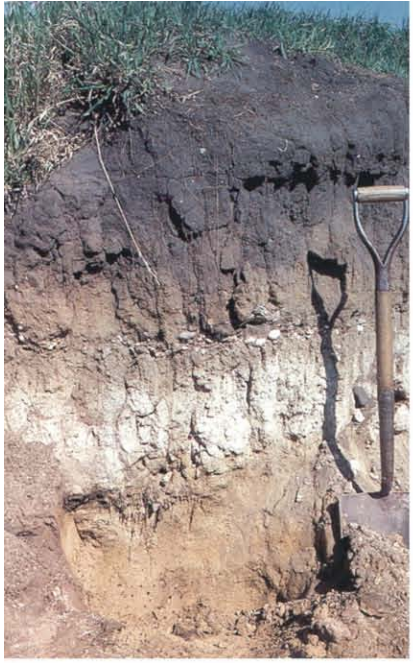
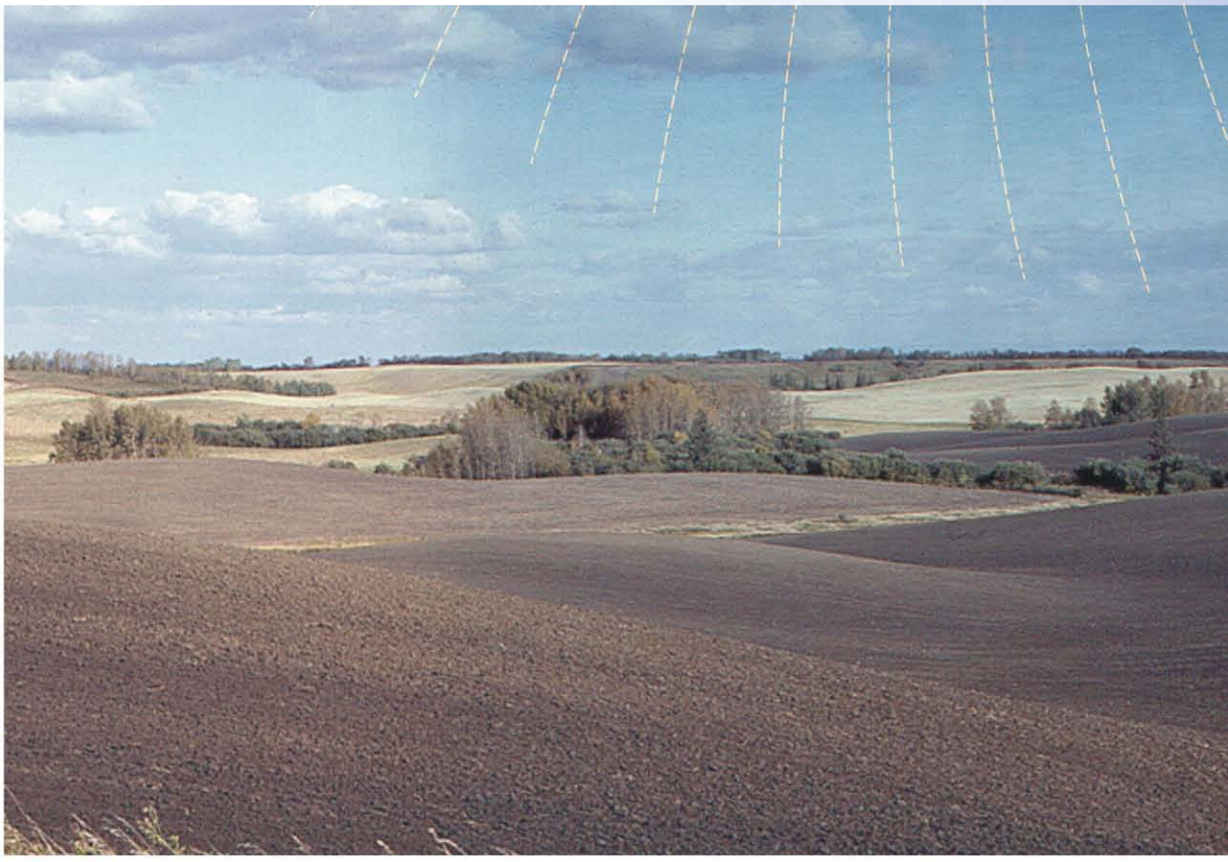


Soils of the Municipality of Springfield
Report No. D88 2011



Canada

Growing Forward

Manitoba

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Additional Poster-Sized Maps Included with Report:

1:20,000 Soil Series Maps for each Township (13 maps)

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Township 10 Range 5E	Township 11 Range 5E	Township 12 Range 5E
Township 10 Range 6E	Township 11 Range 6E	Township 12 Range 6E
Township 10 Range 7E	Township 11 Range 7E	
Township 10 Range 8E	Township 11 Range 8E	

The following maps use the original 1:20,000 data, but are printed at 1:50,000:

- Dryland Agricultural Capability Map
- Soil Drainage Map
- Surface Soil Texture Map

Part 1 General Description of the Study Area

1.1 Location and Extent

The Municipality of Springfield covers an area of approximately 11.5 townships or 110,351 hectares (272,683 acres) extending east from the City of Winnipeg (Map 1). The municipality is comprised of 9 townships (Township 10 and 11 Range. 5, 6, 7 and 8E; and Township 12, Range 6E) and parts of 4 other townships (Township 10, 11 and 12 Range 4E and Township 12 Range 5E).

This report contains soil resource information and maps at a scale of 1:20,000 for an area formerly covered in the reconnaissance survey (1:126,720) of the Winnipeg and Morris Map Sheet Areas, Report No. 5 (Ehrlich et al., 1953).

1.2 Soils

Soil materials are dominantly deep, lacustrine clay sediments with areas of thin, sandy to loam textured lacustrine veneers over stony, extremely calcareous glacial. Extremely calcareous, stony glacial till and local areas of gravelly sand outwash and beach deposits are also present. Extensive organic deposits are located towards the eastern part of the municipality.

Soils classified as Humic Gleysols and Black Chernozems are predominant with a small portion of soils classified as Fen and Forest peat and as Brunisols, Luvisols and Regosols

The relatively flat topography and a predominance of clay soils results in the majority of soils being classified as imperfectly to poorly drained.

Part 2 Methodology

2.1 Mapping and Map Scale

Detailed soil mapping at a 1:20,000 scale (approx. 5 cm equals one km) was completed for the Rural Municipality of Springfield. Soil profiles were examined to a depth of one metre at sites approximately 150 metres apart along traverses that were spaced approximately 0.8 km apart. The initial inspection point in each section was located 50 to 100 metres from a road allowance and approximately 0.4 km from a selected corner of the section. Additional sites along road allowances were also examined to assist in locating soil boundaries. This method of sampling provided approximately 25 to 30 inspection sites per section of land or a soil inspection density of 1 site per 8 to 10 hectares. Occasionally, additional soil inspection traverses or checks occurred where soil complexity necessitated additional field observation.

2.2 Map Units

The information from soil inspection sites forms the basis for delineating soil boundaries on a map. Each geographic area enclosed by these soil boundaries is referred to as a soil polygon. Each soil polygon is named according to the soil series that are present in the polygon.

A soil series is defined as a naturally occurring soil body so that any profile within that vody has a similar number and arrangement of hoirizons whose colour, texture, structure, consistency, reaction and composition are within a narrowly defined range. If a soil has properties that vary slightly from the prescribed range of the series, a soil series variant is established.

A soil polygon can contain up to three named soil series. The collective name or label of a soil polygon is referred to as a map unit.

A map unit represents portions of the soil landscape that have characteristics and properties varying within narrow limits that are determined by the intensity of the survey.

A map unit contains one or more than one soil or non-soil plus a certain proportion of unnamed inclusions. Map units are delineated on the basis of the types and relative proportions of their soils or non-soils, as well as on the basis of external criteria such as slope, stoniness or erosion.

2.3 Simple and Compound Map Units

There are two major types of map units: simple and compound. The difference between a simple and compound map is the proportion and contrast of their components.

A **Simple Map Unit** contains predominantly one soil or non-soil. Its components vary as follows: the predominant component comprises at least 65 percent with up to 35 percent of non-limiting, similar components (components that are alike in most properties and behaviour), or up to 25 percent of non-limiting dissimilar components (components that do not affect management of the map unit but have a significant number of properties that vary from the predominant component), or up to 15 percent of limiting, dissimilar components (components which have many contrasting properties and usually affect management differently).

A **Compound Map Unit** contains predominantly more than one soil or non-soil (or a combination of both). The proportions of the two major components may vary from one considerably exceeding the other to both being approximately equal. Complementary to the definition of a single map unit, the proportions of components vary according to their areal extent and contrasting characteristics as they may affect soil management or use. Major components vary as follows: if other components are similar and non-limiting no single component represents more than 65 percent; or if other components are dissimilar and non-limiting no single component represents 75 percent or more; or if other components are dissimilar and limiting no single component represents 85 percent or more.

For the purpose of describing compound map units, components are considered dominant if they occupy over 40 percent of the unit. They are considered significant between 15-40 percent and minor if they occupy less than 15 percent. Minor components are described only if they are highly contrasting.

2.4 Phases

It is often desirable to indicate a condition or quality of soil property or landscape feature that deviates significantly from the normal definition of map units using a map unit symbol. These variations or phases of soil properties and landscape features, varying from delineation to delineation, significantly affect soil behaviour and land management or use.

Soil properties that are commonly used as phase criteria include texture, depth, surface peat, salinity and physical disruption. Properties of land that are used include slope, wind and water erosion, stoniness, rockiness and altered drainage.

The four properties are erosion, slope class, degree of stoniness and salinity. The degree or magnitude of each is designated in Table 1.

