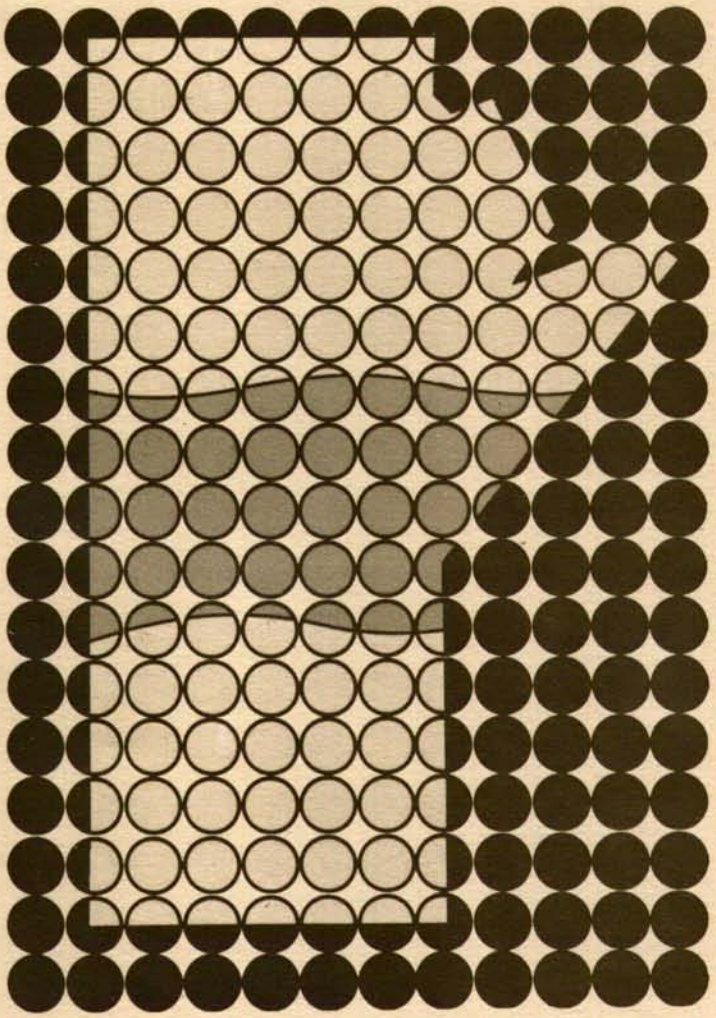

CANADA–MANITOBA
Soil Survey

Soils of the West Interlake Area

Report D-36

1982

MG-6593-15

SOILS REPORT No. D36 1981

SOILS OF THE WEST-INTERLAKE AREA

by

Glenn Podolsky

CANADA-MANITOBA SOIL SURVEY

AGRICULTURE CANADA

MANITOBA DEPARTMENT OF AGRICULTURE

DEPARTMENT OF SOIL SCIENCE, UNIVERSITY OF MANITOBA

PREFACE

This interim report and map of the detailed field and laboratory study of the soils of the West-Interlake area are one in a new series of such soil survey reports covering special interest areas in southern Manitoba. These reports reflect the growing concern by various government agencies that support the Canada-Manitoba Soil Survey, that a knowledge of the development and distribution of the soils of Manitoba is the key to understanding their properties, behavior and response to management. This concern requires that soils be described both in terms of their basic properties and the nature of the environmental setting in which they are found. Thus, when an area such as that in the West-Interlake study requires delineation of land of high or low value for crop production or for other uses, the basic reference document is an accurate and reliable soil map.

The land resource information included in this resurvey covers approximately 10,750 ha of land in the Municipalities of Siglunes, Coldwell and St. Laurent. It covers only a fraction of the area covered in the former reconnaissance surveys of Grahamdale (1971) and Fisher-Teulon (1961). However, the projected more intensive use of the soils for agriculture and the growing competition for other uses of land in the area has created a need for more up-to-date, more accurate and more detailed soil information. The increased examination of soils in the field, the use of current aerial photography, the use of improved methods of studying soils in the laboratory and the accumulated knowledge of the properties and uses of soils over the years, have all contributed to the additional information contained in this new series of reports and maps.

During the course of the resurvey of the West-Interlake area, a large volume of site specific data for the soils mapped in the area was generated, that for practical reasons cannot be included in this interim report. These data are currently being input into the Canada Soil Information (CanSIS) data bank. This computerized system of data management permits automated manipulation and statistical evaluation of large volumes of data for soil characterization and interpretations. These data will shortly be available on request. In addition, the cartographic file of CanSIS provides a capability to produce derived maps of various kinds quickly and inexpensively. The types of derived maps that can be generated from the basic soil map include the sixteen interpretations that are provided in tabular form in this report as well as a number of single feature maps for such characteristics as drainage, texture of surface deposits, slope, stoniness, distribution of salinity, etc. A package of interpretive maps and single feature derivative maps can be made available on request to: The Canada-Manitoba Soil Survey, Dept. of Soil Science, Rm. 362, Ellis Bldg., University of Manitoba, Winnipeg R3T 2N2.

The Canada-Manitoba Soil Survey trusts that this report and accompanying map will be of value to all individuals and agencies involved with the use of land within the map area.

R.E. Smith

Director

Canada-Manitoba Soil Survey

ACKNOWLEDGEMENTS

The report on the soils of the West-Interlake Area was conducted as a joint project of the Manitoba Department of Agriculture and the Canada Department of Agriculture in response to a request from the Municipal Planning Branch.

Grateful acknowledgement is made to the following persons:

R. E. Smith, Director of the Canada-Manitoba Soil Survey for reviewing the manuscript.

R. DePape and J. Griffiths for compiling and drafting the maps and sketches.

E. St. Jacques, R. Mirza, J. Madden and K. Yeung for laboratory analyses, carried out under the supervision of P. Haluschak.

D. Sandberg for typing and assisting in preparation of the report.

C. Cohen for digitizing the soil map.

The soils were mapped by G. P. Podolsky, assisted by A. Bourrier.

HOW TO USE THIS SOILS REPORT

This report on the Soils of the West-Interlake area contains information on the soils of the area, their origin, their formation, their classification and their potential for various uses such as dryland agriculture, irrigation, engineering projects and recreation. The report is presented in four parts: Part I provides a general description of the area; Part II describes mapping methodology; Part III discusses the formation, classification and morphology of soils and Part IV is an interpretive section on soils for various uses. The soil maps are presented in the form of photo mosaic copies and are found in the accompanying folder.

In order to assist the user in retrieving soil information quickly, the following steps are suggested:

Step 1 Consult the map section. Select the appropriate map sheet(s) and specific area.

Step 2 Note the map unit symbols that occur in the area of interest. Compound symbols have their percentile composition in the numerator. The denominator indicates associated landscape features of erosion, topography, stoniness and salinity, respectively. See Section on map symbology, Appendix E.

Step 3 Consult the "Legend of the West-Interlake Study", Appendix E. Symbols are listed alphabetically, giving soil name, soil texture, drainage and subgroup.

Step 4 Consult the appropriate tables and corresponding guides in Part IV for interpretive information of identified soil types.

Step 5 For additional information on the soils, consult Part III where the soils are described in alphabetical order according to soil name.

Table 1. SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA
NOVEMBER, 1980

Map Project Designation	Name (Soil Report No.)	Report[1] Status	Area in Hectares	Map Unit[2] Description	Survey[3] Intensity Level	Map Scale	Map[4] Base	Land Evaluation[5] & Interpretations
Detailed Studies and Surveys								
D1	Pasquia (No. 11)	Pub.	57,200	a,b,d	3	1:63,360	Color	A
D2	Glenlea Research Station	Int.	541	a,b	1	1:7,920	Photo	A
D3	Morden Experimental Farm	Int.	256	a,b	1	1:12,000	Photo	A
D4	Onanole	Int.	768	a,b	1	1:7,920	Photo	U
D5	York Factory Area	Int.	768	a	3	1:63,360	B&W	
D6	McCreary Tile Drain Project	Int.	64	a,b	1	1:5,000	B&W	A
D7	Brandon Experimental Farm	Pre.	768	a,b	1	1:7,920	Photo	A
D8	Portage Potato Farm	Int.	480	a,b	1	1:4,800	Photo	A
D9	Portage la Prairie (No. 17)	Pub.	113,200	a,b,c	2	1:20,000	Photo	A,I,E,U,R
D10	Morden-Winkler (No. 18)	Pub.	71,424	a,b,c	2	1:20,000	Photo	A,I,E,U,R
D11	Deep Lake	Int.	1,400	a,b	1	1:6,000	B&W	R
D12	Thompson Environmental Study	Int.	32	a,b	1	1:1,000	B&W	
D13	Organic Soil Study of Alexander L.G.D.	Int.	29,456	a,b	3	1:63,360	B&W	A
D14	Winnipeg Region	Pub.	280,000	a,b,c	2	1:20,000	Photo	A,E,U,R
D15	Brandon Region	Pub.	59,600	a,b,c	2	1:20,000	Photo	A,E,U,R
D16	Boissevain-Melita (No. 20)	Pub.	262,912	a,b,c	2	1:20,000	Photo	A,I,E,U,R
D17	Carman	Data continuing	35,840	a,b	2	1:20,000	B&W	A,E,R
D18	Orr Lake	Int.	20	a,b	1	1:1,000	B&W	
D19	Pelican-Rock Lake	Data	14,080	a,b	2	1:20,000	Photo	A,E,R,I
D20	West Portage	Pre. continuing	88,567	a,b	2	1:20,000	Photo	A,I,E,R
D21	Minnewasta	Int.	2,560	a,b	2	1:20,000	Photo	A,E,R,I
D22	Killarney	Int.	4,600	a,b	2	1:20,000	Photo	A,E,R,I
D23	Matlock-Gimli-Riverton	Int.	18,400	a,b	2	1:20,000	Photo	A,E,R,I
D24	Glenboro	Int.	5,960	a,b	2	1:20,000	Photo	A,E,R,I
D25	Sandy Lake	Int.	1,720	a,b	2	1:20,000	Photo	A,E,R,I
D26	Beausejour	Int.	10,813	a,b	2	1:20,000	Photo	A,E,R,I,U
D27	Rockwood	Int.	12,928	a,b	2	1:20,000	Photo	A,E,R,I,U
D28	Oak Lake	Int.	1,293	a,b	2	1:20,000	Photo	A,I
D29	Bird River	Int.	2,560	a,b	2	1:20,000	Photo	A,E,R
D30	North Shore Lac du Bonnet	Int.	2,400	a,b	2	1:20,000	Photo	A,E,R
D31	Grindstone Point	Int.	8,040	a,b	2	1:20,000	Photo	A,E,R

Table 1 SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
NOVEMBER, 1980

Map Project Designation	Name (Soil Report No.)	Report[1] Status	Area in Hectares	Map Unit[2] Description	Survey[3] Intensity Level	Map Scale	Map[4] Base	Land Evaluation[5] & Interpretations
D32	Paint Lake	Int.	2,880	a,b	2	1:10,000	Photo	A,E,R
D33	Cranberry Portage	Int.	80	a,b	1	1:5,000	Photo	A,E,R
D34	Dauphin	Pre.	6,400	a,b	2	1:20,000	Photo	A,E,R,I
D35	South Riding Mtn.	Pre.	17,095	a,b	2	1:20,000	Photo	A,E,R
D36	West Interlake	Int.	10,036	a,b	2	1:20,000	Photo	A,E,I,R
D37	Swan R. Townsite	Pre.	7,680	a,b	2	1:20,000	Photo	A,E,R,I
D38	Hadashville-organic	Pre.	6,475	a,b	3	1:40,000	Photo	A,E,I,R
D39	Rat River	Pre.	27,972	a,b	3	1:40,000	Photo	A,E,I,R
D40	Falcon L-Brereton L	Pre.	25,900	a,b	2	1:20,000	Photo	A,E,R
D41	Quesnel Lake-North Shore Winnipeg River	Data	3,000	a,b	2	1:20,000	Photo	A,E,R
D42	Duck Mountain	Data	3,036	a,b	2	1:20,000	Photo	A,E,R
D43	Spruce Woods	Data continuing	24,400		3	1:40,000	Photo	A,E,R
D44	McGregor	Pre.	3,910	a,b	2	1:20,000	Photo	A,E,R
D45	South Central-Escarpment	Data continuing	40,500		2,3	1:20,000 1:40,000	Photo Photo	A,E,R A,E,R
D46	Arborg-Riverton	Pre.	2,590	a,b	2	1:20,000	Photo	A,E,R,I
D47	Roblin	Pre.	4,096	a,b	2	1:20,000	Photo	A,E,R,I
D48	Flin Flon	Pre. continuing	5,200	a,b	2	1:20,000	Photo	A,E,R

Table 1 SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
NOVEMBER, 1980

Map Project Designation	Name (Soil Report No.)	Report[1] Status	Area in Hectares	Map Unit[2] Description	Survey[3] Intensity Level	Map Scale	Map[4] Base	Land Evaluation[5] & Interpretations
Reconnaissance Surveys								
R1	South Western (No. 3)	Pub.	709,600	d	3	1:125,000	B&W	A
R2	South Central (No. 4)	Pub.	967,600	d	3	1:125,000	B&W	A
R3	Winnipeg and Morris (No. 5)	Pub.	1,419,200	d	3	1:125,000	Color	A
R4	Rossburn and Virden (No. 6)	Pub.	1,372,400	d	3	1:125,000	Color	A
R5	Carberry (No. 7)	Pub.	967,600	d	3	1:125,000	Color	A
R6	West-Lake (No. 8)	Pub.	592,800	d	3	1:125,000	Color	A
R7	Grandview (No. 9)	Pub.	689,200	d	3	1:125,000	Color	A
R8	Nelson River Basin (No. 10)	Pub.	224,000	b	3	1:100,000	Color	A
R9	Fisher and Teulon (No. 12)	Pub.	949,200	a,c	3	1:100,000	Color	A
R10	Swan River (No. 13)	Pub.	316,000	a,c	3	1:125,000	Color	A
R11	South Eastern (No. 14)	Pub.	749,200	a,c	3	1:125,000	Color	A,F
R12	Lac du Bonnet (No. 15)	Pub.	764,800	a,c	3	1:125,000	Color	A,F,R
R13	Grahamdale (No. 16)	Pub.	764,800	a,b	3	1:125,000	Color	A,F,U,R,E
R14	Red Rose-Washow Bay (No. 19)	Pub.	704,400	a,b	3	1:125,000	Color	A,F
R15	Boissevain-Melita (No. 20)	Pub.	299,520	a,b	2	1:40,000	Photo	A,I,E
R16	Ste. Rose	Pre.	658,800	a,b	3	1:125,000	Color	A,I,E,R,F
R17	Waterhen	Pre.	949,600	a,b	4	1:125,000	B&W	A
R18	Swan Lake	Data	599,200	a,b	3,4	1:125,000	B&W	A
R19	The Pas	Pre.	814,400	a,b	4	1:125,000	B&W	A
R20	Grand Rapids	Pre.	800,000	a,b	4	1:125,000	B&W	A
R21	Cormorant	Int.	920,000	a,b	4	1:125,000	B&W	A
R22	Wekusko	Pre.	1,400,000	a,b	4	1:125,000	B&W	A
R23	Pointe du Bois	Data	740,000	a,b				
R24	Roseau River	Pub.	45,200	a,b	3	1:63,360	B&W	A
R25	Red Deer Lake	Pub.	34,860	a,b	2	1:31,680	Photo	A
R26	Cross Lake and Norway House	Pre.	615,200	a,b	4	1:125,000	B&W	A

Table 1 SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
NOVEMBER, 1980

Map Project Designation	Name (Soil Report No.)	Report[1] Status	Area in Hectares	Map Unit[2] Description	Survey[3] Intensity Level	Map Scale	Map[4] Base	Land Evaluation[5] & Interpretations
Biophysical and Exploratory Surveys								
B1	Lake Winnipeg, Churchill & Nelson Rivers	Pub.	3,600,000	e	4	1:250,000 1:50,000	B&W	
B2	Churchill Transportation Corridor	Data	179,000	f	4	1:125,000	B&W	
	N.R.I.P. (Northern Resource Information Project)		11,389,600	f	4	1:125,000	B&W	
B3	54C Hayes River	Int.	1,370,300	f	4	1:125,000	B&W	
B4	54D Kettle Rapids	Int.	1,370,300	f	4	1:125,000	B&W	
B5	52M Carrol Lake	Int.	634,000	f	4	1:125,000	B&W	
B5	62P Hecla	Int.	466,200	f	4	1:125,000	B&W	
B6	53D Deer Lake	Int.	629,700	f	4	1:125,000	B&W	
B6	63A Berens River	Int.	848,500	f	4	1:125,000	B&W	
B7	53M Knee Lake	Int.	1,405,900	f	4	1:125,000	B&W	
B8	53L Oxford House	Int.	1,441,100	f	4	1:125,000	B&W	
B8	63H Norway House	Data	540,800	f	4	1:125,000	B&W	
B9	SE 1/4 64A Split Lake	Int.	342,400	f	4	1:125,000	B&W	
B9	63P Sipiwesk	Int.	1,405,900	f	4	1:125,000	B&W	
B10	53E Island Lake	Pre.	1,286,900	f	4	1:125,000	B&W	
E1	Surface Deposits & Soils of Northern Manitoba	Int.		g	5	1:1,267,000	B&W	
E2	Exploratory Terrain Study of Northern Manitoba and Southern Keewatin, N.W.T.	Int.		g	5	1:1,000,000	B&W	

1. Report Status
   Pub.-Published Report and Map
   Int.-Interim Report and Map
   Pre.-Preliminary Map and Legend
   Data-Field Data Only

2. Map Unit Descriptions Code
   a-single series and phases
   b-series complexes defined as to proportion
   c-series complexes undefined as to proportion
   d-associations
   e-biophysical units (materials and physiography)
   f-biophysical units (associations & complexes of associations)
   g-regional and local physiographic units

Table 1

3.Survey Intensity Levels

Code	Name	Scale	Minimum Size Delineation(ha)	Inspection Density (Approx. range)
1	Very detailed	>1:12,000	<1.5	>1 per 3 ha
2	Detailed	1:12,000 to 1:40,000	1.5-16	1 per 3 to 50 ha
3	Semi-detailed	1:40,000 to 1:125,000	16 to 256	1 per 10 to 1000 ha
4	Reconnaissance	1:125,000 to 1:250,000	256 to 625	1 per 100 to 110,000 ha
5	Exploratory	1:250,000 to 1:1,000,000	625 to 10,000	1 per 300 to 500,000 ha

4.Published Map Base Code

Photo-Photomosaic
B&W -Black and white line
Color-Colored line

5.Interpretations Code

A-Agriculture Capability
E-Engineering
F-Forestry
I-Irrigation Suitability
U-Urban Planning and Community Development
R-Recreation

TOTAL HECTARAGE COVERED

	1980	To Date
Initial Reconnaissance	---	18,747,200
Initial Detailed	10,500	13,460
Reconnaissance		284,800
Detailed Resurvey	86,500	1,497,795
Biophysical Survey	---	11,389,600

CONTENTS

Appendix

LIST OF TABLES

LIST OF FIGURES

PART 1

GENERAL DESCRIPTION OF AREA

1.1 LOCATION AND EXTENT

The West-Interlake study area covers an area of approximately 10,750 hectares, located along the western portion of the Interlake district as outlined in Figures 1 and 2. The study areas are adjacent to or in the vicinity of Ashern, Moosehorn Bay, The Narrows, Lundar, Lundar Beach, Oak Point and St. Laurent.

This project is a resurvey of portions of the area formerly covered by the reconnaissance soil surveys of the Grahamdale area at 1:126,000 scale (1971) and Fisher-Teulon area at 1:100,000 scale (1961). The present detailed resurvey was carried out at a scale of 1:20,000.

The study area includes portions of the Municipalities of Siglunes, Coldwell and St. Laurent.

1.2 LAND USE

The present land use throughout the West-Interlake study area is primarily agriculture. Recreation plays an important role in areas such as The Narrows, Lundar Beach and St. Laurent. The major service centers are Lundar, Ashern and St. Laurent which supply essential services such as shopping centers, schools, and agricultural supplies. The availability and accessibility of these centers are important factors in supporting the rural farm and non-farm communities in these areas.

Agriculture consists dominantly of mixed farming including cereal grains and livestock production. Mixed farming is a common practise in many instances due to the variability in land capability for different uses. Land with adverse qualities such as stoniness and poor drainage are better suited to livestock production until improvement can be made for grain and forage production.

Recreational activities such as cottaging, camping, hiking, swimming, boating and fishing are provided in areas such as The Narrows, Lundar Beach, Oak Point and St. Laurent on Lake Manitoba because of the favorable water shoreline, and beach characteristics. There is an increasing concentration of cottages along the shoreline and on lands at greater distances from the shoreline. These areas afford a desirable and contrasting setting for urban dwellers in surrounding towns and Winnipeg.

1.3 RELIEF AND DRAINAGE

The principal relief and drainage features of the West-Interlake area are shown in Figures 3 and 4.

The highest land of the study area is in the eastern portion, where the elevation ranges from 875 ft.(267 m) to 900 ft. (274 m) above sea level. From here the area slopes gently westward to Lake Manitoba at 813 ft.(248 m) A.S.L. The land has a distinctive low ridge and swale topography with a general northwest to southeast linear orientation. The ridges rise only a few feet above the intervening depressions but they have a major damming effect on the drainage of the area.

Surface drainage is poorly developed over most of the West-Interlake study area. There are no well developed creeks or rivers to provide drainage. With no continuous waterways in the area, runoff from the ridges collects in the adjoining swales or in larger swamps and intermittent lakes. Although drainage ditches provide some drainage, improvement is difficult due to the lack of natural channels and the presence of numerous ridges perpendicular to the land fall.

1.4 GEOLOGY AND SOIL PARENT MATERIAL

A surface mantle of unconsolidated mineral materials covers the bedrock formations throughout the West-Interlake area. These unconsolidated materials are composed of rock fragments derived from the action of the continental ice sheets which completely covered Manitoba in recent geological times. The ice sheets picked up and transported huge quantities of materials from the bedrock formations over which they passed. When the ice sheets melted, the ma-

terials were deposited as glacial drift in various forms.

