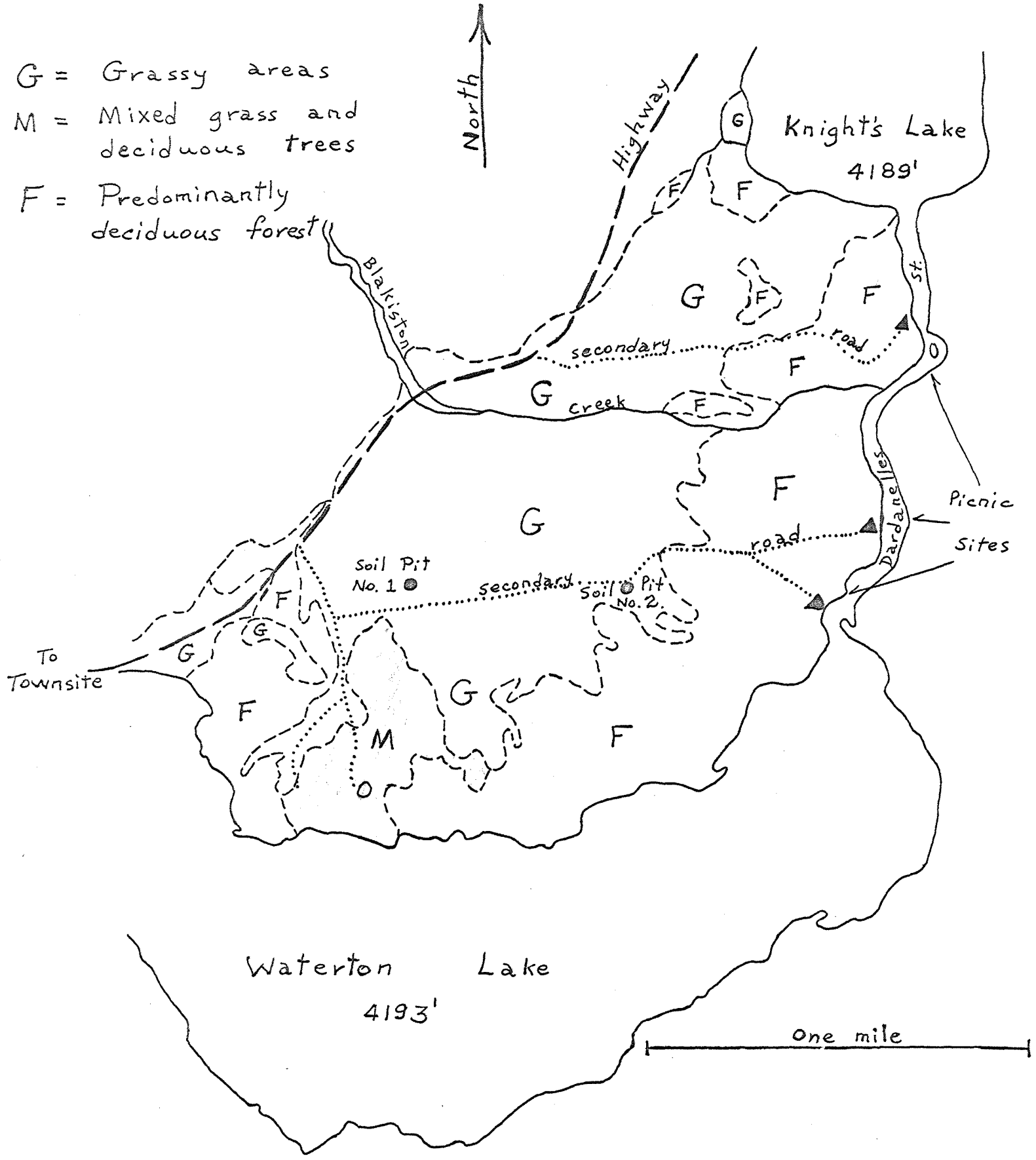


Figure 3: Cultural Features of Blakiston Fan and Vicinity as of 1972

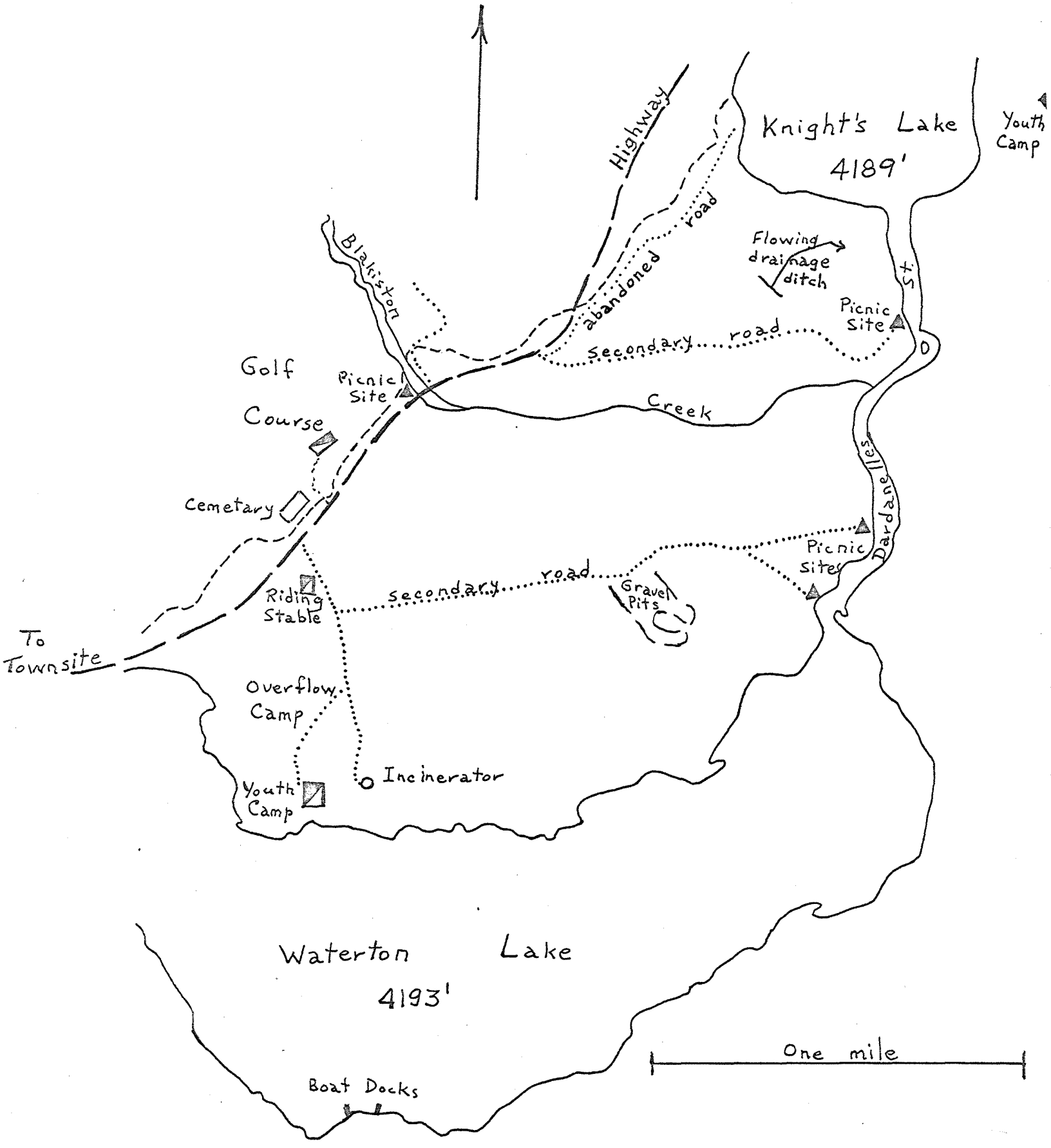
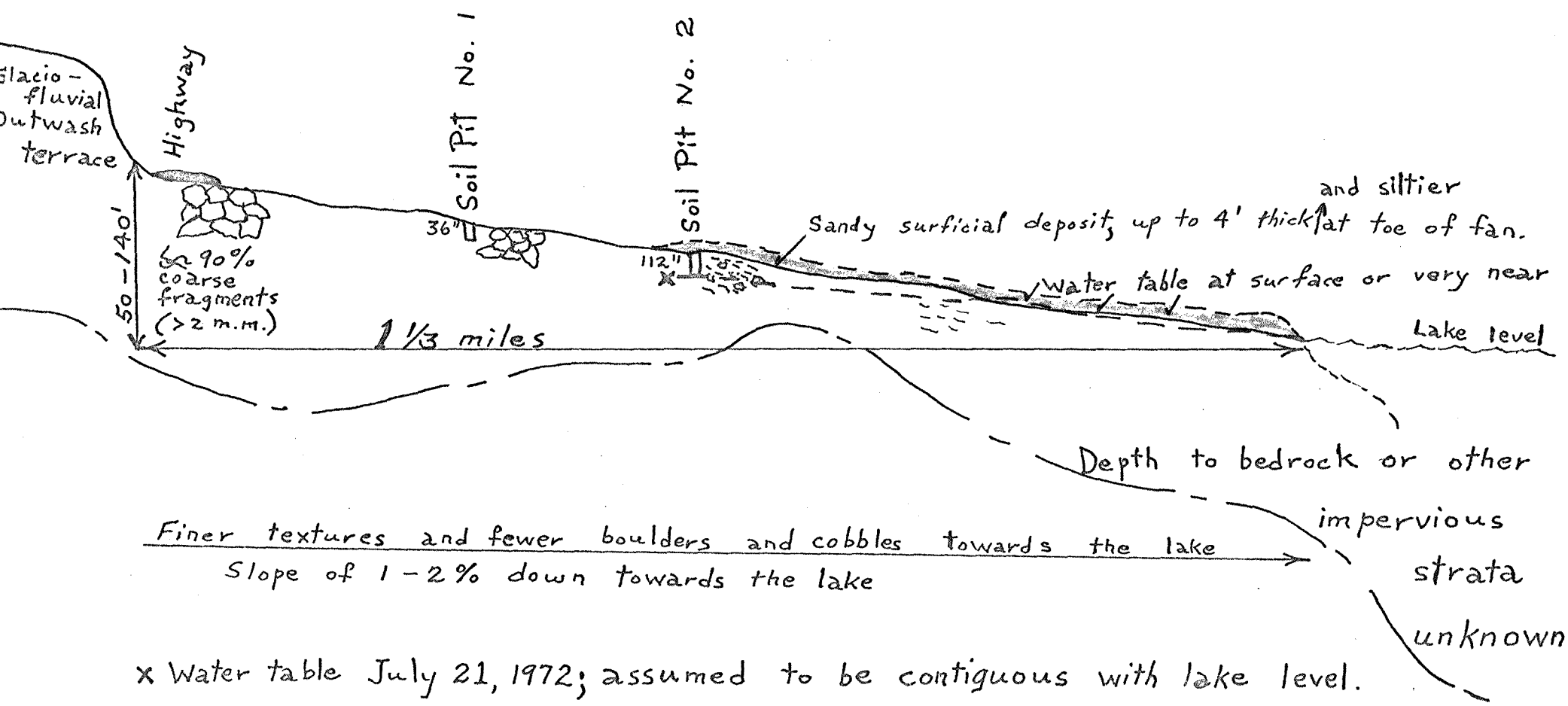


Figure 4: Diagrammatic East to West Cross-section of Blakiston Fan.



x Water table July 21, 1972; assumed to be contiguous with lake level.

Figure 5: Location of Water Percolation Test Holes on Blakiston Fan

Test Hole No.	Water Percolation Rate in mins./1 inch
1	3
2	11
3	3
4	3
5	5
6	15
7	3

Water infiltration rate (at soil surface) = 5 inches/hour