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 normal or unaffected soil series is used alone without modifiers (example in Table 1).

If one or more phase features are recognized, 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 salinity. If a particular feature is not observed to be significant, a x is used in its appropriate designated location in the map symbol (Table 1).

An example of a compound unit is as follows: 70 percent consists of Fairland (FND^{7}) series having no erosion (x), very gently sloping topography (c), no stones at the surface (x), no salinity (x), and 30 percent Glenboro (GBO^{3}) series having no erosion (x), very gently sloping topography (c), no stones (x) and no (x) salinity (Table 1).

2.5 Sampling

Selected surface and subsurface soil samples were analyzed for texture, pH, organic matter, salinity and calcium carbonate content.

Map 1. Location of Study Area

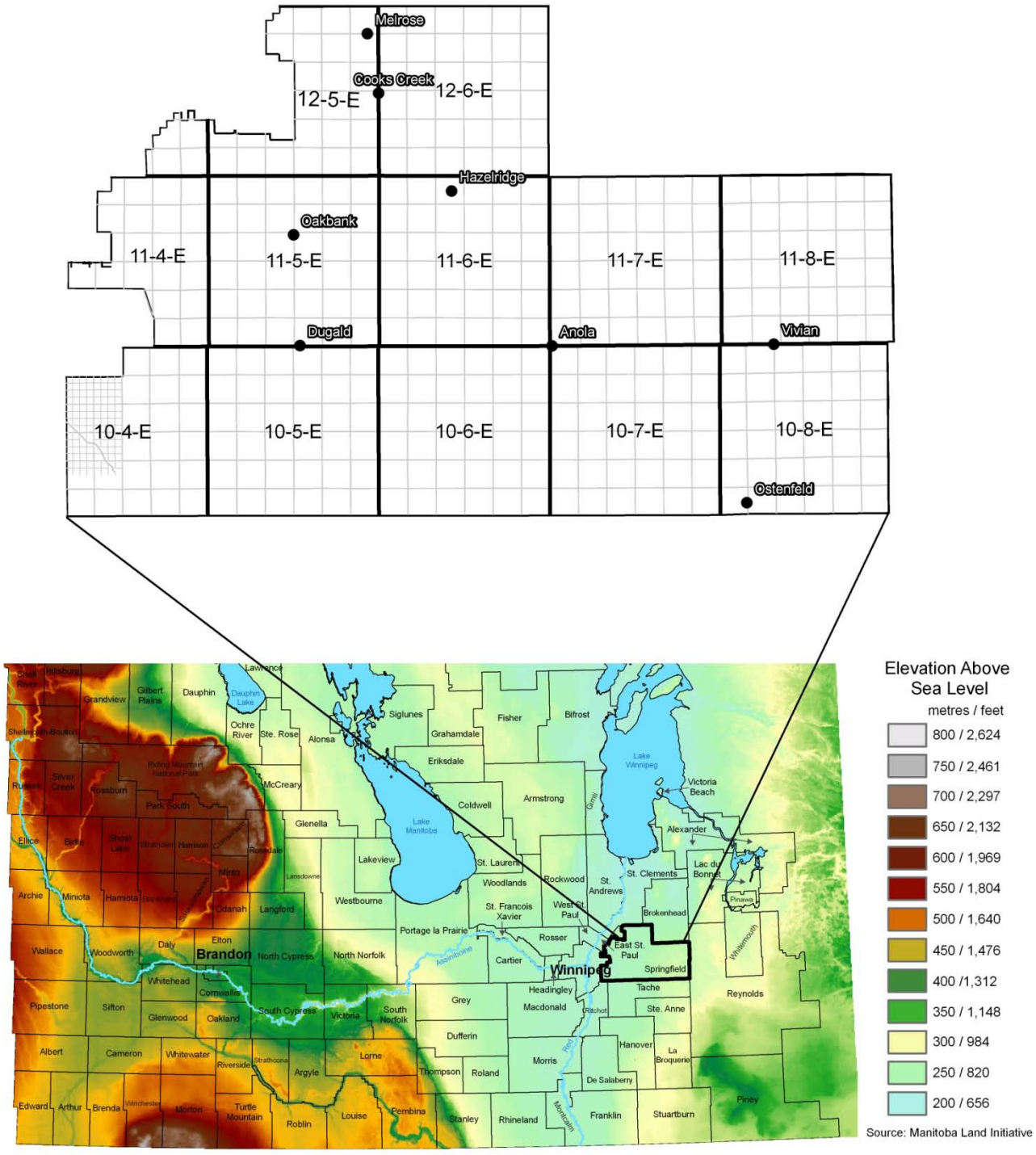
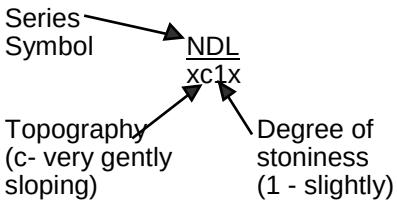
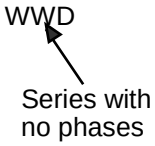


Table 1. Map Unit Symbol

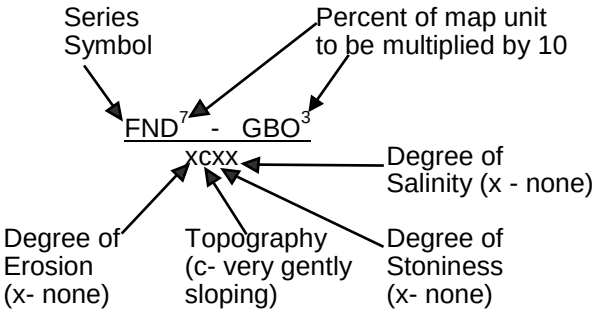
Soil series maps contain labels similar to those shown below. A description of each kind of labels is indicated below.

Simple Map Units





Compound Map Units



Variant Symbols

p	peaty
d	drained
1	texture
v	very poorly drained

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

Phases

Degree of Erosion

x	non-eroded or minimal
1	slightly eroded
2	moderately eroded
3	severely eroded
o	overblown/overwash

Degree of Stoniness

		(Surface covered)
x	non-stony	< .01 %
1	slightly stony	.01 - .1 %
2	moderately stony	>.1 - 3 %
3	very stony	>3 - 15 %
4	exceedingly stony	>15 - 50 %
5	excessively stony	> 50 %

Topography (Slope Class)

x	0 - .5 %	level to nearly level
b	>.5 – 2 %	nearly level
c	>2 – 5 %	very gently sloping
d	>5 – 9 %	gently sloping
e	>9 – 15 %	moderately sloping
f	>15 - 30 %	strongly sloping
g	>30 - 45 %	very strongly sloping
h	>45 - 70 %	extremely sloping

Degree of Salinity

		Cond. (mS/cm)
x	non-saline	0 - 4
s	weakly saline	>4 - 8
t	moderately saline	>8 - 16
u	strongly saline	> 16

Part 3 Development and Classification

3.1 Introduction

This section of the report describes the main characteristics of the soils and their relationship to the factors of soil development.

3.2 Classification

Soils in the study area are classified according to the System of Soil Classification for Canada. This system is hierarchical employing 5 levels of generalization or categories of classification. Beginning with the most generalized, these categories are the order, great group, subgroup, family and series. The classification is based on measurable soil properties that can be observed in the field, or can be inferred from other properties observable in the field. The properties selected as criteria for the higher categories are the result of soil genesis or of factors that affect soil genesis. Properties utilized to differentiate soils at the lower levels of family and series affect management. The five levels of generalization are defined as follows:

Order - Soil orders are defined on the basis of soil properties that reflect the soil environment and the kind and degree of dominant soil forming process. An example is a Chernozem in which soils with dark coloured surface horizons develop under sub-humid climate and dominantly grassland environments.

Great Group - Each order is subdivided into great groups based on differences in the strength of dominant processes or a major contribution of a process in addition to a dominant one. Such processes result in particular kinds, arrangements and degrees of expressions of pedogenic horizons. An example is a Luvic Gleysol in which the dominant process is considered to be gleying but clay accumulation in the B-horizon is also a major process.

Subgroup - Subgroups are subdivisions of great groups and are defined according to the kind and arrangement of horizons that indicate the central concept of the great group eg. Orthic, intergrades toward soils in other orders, ex. Gleyed or special features such as lime carbonate in B-horizons.

Family - Families are established within a subgroup based on the similarity of physical and chemical properties that affect management. The properties that are considered important for recognizing families are particle size distribution, mineralogy, soil climate, soil reaction and thickness of solum.

Series - The series consists of soils that form in a particular kind of material and have horizons with color, texture, structure, consistence, thickness, reaction and chemical composition that are similar in differentiating characteristics and in their arrangement in the soil profile.

The classification of soils in the study area in relation to parent material, texture and drainage is shown in Tables 2 and 3.