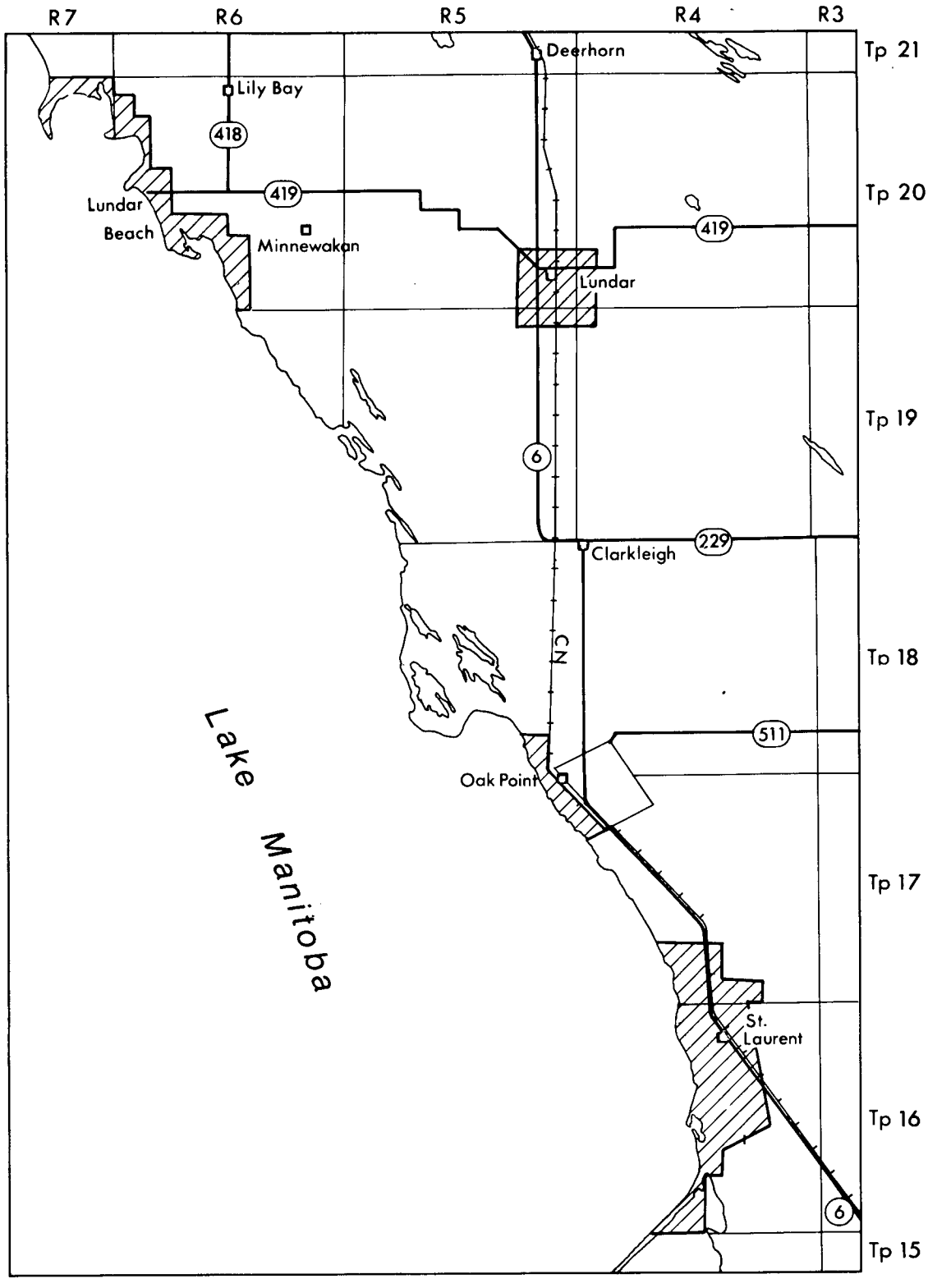

Figure 1: West-Interlake Study Area

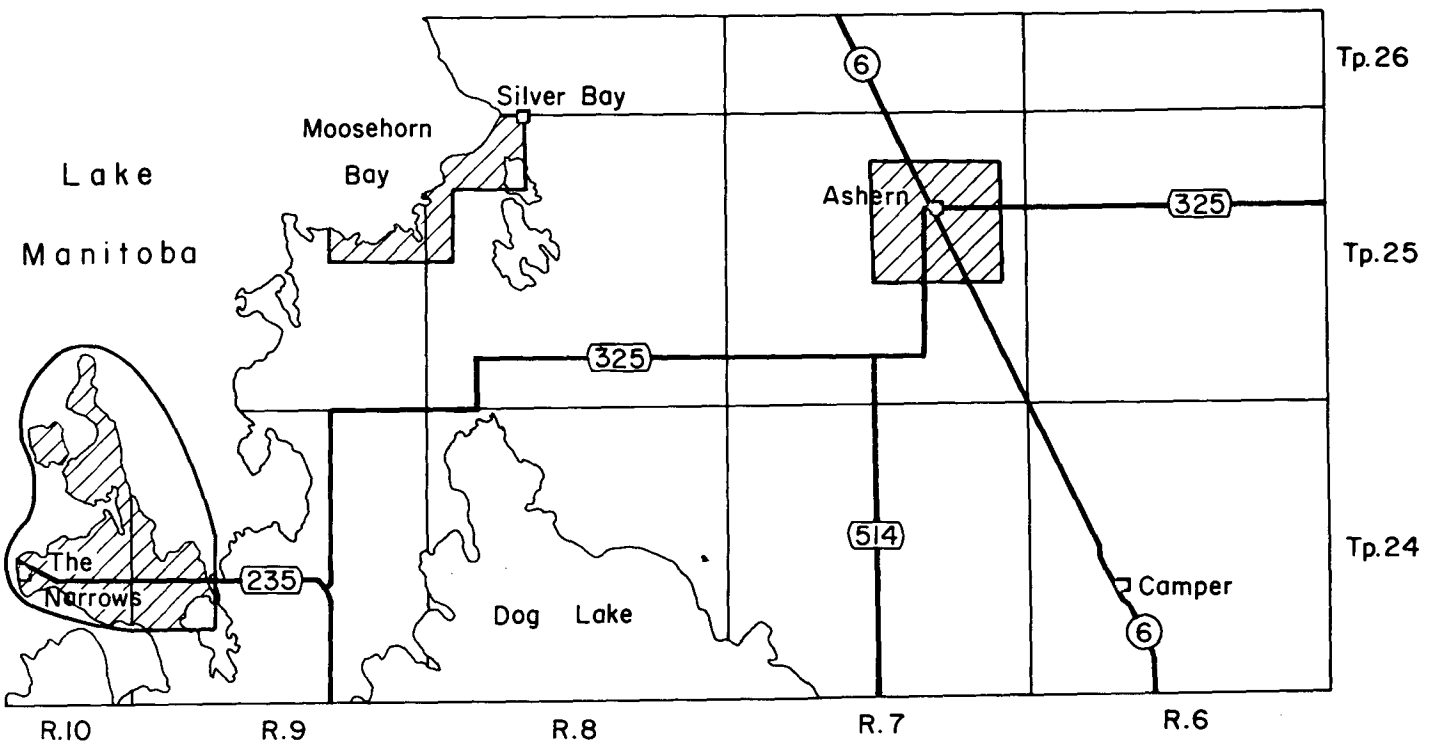

Figure 2: West-Interlake Study Area

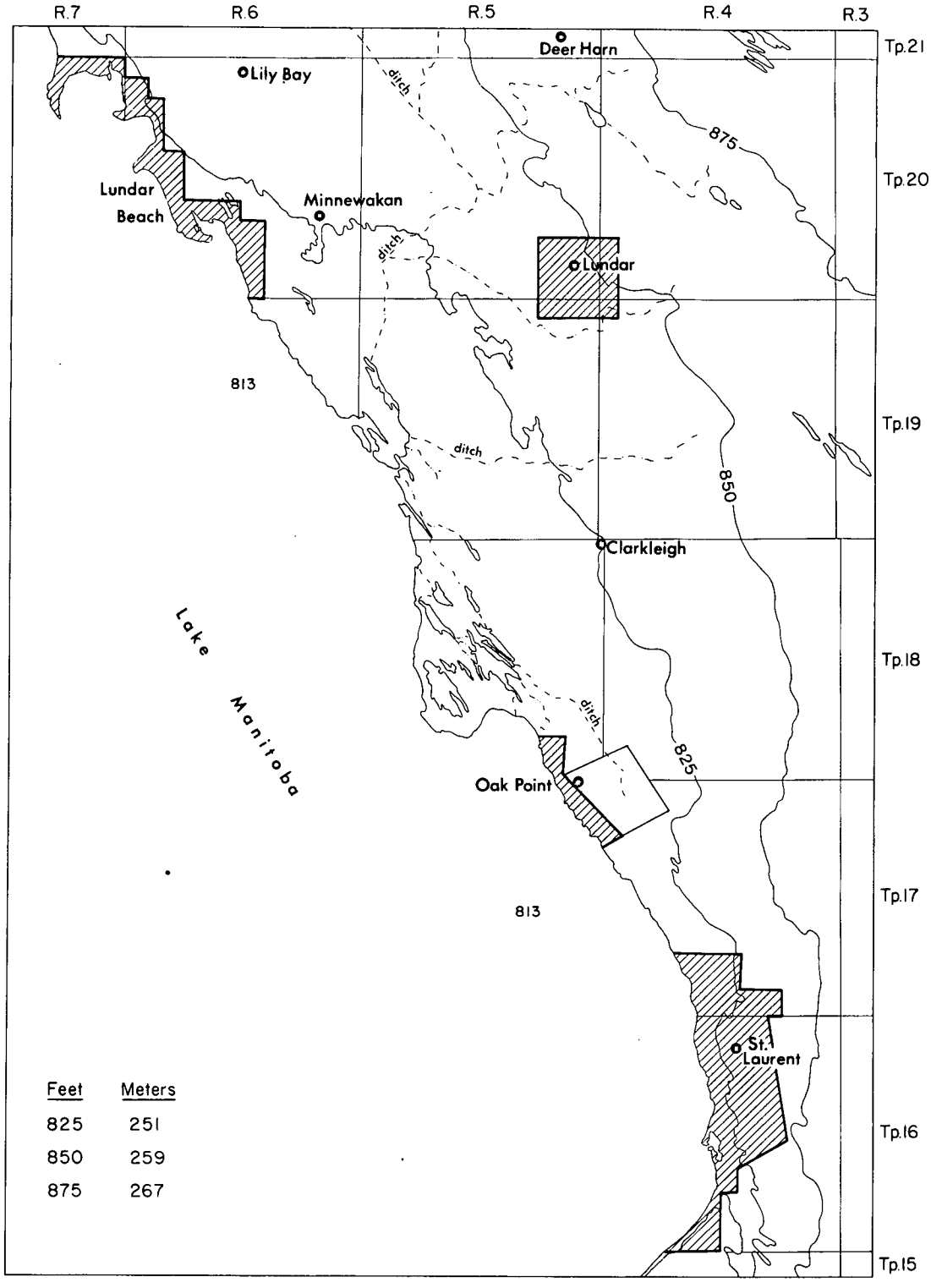

Figure 3: Relief and Drainage

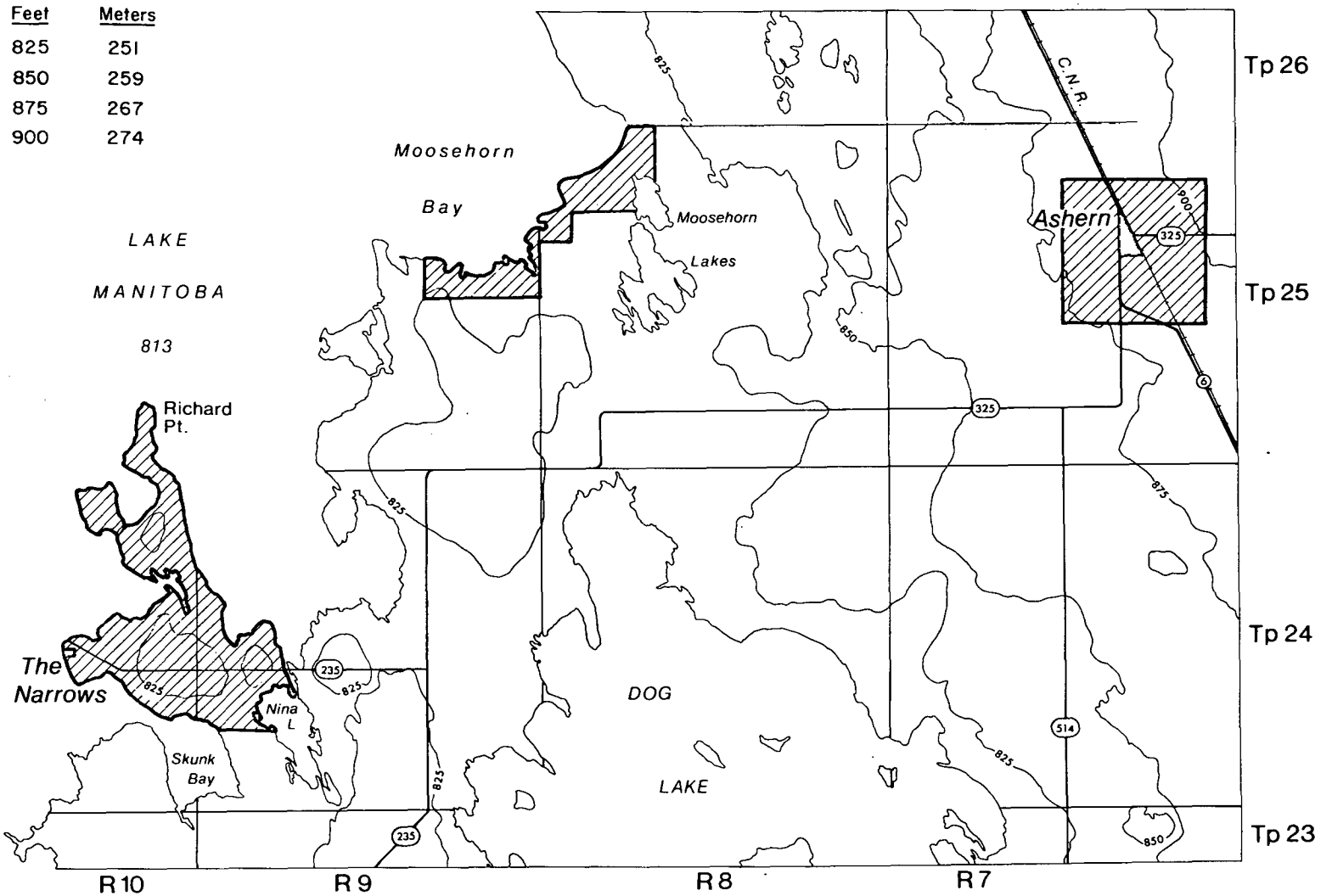

Figure 4: Relief and Drainage

Geology

The bedrock formations of the West-Interlake study area are shown in Figure 5. The area is underlain entirely by Paleozoic limestones and dolostones of the Devonian and Silurian Periods. These rock formations contributed most of the materials that make up the surface deposits of the area. The bedrock formations trend in a northwest-southeast direction and generally dip in a westerly direction.

Surface Deposits and Physiographic Areas

The terrain of the West-Interlake area lies within the Manitoba Plain Division of the Interior Plains Region of Canada. On the basis of surface deposits the area falls into the Interlake Plain section.

The Interlake Plain is a gently undulating area of ground moraine consisting of medium to moderately fine textured strongly to extremely calcareous till derived from limestone and granitic rocks. The depth of till is variable throughout the study area and in places (Moosehorn Bay, The Narrows, Ashern, Lundar) the limestone bedrock outcrops at the surface or is covered by only a thin mantle. Large areas of the till plain are characterized by a distinctive low ridge and swale topography. A majority of the soils are stony. The area is covered by scrubby aspen, with minor occurence of bur oak and white spruce. The trees are stunted in growth by the high-lime content of the soils, subsoil salinity and by restricted rooting space where the bedrock is close to the surface. Areas of natural grassland occur bordering Lake Manitoba, where soil salinity and poor drainage have prevented tree growth.

1.5 CLIMATE

In relation to worldwide climatic conditions the West-Interlake area lies within the Dfb(1) region, and is designated as dominantly subhumid, cool continental. Due to its location in the center of the continent a great distance from the moderating effect of the oceans, the summer temperatures are higher, winter temperatures are lower and annual temperature range much greater than the world average for the same latitude.

The mean annual precipitation for the area is 508 mm with approximately 381 mm falling as rain during the period of April to October and about 127 mm falls as snow during winter. June is the wettest month with 86.4 mm.

The study area has a mean annual temperature of about 1.06 degrees C. July is the warmest month with an average temperature of 19.04 degrees C. January is the coldest month with an average temperature of -19.7 degrees C. The frost-free season (0 degrees C), from May 24 to September 16 is about 115 days.

1.6 VEGETATION

The West-Interlake area lies within the Aspen-Oak and Manitoba Lowlands Sections of the Boreal Forest Region of Canada or delineated by Rowe(2).

The Aspen-Oak Section includes the St. Laurent, Oak Point, Lundar and The Narrows portions of the study area. Aspen is the most prevalent species. A general distribution of bur oak is also characteristic of this section. The most common grass species are big and little bluestem and wild rye. The open grassland areas that occur along Lake Manitoba are a result of poor drainage and soils salinity. The native vegetation in these areas is dominantly meadow grasses, reeds, sedges and salt-tolerant species.

The Ashern and Moosehorn Bay portions of the study area are part of the Manitoba Lowlands Section. While aspen is still the dominant species in these areas, black spruce and tamarack are prevalent in the poorly drained positions. Significant white spruce and jack pine occur on the better drained ridges. In local areas where the limestone bedrock is at or near the surface, trees cannot survive and dry grassland species, such as spear grasses and Potentilla form a sparse vegetative cover.

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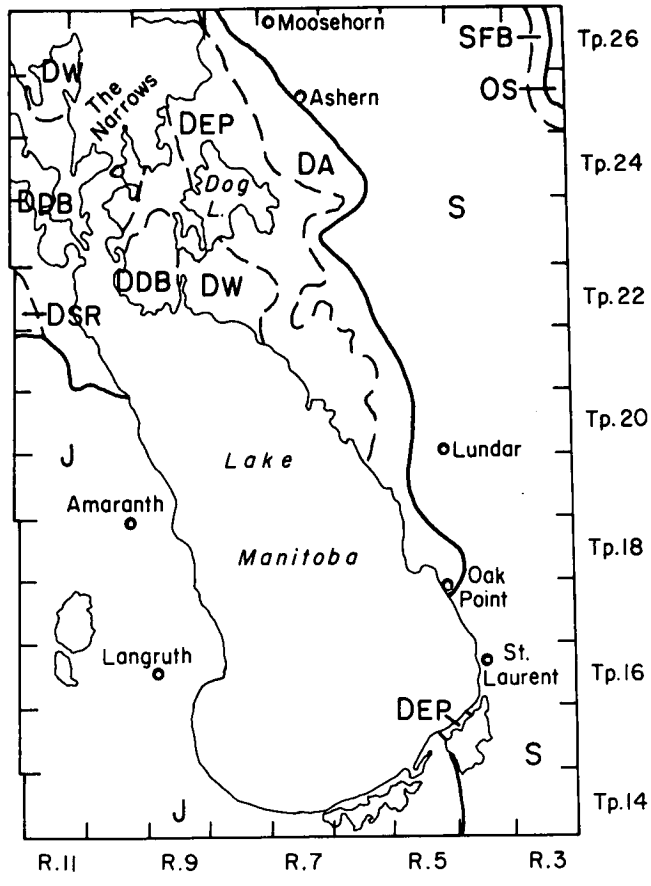
(1) Koppen, W. and Geiger, Handbuch der Klimatologie, Bond 1, Teil C, Gebuder Borntradger, Berlin, 1936.

(2) Rowe, J.S. 1972. Forest Regions of Canada. Publication No. 1300, Dept. of the Environment, Canada Forestry Service, Ottawa.



MESOZOIC

J Jurassic: Amaranth, Reston, Melita Formations. Shales, Sandstone, Limestone, Dolomite

PALEOZOIC

D Devonian: DSR - Souris River, DDB - Dawson Bay, DW - Winnipegosis, DEP - Elm Point, DA - Ashern Formations. Limestone, Dolostone and Minor Red Shale

S Silurian: Interlake Group, SFB - Fisher Branch Formation. Dolomite

O Ordovician: OS - Stonewall Formation. Dolomite

Figure 5: Geology of Underlying Bedrock

PART 2

METHODOLOGY

2.1 MAPPING

Soil mapping was conducted by examining soil profiles to depths of one meter along selected traverses in each section. In cultivated or accessible areas the soils were examined at about 150 meter intervals along each traverse; two traverses were made per section of land. Sites adjacent to the traverse and along road allowances were also examined to provide additional ground truthing and to help locate soil boundaries between sections. This field method provided approximately 25 to 30 inspection sites per section or one site per 10 ha.

Boundaries delineating the various soil types in the map area were compiled on an air photo mosaic at a scale of 1:20,000 or 3 inches equal one mile.

2.2 UNITS OF MAPPING

The basic unit of mapping in the West-Interlake area is the soil series. It is defined as a naturally occurring soil body such that any profile within that body has a similar number and arrangement of horizons, whose color, texture, structure, consistence, thickness, reaction and composition are within a narrowly defined range. Any additional features of the landscape or surface expression are expressed as phases and include degree of erosion of the soil profile, slope class, stoniness or salinity.

The delineation of map units, whether they be single soil series or soil series complexes, is not exact; they vary with local topography, drainage, erosion and soil profile properties. The decision to outline and label any given area is based on interpretation and extrapolation of observed soil and landscape features and air photo interpretation. The delineation of soil boundaries serves to separate soils having properties and conditions which are significant for potential use as field management units.

Delineated areas that are homogeneous in soil properties and external features are labelled as a simple or pure mapping unit. This area, however, may contain a small proportion, usually less than 15 percent, of related but unlike soil series or phases. Where different soils or external properties occur in intricate patterns and in such small areas that it is not pratical to show them separately because of map scale, they are combined to form compound or complex mapping units. The dominant and significant kinds of related but unlike soil series and phases that occur in such units are indicated in percentile proportions.

Very often, it is desirable to indicate by map unit symbol, minor variations in certain intrinsic properties of soils or landscape features that deviate from the normal. These variants or phases of series usually affect soil management. In the West-Interlake study, the effect of four such properties and features are indicated. These are erosion, slope class, degree of stoniness and salinity. The degree or magnitude of each is designated in the following manner:

Erosion

- x - none or only very slight erosion
- 1 - weakly eroded
- 2 - moderately eroded
- 3 - severely eroded
- 0 - overblown

Slope Class

- x - slope classes a-b, i.e. less than 2 percent slope is considered normal for the soil series
- c - 2 to 5 percent slope
- d - 5 to 9 percent slope
- e - 9 to 15 percent slope
- f - 15 to 30 percent slope
- g - 30 to 45 percent slope

Stoniness

- x - non stony
- 1 - slightly stony
- 2 - moderately stony
- 3 - very stony
- 4 - exceedingly stony
- 5 - excessively stony

Salinity

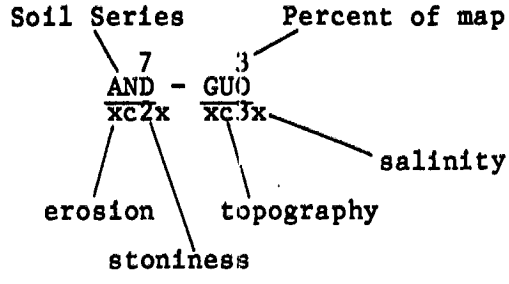
- x - non saline
- s - slightly saline
- t - moderately saline
- u - strongly saline

The convention employed to indicate these features in the map symbol is as follows:

If none of the above properties are observed to be significant, the map symbol representing the pure or unaffected soil series is used alone without modifiers.

If one or more phase features are used, the appropriate letter or number is placed below the soil series symbol in one of four designated locations in the map unit symbol. The designated order is erosion, slope class, stoniness and finally, salinity. If a particular feature is not observed to be significant, an x is used in its appropriate designated location in the map symbol.

For example, the compound map unit coded:



Is interpreted to mean that 70 percent of the mapping unit consists of Aneda (AND 7) series, having minimal or no erosion (x), gently sloping (c) topography, moderate (2) stoniness, no salinity (x); and 30 percent Gunton (GUO 3) series having no erosion (x), gently sloping (c) topography, very stony (3) surface conditions and no (x) salinity.

Definitions of the erosion, topography, stoniness and salinity classes are given in the Glossary.

2.3 SAMPLING

During the course of field investigations and mapping, soil samples were taken at selected locations for soil characterization, salinity and irrigation suitability studies. Eight profiles were described in detail and sampled for soil characterization analysis. For the salinity studies soils were sampled in areas where salinity was suspected to be a problem at 10 to 25 cm and 50 to 60 cm depths for electrical conductance measurements and soluble salt analysis.

PART 3

SOIL DESCRIPTIONS

3.1 SOIL DEVELOPMENT

The principal factors affecting soil formation are climate, relief, drainage, vegetation and parent material. Soils exhibit definite morphological characteristics reflecting their environment. Through observation of these characteristics, it is possible to classify soils into natural units and infer their genesis or the processes involved in their formation.

Only slight climatic differences occur throughout the West-Interlake area, but they are sufficient to produce change in the dominant vegetative associations and genetic soil types. Variation in microclimate within short distances due to differences in topography, aspect and drainage is significant in soil development. Ridges or more steeply sloping areas are usually locally arid since a large part of the precipitation runs off. Depressions are locally humid as they collect water and are wetter and cooler than surrounding soils. The macro and micro climate determine the kind of vegetation under which soils develop. The vegetation in turn affects the amount of, and the manner in which organic matter is added to the soil. The climate also determines the micro-organism activity, the rate of production and decomposition of organic matter, the rate and extent of mineral weathering and the rate at which products of weathering are accumulated in, or are removed from the soil.

The texture, mineralogical composition and age of the soil material affect the kind of soil that develops. Because of the extremely calcareous nature of the parent materials in the West-Interlake area and the youthfulness of the area, most of the soil development is weak and the profiles are shallow. Soils found on extremely calcareous parent material usually develop shallower profiles than those found in less calcareous parent material under similar conditions.

In the southern portion of the West-Interlake area Chernozemic Rego Black soils have developed under grassland and the Dark Gray soils under forest-grassland vegetation. Organic matter is added to the soil in the form of grass roots and leaves, and accumulates in the surface horizons giving them a dark color. The shallowness and lack of B horizon in the Rego Blacks (Isafold and Lundar series) is attributed to youthfulness and the calcareous nature of the soil. The surface mineral horizons of the Dark Gray soils are high in organic matter but exhibit varying degrees of leaching and development of a B horizon due to cooler subhumid climatic conditions and forest vegetation. These soils are typified by the Aneda and Inwood series.

The northern part of the study area has Eluviated Eutric Brunisols associated with the Dark Gray soils on the extremely calcareous till. These soils are mapped as Fairford and Hilbre. Profile development is thin on these soils because of youthfulness and the extremely calcareous parent material. Certain segments of the study area have soil development which has resulted in the formation of eluvial and illuvial horizons characteristic of Gray Luvisol soils.

A large percentage of the map area consists of poorly drained Gleysolic soils in which soil development has been influenced by the accumulation of runoff water in depressional areas of the landscape. These soils are under the influence of excessive moisture conditions for much of the year. Most of the poorly drained soils of the West-Interlake area are Humic Gleysols characterized by a thin mesic peat surface horizon underlain by a dark colored mineral horizon high in organic matter. Clarkleigh and Meleb are characteristic soils which have developed on extremely calcareous till.

3.2 DESCRIPTION OF SOIL SERIES

A convenient reference table on the relationship of soil series in the West-Interlake area to the soil drainage class, subgroup and parent material is provided in Table 2. A more comprehensive grouping of soils and parent materials is presented in Table 3.

The soil series for the study area are described in alphabitical order and include a general description of the genetic profile type, texture, parent material, topography and drainage. A general statement on the distribution, surface runoff, stoniness and vegetation is included. Additional information on the suitability and management of each soil for agricultural, engineering and recrea-

tional uses is given in Section IV of this report.

The position of selected soils in a typical landscape in relation to parent materials, vegetation, drainage and topography is exemplified by a cross-section in Appendix B.