Table 2. Soils of the Study Area

Soil Symbol	Soil Name	Soil Drainage	Surface Texture	Textural Group of Soil Profile	Total ac	Total ha	% of RM
AND	Aneda	Well	Loam	Medium to Moderately Fine	4,548	1,841	1.67
ASZ	Agassiz	Rapid	Loamy sand	Very Coarse	99	40	0.04
BLO	Berlo	Imperfect	Loamy fine sand	Coarse	183	74	0.07
BVR	Beaverdam Lake	Imperfect	Loamy sand	Very Coarse over Medium to Mod. Fine	9,175	3,713	3.36
BYD	Berry Island	Poor	Loamy sand	Very Coarse over Medium to Mod. Fine	2,390	967	0.88
CAY	Cayer	Very Poor	Mesic fen peat	Organic over Fine to Very Fine	7,747	3,135	2.84
CBY	Colby	Imperfect	Loamy fine sand	Coarse over Medium to Mod. Fine	1,622	656	0.59
CIO	Caliento	Imperfect	Loamy fine sand	Coarse over Medium to Mod. Fine	116	47	0.04
CKG	Clarkleigh	Poor	Clay loam	Medium to Moderately Fine	50	20	0.02
CRN	Crane	Very Poor	Mesic fen peat	Organic over Medium to Moderately Fine	203	82	0.07
DCS	Dencross	Imperfect	Clay	Fine to very Fine over Medium	4,834	1,956	1.77
DMR	Delmar	Poor	Loam	Mod. Coarse to Medium over Fine to V. Fine	951	385	0.35
DVD	Davidson	Well	Fine sand	Coarse	107	43	0.04
FHT	Fisherton	Imperfect	Clay loam	Moderately Fine over Medium to Mod. Fine	8	3	<0.01
FIH	Fisher	Imperfect	Silty clay loam	Medium to Moderately Fine	722	292	0.26
FMS	Framnes	Imperfect	Clay	Fine to very Fine over Medium	17	7	0.01
FTE	Fortier	Imperfect	Clay	Fine to Very Fine	31	13	0.01
FYL	Fyala	Poor	Clay	Fine to Very Fine	1,084	439	0.40
GDT	Grindstone	Very Poor	Mesic forest peat	Organic over Medium to Moderately Fine	445	180	0.16
GEW	Greenwald	Imperfect	Loamy fine sand	Mod. Coarse to Medium over Fine to V. Fine	1,387	561	0.51
GFS	Glenfields	Poor	Clay loam	Moderately Fine	237	96	0.09
GHP	Glenhope	Imperfect	Very fine sandy loam	Mod. Coarse to Medium over Medium to Mod. Fine	32	13	0.01
GNL	Glenella	Imperfect	Loamy fine sand	Mod. Coarse to Medium over Fine to V. Fine	1,901	769	0.70
GOO	Glenmoor	Poor	Clay	Fine to very Fine over Medium	545	221	0.20
GRH	Garrioch	Imperfect	Loamy sand	Very Coarse over Medium to Mod. Fine	300	121	0.11
GSI	Grossil	Well	Clay	Medium to Moderately Fine	252	102	0.09
GSO	Garson	Well	Loam	Medium to Moderately Fine	681	276	0.25
GUO	Gunton	Well	Loamy sand	Very Coarse over Medium to Mod. Fine	4,889	1,978	1.79
HDG	Hodgson	Well	Silty clay loam	Medium to Moderately Fine	64	26	0.02
HDN	Hoddinott	Imperfect	Clay	Fine to very Fine over Medium	79	32	0.03
ISF	Isafold	Well	Loam	Medium to Moderately Fine	498	202	0.18
IWO	Inwood	Imperfect	Loam	Medium to Moderately Fine	16,681	6,751	6.12
KIC	Kircro	Very Poor	Mesic fen peat	Organic over Coarse	1,234	499	0.45
KLI	Kline	Poor	Clay	Medium to Moderately Fine	10,243	4,145	3.76
KRW	Kergwenan	Imperfect	Loamy sand	Very Coarse	1,441	583	0.53
KRY	Kerry	Poor	Fine sand, Loamy sand	Coarse	350	142	0.13
LBU	Libau	Well	Clay	Medium to Moderately Fine	1,360	550	0.50
LKD	Lakeland	Imperfect	Clay loam	Moderately Fine	297	120	0.11
LRY	Leary	Rapid	Loamy sand	Very Coarse	7,560	3,059	2.77
LSD	Lonesand	Imperfect	Loamy fine sand	Coarse	362	147	0.13
LSW	Lenswood	Imperfect	Loamy fine sand	Coarse	384	155	0.14
LUR	Lundar	Imperfect	Loam	Medium to Moderately Fine	1,754	710	0.64
LWY	Ledwyn	Imperfect	Clay loam	Moderately Fine	62	25	0.02
LYI	Lydiatt	Poor	Fine sandy loam	Mod. Coarse over Fine over Mod. Fine	313	127	0.11
LYW	Ladywood	Imperfect	Very fine sandy loam	Moderately Coarse to Medium	141	57	0.05

Table 2. Soils of the Study Area (cont'd)

Soil Symbol	Soil Name	Soil Drainage	Surface Texture	Textural Group of Soil Profile	Total ac	Total ha	% of RM
MCR	McCreary	Imperfect	Clay loam	Moderately Fine over Medium to Mod. Fine	903	366	0.33
MEB	Meleb	Poor	Clay loam	Medium to Moderately Fine	4,211	1,704	1.54
MGT	Magnet	Poor	Clay loam	Moderately Fine over Medium to Mod. Fine	99	40	0.04
MNT	Malonton	Poor	Fine sand, Loamy sand	Coarse	2,079	841	0.76
MRQ	Marquette	Imperfect	Clay	Medium to Moderately Fine	22,731	9,199	8.34
MRS	Morris	Imperfect	Clay	Fine to Very Fine	128	52	0.05
MYT	Myrtle	Well	Clay	Fine to Very Fine	139	56	0.05
NIV	Niverville	Imperfect	Clay loam	Medium to Moderately Fine over Fine	2,109	854	0.77
NUS	Nourse	Imperfect	Fine sandy loam	Mod. Coarse over Fine over Mod. Fine	697	282	0.26
OBO	Osborne	Poor	Clay	Fine to Very Fine	71,143	28,791	26.09
OKO	Okno	Very Poor	Mesic forest peat	Organic over Fine to Very Fine	4074	1,649	1.49
PGU	Peguis	Imperfect	Clay	Medium to Moderately Fine	2121	859	0.78
PLN	Pelan	Imperfect	Loamy fine sand	Coarse over Medium to Mod. Fine	2395	969	0.88
PMG	Plum Ridge	Imperfect	Very fine sandy loam	Moderately Coarse to Medium	464	188	0.17
PPL	Poppleton	Imperfect	Loamy fine sand	Coarse	937	379	0.34
PRG	Pine Ridge	Well	Fine sand	Coarse	2,202	891	0.81
RIV	Red River	Imperfect	Clay	Fine to Very Fine	38,588	15,616	14.15
RLL	Rochelle	Poor	Silty clay loam	Medium to Moderately Fine	134	54	0.05
RTV	Rat River	Very Poor	Mesic forest peat	Organic over Coarse	4,703	1,903	1.72
SCY	Scanterbury	Imperfect	Clay	Fine to Very Fine	8,067	3,265	2.96
SDI	Sandilands	Well	Fine sand	Coarse	344	139	0.13
SFT	Sifton	Poor	Clay loam	Medium to Moderately Fine over Fine	161	65	0.06
SLB	St. Labre	Well	Loamy fine sand	Coarse over Medium to Mod. Fine	618	250	0.23
SMA	St. Malo	Well	Very fine sandy loam	Mod. Coarse to Medium over Medium to Mod. Fine	181	73	0.07
SOR	St. Norbert	Well	Clay	Fine to Very Fine	256	104	0.09
SPG	Sprague	Poor	Loamy fine sand	Coarse over Medium to Mod. Fine	2,134	864	0.78
STW	Stonewall	Well	Loam	Medium over Bedrock	22	9	0.01
SUW	Sundown	Poor	Loamy sand	Very Coarse	420	170	0.15
WGE	Wintergreen	Imperfect	Loamy fine sand	Coarse	287	116	0.11
WOM	Woodmore	Imperfect	Very fine sandy loam	Mod. Coarse to Medium over Medium to Mod. Fine	139	56	0.05
WRN	Warner	Well	Clay loam	Moderately Fine over Medium to Mod. Fine	66	27	0.02
WTD	Wentland	Poor	Very fine sandy loam	Moderately Coarse to Medium	270	109	0.10
WWB	Willowbend	Poor	Loam	Medium to Moderately Fine	10	4	<0.01
$UL	Unclassified				12,251	4,958	4.49
$UR	Urban				68	27	0.02
$ZZ	Water				148	60	0.05

Table 3. Relationship between Soil Series, Soil Drainage, Mode of Origin, Parent Material and Soil Classification

Mode of Origin	**Till over Limestone Bedrock**	**Fluvial or (Outwash)**	**Fluvial over Till**	**Till**	**Lacustrine over Till**	**Lacustrine over Till**	**Lacustrine over Till**	**Lacustrine over Till**	**Lacustrine over Till**	**Lacustrine & deltaic**
Soil material	**(L, CL) Extremely Calcareous Till over Limestone**	**Sand & Gravel**	**Sand & Gravel over (L, CL) Extremely Calcareous Till**	**(L, CL) Extremely Calcareous Till**	**(FS, LFS) over (L, CL) Extremely Calcareous Till**	**(LVFS, VFSL, L, SiL) over (L, CL) Extremely Calcareous Till**	**(CL, SiCL) over (L, CL) Extremely Calcareous Till**	**(SiC, C, HC) over (L, CL) Extremely Calcareous Till**	**(LVFS, VFSL, L, SiL) over (C) over (L, CL) Extremely Calcareous Till**	**(FS, LFS)**
Soil Classification / Drainage										
Well drained										
Orthic Gray Luvisol				Garson (GSO)	St. Labre (SLB)					
Eluviated Eutric Brunisol										Pine Ridge (PRG)
Eluviated Dystric Brunisol										Sandilands (SDI)
Orthic Dark Gray Chernozem	Stonewall (STW)	Leary (LRY)	Gunton (GUO)	Aneda (AND)		St. Malo (SMA)		Libau (LBU)		Davidson (DVD)
Orthic Black Chernozem		Agassiz (ASZ)								
Calcareous Black Chernozem								Grossil (GSI)		
Rego Black Chernozem				Isafold (ISF)			Warner (WRN)			
Imperfectly drained										
Gleyed Gray Luvisol					Caliento (CIO)					Wintergreen WGE
Gleyed Dark Gray Luvisol										Berlo (BLO)
Gleyed Eluviated Dystric Brunisol										Lonesand (LSD)
Gleyed Dark Gray Chernozem		Kergwenan (KRW)	Beaverdam (BVR)	Inwood (IWO)	Pelan (PLN)	Woodmore (WOM)	Fisherton (FHT)	Peguis (PGU)	Nourse (NUS)	Poppleton (PPL)
Gleyed Rego Black Chernozem			Garrioch (GRH)	Lundar (LUR)	Colby (CBY)	Glenhope (GHP)	McCreary (MCR)	Marquette (MRQ)		Lenswood (LSW)
Poorly drained										
Rego Humic Gleysol (Black zone)		Sundown (SUW)		Clarkleigh (CKG)	Sprague (SPG)		Magnet (MGT)	Kline (KLI)	Lydiatt (LYI)	Malonton (MNT)
Rego Humic Gleysol (Dark Gray zone)			Berry Island (BYD)	Meleb (MEB)						Kerry (KRY)

Table 3. Relationship between Soil Series, Soil Drainage, Mode of Origin, Parent Material and Soil Classification (cont'd)

Mode of Origin	Lacustrine						Alluvial		Shallow (40 to 130 cm) Organic soils over Mineral soil material		
Soil material	**(VFS, LVFS, VFSL, L, SiL)**	**(SCL, CL, SiCL)**	**(SiC, C, HC)**	**(LVFS, VFSL, L, SiL) over (SiC, C, HC)**	**(VFSL, L, CL, SiCL) over (SiC, C, HC)**	**(SiC, C, HC) over (SiL, SiCL)**	**(VFSL, L, SiL, CL, SiCL)**	**(SC, SiC, C, HC)**	**Organic over Clayey Lacustrine**	**Organic over Sandy Lacustrine**	**Organic over Loamy Till**
Soil Classification / Drainage											
Well drained											
Cumulic Regosol							Hodgson (HDG)				
Orthic Dark Gray Chernozem			St. Norbert (SOR)								
Orthic Black Chernozem			Myrtle (MYT)								
Imperfectly drained											
Gleyed Cumulic Regosol							Fisher (FIH)	Fortier (FTE)			
Gleyed Dark Gray Chernozem	Ladywood (LYW)	Ledwyn (LWY)		Greenwald (GEW)		Framnes (FMS)					
Gleyed Black Chernozem			Scanterbury (SCY)			Hoddinott (HDN)					
Gleyed Rego Black Chernozem	Plum Ridge (PMG)	Lakeland (LKD)	Red River (RIV)	Glenella (GNL)	Niverville (NIV)	Dencross (DCS)					
Gleyed Solonetzic Black Chernozem			Morris (MRS)								
Poorly drained											
Rego Humic Gleysol (Black zone)	Wentland (WTD)	Glenfields (GFS)	Osborne (OBO)	Delmar (DMR)	Sifton (SFT)	Glenmoor (GOO)	Willowbend (WWB) Rochelle (RRL)				
Rego Humic Gleysol (Dark Gray zone)			Fyala (FYL)								
Very Poorly drained											
Terric Mesisol (Mesic forest peat)									Okno (OKO)	Rat River (RTV)	Grindstone (GDT)
Terric Mesisol (Mesic fen peat)									Cayer (CAY)	Kircro (KIC)	Crane (CRN)

Part 4 Agricultural Use and Management Interpretations of Soils

4.1 Introduction

These sections provide predictions for the performance or soil suitability ratings for various land uses based on soil and landscape characteristics, laboratory data and on soil behaviour under specified conditions of land use and management. Suitability ratings or interpretations for various land use applications are intended to serve as guides for planners and managers.

The management of soil and landscape data using Geographic Information System (GIS) technology enables rapid and more quantitative analysis of natural soil variability than is possible using manual techniques. The areal distribution of various soil components and properties that occur in complex landscapes can be highlighted in a mapped form and can thereby assist in planning and managing the soil resource. Such maps illustrate the distribution of individual soil properties and indicate the degree of soil limitation or potential for agricultural use and environmental applications.

A series of derived and interpretive maps are included in this section to assist in the interpretation of the soil resource information for the study area. The Geographic Information System uses the 1:20,000 scale soil map and related soil analysis and landscape information to generate these colour thematic maps.

The maps portray a selection of individual soil properties or landscape conditions for map unit delineations. Combinations of soil properties or landscape features affecting land use and management are derived as specific interpretations. Derived maps portray specific interpretations based on the dominant condition in each map polygon.

Soil properties determine to a great extent the potential and limitations for both dryland and irrigation agriculture. In this section, interpretive soil information is provided for agricultural land use evaluations such as:

a) soil capability for agriculture
b) irrigation suitability

A summary of the soil series indicating their interpretive classification for agricultural capability and irrigation suitability is provided in Table 4.

Table 4. Agricultural Capability and Irrigation Suitability Ratings of Soils

Soil Code & Phase	Soil Name	Total ac	Total ha	Percent of RM	Drainage	Surface Texture	Ag. Cap. Class	Irrigation Suitability		
								Class	General Rating	Rating for Irrigated Potatoes
$UL	Unclassified	12,251	4,958	4.49	-		-	- -	-	
$UR	Urban	68	27	0.02	-		-	- -	-	
$ZZ	Water	148	60	0.05	-		-	- -	-	
AND/xc2x	Aneda	264	107	0.10	W	L	3D	3d Bt2	Fair	5
AND/xc3x	Aneda	287	116	0.11	W	L	4DP	3d Bt2p	Fair	5
AND/xcxx	Aneda	82	33	0.03	W	L	3D	3d Bt2	Fair	4
AND/xx2x	Aneda	3,153	1,276	1.16	W	L	3D	3d A	Fair	5
AND/xx3x	Aneda	376	152	0.14	W	L	4DP	3d Bp	Fair	5
AND/xxxx	Aneda	0	0	0.00	W	L	3D	3d A	Fair	4
ASZ/xc1x	Agassiz	99	40	0.04	W	LS	5M	4m Bt2	Poor	5
BLO/xxxx	Berlo	183	74	0.07	I	FS	3MW	2w A	Good	3
BVR/xc2x	Beaverdam Lake	9	4	<0.01	I	LS	4M	3mxBt2	Fair	5
BVR/xc3x	Beaverdam Lake	86	35	0.03	I	LS	4M	3mxBt2p	Fair	5
BVR/xx4x	Beaverdam Lake	14	6	0.01	I	LS	5P	3mxCp	Fair	5
BVR/xxxx	Beaverdam Lake	9,608	3,888	3.52	I	LS	4M	3mxA	Fair	5
BYD/xxxx	Berry Island	2,270	919	0.83	P	FSL	5W	4w A	Poor	5
BYDp/xxxx	Berry Island, peaty	384	156	0.14	VP	Mesic	6W	4w A	Poor	5
CAY/xxxx	Cayer	7,747	3,135	2.84	VP	Mesic	O-3W	0 A	Organic	5
CBY/xxxx	Colby	1,570	635	0.58	I	LFS	2M	3w A	Fair	4
CIO/xxxx	Caliento	175	71	0.06	I	FS	2M	3w A	Fair	4
CKG/xxxx	Clarkleigh	60	24	0.02	P	CL	5W	4w A	Poor	5
CRN/xxxx	Crane	203	82	0.07	VP	Mesic	O-5WD	0 A	Organic	5
DCS/xbxx	Dencross	899	364	0.33	I	C	2W	4k A	Poor	5
DCS/xxxx	Dencross	5,961	2,412	2.19	I	C	2W	4k A	Poor	5
DMR/xxxx	Delmar	1,017	412	0.37	P	FSL	5W	4w A	Poor	5
DVD/xc1x	Davidson	61	25	0.02	W	LFS	3M	2m Bt2	Good	4
DVD/xxxx	Davidson	39	16	0.01	W	LFS	3M	2m A	Good	2
FHT/xxxx	Fisherton	8	3	<0.01	I	CL	2W	3w A	Fair	4
FIH/xxxx	Fisher	716	290	0.26	I	SICL	3I	3w Bi	Fair	3
FMS/xxxx	Framnes	17	7	0.01	I	C	2W	4kxA	Poor	5
FTE/xxxx	Fortier	31	13	0.01	I	SIC	2W	3wxBi	Fair	5
FYLp/xxxx	Fyala, peaty	1,084	439	0.40	VP	Mesic	6W	4kwA	Poor	5
GDT/xxxx	Grindstone	445	180	0.16	VP	Mesic	O-6WD	0 A	Organic	5
GEW/xxxx	Greenwald	1,387	561	0.51	I	FSL	2W	3wxA	Fair	4
GFS/xxxs	Glenfields	3	1	<0.01	P	SICL	5W	4w A	Poor	5
GFS/xxxx	Glenfields	234	95	0.09	P	SICL	5W	4w A	Poor	5
GHP/xxxx	Glenhope	32	13	0.01	I	FSL	2M	3w A	Fair	4
GNL/xxxx	Glenella	1,836	743	0.67	I	FSL	2W	3wxA	Fair	4
GOOd/xxxx	Glenmoor, drained	911	369	0.33	P	C	3W	4kwA	Poor	5
GRH/xx2x	Garrioch	106	43	0.04	I	LS	4M	3mxA	Fair	5
GRH/xxxx	Garrioch	194	79	0.07	I	LS	4M	3mxA	Fair	5
GSI/xx1x	Grossil	16	6	0.01	W	C	2D	3k A	Fair	5
GSI1/xx2x	Grossil, clay till substrate var.	100	40	0.04	W	C	2DP	4kxA	Poor	5

Table 4. Agricultural Capability and Irrigation Suitability Ratings of Soils (cont'd)