TABLE 2

Soil Series of the West-Interlake Area Arranged in Relation to Soil Drainage Class, Subgroup and Parent Material

Table 2. Soil Series of the West-Interlake Area Arranged in Relation to Soil Drainage Class, Subgroup, and Parent Material

Soil Drainage Class	Subgroup	Parent Materials: Glacial Till medium to mod. fine	Till/Limestone Rock med. to mod. fine	Fluvial sand and gravel	Fluvial/Till sand and gravel	Lacustrine coarse	Lacustrine/Till coarse	Organic Mesic Fen over Till
Well	Orthic Gray Luvisol	Garson (GSO)					St. Labre (SLB)	
	Eluviated Eutric Brunisol	Fairford (FFD)	Hilbre (HIB)					
	Orthic Dark Gray	Aneda (AND)	Stonewall (SWW)	Leary (LRY)	Gunton (GUO)	Davidson (DVD)		
	Orthic Black		Narcisse (NCS)					
	Rego Black	Isafold (ISF)	Alonsa (AOS)					
	Dark Gray, lithic		Sandridge (SDE)	Lynx Bay (LXB)				
Imperfect	Gleyed Dark Gray	Inwood (IWO)	Faulkner (FKR)					
	Gleyed Rego Black	Lundar (LUR)						
Poor	Rego Humic Gleysol	Clarkleigh (CKG) Meleb (MEB)						
Poor to very poor	Terric Mesisol							Crane (CRN)

TABLE 3

Parent Materials and Related Soils of the West-Interlake Study Area

1. Soils developed on loamy, stony extremely calcareous glacial till and water modified till.

   a) Well to moderately well drained

      * Garson series (Orthic Gray Luvisol) GSO

      * Aneda series (Orthic Dark Gray) AND

      * Fairford series (Eluviated Eutric Brunisol) FFD

      * Isafold series (Rego Black) ISF

   b) Imperfectly drained

      * Inwood series (Gleyed Dark Gray) IWO

      * Lundar series (Gleyed Rego Black, carbonated) LUR

   c) Poorly drained

      * Clarkleigh series (Rego Humic Gleysol, carbonated) CKG

      * Meleb series (Rego Humic Gleysol, carb.) MEB

2. Soils developed on strongly to extremely calcareous, stony, loamy till underlain by limestone bedrock within 1 meter.

   a) Well drained

      * Hilbre series (Eluviated Eutric Brunisol) HIB

      * Stonewall series (Orthic Dark Gray) SWW

      * Narcisse series (Orthic Black, lithic, 0-50 cm) NCS

      * Alonsa series (Rego Black) AOS

      * Sandridge series (Dark Gray, lithic, 0-50 cm) SDE

   b) Imperfectly drained

      * Faulkner series (Gleyed Dark Gray) FKR

3. Soils developed on moderately to strongly calcareous outwash and beach deposits.

   a) Well drained

      * Leary series (Orthic Dark Gray) LRY

4. Soils developed on strongly calcareous outwash and beach deposits over limestone bedrock which occurs within 1 meter of the surface.

   a) Well drained

      * Lynx Bay series (Dark Gray, lithic) LXB

5. Soils developed on strongly calcareous outwash and beach deposits overlying extremely calcareous, loamy stony till.

   a) Well drained

      * Gunton series (Orthic Dark Gray) GUO

6. Soils developed on moderately to strongly calcareous sandy outwash and lacustrine deposits.

a) Well drained

* Davidson series (Orthic Dark Gray) DVD

7. Soils developed on 25 to 100 cm of moderately to strongly calcareous coarse textured deposits over extremely calcareous, stony, loamy till.

a) Well drained

* St. Labre series (Orthic Gray Luvisol) SLB

8. Organic soils developed on 40 to 160 cm of mesic fen peat, underlain by loamy glacial till.

a) Poorly to very poorly drained

* Crane series (Terric Mesisol) CRN

9. Miscellaneous soils and materials. Soils developed on stratified, calcareous, sandy to sandy-skeletal beach and bar deposits of recent origin.

a) Rapid to imperfectly drained

* Sand Beach (Orthic Regosol) Sb

10. Shallow peat and muck deposits over undifferentiated materials.

a) Poor to very poorly drained

* Marsh (Rego Gleysol) Mh

b) Limestone and Dolostone Rock Outcrop

* Rock (Regosol) R

Aneda Series (AND)

The Aneda series consists of well to moderately well drained Orthic Dark Gray soils developed on extremely calcareous, stony glacial till. The surface texture ranges from a sandy loam to loam. The topography is irregular, very gently to gently sloping. Surface runoff is moderate and permeability is medium to moderately slow. The vegetation consists mainly of aspen with occasional burr oak.

The Aneda soil is characterized by a thin neutral, slightly acid partially decomposed leaf mat, and a dark gray Ahe horizon of 3 to 10 cm thick and underlain by a dark yellowish brown Btj horizon of 6 to 12 cm thick. The extremely calcareous C horizon is very pale brown and may have a somewhat platy, fissile structure. The Bt horizon is not as well developed as the Garson soil; the subsoil characteristics of both series are very similar.

Alonsa Series (AOS)

The alonsa series consists of well drained and moderately well drained Rego Black soils developed on thin extremely calcareous glacial and water-modified till over limestone bedrock at depths of 0.5 to 1.0 meter. Surface textures vary from sandy loam to loam. They occupy the well drained ridges and knolls. The topography is level to irregular, gently sloping. These soils were developed under tall grasses, semi-open bur oak and stunted poplar. The soils are moderately to very stony; some areas have been cleared, but most of these soils remain under natural vegetation.

The solum and parent materials are similar to the Isafold series except that bedrock occurs within one meter of the surface.

The solum consists of an Ah horizon 12 to 20 cm thick, very dark gray in color, granular, friable and mildly alkaline in reaction. The texture is variable ranging from sandy loam to clay loam, but dominantly loam. This surface grades sharply into light gray to white extremely calcareous glacial till.

Clarkleigh Series (CKG)

The Clarkleigh series consists of Rego Humic Gleysol, carbonated soils developed on extremely calcareous, medium textured water-worked till and includes soils developed on a very thin mantle (less than 15 cm) of lacustrine sediments over the till. Surface textures range from sandy loam to clay. These soils occupy the level to depressional positions of the irregular very gently sloping till plain. Runoff is slow to very slow; permeability is impeded because of a high water table. Stoniness is variable depending on the degree of water-working and the depth of the lacustrine mantle. The native vegetation consists dominantly of meadow grasses, sedges, reeds with some willow, swamp birch or black poplar. These soils may be saline in areas of discharge or where lateral seepage occurs.

The Clarkleigh soil is characterized by a moderately to strongly calcareous, thin partially decomposed peat layer 5 to 10 cm, and a thin very dark gray Ah horizon 7 to 20 cm; remnant calcareous shells of aquatic organisms are usually present. A thin transitional gray to dark gray AC horizon is present above a white lime accumulation layer. Gravelly and cobbly lag deposits may occur in the material as a result of water working and sorting. The parent materials are similar to the Lundar and Inwood series.

Crane Series (CRN)

The Crane series consists of very poorly drained organic soils developed on shallow deposits of mesic fen peat and underlain by extremely calcareous medium textured till. The Crane series is a Terric Mesisol with a thin fibric surface layer underlain by dominantly mesic fen peat which grades into more decomposed humic fen or aquatic peat above the mineral substrate. The underlying till substrate occurs between 40 and 160 cm of the surface.

The Crane soils occur in the depressional positions adjacent to the Aneda-Inwood soils and are often associated with Meleb series. The native vegetation is dominantly sedge, weed-grass with some willow and swamp birch.

Davidson Series (DVD)

The Davidson series consists of well to moderately well drained Orthic Dark Gray soils developed on moderately calcareous, sandy, deltaic and beach deposits. Surface textures vary from sandy loam to medium sand. The topography is irregular, very gently to gently sloping; runoff is moderate; permeability is rapid. The depth of sand is usually one to two meters to the underlying clay or till. The native vegetation is dominantly aspen with occasional white spruce or jackpine.

The Davidson soil is characterized by a dark gray Ahe horizon 16 to 24 cm thick and a very dark grayish brown Bm horizon. A lime carbonate layer may be present at 30 to 50 cm depth. Internal drainage is good as indicated by the absence of iron mottling within one meter.

Fairford Series (FFD)

The Fairford series consists of well drained Eluviated Eutric Brunisol soils, developed on extremely calcareous glacial till. Surface texture varies from loam to clay loam. These soils occupy much of the well drained land in the Interlake Till Plain. They occur commonly with Garson soils. The topography is very gently sloping to gently sloping. The native vegetation is aspen, jack pine, and white spruce. The Fairford soils are very stony. A representative profile is described below:

The solum of Fairford soil is generally less than 20 cm, characterized by a thin (less than 25 cm broken light-colored eluvial Ae horizon or a several cm thick Aej horizon overlying a thin, weakly developed textural B horizon). The Aej horizon is slightly acid or neutral, and the B horizon is neutral.

Faulkner Series (FKR)

The Faulkner series consists of imperfectly drained Gleyed Dark Gray soils developed on extremely calcareous loamy glacial till overlying limestone bedrock at depths of 0.5 to 1 meter. These soils are similar to the Inwood series in chemical and physical characteristics. The surface texture varies from sandy loam to sandy clay loam. They occupy the intermediate slopes in association with the Stonewall or Sandridge series. Runoff is slow, and permeability is moderately slow. These soils are moderately to very stony.

The soils is characterized by a shallow solum with a thin LH horizon of 4 to 7 cm, a thin dark gray Ahe horizon 3 to 7.5 cm thick, a weakly developed Bt horizon 4 to 15 cm, thick which grades sharply into the extremely calcareous loamy till. Usually fine yellowish brown mottles are present below the solum.

Garson Series (GSO)

The Garson series consists of very thin, moderately well to well drained, Orthic Gray Luvisol soils developed on extremely calcareous, stony, glacial till. The surface texture varies from loamy fine sand to loam. The topography is irregular very gently to gently sloping. Surface runoff is moderate and permeability is medium to moderately slow. The vegetation consists mainly of aspen with occasional bur oak.

The Garson soil is characterized by a thin neutral to slightly acid leaf mat, a distinct gray Ae horizon 4 to 11 cm thick, and a dark yellowish brown Bt horizon 6 to 10 cm thick. The extremely calcareous C horizon is very pale brown and may have a somewhat platy or fissile structure.

Gunton Series (GUO)

The Gunton series consists of very thin, well to moderately well drained, Orthic Dark Gray soils developed on thin sandy and gravelly outwash overlying water-worked, extremely calcareous, stony glacial till. The solum is similar to the Leary series having a surface texture ranging from loamy fine sand to fine sandy loam. The thickness of the moderately coarse upper layer ranges from 15 to 40 cm and changes abruptly to stratified gravelly and sandy deposits which vary in thickness from 10 to 60 cm. The topography is irregular, very gently to gently sloping. Surface runoff is moderate and permeability is rapid in the upper deposits and moderate to moderately slow in the underlying loamy till. Vegetation consists of bur oak, grasses, herbs, hazel and some aspen.

The Gunton series is characterized by a thin partially decomposed leaf mat derived from deciduous tree and grass vegetation, a dark gray Ah or Ahe horizon of variable thickness depending on the uniformity of the moderately coarse layer, and a brown to dark yellowish brown Bm or Bt horizon which usually terminates at the contact of the gravelly layer. The

underlying loamy glacial till is pale brown and varies in structure from weak fine granular to somewhat platy or fissile.

Hilbre Series (HIB)

The Hilbre series consists of well drained Eluviated Eutric Brunisol soils, developed on .5 to 1 m of extremely calcareous glacial till overlying limestone bedrock. The topography is very gently sloping to gently sloping. The vegetation is aspen, jack pine and white spruce.

The solum of Hilbre soils is generally less than 20 cm characterized by a thin light colored eluvial Ae horizon or several cm thick Aej horizon overlying a thin, weakly developed B horizon. The Hilbre soils correlate with Fairford rock substrate phase soils in previously published soil survey reports.

Isafold Series (ISF)

The Isafold series consists of moderately well drained Rego Black soils developed on extremely calcareous loamy glacial till. The surface texture varies widely from sandy loam to clay due to the inclusion of soils with a thin mantle of lacustrine sediments up to 15 cm thick over the till. These soils occupy the well drained ridges and knoll position of gently sloping ridge and swale topography. Runoff is moderate and permeability is moderate to moderately slow. The native vegetation consists of mixed prairie grasses, with semi-open stands of stunted aspen and bur oak. These soils are moderately to very stony and few areas can be cultivated without intensive stone removal.

Inwood Series (IWO)

The Inwood series consists of imperfectly drained Gleyed Dark Gray soils developed on extremely calcareous loamy textured till and water-worked till. The dominant surface texture is loam, but textures range from gravelly sand to clay because of sorting and local deposition as glacial Lake Agassiz receded from the area. Minor but significant areas of gravelly and cobbly lag deposits also occur in the material. These areas are very hard to separate from the unmodified till because they are very shallow, occur in random pattern, and usually have the same landform as the surrounding till.

These Inwood soils occur on the intermediate and lower landscape position on very gently to irregular ridge and swale topography. Runoff is slow; permeability is moderately slow. The groundwater table is near the surface during the spring runoff. Inwood soils are generally stony; the amount of stones increases in areas of more severe water working. The native vegetation is dominantly aspen; with some rose, willow, meadow-prairie grasses and herbs.

All Inwood soils are leached but the degree of leaching is variable within small areas. Dark gray soils having weakly developed B horizons with some translocated clay and organic matter are intermixed with soils lacking a distinct B horizon (Rego Dark Gray soils). Inwood soils are usually characterized by a shallow solum with a thin LH horizon, a thin Ahe horizon 3 to 7.5 cm thick, a weakly developed Bt or Bm horizon 4 to 15 cm thick which grades sharply into light gray, extremely calcareous till.

Leary Series (LRY)

The Leary series consists of well to excessively drained Dark Gray soils developed on coarse gravel beach and outwash deposits. Commonly there is a thin sandy surface mantle over the coarser material. Surface textures range from loamy fine sand to sand. The topography is very gently sloping usually in the form of long, low, narrow ridges. Surface runoff is moderate; permeability is rapid to very rapid. Vegetation consists of bur oak, grasses, choke cherries and saskatoons.

The Leary soil is characterized by a dark gray Ah or Ahe horizon that is variable in thickness depending on the uniformity of the sandy surface mantle. The brown to dark yellowish brown Bm commences at the contact of a gravelly coarser layer and may have a horizon with slight clay accumulation and clay coating around the pebbles and sand grains. The parent material consists of pale brown, stratified layers of coarse sand and gravel.

Lundar Series (LUR)

The Lundar series consists of imperfectly drained carbonated Gleyed Rego Black soils developed on extremely calcareous loamy and water modified till. In some areas these soils may have a very thin mantle of lacustrine sediments over the till.

The surface texture ranges from silty clay loam to silty clay. This soil occupies the intermediate position between the ridge and swale sequence. The topography is level to very gently sloping, runoff is moderately slow, and permeability is moderately slow. The native vegetation consists of native grasses, aspen, black poplar and some willow. These soils usually are very stony.

The Lundar soil is characterized by a thin very dark gray Ah horizon grading directly into the gleyed, extremely calcareous parent material. The A horizon is moderately alkaline and contains considerable lime carbonate.

Lynx Bay Series (LXB)

The Lynx Bay series consists of moderately well drained Orthic Dark Gray soils developed on moderately to strongly calcareous outwash and beach deposits over limestone bedrock. The solum is similar to the Gunton or Leary series; properties of the outwash and beach deposits are similar to those of the Leary series. The topography is very gently sloping to irregularly gently sloping. Permeability is rapid in the coarse textured outwash and moderate in the fractured permeable limestone within a meter of the surface. The surface textures range from medium sand to fine sandy loam. Native vegetation consists of aspen, bur oak and native grasses.

Marsh (Mh)

The Marsh consists of very poorly drained, carbonated Rego Gleysol soils developed on lacustrine clay or thin mucky loam deposits over extremely calcareous till and/or moderately calcareous clay. These soils occur on level to depressional areas that are covered with water and are usually saturated for most of the year. The native vegetation consists entirely of reeds and sedges.

These soils have a thin surface layer of either muck or mineral material high in organic matter content and are underlain by strongly gleyed, olive gray mineral materials. A very thin Ahg horizon, less than 2.5 cm thick, may be present below the muck surface layer.

Marsh soils are undifferentiated with respect to texture and composition of their parent material. They also are much more poorly drained than other Gleysolic soils.

Meleb Series (MEB)

The Meleb series consists or poorly drained, carbonated, Rego Humic Gleysol soils developed on extremely calcareous, stony glacial till. A thin peat covering of 10 to 30 cm may be present and underlain by textures ranging from sandy loam to clay due to some inwash in the level to depressional topographic position. They occur in association with the Garson, Aneda and Inwood soils. The native vegetation is dominantly meadow grasses, sedges and herbs with inclusions of willow, black poplar and some aspen.

The Meleb soil profile consists of a thin layer of fen peat overlying a thin dark gray Ah horizon 6 to 10 cm thick, alkaline and calcareous, and underlain by a light gray to white, extremely calcareous till. In soils that have had some inwash or sorting the Ah horizon terminates at the contact of the modified sediments and underlying till. A thin gravelly or cobbly lens may occur at the contact.

Narcisse Series (NCS)

The Narcisse series are Orthic Black, lithic phase soils developed on a thin (0-50 cm) mantle of stratified extremely calcareous, medium-textured till over limestone bedrock. The surface textures range from sandy loam to clay loam. The Narcisse soils are found on well-drained sites which are locally arid due to the low water-holding capacity of the thin till deposits over the rock. The topography is level to very gently sloping. Permeability is moderate throughout the till but is impeded at the bedrock. These soils are exceedingly stony. The vegetation consists mainly of grasses and open stands of stunted aspen, oak and jack pine.

The solum of the Narcisse soils is thin (10-20 cm). A thin to discontinuous leaf mat is underlain by a black to very dark gray A horizon and a dark grayish brown B horizon. The B horizon may be calcareous due to incomplete dissolution and removal of small particles of limestone. A gravelly lens of variable thickness may occur between the till and the underlying bedrock.

Narcisse soils are usually associated with Fairford, Faulkner and Rock outcrop.

Sand Beach (Sb)

Sand beaches are stratified, sandy ridges of recent origin. They are presently in the process of formation in relatively sheltered locations along the Lake Manitoba shoreline. The material varies from relatively pure deposits of fine and medium sand, to gravelly deposits containing many large rounded stones and pebbles. Drainage varies from poor to rapid, depending upon the topographic position and level of the adjacent lake waters. These areas have little or no profile development, and therefore are considered to be Orthic Regosols. These soil areas have no agriculture of forestry value, but do provide excellent recreational sites. Some sand beaches support scattered stands of willow, aspen, and grasses.

St. Labre Series (SLB)

The St. Labre series consists of moderately well to well drained Orthic Gray Luvisol soils developed on moderately to strongly calcareous, moderately coarse to coarse textured sandy lacustrine deposits overlying extremely calcareous, loam to clay textured till deposits. The surface layers range from a fine sand to loamy sand and average about 30 to 60 cm in thickness. The topography is irregular, very gently sloping. Runoff is moderately rapid. Permeability ranges from moderately rapid to slow. The native vegetation consists of bur oak, grasses, some aspen, choke cherry, and saskatoon.

The St. Labre soil is characterized by a thin partially decomposed leaf mat, a thick light gray to gray Ae horizon within the sandy overlay and a thin moderately developed textural B horizon either within the sandy layer or in the finer textured substrate. A pebble line may be encountered at the contact of the extremely calcareous loam to clay loam till.

Stonewall Series (SWW)

The Stonewall series consists of moderately well to well drained Orthic Dark Gray soils developed on less than one meter (50 to 100 cm) of extremely calcareous, loamy till over limestone bedrock. These soils have a similar solum to the Sandridge and Aneda series but differ in the depth to bedrock. The topography is irregular, gently sloping; runoff is moderate; and permeability is moderate in the loamy till and variable in the fractured, permeable limestone bedrock. The native vegetation consists of trembling aspen, bur oak, hazel, forbs and native grasses.

The soil is characterized by a thin, moderately decomposed leaf mat; a thin (4 to 8 cm) dark gray friable A horizon, and a thin (12 to 20 cm) granular, brown B horizon. The solum is normally less than 25 cm thick. The physical characteristics of the solum and parent material are similar to the Aneda series.

Sandridge Series (SDE)

The Sandridge series consists of moderately well drained Dark Gray, lithic phase soils developed on thin, extremely calcareous (less than 50 cm) till over limestone bedrock. These soils are similar to the Stonewall soils whose parent material ranges from 50 to 100 cm over limestone bedrock. Topography is irregular, gently sloping; runoff is moderate. Permeability is moderately slow in the loamy till and variable in the fractured permeable bedrock below. The native vegetation consists of bur oak, trembling aspen, hazel, and occasional jack pine.

The soil is characterized by a solum less than 25 cm thick, having a thin, leaf mat, a thin dark gray somewhat blotched A horizon of 4 to 6 cm thick and a granular grayish brown B horizon with some clay and organic coatings on the peds. These soils have similar physical and chemical properties as the Aneda and Stonewall soils, differing only in the depth of glacial till to limestone bedrock.

PART 4

USE AND MANAGEMENT INTERPRETATIONS OF SOILS

4.1 INTRODUCTION

This section provides predictions of performance or soil suitability ratings for various uses of soils based on field observations of soil and landscape characteristics, laboratory data and on observations of soil behavior under specified conditions of land use and management. Suitability ratings or interpretations are intended only to serve as guides for planners and managers. Caution, with an understanding of the limitations of the soil map must be exercised when applying suitability ratings to soil map units. The value of any rating or interpretation depends upon the nature and composition of individual map unit delineations which in turn depends on the scale of mapping and intensity of ground truthing employed in the survey.

There are two kinds of mapping units employed in the resurvey of soils in Manitoba.

They are simple mapping units and compound mapping units.

Simple mapping units are usually occupied by one kind of soil series, the properties of which vary within very narrow limits. Often as not they contain minor inclusions of related but unlike soil types. The proportion of such unlike soils tends to increase as the intricacy of soil pattern increases or as the intensity of ground truthing decreases. In any event, such mapping units are usually named after the dominant soil series and any available information about the soil series is applicable to the entire mapping unit. Predictions concerning soil conditions and behavior can be done confidently.

Compound mapping units on the other hand, usually contain significant proportions of two or more unlike soil series. These soils are related geographically but cannot be mapped or delineated separately because of a combination of such factors as the intricacy of soil pattern, map scale and survey effort. In many compound map units, differences in soil types and other characteristics are strongly contrasting. Dominant, subdominant and minor (if strongly contrasting) soil series are identified and the relative proportion that each occupies within a single map delineation is specified. In compound map units, interpretation or suitability ratings can only be applied to that portion of the mapping unit occupied by each identified soil series. In order to apply interpretations to field conditions, it is essential that users determine where each identified soil series in the mapping unit occurs in the landscape. Information contained in the legend accompanying the soil map and other sections of the report is useful for this purpose.

A second type of compound mapping unit is called a soil complex. This compound mapping unit usually contains two or more related but unlike soil series which occur in unspecified proportions. In most cases, the differences in soil profile and other characteristics are not strongly contrasting. Soil complexes are often employed in the mapping of organic soil areas. In such areas ground truthing is limited to such a degree that the proportions of constituent soil series within each map unit delineation is not possible to determine. Complexes are often used in the mapping of beach and outwash deposits. Here, soil profile variability occurs over such short intervals of distance that they cannot be shown separately nor can their relative proportions be adequately determined in compound units without excessive and expensive ground truth effort. Interpretations applied to such units cannot be employed with the same degree of confidence as in the case of simple or more specifically defined compound mapping units.

In this section, interpretive soil information is provided for the following land use evaluations:

1. Agriculture
   a) dryland farming capability
   b) irrigation suitability
2. Engineering Uses
3. Recreation Uses

4.2 SOIL CAPABILITY FOR AGRICULTURE

Dryland Agriculture

Soil capability classification for dryland agriculture is based on evaluation of both internal and external soil characteristics that influence soil suitability and limitations for agricultural use. In this classification, mineral soils are grouped

into capability classes, subclasses and units based on their limitations for dryland farming, risk of damage when the soils are used and the way they respond to management(3). There are seven capability classes, each of which groups soils together that have the same relative degree of limitation or hazard for agricultural use. The limitation becomes progressively greater from Class 1 to Class 7. The class indicates the general suitability of the soils for agriculture. The first three classes are considered capable of sustained production of common field crops, the fourth is marginal for sustained arable culture, the fifth is suitable only for improved permanent pasture, the sixth is capable of use only for native pasture while the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture.

Organic soils within the map area are rated for "potential" agricultural capability after the method of Leeson(4). Capability ratings of organic soils for agriculture must recognize that most organic soils have little or no value for agriculture in their native state and their potential is only achieved through reclamation or development implemented with varying degrees of difficulty. Capability class definitions for organic soils are the same as for mineral soils. They are however, identified on maps and tables with the prefix "O".

Soil Capability subclasses are divisions within classes which group soils with similar kinds of limitations and hazards for agricultural use. The various kinds of limitations recognized at the subclass level are defined in Table 4.

Soil capability units are divisions within the subclass category that groups soils together that will similarly to a given management input.

A summary of the soils in the West-Interlake area showing their major characteristics and their interpretive classification for dryland agriculture is presented in Table 5.

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(3) Anon. 1965. Land capability classification for agriculture Report No. 2, Canada Land Inventory, Canada Dept. Regional Economic Expansion, Ottawa. 16 pp.

(4) Leeson, Bruce et al. 1969. An organic soil capability classification for agriculture and a study of the organic soils of Simcoe County, Soil Sci. Dept., Ontario Agricultural College, Guelph, Ontario.

TABLE 4

Agricultural Capability Subclass Limitations

C - Adverse climate: This subclass denotes a significant adverse climate for crop production as compared to the "median" climate which is defined as one with sufficiently high growing season temperatures to bring field crops to maturity, and with sufficient precipitation to permit crops to be grown each year on the same land without a serious risk of partial or total crop failures.

D - Undersirable soil structure and/or low permeability: This subclass is used for soils difficult to till, or which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock.

E - Erosion: Subclass E includes soils where damage from erosion is a limitation to agricultural use. Damage is assessed on the loss of productivity and on the difficulties in farming land with gullies.

F - Low fertility: This subclass is made up of soils having low fertility that either is correctable with careful management in the use of fertilizers and soil amendments or is difficult to correct in a feasible way. The limitation may be due to lack of available plant nutrients, high acidity or alkalinity, low exchange capacity, high levels of carbonates or presence of toxic compounds.