Soil Code & Phase	Soil Name	Total ac	Total ha	Percent of RM	Drainage	Surface Texture	Ag. Cap. Class	Irrigation Suitability		
								Class	General Rating	Rating for Irrigated Potatoes
GSI1/xxxx	Grossil, clay till substrate var.	70	28	0.03	W	C	2D	4kxA	Poor	5
GSO/xx2x	Garson	555	225	0.20	W	L	3D	3d A	Fair	5
GUO/xc2x	Gunton	94	38	0.03	W	LS	5M	4m Bt2	Poor	5
GUO/xc3x	Gunton	28	12	0.01	W	LS	5M	4mBt2p	Poor	5
GUO/xcxx	Gunton	538	218	0.20	W	LS	5M	4m Bt2	Poor	5
GUO/xx2x	Gunton	139	56	0.05	W	LS	5M	4m A	Poor	5
GUO/xxxx	Gunton	4,192	1,697	1.54	W	LS	5M	4m A	Poor	5
HDG/xxxx	Hodgson	67	27	0.02	W	SIL	2I	2k A	Good	2
HDN/xxxx	Hoddinott	247	100	0.09	I	C	2W	4k A	Poor	5
ISF/xx2x	Isafold	246	100	0.09	W	L	3D	3d A	Fair	5
ISF/xx3x	Isafold	236	96	0.09	W	L	4DP	3d Bp	Fair	5
IWO/xb2x	Inwood	159	64	0.06	I	L	3D	3dwA	Fair	5
IWO/xc2x	Inwood	20	8	0.01	I	L	3D	3dwBt2	Fair	5
IWO/xc3x	Inwood	28	11	0.01	I	L	4DP	3dwBt2p	Fair	5
IWO/xx1x	Inwood	108	44	0.04	I	L	3D	3dwA	Fair	4
IWO/xx2x	Inwood	12,788	5,175	4.69	I	L	3D	3dwA	Fair	5
IWO/xx3x	Inwood	1,021	413	0.37	I	L	4DP	3dwBp	Fair	5
IWO/xxxx	Inwood	526	213	0.19	I	L	3D	3dwA	Fair	4
KIC/xxxx	Kircro	1,349	546	0.49	VP	Mesic	O-3W	0 A	Organic	5
KLI/xb2x	Kline	250	101	0.09	P	C	5W	4kwA	Poor	5
KLI/xx1x	Kline	15	6	0.01	P	C	5W	4kwA	Poor	5
KLI/xx2x	Kline	69	28	0.03	P	C	5W	4kwA	Poor	5
KLI/xxxs	Kline	82	33	0.03	P	C	5W	4kwA	Poor	5
KLI/xxxx	Kline	1,831	741	0.67	P	C	5W	4kwA	Poor	5
KLI1/xxxs	Kline, clay till substrate var.	24	10	0.01	P	C	5W	4kwA	Poor	5
KLI1/xxxx	Kline, clay till substrate var.	96	39	0.04	P	C	5W	4kwA	Poor	5
KLI1d/xxxs	Kline, clay till substrate variant, drained	29	12	0.01	P	C	3NW	4kwA	Poor	5
KLI1d/xxxx	Kline, clay till substrate variant, drained	746	302	0.27	P	C	3W	4kwA	Poor	5
KLId/xx2x	Kline, drained	62	25	0.02	P	C	3W	4kwA	Poor	5
KLId/xxxs	Kline, drained	70	28	0.03	P	C	3NW	4kwA	Poor	5
KLId/xxxx	Kline, drained	6,217	2,516	2.28	P	C	3W	4kwA	Poor	5
KLIp/xxxx	Kline, peaty	1,492	604	0.55	VP	Mesic	6W	4kwA	Poor	5
KRW/xxxx	Kergwenan	1,151	466	0.42	I	FSL	4M	4m A	Poor	5
KRY/xxxx	Kerry	350	142	0.13	P	FS	5W	4w A	Poor	5
LBU/xc3x	Libau	7	3	<0.01	W	C	3P	3k Bt2p	Fair	5
LBU/xx2x	Libau	199	80	0.07	W	C	2DP	3k A	Fair	5
LBU/xx3x	Libau	69	28	0.03	W	C	3P	3k Bp	Fair	5
LBU/xxxx	Libau	554	224	0.20	W	C	2D	3k A	Fair	5
LBU1/xx1x	Libau, clay till substrate var.	160	65	0.06	W	C	2D	4kxA	Poor	5
LBU1/xx2x	Libau, clay till substrate var.	118	48	0.04	W	C	2DP	4kxA	Poor	5

Table 4. Agricultural Capability and Irrigation Suitability Ratings of Soils (cont'd)

Soil Code & Phase	Soil Name	Total ac	Total ha	Percent of RM	Drainage	Surface Texture	Ag. Cap. Class	Irrigation Suitability		
								Class	General Rating	Rating for Irrigated Potatoes
LBU1/xxxx	Libau, clay till substrate var.	414	167	0.15	W	C	2D	4kxA	Poor	5
LKD/xxxx	Lakeland	297	120	0.11	I	CL	2W	3w A	Fair	3
LRY/xc2x	Leary	826	334	0.30	R	LS	5M	4m Bt2	Poor	5
LRY/xc3x	Leary	877	355	0.32	R	LS	5M	4m Bt2p	Poor	5
LRY/xcxx	Leary	4,329	1,752	1.59	R	LS	5M	4m Bt2	Poor	5
LRY/xx3x	Leary	43	17	0.02	R	LS	5M	4m Bp	Poor	5
LRY/xxxx	Leary	908	367	0.33	R	LS	5M	4m A	Poor	5
LSD/xxxx	Lonesand	362	147	0.13	I	FS	4M	2mwA	Good	3
LSW/xxxx	Lenswood	384	155	0.14	I	LFS	3MW	2mwA	Good	3
LUR/xb3x	Lundar	42	17	0.02	I	L	4DP	3dwBp	Fair	5
LUR/xx1x	Lundar	33	13	0.01	I	L	3D	3dwA	Fair	4
LUR/xx2x	Lundar	493	200	0.18	I	L	3D	3dwA	Fair	5
LUR/xx3x	Lundar	194	79	0.07	I	L	4DP	3dwBp	Fair	5
LUR/xx4x	Lundar	51	21	0.02	I	L	5P	3dwCp	Fair	5
LUR/xx5x	Lundar	110	44	0.04	I	L	6P	3dwDp	Poor	5
LUR/xxxx	Lundar	669	271	0.25	I	L	3D	3dwA	Fair	4
LWY/xxxx	Ledwyn	62	25	0.02	I	CL	2W	3w A	Fair	3
LYI/xxxx	Lydiatt	313	127	0.11	P	FSL	5W	4w A	Poor	5
LYW/xxxx	Ladywood	141	57	0.05	I	VFS	2M	2w A	Good	3
MCR/xxxx	McCreary	887	359	0.33	I	CL	2W	3w A	Fair	4
MCR1/xxxx	McCreary, clay till substrate var	23	9	0.01	I	CL	2W	3wxA	Fair	4
MEB/xx5x	Meleb	71	29	0.03	P	L	6P	4wDp	Poor	5
MEB/xxxx	Meleb	5,736	2,321	2.10	P	L	5W	4w A	Poor	5
MEB1/xxxx	Meleb	20	8	0.01	P	L	5W	4w A	Poor	5
MGT/xxxx	Magnet	171	69	0.06	P	CL	5W	4w A	Poor	5
MNT/xxxx	Malonton	1,947	788	0.71	P	LFS	5W	4w A	Poor	5
MRQ/xb2x	Marquette	473	191	0.17	I	C	2WP	4k A	Poor	5
MRQ/xx1x	Marquette	615	249	0.23	I	C	2W	4k A	Poor	5
MRQ/xx2x	Marquette	452	183	0.17	I	C	2WP	4k A	Poor	5
MRQ/xxxx	Marquette	12,538	5,074	4.60	I	C	2W	4k A	Poor	5
MRQ1/xx1x	Marquette, clay till substrate var	981	397	0.36	I	C	2W	4kxA	Poor	5
MRQ1/xxxs	Marquette, clay till substrate var	162	66	0.06	I	C	3N	4kxA	Poor	5
MRQ1/xxxx	Marquette, clay till substrate var	6,669	2,699	2.45	I	C	2W	4kxA	Poor	5
MRS/xxxx	Morris	578	234	0.21	I	C	2DW	4kxA	Poor	5
MYT/xc1x	Myrtle	2	1	<0.01	W	C	2T	4kxBt2	Poor	5
MYT/xxxx	Myrtle	137	55	0.05	W	C	1	4kxA	Poor	5
NIV/xxxx	Niverville	2,109	854	0.77	I	CL	2W	3wxA	Fair	4
NUS/xxxx	Nourse	697	282	0.26	I	FSL	2W	3wxA	Fair	4
OBO/xxxx	Osborne	261	106	0.10	P	C	3W	4kwA	Poor	5
OBOd/xxxs	Osborne, drained	5,239	2,120	1.92	P	C	3NW	4kwA	Poor	5
OBOd/xxxx	Osborne, drained	65,012	26,309	23.84	P	C	3W	4kwA	Poor	5
OBOp/xxxx	Osborne, peaty	911	369	0.33	VP	Mesic	6W	4kwA	Poor	5

Table 4. Agricultural Capability and Irrigation Suitability Ratings of Soils (cont'd)

Soil Code & Phase	Soil Name	Total ac	Total ha	Percent of RM	Drainage	Surface Texture	Ag. Cap. Class	Irrigation Suitability		
								Class	General Rating	Rating for Irrigated Potatoes
OBOpd/xxxx	Osborne, peaty, drained	35	14	0.01	P	Mesic	3W	4kwA	Poor	5
OKO/xxxx	Okno	4,074	1,649	1.49	VP	Fibric	O-4WL	0 A	Organic	5
PGU/xx1x	Peguis	79	32	0.03	I	C	2W	4k A	Poor	5
PGU/xx2x	Peguis	67	27	0.02	I	F	2WP	4k A	Poor	5
PGU/xxxx	Peguis	1,987	804	0.73	I	C	2W	4k A	Poor	5
PGU1/xx1x	Peguis, clay till substrate var.	67	27	0.02	I	F	2W	4kxA	Poor	5
PGU1/xx2x	Peguis, clay till substrate var.	103	42	0.04	I	C	2WP	4kxA	Poor	5
PLN/xx3x	Pelan	94	38	0.03	I	LFS	3P	3x Bp	Fair	5
PLN/xxxx	Pelan	2,246	909	0.82	I	LFS	2M	3x A	Fair	4
PMG/xxxx	Plum Ridge	480	194	0.18	I	VFSL	2M	2w A	Good	3
PPL/xxxx	Poppleton	930	376	0.34	I	LFS	3MW	2mwA	Good	3
PRG/xc2x	Pine Ridge	118	48	0.04	W	FS	5M	3m Bt2	Fair	5
PRG/xc3x	Pine Ridge	333	135	0.12	W	FS	5M	3mBt2p	Fair	5
PRG/xcxx	Pine Ridge	384	155	0.14	W	FS	5M	3m Bt2	Fair	2
PRG/xx2x	Pine Ridge	11	5	<0.01	W	FS	5M	3m A	Fair	5
PRG/xx3x	Pine Ridge	43	17	0.02	W	FS	5M	3mBp	Fair	5
PRG/xxxx	Pine Ridge	1,667	674	0.61	W	FS	5M	3m A	Fair	2
RIV/xbxx	Red River	417	169	0.15	I	C	2W	4kxA	Poor	5
RIV/xxxs	Red River	439	178	0.16	I	C	3N	4kxA	Poor	5
RIV/xxxx	Red River	34,776	14,073	12.75	I	C	2W	4kxA	Poor	5
RLL/xxxx	Rochelle	137	55	0.05	P	L	5IW	4w Ci	Poor	5
RTV/xxxx	Rat River	4,703	1,903	1.72	VP	Mesic	O-4WL	0 A	Organic	5
SCY/xbxx	Scanterbury	41	17	0.02	I	C	2W	4kxA	Poor	5
SCY/xcxx	Scanterbury	5	2	0.00	I	C	2WT	4kxA	Poor	5
SCY/xxxx	Scanterbury	7,642	3,093	2.80	I	C	2W	4kxA	Poor	5
SDI/xxxx	Sandilands	344	139	0.13	W	FS	5M	3m A	Fair	3
SFT/xxxx	Sifton	161	65	0.06	P	CL	5W	4wxA	Poor	5
SLB/xxxx	St. Labre	738	299	0.27	W	FS	3M	2x A	Good	4
SMA/xxxx	St. Malo	181	73	0.07	W	FSL	2X	2x A	Good	4
SOR/xxxx	St. Norbert	256	104	0.09	W	C	2D	4kxA	Poor	5
SPG/xxxx	Sprague	1,743	705	0.64	P	LFS	5W	4w A	Poor	5
SPGp/xxxx	Sprague, peaty	817	331	0.30	VP	Mesic	6W	4w A	Poor	5
STW/xxxx	Stonewall	22	9	0.01	W	L	4R	4r A	Poor	5
SUW/xxxx	Sundown	442	179	0.16	P	LS	5W	4w A	Poor	5
SUWp/xxxx	Sundown, peaty	8	3	0.00	VP	Mesic	6W	4w A	Poor	5
WGE/xxxx	Wintergreen	287	116	0.11	I	FS	4M	2mwA	Good	3
WOM/xx2x	Woodmore	15	6	0.01	I	VFSL	2WP	3wA	Fair	5
WOM/xxxx	Woodmore	70	28	0.03	I	VFSL	2W	3w A	Fair	4
WRN/xxxx	Warner	18	7	0.01	W	CL	2X	2kxA	Good	4
WRN1/xxxx	Warner, clay till substrate var.	49	20	0.02	W	CL	2X	2kxA	Good	4
WTD/xxxx	Wentland	270	109	0.10	P	VFSL	5W	4w A	Poor	5
WWB/xxxx	Willowbend	10	4	<0.01	P	L	5IW	4w Ci	Poor	5

4.2 Soil Capability for Agriculture

The soil capability rating for agriculture is based on an evaluation of both the soil characteristics and landscape conditions that influence the soil suitability and limitations for agricultural use (Anon, 1965) (Table 8 of Appendix 1).

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 agriculture, 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. A description of the capability classes is provided in Table 9 of Appendix 1.

Soil capability subclasses identify the soil properties or landscape conditions that may limit use or be a hazard. The various kinds of limitations recognized at the subclass level are defined in Table 10 of Appendix 1.

Class 1 soils in the map area have level to very gently sloping topography, are deep and well to moderately well drained with no major limitations for crop use.

Class 2 soils include the imperfectly drained soils with a wetness limitation (2W) and the well-drained and imperfectly drained soils having a topographic limitation (2T). The 2-5 % slopes associated with the 2T soils may increase cultivation costs over that of a smooth landscape and increase the risk of water erosion.

Class 3 soils have a moderately severe limitation associated with gently sloping topography (5-9 %) resulting in a moderate risk of water erosion.

Class 4 soils are poorly drained with a severe restriction to the growth of crops or choice of crops. The timing of cultivation or choice of crops is severely limited because of the wetness limitation.

Class 5 soils have very severe limitations as a result of excess water (5W). This Class includes the lower, depressional areas of the poorly drained soils.

Class 6 soils have an extremely severe limitation due to excess wetness and/or steep slopes, which restricts cropping to production of perennial forages.

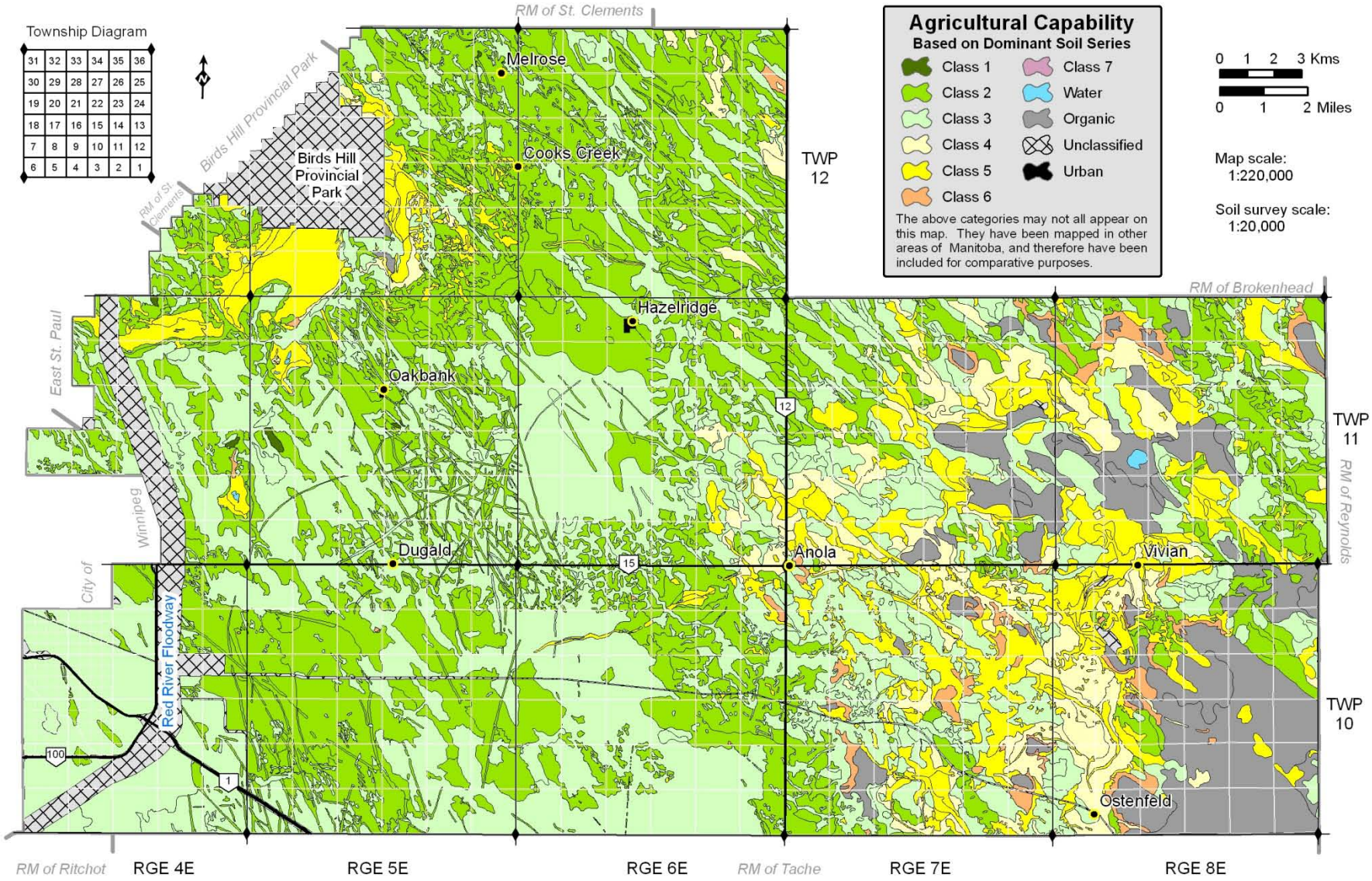
Class 7 soils have no capability for arable culture. However, these soils may have high capability for native vegetation species and habitat for waterfowl and wildlife.