I - Inundation by streams or lakes: This subclass includes soils subjected to inundation causing crop damage or restricting agricultural use.

L - Coarse wood fragments: In the rating of organic soils, woody inclusions in the form of trunks, stumps and branches (>10 cm diameter) in sufficient quantity to significantly hinder tillage, planting and harvesting operations.

M - Moisture limitation: This subclass consists of soils where crops are adversely affected by droughtiness owing to inherent soil characteristics. They are usually soils with low water-holding capacity.

N - Salinity: Designates soils which are adversely affected by the presence of soluble salts.

P - Stoniness: This subclass is made up of soils sufficiently stony to significantly hinder tillage, planting, and harvesting operations. Stony soils are usually less productive than comparable non-stony soils.

R - Consolidated bedrock: This subclass includes soils where the presence of bedrock near the surface restricts their agricultural use. Consolidated bedrock at depths greater than 1 meter from the surface is not considered as a limitation, except on irrigated lands where a greater depth of soil is desirable.

T - Topography: This subclass is made up of soils where topography is a limitation. Both the percent of slope and the pattern or frequency of slopes in different directions are important factors in increasing the cost of farming over that of smooth land, in decreasing the uniformity of growth and maturity of crops, and in increasing the hazard of water erosion.

W - Excess water: Subclass W is made up of soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas.

X - Cumulative minor adverse characteristics: This subclass is made up of soils having a moderate limitation caused by the cumulative effect of two or more adverse characteristics which singly are not serious enough to affect the class rating.

Irrigation Suitability

Irrigation suitability of soils is determined by evaluating the nature of both internal and external soil characteristics(5). The classification of soils for irrigation suitability consists of two categories: class and subclass.

The suitability class groups soils having the same relative suitability or degree of limitation or hazard for irrigation use. Four classes are utilized grading from Class 1, which is very good to Class 4, which is poor. The four classes are:

Class 1 - Very good: These are soils of fine sandy loam to clay loam texture which are well suited for irrigation use. The soils have good water retention capacity, good permeability, low salt content, good drainage and low general gradient of land surface.

Class 1 - Good: These are soils of loamy fine sand to light clay texture which are moderately well suited for irrigation use. Slight limitation to use results from soil factors such as water holding capacity, permeability, depth of material, salt content, topographic factors such as slope and pattern or drainage restrictions arising from surface drainage and depth to water table.

Class 3 - Fair: These are coarse or fine textured soils which are fair to marginally suitable because of some unfavourable characteristics that limit production and cause management problems under irrigation use. Soil, topographic or drainage factors are more restrictive than in Class 2.

Class 4 - Poor: These are soils that are considered poor to unsuitable for irrigation use because of severe drainage problems, impermeable geologic material, salinity, very low water holding capacity, very rapid permeability, topography or a combination of these problems.

The suitability subclass identifies soils with similar kinds of limitations and hazards related to both internal and external soil characteristics. The internal characteristics include both permanent and non-permanent properties; the permanent properties are those that will not change over time whereas the non-permanent properties may be altered with time by specific management. The properties which affect irrigation suitability of soil are listed as follows:

1. Internal Characteristics

   a) Permanent - Texture, uniformity and depth of geologic deposit, hydraulic conductivity and water storage capacity

   b) Non-permanent - Structure, drainage, fertility, reaction, salinity, exchangeable sodium

2. External Characteristics

   a) Topography, erosion, stoniness, vegetative cover

The classification criteria for irrigation suitability are summarized in Table 11. Appendix C. The soils of the West-Interlake area are evaluated for irrigation suitability in Table 5

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(5) PFRA. 1964. Handbook for the classification of irrigation land in the prairie provinces. Prepared by Committee of the Canada Dept. of Agriculture. PFRA, Regina, Sask. 92 pp.

Table 5. Agricultural Interpretations for Soils in the West-Interlake Study Area

Map Symbol	Soil Name, Texture, Phase	Agricultural Capability (Dryland)	Irrigation Suitability
AND	Aneda, loam	2X	3S
AND/xx2x	Aneda, moderately stony	3P	3S
AND/xx3x	Aneda, very stony	4P	3S
AND/xx4x	Aneda, exceedingly stony	5P	4S
AOS	Alonsa, loam	4R	4S
AOS/xx3x	Alonsa, very stony	4RP	4S
AOS/xx4x	Alonsa, loam, exceedingly stony	5P	4S
CKG	Clarkleigh, clay loam	5W	4D
CKGp	Clarkleigh, peaty	5W	4D
CKG/xx1x	Clarkleigh, slightly stony	5W	4D
CKG/xxxs	Clarkleigh, slightly saline	5W	4D
CKG/xx1s	Clarkleigh, slightly stony, slightly saline	5W	4D
CKG/xx2x	Clarkleigh, moderately stony	5W	4D
CKG/xx2s	Clarkleigh, moderately stony, slightly saline	5W	4D
CKG/xx3x	Clarkleigh, very stony	5W	4D
CKG/xx3s	Clarkleigh, very stony, slightly saline	5W	4D
CRN	Crane, mesic peat	05WD	4D
DVD	Davidson, fine sand	4M	3S
DVD/xx3x	Davidson, very stony	4MP	3S
DVD/xx4x	Davidson, exceedingly stony	5P	3S
FFD	Fairford, loam	2X	3S
FFD/xx2x	Fairford, moderately stony	3P	3S
FFD.xx3x	Fairford, very stony	4P	3S
FFD/xc3x	Fairford, gently sloping, very stony	4P	3S
FFD/xx4x	Fairford, exceedingly stony	5P	4S
FFD/xc4x	Fairford, gently sloping, exceedingly stony	5P	4S
FKR	Faulkner, loam	4R	4S
FKR/xx3x	Faulkner, very stony	4RP	4S
FKR/xx4x	Faulkner, exceedingly stony	5P	4S
FKR/xx5x	Faulkner, excessively stony	6P	4S
GSO	Garson, loam	2X	3S
GSO/xx2x	Garson, moderately stony	3P	3S
GSO/xx3x	Garson, very stony	4P	3S
GSO/xx4x	Garson, exceedingly stony	5P	4S
GUO	Gunton, loamy sand	5M	4S
GUO/xc3x	Gunton, gently sloping, very stony	5M	4S
GUO/xx4x	Gunton, exceedingly stony	5MP	4S

Table 5. cont'd

Map Symbol	Soil Name, Texture, Phase	Agricultural Capability (Dryland)	Irrigation Suitability
HIB	Hilbre, loam	4R	4S
HIB/xx4x	Hilbre, exceedingly stony	5P	4S
HIB/xx5x	Hilbre, excessively stony	6P	4S
ISF	Isafold, loam	2X	3S
ISF/xx1x	Isafold, slightly stony	2P	3S
ISF/xx2x	Isafold, moderately stony	3P	3S
ISF/xx3x	Isafold, very stony	4P	3S
ISF/xc3x	Isafold, gently sloping, very stony	4P	3S
IWO	Inwood, loam	2W	4SD
IWO/xx2x	Inwood, moderately stony	3P	4SD
IWO/xx3x	Inwood, very stony	4P	4SD
IWO/xc3x	Inwood, gently sloping, very stony	4P	4SD
IWO/xx4x	Inwood, exceedingly stony	5P	4SD
LRY	Leary, loamy sand	5M	4S
LRY/xx3x	Leary, very stony	5M	4S
LUR	Lundar, loam	2W	4SD
LUR/xxxs	Lundar, slightly saline	3N	4SD
LUR/xx1x	Lundar, slightly stony	2P	4SD
LUR/xx2x	Lundar, moderately stony	3P	4SD
LUR/xx2s	Lundar, moderately stony, slightly saline	3NP	4SD
LUR/xx3x	Lundar, very stony	4P	4SD
LUR/xx3s	Lundar, very stony, slightly saline	4P	4SD
LXB	Lynx Bay, loamy sand	5MR	4S
LXB/xc3x	Lynx Bay, gently sloping, very stony	5MR	4S
LXB/xx4x	Lynx Bay, exceedingly stony	6PR	4S
LXB/xc4x	Lynx Bay, gently sloping, exceedingly stony	6PR	4S
Mh	Marsh	7W	4D
MEB	Meleb, clay loam	5W	4D
MEBp	Meleb, peaty	5W	4D
MEB/xx2x	Meleb, moderately stony	5W	4D
MEB/xx3x	Meleb, very stony	5W	4D
MEB/xx4x	Meleb, exceedingly stony	5WP	4SD
NCS	Narcisse, loam	5R	4S
NCS/xx3x	Narcisse, very stony	5RP	4S
NCS/xx4x	Narcisse, exceedingly stony	5RP	4S
NCS/xx5x	Narcisse, excessively stony	6P	4S
R	Rock	7R	4S

Table 5. cont'd

Map Symbol	Soil Name, Texture, Phase	Agricultural Capability (Dryland)	Irrigation Suitability
Sb	Sand Beach, sand	7MW	4S
Sb/xcxx	Sand Beach, gently sloping	7MW	4S
SLB	St. Labre, loamy sand	4M	3S
SLB/xx4x	St. Labre, exceedingly stony	5P	4S
SWW	Stonewall, loam	4R	4S
SWW	Stonewall, exceedingly stony	5P	4S
SDE	Sandridge, loam	5R	4S
SDE/xx5x	Sandridge, excessively stony	6P	4S
Zz	Water	7W	4D

the severity of the combined effects of several soil properties on suitability for a particular use will result in downgrading an evaluation. This is left to the discretion of the interpreter. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. Class limits established for rating the suitability of individual soil properties take this into account. For a selected use, therefore, only those soil properties which most severely limit that use are specified.

Engineering description of the soils and their estimated properties significant to engineering are provided in Table 7. These data, in addition to information contained in other sections of the report have been used to rate the soils according to their suitability for ten selected engineering uses in Table 8. When using these interpretations, consideration must be given to the following assumptions:

1. Interpretations are based on predictions of soil behavior under defined conditions of use and management as specified in the preamble to each of Tables 12 through 25 (Appendix C).

2. Soil ratings do not include site factors such as nearness to towns and highways, water supply, aesthetic values, etc.

3. Soil ratings are based on natural, undisturbed soil.

4. Soil suitability ratings are usually given for the entire soil, but for some uses, they may be based on the limitations of an individual soil horizon or other earthy layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 meters, but in some kinds of soils, reasonable estimates can be given for soil material at greater depths. It should be noted here that the term "soil" has been used throughout the report in the pedologic sense and differs in concept from that commonly used by engineers.

5. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the soil limitations. The use of soils rated as poor depends on the nature of the limitations, whether or not the soil limitation can be altered successfully and economically, and on the scarcity of good sites.

6. Interpretations of map units do not eliminate the need for on-site evaluation by qualified professionals. Due to the variable nature of soils, and the scale of mapping, small, unmappable inclusions of soils with different properties may be present in an area where a development is planned. The need for or importance of on-site studies depends on the use to be made of the soil and the kinds of soil and soil problems involved.

TABLE 6

Codes utilized to identify limitations in evaluating soil suitability for selected Engineering and Recreational Uses(Tables 8 and 9)

a subgrade properties

b thickness of topsoil

c coarse fragments on surface

d depth to bedrock

e erosion or erodibility

f susceptibility to frost hazard

g contamination hazard of groundwater

h depth to seasonal water table

i flooding or inundation

j thickness of slowly permeable material

k permeability or hydraulic conductivity

l shrink-swell properties

m moisture limitations or deficit

n salinity or sulphate hazard

o organic matter

p stoniness

q depth to sand or gravel

r rockiness

s surface texture

t topographic slope class

u moist consistence

w wetness or soil drainage class

z permafrost

4.4 SOIL SUITABILITY FOR SELECTED RECREATION USES

This section provides interpretations of the soil suitability for recreational development. All types of soil can be used for recreational activities of some kind.

Soils and their properties determine to a large degree, the type and location of recreational facilities. Wet soils are not suitable for campsites, roads, playgrounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is contemplated. It is difficult to maintain grass cover for playing fields and golf courses on droughty soils. The feasibility of many kinds of outdoor activities are determined by other basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreation uses is shown in Table 9 according to four classes, Good, Fair, Poor and Very poor defined previously in the section on Engineering Uses. Subclasses are employed to identify the kind of limitation or hazard for a particular use. An explanation of subclass symbols are provided in Table 6.

The guidelines for various recreation uses are presented in Appendix C, Tables 22 to 25.

TABLE 7

Engineering Description of the Soils and Their Estimated Properties Significant to Engineering

Table 7. Engineering Description of the Soils and Their Estimated Properties Significant to Engineering.

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	AASHO	% Passing No. 10 (2.0) mm	No. 40 (0.42) mm	No. 200 (.074) mm	Permea-bility cm/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
AND	Aneda	0-25	L-CL	CL-ML	A-5	70-90	65-80	45-65	1.5-5.1	6.5-7.0	none	low	moderate	more than
		25-75	L-SiL	CL-ML	A-4	70-85	60-80	40-60	1.5-5.1	7.8-8.2	low	low	moderate	1.5 m
AOS	Alonsa	0-25	L-CL	ML to CL	A-4 to A-6	70-90	65-80	45-65	1.5-5.1	6.5-7.2	none	low	moderate	more than
		25-75	L-SiL	ML to CL	A-4 to A-6	70-85	60-80	40-60	1.5-5.1	7.6-8.0	none	low	moderate	1.5 m
		75+	Limestone Bedrock											
CKG	Clarkleigh	0-20	CL	ML to CL	A-4	80-90	75-80	40-70	.5-2.0	7.4-7.8	low	low	moderate	seasonal
		20-100	SiL-SiCL	ML to CL	A-4 to A-6	80-90	75-80	40-70	.5	7.6-8.2	moderate	low	moderate	at surface
CRN	Crane	0-100	Mesic peat	-	-	-	-	-	-	6.0-7.0	low	low	-	at surface
		100+	L-SiL	CL to ML	A-4 to A-6	70-85	60-80	40-60	.25-1.5	7.8-8.2	low	low	moderate	
DVD	Davidson	0-25	LFS	SM	A-2-4	100	70-85	25-45	15.2-25.4	6.0-6.5	none	low	none	below
		25-110	LFS-FS	SM	A-2-4 to A-3	95-100	90-100	20-40	15.2-25.4	7.0-7.5	none	low	none	1.5 m
		110+	C	CH	A-7-6	100	95-100	70-90	.2	7.6-8.0	none	low	high	
FFD	Fairford	0-13	L-CL	CL-ML	A-4	85-95	80-90	50-70	1.5-5.1	6.5-7.0	none	low	moderate	1.5 m
		13-90	L	CL-ML	A-4	75-85	70-80	50-70	1.5-2.5	7.5-8.0	low	low	moderate	
FKR	Faulkner	0-25	L-CL	CL to ML	A-5	70-90	65-80	45-65	2-6.4	6.5-7.2	low	low	moderate	seasonal
		25-85	L-SiL	ML to CL	A-4	70-85	60-80	40-60	2-6.4	7.6-8.0	low	low	moderate	1 m
		85+	Limestone Bedrock											
GSO	Garson	0-20	L-CL	CL to ML	-	70-85	65-80	45-65	1.5-5.1	6.8-7.2	none	low	moderate	2m
		20-100	SiL-SiCL	ML to CL	A-4 to A-7-6	70-85	65-80	40-60	.5-5.1	7.6-8.2	low	low	moderate	

Table 7. Cont'd

Map Symbol	Soil Series	Depth cm	Classification USDA	Unified	AASHO	% Passing No. 10 (2.0) mm	No. 40 (0.42) mm	No. 200 (.074) mm	Permeability cm/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
GUO	Gunton	0-25	LFS-FSL	SM	A-2-4 to A-4	80-90	70-85	20-30	12.7-25.4	6.6-7.2	none	low	low	greater
		25-75	Gr-LS	Gp to GW	A-1	50-80	15-30	1-5	50.8	7.6-8.0	none	low	none	than 2 m
		75+	L-SiL	CL to ML	A-4 to A-6	70-85	60-80	40-60	.1-.5	7.8-8.2	low	low	moderate	
HIB	Hilbre	0-60	L-CL	CL	A-4 to A-6	85-95	80-90	60-80	1.3-3.8	7.0-7.5	low	low	moderate	2 m
		60+	Rock	-	-	-	-	-	-	-	-	-	-	-
ISF	Isafold	0-20	L-CL	CL to CH	A-6 to A-7-5	75-90	65-80	50-70	1.5-5.1	7.2-7.6	none	low	moderate	2 m
		20-100	L-SiL	CL	A-4	70-85	60-80	45-65	1.5	7.6-8.0	low	low	moderate	
IWO	Inwood	0-20	L-CL	CL to CH	A-6 to A-7-5	75-90	65-80	50-70	1.5-5.1	7.0-7.2	none	low	moderate	seasonal
		20-100	L-SiL	CL	A-4	70-85	60-80	45-65	1.5	7.6-8.0	low	low	moderate	0.5 m
LRY	Leary	0-25	LMS-MSL	SM	A-2	75-95	-	10-20	15.2-30.5	6.5-7.4	none	low	none	2 m
		25-75	GrLS-FGr	GW to Gp	A-1	-	-	0-2	50.8	7.6-8.2	none	low	none	
		75+	Strat. Cs-FGr	GW to Gp	A-1	20-75	-	0-2	50.8	7.6-8.2	none	low	none	
LUR	Lundar	0-25	L-CL	CL	A-6 to A-7-6	85-95	75-90	50-80	1.5-5.1	7.4-7.8	low	low	moderate	seasonal
		25-100	L-SiCL	ML to CL	A-4 to A-6	85-95	75-90	50-75	1.5	7.8-8.2	moderate	low	moderate	.5 m
LXB	Lynx Bay	0-45	SiL-SiCL	ML to CL	A-4 to A-6	75-90	70-85	50-70	0.5-6.35	6.8-7.4	low	low	moderate	2 m
		45+	fractured and permeable limestone bedrock											
MEB	Meleb	0-15	L-CL	OL to OH	A-4 to A-6	80-95	70-80	50-70	1.5-5.1	7.6-8.0	low	low	moderate	seasonal
		15+	L-SiCL	ML to CL	A-4 to A-6	80-95	70-80	50-70	.5	7.8-8.2	moderate	low	moderate	at surface

Table 7. Cont'd

Map Symbol	Soil Series	Depth cm	Classification USDA	Unified	AASHO	% Passing No. 10 (2.0) mm	No. 40 (0.42) mm	No. 200 (.074) mm	Permeability cm/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Mh	Marsh	0-25	Muck and SiL	OL	A-4	100	100	80-100	2.5-5.0	7.5-8.0	none to moderate	low	moderate	at surface
		25-50	SiL	ML	A-4	100	100	80-100	2.5-5.0	7.5-8.0	none to moderate	low	moderate	
		50+	L Till	ML-CL	A-4 to A-6	90-100	70-90	50-70	1.0-5.0	8.0-8.5	none to moderate	low to moderate		
NCS	Narcisse	0-45	L	ML	A-5 to A-6	70-90	65-80	50-70	2.5-5.0	7.0-7.5	none	low	moderate	1.5 m
		45+	Rock	-	-	-	-	-	-	-	-	-	-	-
Sb	Sand Beach	0-100	S and Gr	SP,GP, GMorSM	A-1 to A-2	50-100	15-50	0-15	25+	7.0-8.0	none	low	low	0.1 m
SDE	Sandridge	0-20	SiCL-CL	CL	A-6 to A-7	85-95	80-90	45-80	1.3-5.0	6.5-7.0	low	low	moderate	2 m
		20-45	SiL-SiCL	ML to CL	A-4 to A-6	80-95	70-80	35-70	1.3-5.0	7.6-8.2	low	low	moderate	
		45+	Limestone bedrock											
SLB	St. Labre	0-60	FS-LFS	SM to SW	A-2-4	100	90-100	5-30	12.7-25.4+	5.6-6.0	none	low	low	2 m
		60-75	LFS-FSL	SM to SP	A-2 to A-4	100	90-100	5-35	5.1-12.7	6.6-7.2	none	low	low	
		75+	L-SiCL	ML to CL	A-4 to A-6	80-95	70-85	50-70	1.5	7.6-8.2	low	low	moderate	
SWW	Stonewall	0-25	SCL-CL	CL	A-6 to A-7	85-95	80-90	45-80	1.3-5.1	6.5-7.0	low	low	moderate	2 m
		25-90	SiL-SiCL	ML to CL	A-4 to A-6	80-95	70-80	35-70	2.5	7.6-8.2	low	low	moderate	
		90+	Limestone bedrock											

TABLE 8. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil [1]	Sand & Gravel [2]	Road Fill [3]	Permanent Bldgs. With Basements [4]	Local Roads and Streets [5]	Sanitary Trench [6]	Landfill Area [7]	Cover Material [8]	Sewage Lagoons [9]	Septic Fields [10]
AND	Aneda	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fka	Fk
AND /xx2x	Aneda	Pbp	Va	Fa	Fap	Fa	Fp	G	Fsp	Fk	Fk
AND /xx3x	Aneda	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fka	Fk
AND /xx4x	Aneda	Pbp	Va	Pp	Pp	Pp	Pp	G	Pp	Pp	Fkp
AOS	Alonsa	Pb	Va	Fd	Pd	Fd	Vd	Pkg	Pd	Pd	Pd
AOS /xx3x	Alonsa	Pbp	Va	Fdp	Pdp	Fdp	Vd	Pkg	Pdp	Pd	Pd
AOS /xx4x	Alonsa	Pbp	Va	Pp	Pdp	Pp	Vd	Pkg	Pdp	Pdp	Pd
CKG	Clarkleigh	Pw	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKGp	Clarkleigh	Vw	Va	Vw	Va	Va	Vws	Vw	Vsw	Va	Vh
CKG /xx1x	Clarkleigh	Pw	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xxxs	Clarkleigh	Pwn	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xx1s	Clarkleigh	Pwn	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xx2x	Clarkleigh	Pw	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xx2s	Clarkleigh	Pwn	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xx3x	Clarkleigh	Pp	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CKG /xx3s	Clarkleigh	Ppn	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
CRN	Crane	Vw	Va	Vwa	Vah	Vw	Vw	Vw	Vsw	Vah	Vh
DVD	Davidson	Ps	Fa	G	G	G	Vs	Pk	Vs	Pka	Gg
DVD /xx3x	Davidson	Pp	Fa	Fp	Pp	Fp	Vs	Pk	Vs	Pka	Gg
DVD /xx4x	Davidson	Pp	Pp	Pp	Pp	Pp	Vs	Pk	Vs	Pp	Gg
FFD	Fairford	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fka	Fk
FFD /xx2x	Fairford	Pb	Va	Fa	Fap	Fa	Fp	G	Fsp	Fk	Fk
FFD /xx3x	Fairford	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Fk
FFD /xc3x	Fairford	Pbp	Va	Fp	Pp	Fap	Pp	G	Pp	Fkp	Fk
FFD /xx4x	Fairford	Pbp	Va	Pp	Pp	Pp	Pp	G	Pp	Pp	Fkp
FFD /xc4x	Fairford	Pbp	Va	Pp	Pp	Pp	Pp	G	Pp	Pp	Fkp
FKR	Faulkner	Pb	Va	Faw	Pwd	Fwd	Vd	Pg	Pd	Pd	Pd
FKR /xx3x	Faulkner	Pp	Va	Fpd	Pwp	Fwp	Vd	Pg	Pdp	Pd	Pd
FKR /xx4x	Faulkner	Pp	Va	Pp	Pwp	Pp	Vd	Pg	Pdp	Pdp	Pd
FKR /xx5x	Faulkner	Vp	Va	Vp	Vp	Vp	Vdp	Pg	Vp	Pp	Pd

TABLE 8. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil [1]	Sand & Gravel [2]	Road Fill [3]	Permanent Bldgs. With Basements [4]	Local Roads and Streets [5]	Sanitary Trench [6]	Landfill Area [7]	Cover Material [8]	Sewage Lagoons [9]	Septic Fields [10]
GSO	Garson	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fka	Fk
GSO /xx2x	Garson	Pbp	Va	Fa	Fap	Fa	Fp	G	Fsp	Fk	Fk
GSO /xx3x	Garson	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fka	Pp
GSO /xx4x	Garson	Pbp	Va	Pp	Pp	Pp	Pp	G	Pp	Pp	Pd
GUO	Gunton	Ps	Fa	G	Fa	G	Fs	Vk	Vs	Pka	Fka
GUO /xc3x	Gunton	Pp	Fap	Fp	Pp	Fp	Pp	Vk	Vs	Pka	Fkg
GUO /xx4x	Gunton	Pp	Pp	Pp	Pp	Pp	Pp	Vk	Vs	Pp	Fkg
HIB	Hilbre	Pb	Va	Fd	Pd	Fda	Vd	Pg	Pd	Pd	Pd
HIB /xx4x	Hilbre	Pbp	Va	Pp	Pdp	Pp	Vd	Pg	Pdp	Pdp	Pd
HIB /xx5x	Hilbre	Vp	Va	Vp	Pdp	Vp	Vd	Pg	Vp	Vp	Pd
ISF	Isafold	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fka	Fk
ISF /xx1x	Isafold	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fka	Fk
ISF /xx2x	Isafold	Pb	Va	Fa	Fap	Fa	Fp	G	Fp	Fka	Fk
ISF /xx3x	Isafold	Pp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Fk
ISF /xc3x	Isafold	Pp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Fk
IWO	Inwood	Pb	Va	Faw	Pw	Fwa	Pw	Fw	Fs	Fka	Pkh
IWO /xx2x	Inwood	Pb	Va	Faw	Pw	Fwa	Pw	Fw	Fsp	Fka	Phk
IWO /xx3x	Inwood	Pbp	Va	Fp	Pwp	Fwp	Pwp	Fw	Pp	Fkp	Phk
IWO /xc3x	Inwood	Pbp	Va	Fp	Pwp	Fwp	Pwp	Fw	Pp	Ftp	Pkh
IWO /xx4x	Inwood	Pbp	Va	Pp	Pwp	Pp	Pwp	Fw	Pp	Pp	Phk
LRY	Leary	Ps	G	G	G	G	Vsk	Vk	Vs	Vk	Gg
LRY /xx3x	Leary	Psp	G	Fp	Pp	Fp	Vsk	Vk	Vs	Vk	Gg
LUR	Lundar	Pb	Va	Faw	Pw	Fwa	Pw	Fw	Fs	Fka	Phk
LUR /xxxs	Lundar	Pbn	Va	Faw	Pwn	Fwa	Pw	Fw	Fs	Fka	Pkn
LUR /xx1x	Lundar	Pb	Va	Faw	Pw	Fwa	Pw	Fw	Fs	Fka	Phk
LUR /xx2x	Lundar	Pb	Va	Faw	Pw	Fwa	Pw	Fw	Fsp	Fka	Phk
LUR /xx2s	Lundar	Pbn	Va	Faw	Pwn	Fwa	Pw	Fw	Fsp	Fka	Pkn
LUR /xx3x	Lundar	Pbp	Va	Fp	Pwp	Fp	Pwp	Fw	Pp	Fp	Phk
LUR /xx3s	Lundar	Ppn	Va	Fp	Ppn	Fp	Pwp	Fw	Pp	Fp	Pkn
LXB	Lynx Bay	Ps	Fd	Fd	Pd	Fd	Vsd	Vkg	Vsd	Vkg	Pdg