An interpretative map (Map 2) illustrates the agricultural capability rating of the dominant soil series and landscape features for each polygon. The nature of the subclass limitations and the rating of subdominant soil and landscape components are not shown at the scale of this map. Subdominant soil components and the nature of the subclass limitations are indicated in the report (Table 4).

A larger, poster-sized agricultural capability map is included with this report. It contains the original 1:20,000 data but is printed at a scale of 1:50,000 in order to fit on one map sheet.

Agricultural Capability Class	Total ac	Total ha	% of RM
Class 1	137	55	0.05
Class 2	88,846	35,955	32.58
Class 3	101,516	41,082	37.23
Class 4	14,031	5,678	5.15
Class 5	32,289	13,114	11.84
Class 6	4,877	1,974	1.79
Class 7	0	0	0
Organic	18,521	7,448	6.79
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 2. Agricultural Capability



4.3 Irrigation Suitability

The rating guidelines in this section are derived from "An Irrigation Suitability Classification System for the Canadian Prairies" (ISC, 1987). The irrigation suitability rating of the soils is based on soil and landscape characteristics. It does not consider factors such as method of water application, water availability, water quality or economics of this type of land use.

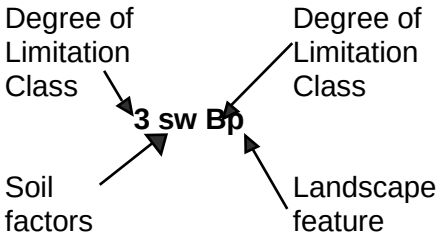
Soil properties considered important for evaluating irrigation suitability are: texture, soil drainage, depth to water table, salinity and geological uniformity. **Landscape features** considered important for rating irrigation suitability are topography and stoniness.

The irrigation suitability of the soil and landscape characteristics in the study area assists in making initial irrigation plans. The next step involves on site field investigation to examine the depth to water table, salinity and geological uniformity to a depth of 3 m. Drainability, drainage outlet requirement, organic matter status and potential for surface crusting are other factors to consider. This assessment also considers potential impact of irrigation on non-irrigated areas as well as on the irrigated area.

The most limiting soil property or landscape features are combined to determine the placement of a land area in one of 16 classes of irrigation suitability which are grouped and described by 4 ratings: **Excellent, Good, Fair** and **Poor** (Table 11 of Appendix 1).

The guidelines are listed in the Appendix 1's Tables 12 and 13, respectively.

An example of an irrigation suitability class rating with subclass limitations is shown:

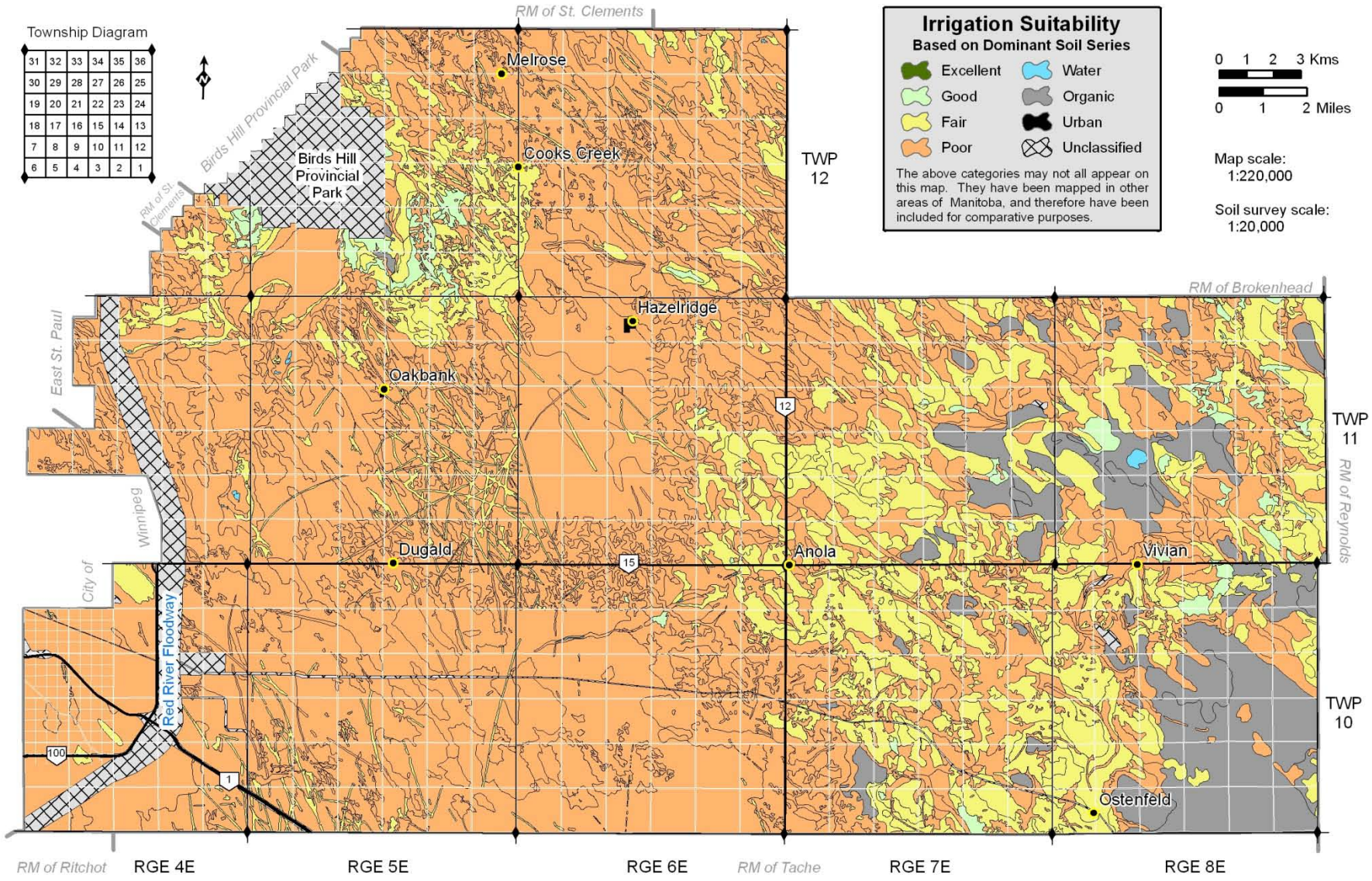


A maximum of 3 codes is used to identify the subclass rating. Salinity (s) and drainage class (w) are soil factors that contribute to the soil rating of 3 or Moderate. The landscape limitation due to stones (p) is Slight or (B). As the soil factor (3 or Moderate) is more limiting than the landscape feature (B or Slight), the general rating for this land area (3B) is Fair (Table 11 of Appendix 1).

Irrigation suitability classes shown on Map 3 are based on the dominant soil for each polygon.

Irrigation Suitability Class	Total ac	Total ha	% of RM
Excellent	0	0	0.00
Good	3871	1,567	1.42
Fair	54,219	21,942	19.88
Poor	183,605	74,303	67.33
Organic	18,521	7,495	6.79
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 3. Irrigation Suitability



4.4 Soil Suitability for Irrigated Potato Production

An evaluation of soil properties and landscape features was used to generate a 5 class rating of land for irrigated potato production. Soil properties considered are: texture, soil drainage, salinity and sodicity. Landscape features that were considered relate to the impact of slope and stoniness. Most suitable soil and landscape conditions occur in **Class 1** and least desirable conditions occur in **Class 5**. Details regarding the criteria applied in the suitability rating are described in Tables 14a and 14b of Appendix 1.

Assumptions:

This evaluation examines soil and landscape factors that are important for irrigated production of potatoes for processing. Production of seed and table potatoes with irrigation may not be impacted to the same degree by soil conditions such as stoniness and texture.

Stoniness hinders soil preparation and interferes with harvesting and increases the chances of potato bruising during harvest.

Deep, well drained sandy loam to loam soils exhibit favorable properties for the production of high quality potatoes. Clay soils with impeded internal soil drainage have a severe limitation to potato production because of reduced oxygen supply and increased incidence of fungal diseases. An increased risk of delayed spring tillage and planting and crop harvesting due to wet conditions can occur on fine textured soils.