TABLE 8. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil [1]	Sand & Gravel [2]	Road Fill [3]	Permanent Bldgs. With Basements [4]	Local Roads and Streets [5]	Sanitary Trench [6]	Landfill Area [7]	Cover Material [8]	Sewage Lagoons [9]	Septic Fields [10]
LXB /xc3x	Lynx Bay	Psp	Fd	Fdp	Pdp	Fdp	Vsd	Vkg	Vsd	Vkg	Pdg
LXB /xx4x	Lynx Bay	Psp	Pdp	Pp	Pdp	Pp	Vsd	Vkg	Vsd	Vkg	Pdg
LXB /xc4x	Lynx Bay	Psp	Pdp	Pp	Pdp	Pp	Vsd	Vkg	Vsd	Vkg	Pdg
Mh	Marsh	Vw	Vah	Vw	Vw	Vw	Vw	Vw	Vw	Vi	Vw
MEB	Meleb	Pw	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
MEBp	Meleb	Vw	Va	Vw	Va	Va	Vws	Vw	Vsw	Va	Vh
MEB /xx2x	Meleb	Pw	Va	Pw	Pw	Pw	Vw	Pw	Pw	Ph	Vh
MEB /xx3x	Meleb	Pp	Va	Pw	Pwp	Pw	Vw	Pw	Pwp	Ph	Vh
MEB /xx4x	Meleb	Pp	Va	Pwp	Pwp	Pwp	Vw	Pw	Pwp	Php	Vh
NCS	Narcisse	Pb	Va	Pd	Pd	Pd	Vd	Pkg	Vd	Vd	Vd
NCS /xx3x	Narcisse	Pbp	Va	Pd	Pd	Pd	Vd	Pkg	Vd	Vd	Vd
NCS /xx4x	Narcisse	Pbp	Va	Pdp	Pd	Pdp	Vd	Pkg	Vd	Vd	Vd
NCS /xx5x	Narcisse	Vp	Va	Vp	Pdp	Vp	Vd	Pkg	Vdp	Vdp	Vd
R	Rock	Vbd	Vad	Vd	Vd	Vr	Vd	Vdg	Vd	Vd	Vd
Sb	Sand Beach	Pbs	G	Fh	Viw	Pi	Vks	Vk	Vs	Vik	Vig
Sb /xcxx	Sand Beach	Psb	G	Fh	Viw	Pi	Vks	Vk	Vs	Vik	Vig
SLB	St. Labre	Ps	Pa	Fa	Fa	Fa	Fs	Fk	Fs	Pka	Fk
SLB /xx4x	St. Labre	Psp	Pp	Pp	Pp	Pp	Pp	Fk	Pp	Pp	Fk
SWW	Stonewall	Pb	Va	Fd	Pd	Fda	Vd	Pg	Pd	Pd	Pd
SWW /xx4x	Stonewall	Pp	Va	Pp	Pdp	Pp	Vd	Pg	Pdp	Pdp	Pd
SDE	Sandridge	Pb	Va	Pd	Vd	Pd	Vd	Pg	Vd	Vd	Vd
SDE /xx5x	Sandridge	Vp	Va	Vp	Vdp	Vp	Vdp	Pg	Vdp	Vdp	Vd
Zz	Water	Vw	Vh	Vw	Vw	Vw	Vw	Vw	Vw	Vw	Vw

TABLE 9. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

MAP SYMBOL AND PHASE	SOIL NAME	Play Ground [11]	Picnic Area [12]	Camp Area [13]	Paths And Trails [14]	Permanent Bldgs Without Basements [4]
AND	Aneda	Fs	Fs	Fs	Fs	Fa
AND /xx2x	Aneda	Fsp	Fs	Fsp	Fs	Fa
AND /xx3x	Aneda	Pp	Fsp	Pp	Fsp	Fp
AND /xx4x	Aneda	Pp	Pp	Pp	Pp	Pp
AOS	Alonsa	Fd	Fs	Fs	Fs	Fd
AOS /xx3x	Alonsa	Pp	Fsp	Pp	Fsp	Fdp
AOS /xx4x	Alonsa	Pp	Pp	Pp	Pp	Pp
CKG	Clarkleigh	Pw	Pw	Pw	Pw	Pw
CKGp	Clarkleigh	Vsw	Vsw	Vsw	Vsw	Vaw
CKG /xx1x	Clarkleigh	Pw	Pw	Pw	Pw	Pw
CKG /xxxs	Clarkleigh	Pwn	Pwn	Pwn	Pwn	Pwn
CKG /xx1s	Clarkleigh	Pwn	Pwn	Pwn	Pwn	Pwn
CKG /xx2x	Clarkleigh	Pw	Pw	Pw	Pw	Pw
CKG /xx2s	Clarkleigh	Pwn	Pwn	Pwn	Pwn	Pwn
CKG /xx3x	Clarkleigh	Pwp	Pw	Pwp	Pw	Pw
CKG /xx3s	Clarkleigh	Pwp	Pwn	Pwp	Pwn	Pwn
CRN	Crane	Vws	Vws	Vws	Vws	Vwa
DVD	Davidson	Fs	Fsm	Fs	G	G
DVD /xx3x	Davidson	Pp	Fsp	Pp	Fp	Fp
DVD /xx4x	Davidson	Pp	Pp	Pp	Pp	Pp
FFD	Fairford	Fs	Fs	Fs	Fs	Fa
FFD /xx2x	Fairford	Fsp	Fs	Fsp	Fs	Fa
FFD /xx3x	Fairford	Pp	Fsp	Pp	Fsp	Fp
FFD /xc3x	Fairford	Pp	Fsp	Pp	Fsp	Fp
FFD /xx4x	Fairford	Pp	Pp	Pp	Pp	Pp
FFD /xc4x	Fairford	Pp	Pp	Pp	Pp	Pp
FKR	Faulkner	Fdw	Fw	Fw	Fw	Fw
FKR /xx3x	Faulkner	Pp	Fwp	Pp	Fwp	Fwp
FKR /xx4x	Faulkner	Pp	Pp	Pp	Pp	Pp
FKR /xx5x	Faulkner	Vp	Vp	Vp	Vp	Pp
GSO	Garson	Fs	Fs	Fs	Fs	Fa
GSO /xx2x	Garson	Fsp	Fs	Fsp	Fs	Fa
GSO /xx3x	Garson	Pp	Fsp	Pp	Fsp	Fap
GSO /xx4x	Garson	Pp	Pp	Pp	Pp	Pp
GUO	Gunton	Pq	Fsm	Fs	G	G
GUO /xc3x	Gunton	Pqp	Fsp	Pp	Fp	Fp
GUO /xx4x	Gunton	Pqp	Pp	Pp	Pp	Pp
HIB	Hilbre	Fd	Fs	Fs	Fs	Fd
HIB /xx4x	Hilbre	Pp	Pp	Pp	Pp	Pp
HIB /xx5x	Hilbre	Vp	Vp	Vp	Vp	Pp
ISF	Isafold	Fs	Fs	Fs	Fs	Fa
ISF /xx1x	Isafold	Fs	Fs	Fs	Fs	Fa
ISF /xx2x	Isafold	Fsp	Fs	Fsp	Fs	Fa

TABLE 9. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

MAP SYMBOL AND PHASE	SOIL NAME	Play Ground [11]	Picnic Area [12]	Camp Area [13]	Paths And Trails [14]	Permanent Bldgs Without Basements [4]
ISF /xx3x	Isafold	Pp	Fsp	Pp	Fsp	Fap
ISF /xc3x	Isafold	Pp	Fsp	Pp	Fsp	Fap
IWO	Inwood	Fws	Fws	Fws	Fws	Faw
IWO /xx2x	Inwood	Fwp	Fws	Fws	Fws	Faw
IWO /xx3x	Inwood	Pp	Fwp	Pp	Fwp	Fwp
IWO /xc3x	Inwood	Pp	Fwp	Pp	Fwp	Fwp
IWO /xx4x	Inwood	Pp	Pp	Pp	Pp	Pp
LRY	Leary	Pqm	Fsm	Fs	G	G
LRY /xx3x	Leary	Pqp	Fmp	Pp	Fp	Fp
LUR	Lundar	Fws	Fws	Fws	Fws	Faw
LUR /xxxs	Lundar	Fwn	Fwn	Fwn	Fwn	Fan
LUR /xx1x	Lundar	Fws	Fws	Fws	Fws	Fwa
LUR /xx2x	Lundar	Fsw	Fws	Fws	Fws	Faw
LUR /xx2s	Lundar	Fwn	Fwn	Fwn	Fwn	Fwn
LUR /xx3x	Lundar	Pp	Fwp	Pp	Fwp	Fwp
LUR /xx3s	Lundar	Pp	Fwn	Pp	Fwp	Fwp
LXB	Lynx Bay	Pdq	Fsc	Fsc	Fc	Pd
LXB /xc3x	Lynx Bay	Pdp	Fp	Pp	Fp	Pd
LXB /xx4x	Lynx Bay	Pdp	Pp	Pp	Pp	Pdp
LXB /xc4x	Lynx Bay	Pdp	Pp	Pp	Pp	Pdp
Mh	Marsh	Vw	Vw	Vw	Vw	Vw
MEB	Meleb	Pw	Pw	Pw	Pw	Pw
MEBp	Meleb	Vws	Vws	Vws	Vws	Va
MEB /xx2x	Meleb	Pw	Pw	Pw	Pw	Pw
MEB /xx3x	Meleb	Pwp	Pw	Pwp	Pw	Pw
MEB /xx4x	Meleb	Pwp	Pwp	Pwp	Pw	Pw
NCS	Narcisse	Fd	Fs	Fs	Fs	Fda
NCS /xx3x	Narcisse	Pp	Fp	Pp	Fp	Fdp
NCS /xx4x	Narcisse	Pp	Pp	Pp	Pp	Pp
NCS /xx5x	Narcisse	Vp	Vp	Vp	Vp	Pp
R	Rock	Vr	Vr	Vr	Pr	Vr
Sb	Sand Beach	Psw	Fis	Piw	Ps	Piw
Sb /xcxx	Sand Beach	Psw	Fis	Piw	Ps	Piw
SLB	St. Labre	Fms	Fs	Fs	G	G
SLB /xx4x	St. Labre	Pp	Pp	Pp	Pp	Pp
SWW	Stonewall	Fd	Fs	Fs	Fs	Fda
SWW /xx4x	Stonewall	Pp	Pp	Pp	Pp	Pp
SDE	Sandridge	Pd	Fs	Fs	Fs	Pd
SDE /xx5x	Sandridge	Vp	Vp	Vp	Vp	Pp
Zz	Water	Vw	Vw	Vw	Vw	Vw

Appendix A

SOIL CORRELATION OF THE WEST-INTERLAKE AREA WITH THE GRAHAMDALE AND FISHER-TEULON AREAS

The West-Interlake soil study replaces small portions of the (1961) Fisher-Teulon and the (1971) Grahamdale studies. This resurvey benefits from advantages derived through more intensive examination of soils in the field, use of a larger mapping scale to permit delineation of numerous important local soils, use of modern aerial photographs and use of improved methods of studying soils in the laboratory.

In the reconnaissance map of the 1971 Grahamdale study at a scale of 1:126,720 or one half inch equals one mile, the basic map unit component employed was the soil series. It was impossible to separate closely related soils in areas of complex landscapes at this scale. Hence, the mapping units often consisted of two or more soil series, i.e. a soil complex. The soil complexes were named according to the soil series they contained and were shown on the soil map by appropriate symbols. The proportion of the soil series in a soil complex was indicated on the soil map in deciles (compound unit). Several defined complexes occur in which the complex was named after the dominant soil series, but sub-dominant members did not appear on the map.

The scale of the detailed reconnaissance map of the 1961 Fisher-Teulon study at 1:100,000 or 5/8 of an inch equals one mile, was slightly larger than the Grahamdale soil map. This scale was also not large enough to permit delineation of important local soils. Mapping units were largely compound types. They were identified and described employing the soil series, as in the Grahamdale study, the currently accepted basic unit of soil classification. However, in certain areas of the Fisher-Teulon study soil series frequently form complex landscape patterns and it was often impossible to show each series separately on the small scale soil map. Where this occured, soil complexes of two or more series formed the mapping units. The soil series and complexes of the Fisher-Teulon study were equivalent to many of those in the Grahamdale study.

The West-Interlake area maps at the scale of 1:20,000 or 3 inches equals approximately one mile differs considerably from the Grahamdale and Fisher-Teulon soil maps. The large scale and more intensive examination of soils in the field has permitted the delineation of more precisely defined simple and compound mapping units whose components, soil series or phases of soil series, have less variability in terms of profile characteristics and related landscape features. In particular, differences in the stratigraphy of surface deposits, depth and type of soil profile, degree of erosion, slope or relief, stoniness and salinity were emphasized.

The correlation of the current soil series of the West-Interlake study with the former soil series and complexes of the Grahamdale and Fisher-Teulon studies is outlined in Table 10.

TABLE 10
Correlation of Soils in the West-Interlake Area with Soils of the (1961) Fisher-Teulon and (1971) Grahamdale Areas

Table 10. Correlation of Soils in the West-Interlake Area with Soils of the (1961) Fisher-Teulon and (1971) Grahamdale Areas

West-Interlake		Grahamdale (1971)		Fisher-Teulon (1961)		
Map Symbol	Soil Name and Subgroup	Series	Complex	Series	Complex or Association	Remarks
AND	Aneda Orthic Dark Gray	Garson		Orthic Dark Gray member Orthic Dark Gray member	Garson Assoc. Stonewall complex	Garson assoc. includes well to imperfectly drained genetic soil types ranging from Dark Gray Chernozems thru Eluviated Eutric Brunisols to Gray Luvisols. Definition of the parent material of the Garson assoc. and Stonewall complex is the same as for Aneda.
AOS	Alonsa Rego Black, lithic	Isafold, rock substrate		Isafold, rock substrate		Rock substrate phase of the Isafold series. Soil profile and parent material definitions are unchanged.
CKG	Clarkleigh Rego Humic Gleysol	Clarkleigh		Clarkleigh		Soil profile and parent material descriptions are equivalent.
CRN	Crane Terric Mesisol	Crane	Crane		Shallow peat, Chatfield complex	Shallow peat and Chatfield complex are undefined shallow organic soil complexes having a significant inclusion of peaty Rego Humic Gleysols on a wide range of mineral soil parent material. Crane series parent material is shallow, usually less than 1.5 meters, mesic fen peat overlying stony extremely calcareous loamy textured till.
DVD	Davidson Orthic Dark Gray	Berlo		Pine Ridge		In the Fisher-Teulon area Pine Ridge mapping units probably include Davidson soils as did Berlo mapping units in the Grahamdale area.

Table10. Cont'd

West-Interlake		Grahamdale (1971)		Fisher-Teulon (1961)		
Map Symbol	Soil Name and Subgroup	Series	Complex	Series	Complex or Association	Remarks
FFD	Fairford Eluviated Eutric Brunisol	Fairford			Stonewall complex	The Fairford series in the Grahamdale is equivalent to West-Interlake. Fairford correlates with Stonewall complex in Fisher-Teulon.
FKR	Faulkner Gleyed Dark Gray, lithic	Inwood, rock substrate		Inwood	Inwood-Narcisse complex	In the Fisher-Teulon study the Inwood-Narcisse complex recognizes limestone bedrock being close to the surface.
GSO	Garson Orthic Gray Luvisol	Garson		Garson	Garson assoc. and complex	Soil profile and soil parent material definitions are unchanged.
GUO	Gunton Orthic Dark Gray	Leary, till substrate	Leary complex	Orthic Dark Gray member	Leary complex, till substrate	Leary till in the Fisher-Teulon study is a complex of Orthic Dark Gray, Dark Gray Luvisol, Eluviated Eutric Brunisol and Gray Luvisol soils. Its parent material description is the same as Gunton.
HIB	Hilbre Eluviated Eutric Brunisol	Fairford, rock substrate			Stonewall rock substrate phase	Stonewall rock substrate is the nearest equivalent to Hilbre in Fisher-Teulon.
ISF	Isafold, Rego Black	Isafold		Isafold	Isafold assoc. and complex	Parent material definition of the Isafold association is the same in all studies. The name has been retained for the well drained, Rego Black member. Isafold series are the same for Grahamdale and West-Interlake.

Table 10.Cont'd

West-Interlake		Grahamdale (1971)		Fisher-Teulon (1961)		
Map Symbol	Soil Name and Subgroup	Series	Complex	Series	Complex or Association	Remarks
IWO	Inwood Gleyed Dark Gray	Inwood		Inwood	Garson complex and assoc.	Soil profile and soil parent material definitions are unchanged.
LRY	Leary Orthic Dark Gray	Leary	Leary	Orthic Dark Gray member	Leary complex	Leary in West-Interlake and Grahamdale are the same soil series. Leary in Fisher-Teulon is a genetic soil type complex.
LUR	Lundar Gleyed Rego Black	Lundar		Lundar	Lundar complex	Lundar series are equivalent in all studies.
LXB	Lynx Bay Orthic Dark Gray, lithic	Leary	Leary	Orthic Dark Gray member	Leary complex	The nearest equivalent to Lynx Bay would be Leary with a rock substrate phase.
MEB	Meleb Rego Humic Gleysol	Meleb		Meleb	Garson assoc. and complex	Soil profile and parent material of the Meleb series in this and the Fisher-Teulon and Grahamdale areas are equivalent.
NCS	Narcisse Orthic Black, lithic	Narcisse		Narcisse		Soil profile and parent material definitions are unchanged.
SLB	St. Labre Orthic Gray Luvisol	Berlo till substrate		Pine Ridge till substrate		St. Labre was not recognized in the Fisher-Teulon study. It is closely related to Pine Ridge till substrate phase.
SWW	Stonewall Orthic Dark Gray, lithic	Garson, rock substrate		Orthic Dark Gray member	Stonewall complex	The rock substrate phases of the Stonewall complex in the Fisher-Teulon and the Garson series in the Grahamdale are the nearest equivalents.

Table 10.Cont'd

West-Interlake		Grahamdale (1971)		Fisher-Teulon (1961)		
Map Symbol	Soil Name and Subgroup	Series	Complex	Series	Complex or Association	Remarks
SDE	Sandridge Orthic Dark Gray, lithic	Garson, rock substrate		Orthic Dark Gray member	Stonewall complex	Similar to Stonewall above.
Mh	Marsh Rego Gleysol		Marsh complex		Marsh complex	Profile and parent material definitions are unchanged.

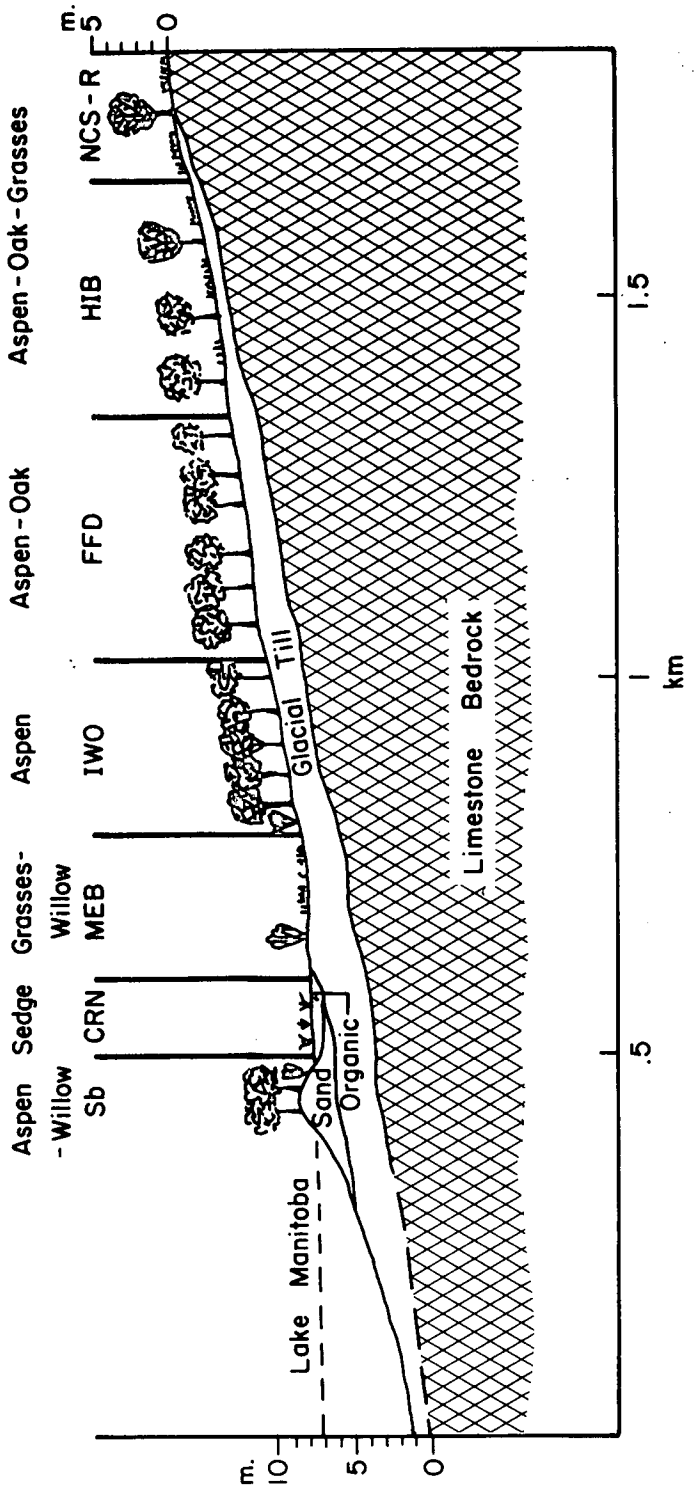


Figure 6: A Schematic Cross-Section of a Typical Landscape Adjacent to Lake Manitoba in the West-Interlake (The Narrows) Area

Appendix C

GUIDES FOR EVALUATING SOIL SUITABILITY FOR SELECTED USES

Table 11. Land Classification Standards for Irrigation Suitability.

Land Characteristics	Subclass		Class 1 - Very Good	Class 2 - Good	Class 3 - Fair	Class 4 - Poor
SOILS	S					
Texture						
very coarse textured very fine textured		v h	Fine sandy loams to clay loams	Loamy fine sand to light clay	Sand to permeable clay	Gravel to clay
Water holding capacity						
low available moisture capacity		q	40 to 60 sat. % >15cm storage in 1.2m <10cm/hr. hydraulic cond.	35 to 65 sat. % >12.5cm storage in 1.2m <12.5cm/hr. hydraulic cond.	25 to 75 sat. % >7.5cm storage in 1.2m <17.5cm/hr. hydraulic cond.	<25 or >75 sat. % <7.5cm storage in 1.2m >17.5cm/hr. hydraulic cond.
Geological Deposit						
shallow deposit over sand or gravel		k	.9m or more of fine sandy loam or heavier	.6m or more of fine sandy loam or heavier, or .75m plus of loamy fine sand or sandy loam	.5m or more of sandy loam or heavier, or .6m plus of loamy sand	<.5m of sandy loam or heavier, or .6m of loamy sand or sand
shallow deposit over impervious substrata		b	>3m of permeable material	>2m of permeable material	>1m of permeable material	<1m of permeable material
Salinity and Alkalinity[1,2]		a	<4 ms/cm in 0-.6m <8 ms/cm below .6m <6 S.A.R.	<4 ms/cm in 0-.6m <12 ms/cm below .6m <8 S.A.R.	<8 ms/cm in 0-.6m <15 ms/cm below .6m <12 S.A.R.	>8 ms/cm in 0-.6m >15 ms/cm below .6m >12 S.A.R.
EXTERNAL FEATURES						
Stones - rock clearing		r	None to light clearing	Light to medium clearing	Light to heavy clearing	Excessively stony
Topography	T	g	<1% and 0.1% in general gradient (0-3% slope)	<3% in general gradient (3-5% slope)	<5% in general gradient (5-10% slope)	>5% in general* gradient (>10% slope)**
Slope excess gradient						
DRAINAGE	D					
restricted outlet			No problem anticipated	Moderate drainage problem anticipated but may be improved at relatively low cost	Moderate to severe drainage problem anticipated but may be improved by expensive but feasible measures	Drainage improvement not considered feasible
water table			below 2.4m most of year	could be above 1.5m for a short period, then recedes to 2.4m or lower	within 1.5m most of year	within 1m most of year

* Criteria for gravity (flood) irrigation requirements.

** Estimated adjustments to slope criteria for overhead or sprinkler type irrigation methods.

[1] If sufficient gypsum is present in the soil, the S.A.R. may be lowered by leaching the soil (a very slow process), and the hydraulic conductivity may then improve.

[2] The degree of salinity may vary widely within short distances, and there may be no clear indication of the area occupied by each salinity class. Unless a very detailed mapping and sampling program is carried out, it is impossible to estimate the acreage occupied by each salinity class.

Table 12. Guide for assessing soil suitability as source of topsoil.

The term "topsoil" includes soil materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens, flower beds, etc. The factors to be considered include not only the characteristics of the soil itself, but also the ease or difficulty of excavation, and where removal of topsoil is involved, accessibility to the site.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	Moist Consistence[2]	Very friable, friable	Loose, firm	Very firm	Cemented
i	Flooding	None	May flood occasionally for short periods	Frequent flooding	Constantly flooded
w	Wetness[2]	Wetness is not determining if better than very poorly drained.			Very poorly drained and permanently wet soils
t	Slope	0-5%	5-9%	9-15%	>15%
p	Stoniness[2]	Stones 10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones 0.1 m apart (Class 5)
c	Coarse fragments[2]: percent, by volume	<3%	3-15%	15-35%	>35%
s	Texture[2]	FSL, VFSL, L, SiL, SL, SC if 1:1 clay is dominant	CL, SCL, SiCL, SC if 2:1 clay is dominant; c and sic if 1:1 clay is dominant	S, LS, C and SiC if 2:1 clay is dominant. organic soils[3]	Marl, diatomaceous earth
b	Depth of Topsoil[4]	>40 cm	15-40 cm	8-15 cm	<8 cm
n	Salinity of Topsoil[5]	E.C. 0-1	E.C. 1-4	E.C. 4-8	E.C. >8

1/ The symbols are used to indicate the nature of the limitation.

2/ For an explanation of texture, consistence, stoniness, coarse fragments and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Non-woody organic materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.

4/ The remaining soil material (at least 8 cm) must be reclaimable after the uppermost soil is removed.

5/ E.C. = Electrical Conductivity (millisiemens/cm).

Table 13. Guide for assessing soil suitability as source of sand and gravel.

The purpose of this table is to provide guidance for assessing the probable supply as well as quality of the sand or gravel for use as road base material and in concrete. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 150 cm, augmented by observations made in deep cuts as well as geological knowledge where available.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	Unified Soil Group	SW SP GW GP	SW-SM SP-SM GP-GM GW-GM	SM SW-SC SP-SC GM GP-GC GW-GC	All other groups and bedrock
h	Depth to Seasonal Water Table	Not class determining if deeper than 50 cm		50 cm	
q	Depth to Sand and Gravel	<25 cm	25-75 cm[2]	>75 cm[2]	
p	Stoniness[3]	Not class determining if stones >.5 m apart (Class 0, 1, 2 and 3)		Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
d	Depth to Bedrock	>100 cm	50-100 cm	<50 cm	

[1] The symbols are used to indicate the nature of the limitation.

[2] Rated good if it is known that the underlying gravel or sand deposit is thick (>100 cm).

[3] For an explanation of stoniness and rockiness, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 14. Guide for assessing soil suitability as source of roadfill.

Fill material for buildings or roads are included in this use. The performance of the material when removed from its original location and placed under load at the building site or road bed are to be considered. Since surface materials are generally removed during road or building construction their properties are disregarded. Aside from this layer, the whole soil to a depth of 150-200 cm should be evaluated. Soil materials which are suitable for fill can be considered equally suited for road subgrade construction.

Symbol[1]	Items Affecting Use[2]	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	Subgrade[3]				
	a. AASHO group index[4]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM, GC[5] and SC[5]	CL (with P.I.[6] <15) and ML	CL (with P.I.[6] of 15 or more), CH and MH[7]	OL, OH and Pt
l	Shrink-swell potential	Low	Moderate	High	
f	Susceptibility to frost action[8]	Low	Moderate	High	
t	Slope	0-15%	15-30%	30-45%	>45%
p	Stoniness[9]	Stones >2 m apart (Class 0, 1 and 2)	Stones 0.5-2 m apart (Class 3)	Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[9]	Rock exposures >35 m apart and cover <10% of the surface	Rock exposure 10-35 m apart and cover 10-25% of the surface	Rock exposure 3.5-10 m apart and cover 25-50% of the surface	Rock exposures <3.5 m apart and cover 50-90% of the surface
w	Wetness[9]	Excessively drained to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
d	Depth to Bedrock	>100 cm	50-100 cm	20-50 cm	<20 cm
h	Depth to Seasonal Water Table	>150 cm	75-150 cm	50-75 cm	<50 cm

1/ The symbols are used to indicate the nature of the limitation.

2/ The first three items pertain to soil after it is placed in a fill; the last six items pertain to soil in its natural condition before excavation for road fill.

3/ This item estimates the strength of the soil material, that is, its ability to withstand applied loads.

4/ Use AASHO group index only where laboratory data are available for the kind of soil being rated; otherwise, use Unified soil groups.

5/ Downgrade suitability rating to fair if content of fines is more than about 30 percent.

6/ P.I. means plasticity index.

7/ Upgrade suitability rating to fair if MH is largely kaolinitic, friable, and free of mica.

8/ Use this item only where frost penetrates below the paved or hardened surface layer and where moisture transportable by capillary movement is sufficient to form ice lenses at the freezing front.

9/ For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 15. Guide for assessing soil suitability for permanent buildings[1].

This guide applies to undisturbed soils to be evaluated for single-family dwellings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundation requirements; but soil slope, susceptibility to flooding and other hydrologic conditions, such as wetness, that have effects beyond those related exclusively to foundations are considered too. Also considered are soil properties, particularly depth to bedrock, which influence excavation and construction costs for the building itself and for the installation of utility lines. Excluded are limitations for soil corosivity, landscaping and septic tank absorption fields.

Symbol[2]	Items Affecting Use	Degree of Soil Suitability[3]			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[4]	With Basements: Very rapidly, rapidly and well drained. Without Basements: Very rapidly, rapidly, well and moderately well drained.	With Basements: Moderately well drained. Without Basements: Imperfectly drained.	With Basements: Imperfectly, poorly, and very poorly drained. Without Basements: Poorly and very poorly drained.	With Basements: Permanently wet soils. Without Basements: Permanently wet soils.
h	Depth to Seasonal Water Table	With Basements: >150 cm Without Basements: >75 cm	With Basements: 75-150 cm Without Basements: 50-75 cm	With Basements: 25-75 cm Without Basements: 25-50 cm	With Basements: <25 cm Without Basements: <25 cm
i	Flooding	None	None	Occasional flooding (once in 5 years)	Frequent flooding (every year)
t	Slope[5]	0-9%	9-15%	15-30%	>30%
a	Subgrade[6]				
	a. AASHO group index[7]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM and GC and SC	CL (with P.I.[8] <15) and ML	CL (with P.I.[8] of 15 or more), CH and MH	OH, OL and Pt
f	Potential Frost Action[9]	Low (F1, F2)	Moderate (F3)	High (F4)	
p	Stoniness[4]	Stones >10 m apart (Class 0 to 1)	Stones 2-10 m apart (Class 2[10])	Stones 0.1-2 m apart (Class 3[10] to 4)	Stones <0.1 m apart (Class 5[10])
r	Rockiness[4],[11]	Rock exposures >100 m apart and cover <2% of the surface	Rock exposures 30-100 m apart and cover 2-10% of the surface	Rock exposures <30 m apart and cover >10% of the surface	Rock exposures too frequent to allow location of permanent buildings
d	Depth to Bedrock[11]	With Basements: >150 cm Without Basements: >100 cm	With Basements: 100-150 cm Without Basements: 50-100 cm	With Basements: 50-100 cm Without Basements: <50 cm	With Basements: <50 cm

1/ By halving the slope limits, this table can be used for evaluating soil suitability for buildings with large floor areas, but with foundation requirements not exceeding those of ordinary three-storey dwellings.

2/ The symbols are used to indicate the nature of the limitation.

3/ Some soils assessed as fair or poor may be good sites from an aesthetic or use standpoint, but they will require more site preparation and/or maintenance.

4/ For an explanation of rockiness, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reduce the slope limits by one half for those soils subject to hillside slippage.

6/ This item estimates the strength of the soil, that is, its ability to withstand applied loads. When available, AASHO Group Index values from laboratory tests were used; otherwise the estimated Unified classes were used.

7/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962), pp. 23-25.

8/ P.I. means plasticity index.

9/ Frost heave only applies where frost penetrates to the assumed depth of the footings and the soil is moist. The potential frost action classes are taken from the United States Army Corps of Engineers (1962), pp. 5-8.

10/ Rate one class better for buildings without basements.

11/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment such as backhoes.

Table 16. Guide for assessing soil suitability for local roads and streets[1].

This guide applies to soils to be evaluated for construction and maintenance of local roads and streets. These are improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year. They consist of: (1) the underlying local soil material (either cut or fill) called the subgrade; (2) the base material of gravel, crushed rock, or lime or soil cement stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They also are graded to shed water and have ordinary provisions for drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than 2 meters. Excluded from consideration in this guide are highways designed for fast-moving, heavy trucks.

Properties that affect design and construction of roads and streets are: (1) those that affect the load supporting capacity and stability of the subgrade, and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified Classification give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth of hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade.

Symbol[2]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[3]	Very rapidly, rapidly, well and moderately well drained	Imperfectly drained	Poorly and very poorly drained	Permanently wet soils
i	Flooding	None	Infrequent (once in 5 years)	Occasional (once in 2-4 years)	Frequent (every year)
t	Slope	0-9%	9-15%	15-30%	>30%
d	Depth to Bedrock[4]	>100 cm	50-100 cm	<50 cm	
a	Subgrade[5]				
	a. AASHO group index[6]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM, GC[7] and SC[7]	CL (with P.I.[8] <15) and ML	CL (with P.I.[8] of 15 or more), CH and MH	OH, OL and Pt
f	Susceptibility to Frost Heave[9]	Low (F1, F2)	Moderate (F3)	High (F4)	
p	Stoniness[3]	Stones >2 m apart (Class 0 to 2)	Stones 0.5-2 m apart (Class 3)	Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[3]	Rock exposures >100 m apart and cover <2% of the surface	Rock exposures 30-100 m apart and cover 2-10% of the surface	Rock exposures <30 m apart and cover >10% of the surface	Rock exposures too frequent to permit location of roads and streets

1/ These guidelines, with some adjustment of slope and rockiness limits, will also be useful for assessing soils for use as parking lots.

2/ Symbols are used to indicate the nature of the limitation.

3/ For an explanation of stoniness, rockiness and soil drainage classes, see the Canada Soil Information System (Canada Soil Survey Committee, 1978).

4/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment and is rippable by machinery.

5/ This item estimates the strength of soil materials as it applies to roadbeds. When available, AASHO Group Index values from laboratory tests were used; otherwise, the estimated Unified classes were used. The limitations were estimated assuming that the roads would be surfaced. On unsurfaced roads, rapidly drained, very sandy, poorly graded soils may cause washboard or rough roads.

6/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962) pp. 23-25.

7/ Downgrade to moderate if content of fines (less than 200 mesh) is greater than about 30 percent.

8/ P.I. means plasticity index.

9/ Frost heave is important where frost penetrates below the paved or hardened surface layer and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing point. The susceptibility classes are taken from the United States Army Corps of Engineers (1962) pp. 5-8.

Table 17. Guide for assessing soil suitability for trench-type sanitary landfills[1].

The trench-type sanitary landfill is a sanitary landfill, in which dry garbage and trash is buried daily in an open trench and covered with a layer of soil material. Suitability of the site is dependent upon the potential for pollution of water sources through groundwater contact with the refuse, or leachate arising from the site. Those properties affecting ease of excavation of the site must be supplemente with geological and hydrological knowledge to provide subsurface soil and groundwater data to a depth of at least 3 to 4.5 m, a common depth of landfills.

Symbol[2]	Items Affecting Use	Degree of Soil Suitability			
		Good - G[3]	Fair - F	Poor - P	Very Poor - V
h	Depth to Seasonal High Water Table	Not class determining if more than 180 cm		100-180 cm	<100 cm
w	Wetness[4]	Not class determining if better than imperfectly drained		Imperfectly drained	Poorly and very poorly drained or permanently wet soils
i	Flooding	None	Rare	Occasional	Frequent
k	Permeability[5]	<5 cm/hr	<5 cm/hr	5-15 cm/hr	>15 cm/hr
t	Slope	0-15%	15-30%	30-45%	>45%
s	Soil Texture[4],[6] (dominant to a depth of 150 cm)	SL, L, SiL, SCL	SiCL[7], CL, SC, LS	SiC, C	Muck, peat, gravel, sand
d	Depth to Hard Bedrock Rippable	>150 cm >150 cm	>150 cm 100-150 cm	100-150 cm 100-150 cm	<100 cm <100 cm
p	Stoniness[4]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones <0.1 m apart (Class 5)
r	Nature of Bedrock	Impermeable			Highly permeable, fractured, easily soluble

1/ Based on soil depth (120 cm) commonly investigated in making soil surveys.

2/ The symbols are used to indicate the nature of the limitation.

3/ If probability is high that the soil material to a depth of 3 to 4.5 m will not alter a rating of good or fair, indicate this by an appropriate footnote, such as "Probably good to a depth of 3.5 m", or "Probably fair to a depth of 3.5 m".

4/ For an explanation of stoniness, texture and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reflects ability of soil to retard movement of leachate from the landfills; may not reflect a limitation in arid and semiarid areas.

6/ Reflects ease of digging and moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.

7/ Soils high in expansive clays may need to be given a suitability rating of poor.

Table 18 . Guide for assessing soil suitability for area-type sanitary landfills.

In the area-type sanitary landfill refuse is placed on the surface of the soil in successive layers. The daily and final cover material generally must be imported. A final cover of soil material at least 60 cm thick is placed over the fill when it is completed.

The soil under the proposed site should be investigated so as to determine the probability that leachates from the landfill can penetrate the soil and thereby pollute water supplies.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	Depth to Seasonal Water Table[2]	>150 cm	150-100 cm	50-100 cm	<50 cm
w	Wetness[2],[3]	Rapid to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
i	Flooding	None	Rare	Occasional	Frequent
k	Permeability[4],[5]	Not class determining if less than 5 cm/hr		5-15 cm/hr	>15 cm/hr
t	Slope	0-9%	9-15%	15-30%	>30%

[1] The symbols are used to indicate the nature of the limitation.

[2] Reflects influence of wetness on operation of equipment.

[3] For an explanation of drainage, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

[4] Reflects ability of the soil to retard movement of leachate from landfills; may not reflect a limitation in arid and semiarid areas.

[5] Due to possible groundwater contamination, impermeable bedrock is considered poor and permeable bedrock is rated very poor for area-type sanitary landfills.

Table 19. Guide for assessing soil suitability as cover material for area-type sanitary landfills.

The term cover material includes soil materials used to put a daily and final covering layer on refuse in area-type sanitary landfills. This cover material may be derived from the area of the landfill or may be brought in from surrounding areas.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	Moist Consistence[2]	Very friable, friable	Loose, firm	Very firm	Cemented
s	Texture[2],[3]	SL, L, SiL, SCL	SiCL, CL, SC, LS	SiC, C	Muck, peat, sand, gravel
d	Depth to bedrock[4]	>150 cm	100-150 cm	50-100 cm	<50 cm
c	Coarse fragments[2]	<15%	15-35%	>35%	
p	Stoniness[2]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones <0.1 m apart (Class 5)
t	Slope	<9%	9-15%	15-30%	>30%
w	Wetness[2]	Not class determining if better than poorly drained		Poorly drained	Very poorly drained or permanently wet soils

[1] The symbols are used to indicate the nature of the limitation.

[2] For an explanation of consistence, texture, coarse fragments, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

[3] Soils having a high proportion of non-expansive clays may be given a suitability rating one class better than is shown for them in this table.

[4] Thickness of material excluding topsoil, which will be stockpiled (see guide for topsoil).

Table 20. Guide for assessing soil suitability for reservoirs and sewage lagoons.

Factors affecting the ability of undisturbed soils to impound water or sewage and prevent seepage are considered for evaluating soils on their suitability for reservoir and lagoon areas. This evaluation considers soil both as a vessel for the impounded area and as material for the enclosing embankment. As the impounded liquids could be potential sources of contamination of nearby water supplies, e.g. sewage lagoons, the landscape position of the reservoir as it affects risk of flooding must also be considered.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	Depth to Water Table[2]	>150 cm	100-150 cm	50-100 cm	<50 cm
i	Flooding[3]	None	None	Subject to infrequent flooding (once in 50 years)	Subject to frequent high level flooding
k	Soil Permeability	0-0.5 cm/hr	0.5-5 cm/hr	5-15 cm/hr	>15 cm/hr
t	Slope	0-2%	2-5%	5-9%	>9%
o	Organic Matter	<2%	2-10%	10-30%	>30%
c	Coarse Fragments[4] <25 cm in diameter, % by volume	<20%	20-35%	>35%	
p	Stoniness[4], >25 cm diameter, percent of surface area	<3% (Class 0, 1 and 2)	3-15% (Class 3)	15-50% (Class 4)	>50% (Class 5)
d	Depth to Bedrock[5]	>150 cm	100-150 cm	50-100 cm	<50 cm
j	Thickness of Slowly Permeable Layer	>100 cm	50-100 cm	50-25 cm	<25 cm
a	Subgrade Unified Soil Classes	GC, SC, CL, & CH	GM, ML, SM & MH	SW & SP	OL, OH & Pt GP, GW

1/ The symbols are used to indicate the nature of the limitation.

2/ If the floor of the lagoon has nearly impermeable material at least 50 cm thick, disregard depth to water table.

3/ Disregard flooding if it is not likely to enter or damage the lagoon (flood waters have low velocity and depth less than 150 cm).

4/ For an explanation of coarse fragments and stoniness classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Surface exposures of non rippable rock are rated very poor. If underlying bedrock is impermeable, rating should be one class better.

Table 21. Guide for assessing soil suitability for septic tank absorption fields.

This guide applies to soils to be used as an absorption and filtering medium for effluent from septic tank systems. A subsurface tile system laid in such a way that effluent from the septic tank is distributed reasonably uniformly into the natural soil is assumed when applying this guide. A rating of poor need not mean that a septic system should not be installed in the given soil, but rather, may suggest the difficulty, in terms of installation and maintenance, which can be expected.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
k	Permeability[2]	Rapid to moderately rapid	Moderate	Slow	Very slow
	Percolation Rate[3] (Auger hole method)	About 8-18 min/cm[3]	18-24 min/cm	Slower than 24 min/cm	
h	Depth to Seasonal Water Table[4]	>150 cm[5]	100-150 cm	50-100 cm	<50 cm
i	Flooding	Not subject to flooding	Not subject to flooding	Subject to occasional flooding (once in 5 years)	Floods every year
t	Slope	0-9%	9-15%	15-30%	>30%
d	Depth to Hard Rock, bedrock or other impervious materials	>150 cm	100-150 cm[6]	50-100 cm	<50 cm

1/ The symbols are used to indicate the nature of the limitation.

2/ The suitability ratings should be related to the permeability of soil layers at and below depth of the tile line.

3/ Soils having a percolation rate less than about 8 min/cm are likely to present a pollution hazard to adjacent waters. This hazard must be noted, but the degree of hazard must, in each case, be assessed by examining the proximity of the proposed installation to water bodies, water table, and related features. The symbol g is used to indicate this condition. Refer to U.S. Dept. of Health, Education and Welfare (1969) for details of this procedure.

4/ Seasonal means for more than one month. It may, with caution, be possible to make some adjustment for the severity of a water table limitation in those cases where seasonal use of the facility does not coincide with the period of high water table.

5/ A seasonal water table should be at least 100 cm below the bottom of the trench at all times for soils rated Good (U.S. Dept. of Health, Education and Welfare, 1969). The depths used to water table are based on an assumed tile depth of 50 cm. Where relief permits, the effective depth above a water table or rock can be increased by adding appropriate amounts of fill.

6/ Where the slope is greater than 9%, a depth to bedrock of 100-150 cm is assessed as poor.

Table 22 Guide for assessing soil suitability for playgrounds.

This guide applies to soils to be used intensively for playgrounds for baseball, football, badminton, and for other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistence that gives a firm surface generally are required. The most desirable soils are free of rock outcrops and coarse fragments.

Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2]	Rapidly, well and moderately well drained soils with no ponding or seepage. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding of short duration and imperfectly drained soils. Water table below 50 cm during season of use.	Imperfectly drained soils subject to seepage or ponding, and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None during season of use.	Occasional flooding. May flood once every 2-3 years during season of use.	Floods every year during season of use.	Prolonged flooding during season of use.
k	Permeability	Very rapid to moderate.	Moderately slow and slow.	Very slow.	
t	Slope	0-2%	2-5%	5-9%	>9%
d	Depth to Bedrock	>100 cm	50-100 cm[3]	<50 cm[3]	
c	Coarse fragments on surface[2]	Relatively free of coarse fragments.	<20% coarse fragments.	>20% coarse fragments.	
p	Stoniness[2]	Stones >10 m apart. (Class 0 to 1)	Stones 2-10 m apart. (Class 2)	Stones 0.1-2 m apart. (Class 3, 4)	Stones <0.1 m apart. (Class 5)
r	Rockiness[2]	Rock exposures >100 m apart and cover <2% of the surface.	Rock exposures 30-100 m apart and cover about 2-10% of the surface.	Rock exposures <30 m apart and cover >10% of the surface.	Rock outcrops too frequent to permit playground location.
s	Surface Soil Texture[2],[4]	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS	SC, SiC, C[5]; S, Si	Peaty soils; S and LS subject to blowing.
q	Depth to Sand or Gravel[6]	>100 cm	50-100 cm	<50 cm	
m	Useful Moisture[7]	Water storage capacity[8] >15.0 cm and/or adequate rainfall and/or low evapotranspiration.	Water storage capacity[8] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration.	Water storage capacity[8] <7.5 cm and/or low rainfall and/or high evapotranspiration.	

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).
Coarse fragments for the purpose of this table include gravels and cobbles.

3/ Downgrade to a very poor suitability rating if the slope is greater than 5%.

4/ Surface soil texture influences soil ratings as it affects foot trafficability, surface wetness, dust, and maintenance. Adverse soil textures may be partially or completely overcome with the addition of topsoil.

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Depth to sand or gravel is considered a limitation in that levelling operations may expose sand or gravel, thereby bringing about adverse surface textures and undesirable amounts of coarse fragments. The addition of topsoil after the levelling process would overcome this limitation.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 23. Guide for assessing soil suitability for camp areas.

This guide applies to soils to be used intensively for tents and camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for campsites and parking areas. The soil should be suitable for heavy foot traffic by humans and limited vehicular traffic. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of site.

Back country campsites differ in design, setting and management but require similar soil attributes. These guides should apply to evaluations for back country campsites but depending on the nature of the facility the interpreter may wish to adjust the criteria defining a given degree of limitation to reflect the changed requirement. For example, small tentsites may allow rock exposures greater than 10 m apart to be considered a slight limitation.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2]	Very rapidly, rapidly, well and moderately well drained soils with no seepage or ponding. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils with no seepage or ponding. Water table below 50 cm during season of use.	Imperfectly drained soils subject to seepage or ponding and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None	Very occasional flooding during season of use. Once in 5-10 years.	Occasional flooding during season of use. Once in 2-4 years.	Flooding during every season of use.
k	Permeability	Very rapid to moderate inclusive.	Moderately slow and slow.	Very slow.	
t	Slope	0-9%	9-15%	15-30%	>30%
s	Surface Soil Texture[2,3]	SL, FSL, VFSL, L	SiL, SCL, CL, SiCL, LS, and sand other than loose sand.	SC, SiC, C[4]; Si	Peaty soils; loose sand subject to blowing.
c	Coarse Fragments on Surface[2,5]	0-20%	20-50%	>50%	
p	Stoniness[2,6]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
r	Rockiness[2,6]	No rock exposures	Rock exposures >10 m apart and cover <25% of the area.	Rock exposures <10 m apart and cover >25% of the area.	Rock exposures too frequent to permit campground location.

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust, and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Coarse fragments for the purpose of this table include gravels and cobbles. Some gravelly soils may be rated as having slight limitations if the content of gravel exceeds 20% by only a small margin, providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

6/ Very shallow soils are rated as having a limitation for rockiness and/or stoniness.

Table 24. Guide for assessing soil suitability for picnic areas.

This guide applies to soils considered for intensive use as park-type picnic areas. It is assumed that most vehicular traffic will be confined to the access roads. Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Symbol[1]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2]	Very rapidly, rapidly, well and moderately well drained soils not subject to seepage or ponding. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils not subject to ponding or seepage. Water Table above 50 cm for short periods during season of use.	Imperfectly drained soils subject to seepage or ponding. Poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None during season of use.	May flood 1 or 2 times per year for short periods during season of use.	Floods more than 2 times during season of use.	Prolonged flooding during season of use.
t	Slope	0-9%	9-15%	15-30%	>30%
s	Surface Soil Texture[2,3]	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS, and sand other than loose sand.	SC, SiC, C[4]; Si	Peaty soils; loose sand subject to blowing.
c	Coarse Fragments on Surface[2]	0-20%	20-50%	>50%	
p	Stoniness[2]	Stones >2 m apart (Class 0 to 2)	Stones 1-2 m apart (Class 3)	Stones 0.1-1 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[2,5,6]	Rock exposures roughly 30-100 or more m apart and cover <10% of the surface.	Rock exposures roughly 10-30 m apart and cover 10-25% of the surface.	Rock exposures <10 m apart and cover >25% of the surface.	Rock exposures too frequent to permit location of picnic areas.
m	Useful Moisture[7]	Water storage capacity[8] >15 cm and/or adequate rainfall and/or low evapotranspiration.	Water storage capacity[8] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration.	Water storage capacity[8] <7.5 cm and/or low rainfall and/or high evapotranspiration.	

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978). Coarse fragments for the purpose of this table, include gravels and cobbles. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Very shallow soils are rated as having severe or very severe limitations for stoniness or rockiness.

6/ The nature and topography of the bedrock exposures may significantly alter these ratings. As such, on-site investigations will be necessary in map units containing bedrock when these are considered as possible sites.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 25. Guide for assessing soil suitability for paths and trails.

It is assumed that the trails will be built at least 45 cm wide and that obstructions such as cobbles and stones will be removed during construction. It is also assumed that a dry, stable tread is desirable and that muddy, dusty, worn or eroded trail treads are undesirable. Hiking and riding trails are not treated separately, but as the design requirements for riding trails are more stringent, a given limitation will be more difficult to overcome. Poor or very poor suitability does not indicate that a trail cannot or should not be built. It does, however, suggest higher design requirements and maintenance to overcome the limitations.

Symbol[1]	Items[2] Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
s	Texture[3],[4]	SL, FSL, VFSL, LS, L	SiL, CL, SiCL, SCL	SC, SiC, C[5]; Sand, Si	Peaty soils; loose sand subject to blowing
c	Coarse Fragment Content[4],[6]	0-20%	20-50%	>50%	
p	Stoniness[4]	Stones >2 m apart (Class 0 to 2)	Stones 1-2 m apart (Class 3)	Stones 0.1-1 m apart (Class 4)	Stones <0.1 m apart (Class 5)
w	Wetness[4]	Very rapidly, rapidly well, and moderately well drained soils. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage and ponding and imperfectly drained soils. Water table may be above 50 cm for short periods during season of use.	Poorly and very poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.	Permanently wet soils.
r	Rockiness[4],[7]	Rock exposures >30 m apart and cover <10% of the surface.	Rock exposures 10-30 m apart and cover 10-25% of the surface.	Rock exposures <10 m apart and cover >25% of the surface.	Rock exposures too frequent to permit location of paths and trails.
t	Slope[8]	0-15%	15-30%	30-60%	>60%
i	Flooding	Not subject to flooding during season of use.	Floods 1 or 2 times during season of use.	Floods more than 2 times during season of use.	Subject to prolonged flooding during season of use.

1/ The symbols are used to indicate the nature of the limitation.

2/ The items affecting use listed in this table are those which have been shown to cause significant differences in trail response. Elevation, aspect, position on slope, and snow avalanching may have slight affects or influence trail management and should be considered in the final site evaluation. Items such as vegetation, fauna, and scenic value are not considered in the guidelines (Epp, 1977).

3/ Texture refers to the soil texture which will form the tread texture. This is the surface texture on level areas but may be a subsurface texture on slopes. Textural classes are based on the less than 2 mm soil fraction. Texture influences soil ratings as it influences foot trafficability, dust, design or maintenance of trails, and erosion hazards.

4/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Coarse fragments for the purpose of this table, include gravels and cobbles. Gravels tend to cause unstable footing when present in high amounts, and are also associated with increased erosion. Cobbles (and stones) must be removed from the trail tread, increasing construction and maintenance difficulties. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix or (b) the fragments are less than 2 cm in size.

7/ The type of rock outcrop (flat lying vs cliffs), and the orientation of the structure (linear cliffs vs massive blocks) can greatly alter the degree of the limitation. Each site with a Rockiness limitation based on the percent rock outcrop above should be evaluated on its own merits and the degree of limitation should then be modified appropriately if necessary.

8/ Slope in this context refers to the slope of the ground surface, not the slope of the tread.

Appendix D

GLOSSARY

AASHO classification (soil engineering) - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

Acid soil - A soil having a pH less than 7.0.

Acidity - (Alkalinity) - The degree of acidity of the soil expressed in pH values. See Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams.

Arable soil - Soil suitable for plowing and cultivation.

Association - A sequence of soils of about the same age, derived from similar parent material, and occuring under similar climatic conditions but showing different characteristics due to variations in relief and in drainage.

1/3 Atmosphere Moisture - The moisture percentage on dry weight basis of a soil sample that has been air dried, screened, saturated and subjected to a soil moisture tension of 345 cm of water through a permeable membrane for a period of 48 hours. It approximates the soil moisture retention capacity.

Available nutrient - That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

Available soil moisture - The portion of water in a soil that can be readily absorbed by plant roots: generally considered to be that water held in the soil up to approximately 15 atmospheres pressure.

Bearing capacity - Capacity of soil (in moist to wet conditions) to support loads such as buildings, people, vehicles, and animals.

Bedrock - The solid rock that underlies soil and regolith or that is exposed at the surface.

Boulders - Stones which are larger than 60 cm in diameter.

Bulk density - The weight of oven dry soil (105 degrees C) divided by its volume at field moisture conditions, expressed in grams per cubic centimeter.

Buried soil - Soil covered by an alluvial, loessial, or other deposit, usually to a depth greater than the thickness of the solum.

Calcareous soil - Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with hydrochloric acid.

Calcium Carbonate Equivalent - Refers to the percent of carbonates in the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate contents of soils are:

noncalcareous	<1%
weakly calcareous	1-5%
moderately calcareous	6-15%
strongly calcareous	16-25%
v. strongly calcareous	26-40%
extremely calcareous	>40%

Capillary fringe - A zone of essentially saturated soil just above the water table. The size distribution of the pores determines the extent and degree of the capillary fringe.

Carbon-nitrogen ratio (C/N ratio) - The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

Cation Exchange Capacity (CEC) - A measure of the total amount of exchangeable cations that can be held by a soil. Expressed in milliequivalents per 100g of soil.

Clay - As a soil separate, the mineral soil particles less than 0.002 mm in diameter: usually consisting largely of clay minerals. As a soil textural class, soil materials that contain 40 or more percent clay, less than 45 percent sand and less than 40 percent silt.

Cobbles - Rock fragments 8 to 25 cm in diameter.

Color - Soil colors are compared with a Munsell color chart. The

Munsell system specifies the relative degrees of the three simple variables of color: hue, value and chroma. For example: 10YR 6/4 means a hue of 10YR, a value of 6, and a chroma of 4.

Complex (soil) - A mapping unit used in detailed and reconnaissance soil surveys where two or more soil series that are so intimately intermixed in an area that it is impractical to separate them at the scale of mapping used.

Concretions - Hard grains, pellets or nodules from concentration of compounds in the soil that cement soil grains together.

Conductivity electrical - A physical quantity that measures the readiness with which a medium transmits electricity. It is expressed as the reciprocal of the electric resistance (ohms) or millisiemens per cm at 25 degrees C of a conductor which is one cm long with a cross sectional area of one square cm. It is used to express the concentration of salt in irrigation water or soil extracts.

Consistence (soil) - The mutual attraction of the particles in a soil mass, or their resistence to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented.

Consumptive use factor (CU) - The ratio of consumptive use of water by a crop to potential evapotranspiration. and transpiration. An actively growing crop that completely covers the soil over a large area and that has an ample supply of readily available soil water has a consumptive use factor of 1.0.

Consumptive use of water - The sum of the depths of water transpired by the plants and evaporated from the soil surface and from intercepted precipitation. It may be less or greater than potential evapotranspiration.

Contour - An imaginary line connecting points of equal elevation on the surface of the soil.

Cover - This term generally has one of the following meanings:

1. Vegetation or other material providing protection
2. In forestry, low growing shrubs and herbaceons plants under trees (i.e., ground cover vrs. tree cover)
3. Any vegetation producing a protective mat on or just above the soil surface.

Creep (soil) - Slow mass movement of soil and soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and by alternate freezing and thawing.

Decile portion - A one-tenth portion. As used in this map symbol A7 B3 means that the A soils cover seven tenths and the B soils cover three tenths of the map unit.

Delta - An alluvial or glaciofluvial fan shaped deposit at the mouth of a river that empties into a lake or sea.

Deflocculate - To separate or to break up soil aggregates into individual particles by chemical or physical means or both.

Degradation (of soils) - The changing of a soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated light colored (Ae) horizon.

Dispersion - Is rated high, moderate or low depending on how readily the soil structure breaks down or slakes because of excess moisture. A rating of high indicates that soil aggregates slake readily; a rating of low indicates that aggregates are resistant to dispersion and remain clumped together.

Drainage (soil) - (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

Drainage in soil reports is described on the basis of actual moisture content in excess of field capacity (that moisture retained after soil is allowed to drain) and length of the saturation period within

the plant root zone. The terms are as follows:

Very rapidly drained - Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm) within the control section and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Rapidly drained - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section, and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Well drained - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equaled by losses. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth. Soil horizons are usually bright colored.

Moderately well drained - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have intermediate to high water storage capacity (5-6cm) within the control section and are usually medium to fine in texture. Soils are commonly mottled in the 50 to 100 cm depth. Colors are dull brown in the subsoil with stains and mottles.

Imperfectly drained - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is major supply. If subsurface water or groundwater, or both, is main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups. These soils generally have mottling below the surface layers and generally have duller colors with depth, generally brownish gray with mottles of yellow and gray.

Poorly drained - Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, Texture, and depth, and are either Gleysolic or Organic.

Dryland farming - The practice of crop production in low rainfall areas without irrigation.

Eluvial horizon - A horizon from which material has been removed in solution or in water suspension.

Eolian - Soil material accumulated through wind action.

Erosion - The wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind or other geological processes. The ratings of erosion are:

Erosion 1 slightly eroded - soil with a sufficient amount of the A horizon removed that ordinary tillage will bring up and mix the B horizon or other lower lying horizons with surface soil in the plow layer.

Erosion 2 moderately eroded - soil with all of the A horizon and a part of the B or other lower lying horizons removed. The plow layer consists mainly of the original horizons below the A or below the original plow layer.

Erosion 3 severely eroded - soils have practically all of the original surface soil removed. The plow layer consists mainly of C horizon material, especially on knolls and steep upper slope positions.

Evapotranspiration - The combined loss of water from a given area, and during a specific period of time, by evaporation from the soil surface and transpiration from plants.

Field Moisture Equivalent - The minimum moisture content at which a drop of water placed on a smoothed surface of the soil will not be absorbed immediately by the soil, but will spread out over the surface and give it a shiny appearance.

Flood plain - The land bordering a stream, built up of sediments from overflow of the stream and subject to innundation when the stream is at flood stage.

Fluvial deposits - All sediments past and present, deposited by flowing water, including glaciofluvial deposits.

Frost heave - The raising of the surface caused by ice in the subsoil.

Friable - Soil aggregates that are soft and easily crushed between thumb and forefinger.

Glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

Gleyed soil - An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have lower chromas or more prominent mottling or both in some horizons than the associated well-drained soil.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas or prominent mottling or both, in some horizons.

Granular Structure - Soil structure in which the individual grains are gouped into small block-like aggregates with indistinct or round edges (spheriodal).

Gravel - Rock fragments 2 mm to 7.5 cm in diameter.

Ground Moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till, most of till is thought to have accumulated under the ice by lodgment, but some till has been let down from the upper surface of the ice by oblation. Resorting and modification may have taken place to some extent by wave-action of glacial melt waters. The topography is most commonly in the form of undulating plains with gently sloping sells and enclosed depressions.

Groundwater - Water beneath the soil surface, usually under conditions where the voids are completely filled with water (saturation).

Halophytic vegetation - vegetation that grows naturally in soils having a high content of various patts. It usually has fleshy leaves or thorns and resembles desert vegetation.

Horizon (soil) - A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes.

Horizon boundary - The lower boundary of each horizon is described by indicating its distinctness and form. The distinctness depends on the abruptness of vertical change (thickness). The Form refers to the variation of the boundary plane.

Distinctness -
abrupt - less than 2 cm
clear - 2 to 5 cm
gradual - 5 to 15 cm
diffuse - more than 15 cm

Form -
smooth - nearly plain
wavy - pockets are wider than deep
irregular - pockets are deeper than wide
broken - parts of the horizon are unconnected with other parts

Humic layer - A layer of highly decomposed organic soil material containing little fibre.

Hydraulic Conductivity - Refers to the effective flow velocity or discharge velocity in soil at unit hydraulic gradient. It is an approximation of the permeability of the soil and is expressed in cm. per hour.

Hydrologic cycle - The conditions through which water naturally passes from the time of precipitation until it is returned to the atmosphere by evaporation and is again ready to be precipitated.

Hydrophyte - Plants growing in water or dependent upon wet or saturated soil conditions for growth.

Illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

Immature soil - A soil having indistinct or only slightly developed horizons. Also called juvenile soil.

Impeded drainage - A condition that hinders the movement of water by gravity through the soils.

Inclusion - Soil type found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

Infiltration - The downward entry of water into the soil

Irrigation - The artificial application of water to the soil for the benefit of growing crops.

Irrigation requirement (IR) - Refers to the amount of water exclusive of effective precipitation that is required for crop production.

Lacustrine deposits - Material deposited by or settled out of lake waters and exposed by lowering of the water levels or elevation of the land. These sediments range in texture from sand to clay and are usually varved (layered annual deposits).

Landscape - All the natural features such as fields, hills, forest, water, etc., which distinquish one part of the earth's surface from another part.

Leaching - The removal from the soil of materials in solution.

Liquid limit (upper plastic limit) - The water content corresponding to an arbitrary limit between the liquid and plastic states of consistency of a soil. The water content at this boundary is defined as that at which a pat of soil cut by a groove of standard dimensions will flow together for a distance of 1.25 cm under the impact of 25 blows in a standard liquid limit apparatus.

Lineal shrinkage - This is the decrease in one dimension expressed as a percentage of the original dimension of the soil mass when the moisture content is reduced from a stipulated percentage (usually field moisture equivalent) to the shrinkage limit.

Mapping Unit - Any delineated area shown on a soil map that is identified by a symbol. A map-

ping unit may be a soil unit, a miscellaneous land type, or a soil complex.

Marsh - Periodically flooded or continually wet areas having the surface not deeply submerged. It is covered dominently with sedges, cattails, rushes or other hydrophytic plants.

Mature soil - A soil having well-developed soil horizons produced by the natural processes of soil formation.

Mesophyte - Plants requiring intermediate moisture conditions and are not very resistant to drought.

Microrelief - Small-scale, local differences in relief including mounds, swales or hollows.

Milliequivalent (me) - One-thousandth of an equivalent. An equivalent is the weight in grams of an ion or compound that combines with or replaces one gram of hydrogen. The atomic or formula weight divided by valence.

Mottles - Irregularly marked spots or streaks, usually yellow or orange but sometimes blue. They are described in order of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottles in soils indicate poor aeration and lack of good drainage.

Outwash - Sediments "washed out" beyond the glacier by flowing water and laid down in thin beds or strata. Particle size may range from boulders to silt.

Ovendry soil - Soil that has been dried at 105 degrees C until it has reached constant weight.

Parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Particle size, soil - The grain size distribution of the whole soil including the coarse fraction. It differs from texture, which refers to the fine earth (less than 2mm) fraction only. In addition, textural classes are usually assigned to specific horizons whereas soil family particle-size classes indicate a composite particle size of a part of the control section that may include several horizons.

The particle-size classes for family groupings are as follows:

Fragmental Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal Particles coarser than 2 mm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle-size class.

Loamy-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loamy particle-size class.

Clayey-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle-size class.

Sandy The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm- 25 cm occupy less than 35% by volume.

Loamy The texture of the fine earth includes loamy very fine sand, very fine sand, and finer textures with less than 35% clay; particles 2 mm-25 cm occupy less than 35% by volume.

Coarse-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Coarse-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Clayey. The fine earth contains 35% or more clay by weight and particles 2mm-25 cm occupy less than 35% by volume.

Fine-clayey. A clayey particle size that has 35-60% clay in the fine earth fraction.

Very-fine-clayey. A clayey particle size that has 60% or more clay in the fine earth fraction.

Ped - An individual soil aggregate such as granule, prism or block formed by natural processes (in contrast with a clod which is formed artificially).

Pedology - Those aspects of soil science involving constitution, distribution, genesis and classification of soils.

Percolation - The downward movement of water through soil. specifically, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of 1.0 or less.

Permafrost -

1. Perennially frozen material underlying the solum.

2. A perennially frozen soil horizon.

Permafrost table - The upper boundary of permafrost, usually coincident with the lower limit of seasonal thaw (active layer).

Permeability - The ease with which water and air pass through the soil to all parts of the profile. It is described as rapid, moderate or slow.

pH - The intensity of acidity and alkalinity, expressed as the logarithm of the reciprocal of the H + concentration. pH 7 is neutral, lower values indicate acidity and higher values alkalinity.

Phase, soil - A soil phase is a unit of soil outside the system of soil taxonomy. It is a functional unit and is used at any categorical level from Order to Series. It is used to characterize soil and landscape properties that are not used as criteria in soil taxonomy. The major phase differentiae are: slope, erosion, deposition, stoniness, texture, salinity, and calcareousness.

Plastic Limit - The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil.

Plasticity Index - The numerical difference between the liquid and the plastic limit. The plasticity index gives the range of moisture contents within which a soil exhibits plastic properties.

Potential evapotranspiration (PE) - The maximum quantity of water capable of being lost as water vapor, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water.

Profile, soil - A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil - The acidity or alkalinity of a soil. Soil reaction classes are characterized as follows:

extremely acid. . . .	pH < 4.5
very strongly acid.	4.5 to 5.0
strongly acid . . .	5.1 to 5.5
medium acid	5.6 to 6.0
slightly acid . . .	6.1 to 6.5
mildly alkaline . .	7.4 to 7.8
mod. alkaline . . .	7.9 to 8.4
strongly alkaline .	8.5 to 9.0
very strongly alkaline.	> 9.0

Regolith - The unconsolidated mantle of weathered rock and soil material on the earth's surface.

Relief - The elevation of inequalities of the land surface when considered collectively.

Runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

Saline Soil - A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of

the saturation extract is greater than 4 millsiemens/cm (ms/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5. Approximate limits of salinity classes are:

non-saline. . . . 0 to 4 ms/cm
slightly saline . 5 to 8 ms/cm
mod. saline . . .9 to 15 ms/cm
strongly saline . . > 15 ms/cm

Salinization - The process of accumulation of salts in the soil.

Salt-Affected Soil - Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or of soluble salts. It includes soils having an excess of salts, or an excess of exchangeable sodium or both.

Sand - A soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

Saturation Percentage - The moisture percentage of a saturated soil paste, expressed on an oven dry weight basis.

Seepage -

1. The escape of water downward through the soil.
2. The emergence of water from the soil along an extensive line of surface in contrast to a spring where water emerges from a local spot.

Series, soil - A category in the Canadian System of Soil Classification. It consists of soils that have soil horizons similar in their differentiating characteristics and arrangement in the profile, except for surface texture and are formed from a particular type of parent material.

Shrinkage limit - This is the moisture content at which an equilibrium condition of volume change is reached and further reduction in moisture content will not cause a decrease in the volume of the soil mass.

Shrinkage ratio - This is the ratio between the volume change and a

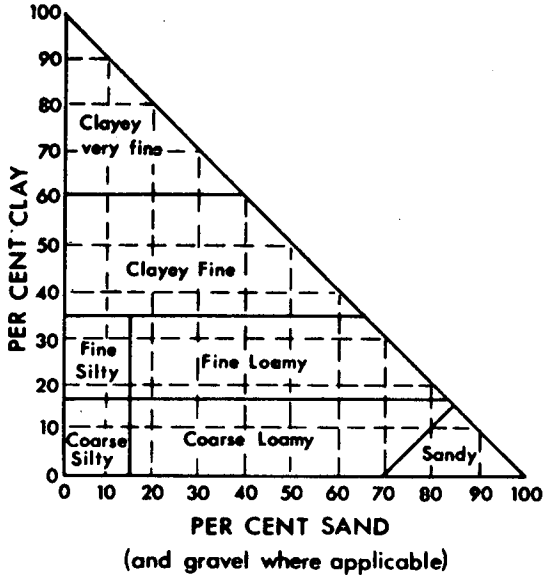


Figure 7: Family particle-size classes

corresponding change in moisture content. It equals the apparent specific gravity of the dried soil.

Silt - (a) Individual mineral particles of soil that range in diameter between 0.05 to .002 mm. (b) Soil of the textural class silt contains greater than 80 percent silt and less than 12 percent clay.

Slickenside - Smoothed surfaces along planes of weakness resulting from the movement of one mass of soil against another in soils dominated by swelling clays.

Sodium-Adsorption Ratio (S.A.R.) - A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exhange reactions with soil. Where the ionic concentrations are expressed as milliequivalents per litre.

Soil - The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time.

Solum - The upper horizons of a soil above the parent material and in which the processes of soil formation are active. It usually comprises the A and B horizons.

Stones - Rock fragments greater than 25 cm in diameter.

Stoniness - The relative proportion of stones in or on the soil. The classes of stoniness are defined as follows:

Stones 0. Nonstony -- Land having less than 0.01% of surface occupied by stones.

Stones 1. Slightly stony -- Land having 0.01-0.1% of surface occupied by stones. Stones 15-30 cm in diameter, 10-30 m apart. The stones offer only slight to no hindrance to cultivation.

Stones 2. Moderately stony -- Land having 0.1-3% of surface occupied by stones. Stones 15-30 cm in diameter, 2-10 m apart. Stones cause some interference with cultivation.

Stones 3. Very stony -- Land having 3-15% of surface occupied by stones. Stones 15-30 cm in diameter, 1-2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.

Stones 4. Exceedingly stony -- Land having 15-50% of surface occupied by stones. Stones 15-30 cm in diameter, 0.7-1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

Stones 5. Excessively stony -- Land having more than 50% of surface occupied by stones. Stones 15-30 cm in diameter, less than 0.7 m apart. The land is too stony to permit cultivation.

Storage Capacity - Refers to the maximum amount of readily available water that can be stored within the rooting zone of a crop in a given soil. For practical irrigation purposes, 50 percent of the total soil water between field capacity and wilting point may be considered as readily available.

Stratified materials - Unconsolidated sand, silt and clay arranged in strata or layers.

Structure - The combination or arrangement of primary soil particles into secondary soil particles, units or peds, which are separated from adjoining aggregates by surfaces of weakness. Aggregates differ in grade (distinctness) of development. Grade is described as structureless (no observable aggregation or no definite orderly arrangement amorphous if coherent, single-grained if noncoherent), weak, moderate, and strong. The aggregates vary in class (size) and are described as fine, medium, coarse, and very coarse. The size classes vary according to the type (shape) of structure. The types of structure are:

Granular - Having more or less rounded aggregates without smooth faces and edges

Platy - Having thin, plate-like aggregates with faces mostly horizontal

Blocky - Having block-like aggregates with sharp, angular corners

Subangular blocky - Having block-like aggregates with rounded and flattened faces and rounded corners By convention an aggregate is described in the order of grade, class and type, e.g. strong, medium, blocky and moderate, coarse, granular. In the parent material of soils the material with structural shapes may be designated as pseudo-blocky, pseudo-platy, etc. In stratified materials, a bed is a unit layer distinctly separable from other layers and is one or more cm thick but a lamina is a similar layer less than 1 cm thick.

Soil Survey - The systematic examination, description, classification, and mapping of soil in an area.

Sulfate Hazard - Refers to the relative degree of attack on concrete by soil and water containing various amounts of sulfate ions. It is estimated from electrolyte measurements and salt analysis on selected profiles and soil samples, and by visual examination of free gypsum within the profile during the course of soil investigation.

Texture, soil - The relative proportions of the fine earth (less than 2 mm.) fraction of a soil. Textural classes are usually assigned to specific horizons whereas family particle size classes indicate a composite particle size of a portion of the control section that may include several horizons.

The size range of the constituent primary particles are as follows:

	Diameter (mm)
Very coarse sand	2.0-1.0
Coarse sand	1.0-0.5
Medium sand	0.5-0.25
Fine sand	0.25-0.10
Very fine sand	0.10-0.05
Silt	0.05-0.002
Clay	< 0.002
Fine clay	< 0.0002

Till, glacial - Unstratified glacial deposites consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth - The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and its impedance to seedling emergency and root penetration.

Topography - Refers to the percent slope and the pattern or frequency of slopes in different directions. A set of 10 slope classes are used to denote the dominant but not necessarily most abundant slopes within a mapping unit. Letters are used for multiple slopes (irregular surface).

Slope Class	Slope Name	Percent slope	Approx. degrees
1	level	0-0.5	0
2	nearly level	.5-2.5	.3-1.5
3	very gentle	2-5	1-3
4	gentle	6-9	3.5-5
5	moderate	10-15	6-8.5
6	strong	16-30	9-17
7	very strong	31-45	17-24
8	extreme	46-70	25-35
9	steep	71-100	35-45
10	very steep	>100	>45

Underground runoff - (or seepage)-Water flowing towards stream channels after infiltration into the ground.

Unified Soil Classification System (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit.

Urban Land - Areas so altered or obstructed by urban works or structures that identification of soils is not feasible.

Variant, soil - A soil whose properties are believed to be sufficiently different from other known soils to justify a new series name, but comprising such a limited geographic area that creation of a new series is not justified.

Varve - A distinct band representing the annual deposit in sedimentary materials regardless of origin and usually consisting of two layers, one thick light colored layer of silt and fine sand laid down in the spring and summer, and the other a thin, dark colored layer of clay laid down in the fall and winter.

Water balance, soil - Is the daily amount of readily available water retained by the soil. The daily soil-water balance is decreased by the amount that the daily consumptive use exceeds the daily rainfall. When daily

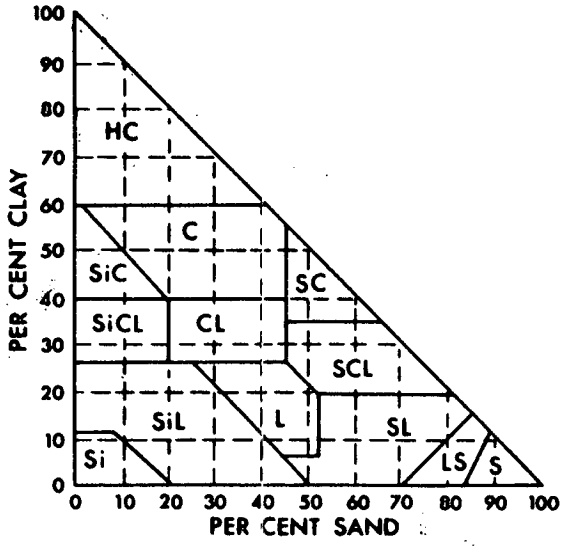
rainfall exceeds the consumptive use, the daily balance increases by the amount of the difference unless the soil-water balance is at storage capacity, in which case the excess is assumed to be lost by runoff or deep percolation.

Water table - (groundwater surface; free water surface; groundwater elevation) Elevation at which the pressure in the water is zero with respect to the atmospheric pressure.

Water-holding capacity - The ability of a soil to hold water. The water-holding capacity of sandy soils is usually considered to be low, while that of clayey soils is high. It is often expressed in cm of water per 30 cm depth of soil.

Weathering - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

Xerophyte - Plants capable of surviving extended periods of soil drought.



Texture Group	Class Symbol	Class Name
Coarse	S	Sand
	LS	Loamy sand
Moderately coarse	SL	Sandy loam
	LVFS	Loamy very fine sand
Medium	Si	Silt
	Sil	Silt loam
	L	Loam
	VFSL	Very fine sandy loam
Moderately fine	SCL	Sandy clay loam
	CL	Clay loam
	SiCL	Silty clay loam
Fine	SC	Sandy clay
	C	Clay
	SiC	Silty clay
Very fine	HC	Heavy clay

Figure 8: Soil Textural Classes

Appendix D

SOIL HORIZON DESIGNATIONS

ORGANIC HORIZONS

Organic horizons are found in Organic soils, and commonly at the surface of mineral soils. They may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon (approximately 30% organic matter) by weight. Two groups of these horizons are recognized, O horizons and the L, F, and H horizons.

O This is an organic horizon developed mainly from mosses, rushes, and woody materials.

Of The fibric horizon is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fiber by volume and a pyrophosphate index of 5 or more. If the rubbed fiber volume is 75% or more, the pyrophosphate criterion does not apply.

Om The mesic horizon is the intermediate stage of decompostion with intermediate amounts of fiber, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of fibric or of humic.

Oh The humic horizon is the most highly decomposed of the organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained. The humic horizon has less than 10% rubbed fiber by volume and a phrophosphate index of 3 or less.

LFH These organic horizons developed primarily from leaves, twigs, woody materials and a minor component of mosses under imperfectly to well drained forest conditions.

L This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.

F This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna as in moder, or it may be a partly decomposed mat permeated by fungal hyphae as in mor.

H This is an organic horizon characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification chiefly through the action of organisms. It is frequently intermixed with mineral, grains, especially near the junction with the mineral horizon.

MASTER MINERAL HORIZONS

Mineral horizons are those that contain less than 30% organic matter by weight as specified for organic horizons.

A This is a mineral horizon or horizons formed at or near the surface in the zone of leaching or removal of materials in solution and suspension or of maximum in situ accumulation of organic matter, or both. Included are:

1. horizons in which organic matter has accumulted as a result of biological activity (Ah);
2. horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of them (Ae);
3. horizons having characteristics of 1) and 2) above but transitional to underlying B or C (AB or A and B);
4. horizons markedly disturbed by cultivation or pasture (Ap).

B This is a mineral horizon or horizons characterized by one or more of the following:

1. an enrichment in silicate clay, iron, aluminum, or humus, alone or in combination (Bt,Bf,Bfh,Bhf, and Bh);

2. a prismatic or columnar structure that exhibits pronounced coatings or stainings and significant amount of exchangeable Na (Bn);

3. an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below, or both, and does not meet the requirements of 1) and 2) above (Bm,Bg).

C This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca,Csa,Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

R This is consolidated bedrock that is too hard to break with the hands or to dig with a spade when moist and that does not meet the requirement of a C horizon. The boundary between the R layer and overlying unconsolidated material is called a lithic contact.

W This is a layer of water in Gleysolic, Organic, or Cryosolic soils. It is called a hydric layer in Organic soils.

LOWER-CASE SUFFIXES

b Buried soil horizon.

c A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, and a layer cemented by calcium carbonate and a duripan are examples.

ca A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than 10cm thick, and if it has a CaCO3 equivalent of less than 15 percent it should have at least 5 percent more CaCO3 equivalent than the parent material (IC). If it has more than 15 percent CaCO3 equivalent it should have 1/3 more CaCO3 equivalent than IC. If no IC is present, this horizon is more than 10 cm thick and contains more than 5 percent by volume of secondary carbonates in concretions or soft, powdery forms.

cc Cemented (irreversible) pedogenic concretions.

e A horizon characterized by the eluviation of clay, iron, aluminum, or organic matter alone or in combination. When dry, it is usually higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae).

f A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR or redder or its hue is 10YR near the upper boundary and becomes yellower with depth. When moist, the chroma is higher than 3 or the value is 3 or less. It contains 0.6% or more pyrophosphate-extractable Al+Fe in textures finer than sand and 0.4% or more in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate-extractable Al+Fe to clay (less than 0.0002mm) is more than 0.05 and organic C exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of organic C to pyrophosphate-extractable Fe is less than 20, or both are true. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. The criteria for "f" do not apply to Bgf horizons. The following horizons are differentiated on the basis of organic carbon content: Bf - 0.5% to 5% organic carbon. Bhf-more than 5% organic carbon.

g A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less. It is used with A and e (Aeg); with B alone (Bg); with B and f (Bfg); with B, h, and f (Bhfg); with B and t (Btg); with C alone (Cg); with C and k (Ckg); and several others. In some reddish parent materials, matrix colors of reddish hues and high chromas may persist despite long periods of reduction. In these soils, horizons are designated as g if there is gray mottling or if there is marked bleaching on ped faces or along cracks.

Aeg This horizon must meet the definitions of A,e, and g.

Bg These horizons are analogous to Bm horizons but they have colors indicative of poor drainage and periodic reduction. They include horizons occurring between A and C horizons in which the main features are (i) colors of low chroma, that is: chromas of 1 or less, without mottles on ped surfaces or in the matrix if peds are lacking; or chromas of 2 or less in hues of 10YR or redder, on ped surfaces or in the matrix if peds are lacking, accompanied by more prominent mottles than those in the C horizon; or hues bluer than 10Y, with or without mottles on ped surfaces or in the matrix if peds are lacking. (ii) colors indicated in (i) and a change in structure from that of the C horizons. (iii) color indicated in (i) and illuviation of clay too slight to meet the requirements of Bt; or accumulation or iron oxide too slight to meet the limits of Bgf. (iv) colors indicated in (i) and removal of carbonates. Bg horizons occur in some Orthic Humic Gleysols and some Orthic Gleysols.

Bfg, Bhfg, Btg, and others When used in any of these combinations the limits set for f, hf, t, and others must be met.

Bgf The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% or more. Pyrophosphate-extractable Al + Fe is less than the minimum limit specified for 'f' horizons. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg of gleyed Podzols. It is distinguished from the Bfg of gleyed Podzols on the basis of the extractability of the Fe and Al. The Fe in the Bgf horizon is thought to have accumulated as a result of the oxidation of ferrous iron. The iron oxide formed is not associated intimately with organic matter or with Al, and it is sometimes crystalline. The Bgf horizons are usually prominently mottled, with more than half of the soil material occurring as mottles of high chroma.

Cg, Ckg, Ccag, Csg, Csag When g is used with C alone, or with C and one of the lower-case suffixes k, ca, s, or sa, it must meet the definiton for C and for the particular suffix.

h A horizon enriched with organic matter. It is used with A alone (Ah); or with A and e (Ahe); or with B alone (Bh); or with B and f (Bhf).

Ah A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more organic carbon than the IC, or both. It contains less than 17% organic carbon by weight.

Ahe An Ah horizon that has undergone eluviation as evidenced, under natural conditions, by streaks and splotches of differing shades of gray and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a lighter-colored Ae.

Bh This horizon contains more than 1% organic carbon, less than 0.3% pyrophosphate-extractable Fe, and has a ratio of organic carbon to pyrophosphate-extractable Fe of 20 or more. Generally the color value and chroma are less than 3 when moist.

Bhf Defined under 'f'.

j Used as a modifier of the suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies. For example Bfgj means a Bf horizon with weak expression of gleying; Bfjgj means a B horizon with weak expression of both 'f' and 'g' features.

Aej It denotes an eluvial horizon that is thin, discontinuous or slightly discernible.

Btj It is a horizon with some illuviation of clay, but not enough to meet the limits of Bt.

Btgj, Bmgj Horizons that are mottled but do not meet the criteria of Bg.

Bfj It is a horizon with some accumulation of pyrophosphate-extractable Al and Fe but not enough to meet the limits of Bf.

Bntj or Bnj Horizons in which development of solonetzic B properties is evident but insufficient to meet the limits for Bn or Bnt.

k Denotes the presence of carbonate, as indicated by visible effervescence when dilute HCl is added. Most often it is used with B and m (Bmk) or C (Ck), and occasionally with Ah or Ap (Ahk, Apk), or organic horizons (Ofk, Omk).

m A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both. It has:

1. Evidence of alteration in one of the following forms:

   a) Higher chromas and redder hues than the underlying horizons.

   b) Removal of carbonates, either partially (Bmk) or completely (Bm).

2. Illuviation, if evident, too slight to meet the requirements of a Bt or a podzolic B.

3. Some weatherable minerals.

4. No cementation or induration and lacks a brittle consistence when moist. This suffix can be used as Bm, Bmgj, Bmk, and Bms.

n A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. It must also have kthe following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry. It is used with B, as Bn or Bnt.

p A horizon disturbed by man's activities, such as cultivation, logging, habitation, etc. It is used with A and O.

s A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

sa A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. The conductivity of the saturation extract must be at least 4 ms/cm and must exceed that of the C horizon by at least one-third.

t An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), etc.

Bt A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may occur at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties:

1. If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizons, as follows:

   a) If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction (2mm) the Bt horizon must contain at least 3% more clay, e.g.,Ae 10% clay-Bt minimum 13% clay.

   b) If the eluvial horizon has more than 15% and less

than 40% total clay in the fine earth fraction, the ratio of the clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more, e.g., 20% clay increase in the Bt over Ae.

c) If the eluvial horizon has more than 40% total clay in the fine earth fraction, the Bt horizon must contain at least 8% more clay than the eluvial horizon, e.g. Ae 50% clay; Bt at least 58% clay.

2. A Bt horizon must be at least 5 cm thick. In some sandy soils where clay accumulation occurs in the lamellae, the total thickness of the lamellae should be more than 10 cm in the upper 150 cm of the profile.

3. In massive soils the Bt horizon should have oriented clays in some pores and also as bridges between the sand grains.

4. If peds are present, a Bt horizon shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1% or more of the cross section, as viewed in thin section.

5. If a soil shows a lithologic discontinuity between the eluvial horizon and the Bt horizon, or if only a plow layer overlies the Bt horizon, the Bt horizon need show only clay skins in some part, either in some fine pores or on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has about 1% or more of oriented clay bodies.

Btj Btj and Btg are defined under j and g.

u A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation. Evidence of marked disruption such as the inclusion of material from other horizons, absence of the horizon, etc. must be evident in at least half of the cross section of the pedon. Such turbation can result from blowdown of trees, mass movement of soil on slopes, and burrowing animals. It can be used with any horizon or subhorizon with the exception of A or B alone; e.g. Aeu, Bfu, BCu.

x A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content. When dry, it has a hard consistence and seems to be cemented. When moist, it has moderate to weak brittleness. It frequently has bleached fracture planes and is overlain by a friable B horizon. Air dry clods of fragic horizons slake in water.

y A horizon affected by cryoturbation as manifested by disrupted and broken horizons,, incorporation of materials from other horizons and mechanical sorting in at least half of the cross section of the pedon. It is used with A, B, and C alone or in combination with other subscripts, e.g. Ahy, Ahgy, Bmy, Cy, Cgy, Cygj, etc.

z A frozen layer. It may be used with any horizon or layer, e.g. Ohz, Bmz, Cz, Wz.

Appendix D

DESCRIPTION OF LANDFORMS

GENETIC MATERIALS

Unconsolidated mineral component

The unconsolidated mineral component consists of clastic sediments that may or may not be stratified, but whose particles are not cemented together. They are essentially of glacial or post-glacial origin but include poorly consolidated and weathered bedrock.

Anthropogenic - Man-made or man-modified materials, including those associated with mineral exploitation and waste disposal.

Colluvial - Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders and blocks that have reached their present position by direct, gravity-induced movement.

They are restricted to products of mass-wasting whereby the debris is not carried by wind, water, or ice (excepting snow avalanches).

Eolian - Sediment, generally consisting of medium to fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive. Individual grains may be rounded and show signs of frosting.

These materials have been transported and deposited by wind action.

Fluvial - Sediment generally consisting of gravel and sand with a minor fraction of silt and clay. The gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification, but massive, nonsorted fluvial gravels do occur. These materials have been transported and deposited by streams and rivers. Finer textured Fluvial deposits of modern rivers are termed Alluvium.

Lacustrine - Sediment generally consisting of either stratified fine snad, silt, and clay deposited on the lake bed; or moderately well sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action.

These are materials that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action.

Marine - Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well stratified to moderately stratified (in some places containing shells). They have settled from suspension in salt or brackish water bodies or have accumulated at their margins through shoreline processes such as wave action and longshore drift.

Morainal - Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.

Saprolite - Rock containing a high proportion of residual silts and clays formed by alteration, chiefly by chemical weathering.

The rock remains in a coherent state, interstitial grain relationships are undisturbed and no downhill movement due to gravity has occurred.

Undifferentiated - A layered sequence of more than three typed of genetic material outcropping on a steep erosional escarpment.

Volcanic - Unconsolidated pyroclastic sediments. These include volcanic dust, ash, cinders, and pumice.

Qualifying Descriptors

These have been introduced to qualify the genetic materials and to supply additional information about the mode of formation or depositional environment.

Glacial - Used to qualify nonglacial genetic materials or process modifiers where there is direct evidence that glacier ice exerted a strong but secondary or indirect control upon the mode of origin of the materials or mode of operation of the process. The use of this qualifying descriptor implies that glacier ice was close to the site of the deposition of a material or the site of operation of a process.

Glaciofluvial - Fluvial materials showing clear evidence of having been deposited either directly in front of or in contact with glacier ice.

Glaciolacustrine - Lacustrine materials deposited in contact with glacial ice.

Glaciomarine - Materials of glacial origin laid down in a marine environment, as a result of settling from melting, floating ice and ice shelves.

Organic component

The organic component consists of peat deposits containing >30% organic matter by weight that may be as thin as 10 cm if they overlie bedrock but are otherwise greater than 40 cm and generally greater than 60 cm thick. The classes and their definitions follow.

B	Bog
N	Fen
S	Swamp

Bog - A bog is a peat-covered or peat-filled area, generally with a high water table. Since the surface of the peatland is slightly elevated, bogs are either unaffected or partly affected by nutrient-rich groundwaters from the surrounding mineral soils. The groundwater is generally acidic and low in nutrients (ombrotrophic). The dominant peat materials are sphagnum and forest peat, underlain, at times, by fen peat.

Fen - A fen is a peat-covered or peat-filled area with a high water table, which is usually at the surface. The dominant materials are shallow to deep, well to moderately decomposed fen peat. The waters are mainly rich in nutrients (minerotrophic) and are derived from mineral soils. The peat materials are therefore higher in both nutrients and pH than the peats associated with bogs.

Swamp - A swamp is a peat-covered or peat-filled area. The peat surface is level or slightly concave in cross section. The water table is frequently at or above the peat surface. There is strong water movement from margins or other mineral sources. The microrelief is hummocky, with many pools present. The waters are neutral or slightly acid. The dominant peat materials are shallow to deep mesic to humic forest and fen peat.

GENETIC MATERIAL MODIFIERS

Material modifiers are used to qualify unconsolidated mineral and organic deposits. Particle-size classes serve to indicate the size, roundness, and sorting of unconsolidated mineral deposits. Fiber classes indicate the degree of decomposition and fiber size of organic materials.

Particle size classes for unconsolidated mineral materials

Blocky: An accumulation of angular particles greater than 256 mm in size.

Bouldery: An accumulation of rounded particles greater than 256 mm in size.

Clayey: An accumulation of particles where the fine earth fraction contains 35% or more clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Cobbly: An accumulation of rounded particles having a diameter of 64-256 mm.

Gravelly: An accumulation of rounded particles ranging in size from pebbles to boulders.

Loamy: An accumulation of particles of which fine earth fraction contains 35% or less clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Pebbly: An accumulation of rounded particles having a diameter of 2-64 mm.

Rubbly: An accumulation of angular fragments having a diameter of 2-256 mm.

Sandy: An accumulation of particles of which the fine earth fraction contains more than 70% by weight of fine snad or coarser particles. Particles greater than 2 mm occupy less than 35% by volume.

Silty: An accumulation ofparticles of which the fine earth fraction contains less than 15% of fine sand or coarser particles and has less than 35% clay. Particles greater than 2 mm occupy less than 35% by volume.

Fiber classes for organic materials

The amount of fiber and its durability are important characterizing features of organic deposits in that they reflect on the degree of decomposition of the material. The prevalence of woody materials in peats is also of prime importance.

Fibric: The least decomposed of all organic materials; there is a large amount of well-preserved fiber that is readily identifiable as to botanical origin. Fibers retain their character upon rubbing.

Mesic: Organic material in an intermediate stage of decompostion; intermediate amounts of fiber are present that can be identified as to their botanical origin.

Humic: Highly decomposed organic material; small amounts of fiber are present that can be identified as to their botanical origin. Fibers can be easily destroyed by rubbing.

Woody: Organic material containing more than 50% of woody fibers.

SURFACE EXPRESSION

The surface expression of genetic materials is their form (assemblage of slopes) and pattern of forms. Form as applied to unconsolidated deposits refers specifically to the product of the initial mode of origin of the materials. When applied to consolidated materials, form refers to the product of their modification by geological processes. Surface expression also indicates the manner in which unconsolidated genetic materials relate to the underlying unit.

Consolidated and Unconsolidated mineral surface classes

Apron - A relatively gently slope at the foot of a steeper slope and formed by materials from the steeper, upper slope.

Blanket - A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but still conforming to the general underlying topography.

Fan - A fan-shaped form similar to the segment of a cone and having a perceptible gradient from the apex to the toe.

Hummocky - A very complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally 9-70% (5-35 degrees).

Inclined - A sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 2-70% (1-35 degrees). The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Level - A flat or very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 2% (1 degree).

Rolling - A very regular sequence of moderate slopes extending from rounded, sometines confined concave depressions to broad, rounded convexities producing a wavelake pattern of moderate relief. Slope length is often 1.6 km or greater and gradients are greater than 5% (3 degrees).

Ridged - A long, narrow elevation of the surface, usually sharp crested with steep sides. The ridges may be parallel, subparallel, or intersecting.

Steep - Erosional slopes, greater than 70% (35 degrees), on both

consolidated and unconsolidated materials. The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material.

Terraced - Scarp face and the horizontal or gently inclined surface (tread) above it.

Undulating - A very regular sequence of gentle slopes that extends from rounded, sometimes confined concavities to broad rounded convexities producing a wavelike pattern of low local relief. Slope length is generally less than 0.8 km and the dominant gradient of slopes is 2-5% (1-3 degrees).

Veneer - Unconsolidated materials too thin to mask the minor irrigularities of the underlying unit surface. A veneer will range from 10 cm to 1 m in thickness and will possess no form typical of the materials's genesis.

Organic surface classes

Blanket - A mantle of organic materials that is thick enough to mask minor irregularities in the under-lying unit but still conforms to the general underlying topography.

Bowl - A bog or fen occupying concave-shaped depressions.

Domed - A bog with an elevated, convex, central area much higher than the margin. Domes may be abrupt (with or without a frozen core) or gently sloping or have a stepped surface.

Floating - A level organic surface associated with a pond or lake and not anchored to the lake bottom.

Horizontal - A flat peat surface not broken by marked elevations and depressions.

Plateau - A bog with an elevated, flat, central area only slightly higher than the margin.

Ribbed - A pattern of parallel or reticulate low ridges associated with fens.

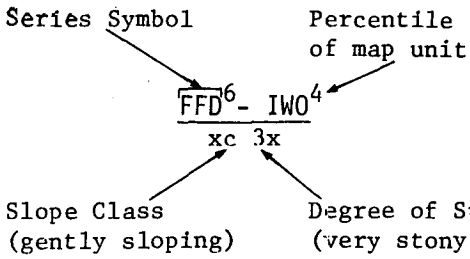
Sloping - A peat surface with a generally constant slope not broken by marked irregularities.

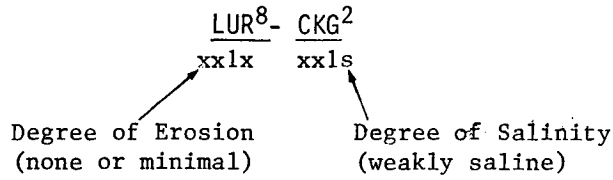
Veneer - A thin (40 cm-1m) mantle of organic materials which generally conforms to the underlying topography. They may or may not be associated with discontinuous permafrost.

Appendix E

MAP UNIT SYMBOLOGY

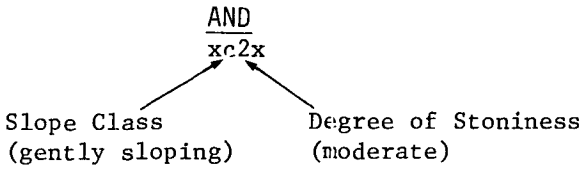
Compound Map Units

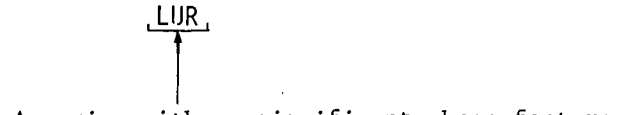




In a compound unit where two series share the same denominator, the phases apply to both series accordingly.

Simple Map Units





Degree of Erosion
- x non-eroded or minimal
- 1 slightly eroded
- 2 moderately eroded
- 3 severely eroded
- o overblown

Slope Class
- x 0-2% level to very gently sloping
- c 2-5% gently sloping
- d 5-9% moderately sloping
- e 9-15% strongly sloping
- f 15-30% steeply sloping
- g 30-60% very steeply sloping
- h over 60% extremely sloping

Stoniness
- x non-stony
- 1 slightly stony
- 2 moderately stony
- 3 very stony
- 4 exceedingly stony
- 5 excessively stony

Degree of Salinity
- x non-saline
- s weakly saline
- t moderately saline
- u strongly saline

TABLE 26

Legend for West-Interlake Study Area

Table 26. Legend for West-Interlake Study Area

Soil Symbol	Soil Name	Surface Texture	Drainage	Subgroup
AND	Aneda	Loam	Well	Orthic Dark Gray
AOS	Alonsa	Loam	Well	Rego Black, lithic
CKG	Clarkleigh	Clay loam	Poor	Rego Humic Gleysol, carbonated
CKGp	Clarkleigh	Clay loam	Poor	Rego Humic Gleysol, carbonated, peaty
CRN	Crane	Mesic peat	Poor to very poor	Terric Mesisol
DVD	Davidson	Fine sand	Well	Orthic Dark Gray
FFD	Fairford	Loam	Well	Eluviated Eutric Brunisol
FKR	Faulkner	Loam	Imperfect	Gleyed Dark Gray, lithic
GSO	Garson	Loam	Well	Orthic Gray Luvisol
GUO	Gunton	Loamy sand	Well	Orthic Dark Gray
HIB	Hilbre	Loam	Well	Eluviated Eutric Brunisol, lithic
ISF	Isafold	Loam	Well-mod. well	Rego Black
IWO	Inwood	Loam	Imperfect	Gleyed Dark Gray
LRY	Leary	Loamy sand	Well	Orthic Dark Gray
LUR	Lundar	Loam	Imperfect	Gleyed Rego Black
LXB	Lynx Bay	Loam	Well	Orthic Dark Gray, lithic
Mh	Marsh	Mucky loam	Poor to very poor	Rego Gleysol
MEB	Meleb	Clay loam	Poor	Rego Humic Gleysol, carbonated
MEBp	Meleb	Clay loam	Poor	Rego Humic Gleysol, carbonated, peaty
NCS	Narcisse	Loam	Well	Orthic Black, lithic

Table 26. Cont'd

Soil Symbol	Soil Name	Surface Texture	Drainage	Subgroup
R	Rock			
Sb	Sand Beach	Sand	Rapid to poor	Orthic Regosol
SLB	St. Labre	Loamy fine sand	Well	Orthic Gray Luvisol
SWW	Stonewall	Loam	Well	Orthic Dark Gray, lithic
SDE	Sandridge	Loam	Well	Orthic Dark Gray, lithic
Zz	Water			