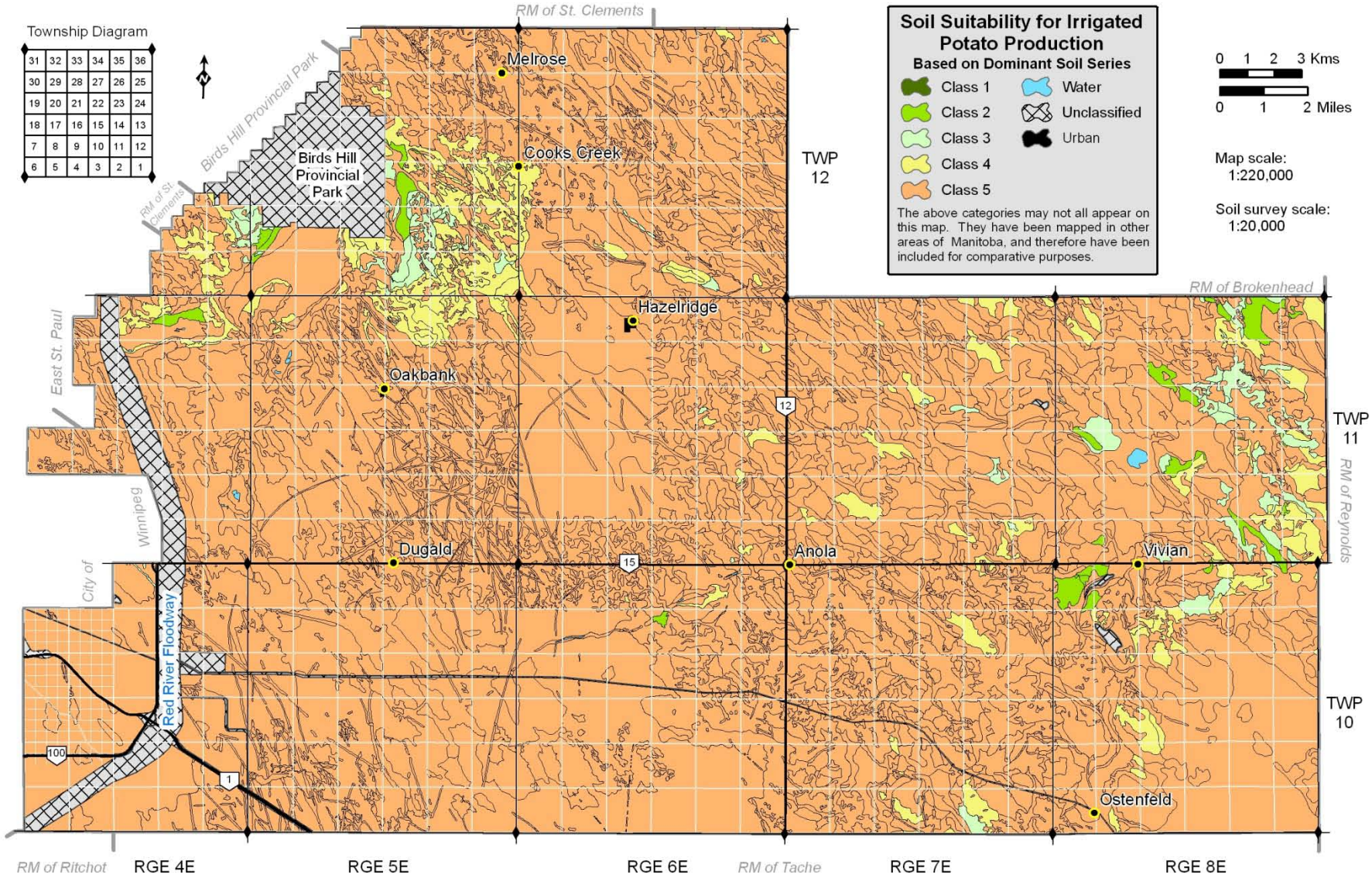
Slope or topography reduces uniform water infiltration and increases the potential for soil erosion and nutrient loss.

This evaluation of soil and landscape properties does not incorporate additional factors that must be assessed for sustainable irrigated production of potatoes. The environmental impact of intensive management practices on soil and water quality; the supply of good quality water, and the suitability of climatic conditions for optimum potato production must all be evaluated.

Soil suitability classes for irrigated potato production are shown on Map 4 and are based on the dominant soil for each polygon.

Irrig. Potato Suitability Class	Total ac	Total ha	% of RM
Class 1	0	0	0
Class 2	2,156	873	0.79
Class 3	4,188	1,695	1.54
Class 4	13,838	5,600	5.07
Class 5	240,034	97,139	88.03
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 4. Soil Suitability for Irrigated Potato Production



4.5 Soil Texture

Mineral particles in soil are grouped according to size into sand (2 - 0.05 mm in diameter), silt (0.05 - 0.002mm) and clay (less than 0.002 mm). The proportion of individual mineral particles present in a soil is referred to as texture. Soil texture is described by means of 13 textural classes defined according to the relative proportions of sand, silt and clay (Figure 1 of Appendix 3). The presence of larger particles (diameter is greater than 2mm) in soil is recognized as:

gravelly - particles ranging from 0.2 to 7.5 cm in diameter

cobbly - rock fragments ranging from 7.5 to 5 cm in diameter

stony - rock fragments ranging from 25 to 60 cm in diameter or if flat 38 to 60 cm long

Soil texture strongly influences the soil's ability to retain moisture, soil fertility and ease or difficulty of cultivation. Water moves easily through coarse-textured (sandy) soils so little moisture is retained and they dry out more quickly than fine textured (clay) soils. As well, sandy soils do not retain plant nutrients as well as clay soils and are lower in natural fertility. Sandy soils often are characterized by loose or single grained structure, which is very susceptible to wind erosion. Clay soils have a high proportion of very small pore spaces which hold moisture tightly and are usually fertile because they are able to retain plant nutrients. Clay soils transmit water very slowly; therefore these soils are susceptible to excess soil moisture conditions.

Textural class names (Table 29 of Appendix 3) are grouped as follows:

Coarse - coarse sand, medium sand, fine sand, loamy coarse sand, loamy sand, loamy fine sand

Moderately Coarse - very fine sand, loamy very fine sand, coarse sandy loam, sandy loam, fine sandy loam

Medium - very fine sandy loam, loam, silt loam, silt

Moderately Fine - sandy clay loam, clay loam, silty clay loam

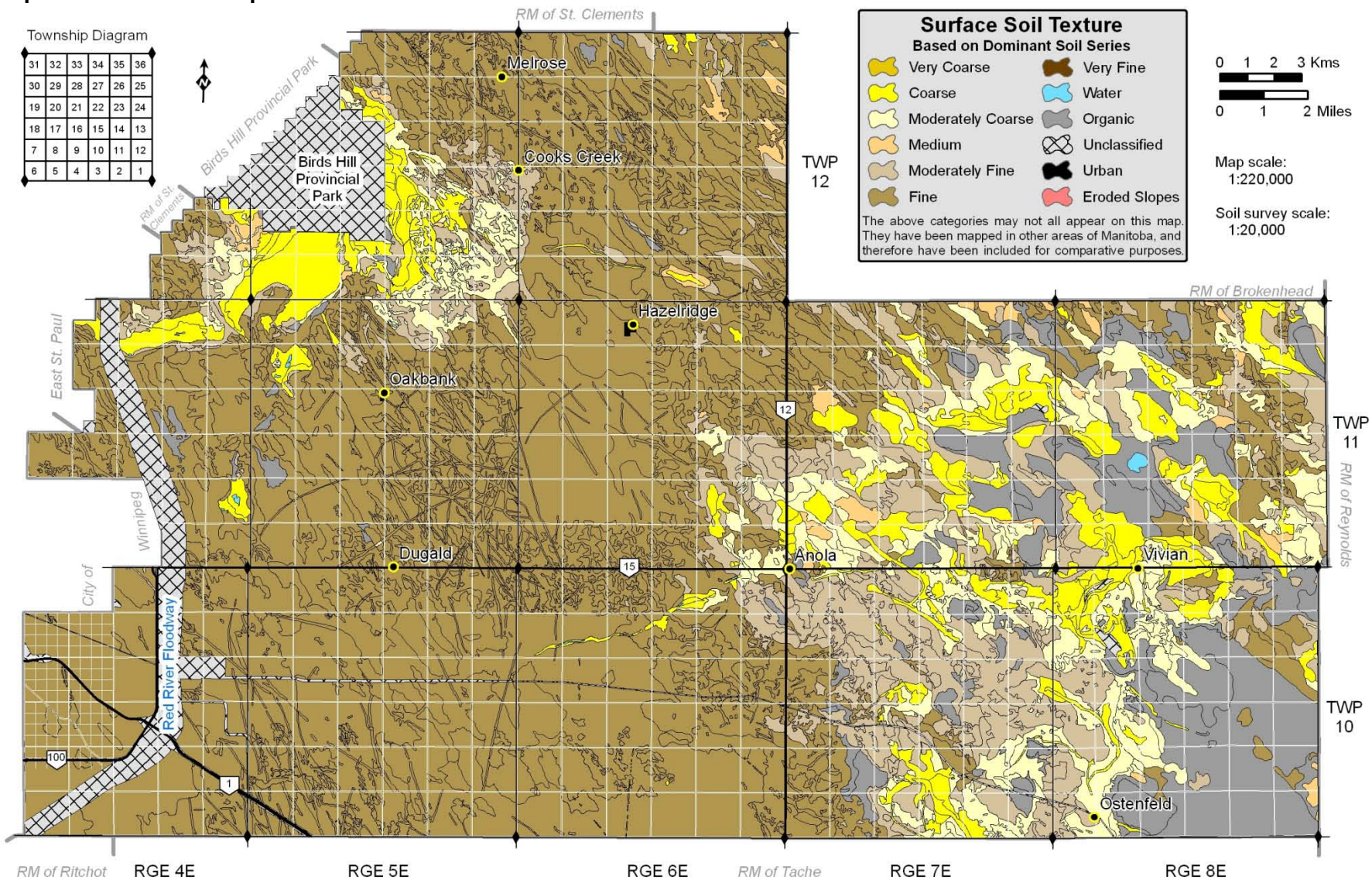
Fine - sandy clay, silty clay, clay, heavy clay (>60%)

Surface soil texture shown in Map 5 illustrates the textural group of the dominant soil for each polygon.

A larger, poster-sized soil texture map is included with this report. It contains the original 1:20,000 data but is printed at a scale of 1:50,000 in order to fit on one map sheet.

Texture Group	Total ac	Total ha	% of RM
Very Coarse	0	0	0.00
Coarse	19,992	8,090	7.33
Moderately Coarse	23,706	9,594	8.69
Medium	2,695	1,091	0.99
Moderately Fine	32,312	13,076	11.85
Fine	158,258	64,045	58.04
Very Fine	0	0	0.00
Organic / Peaty	23,252	9,410	8.53
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 5. Soil Texture Map



4.6 Soil Drainage

Soil drainage refers to the frequency and duration of periods when the soil is free of saturation. Excessive water content in soil limits the free movement of oxygen and decreases the efficiency of nutrient uptake. Delays in spring tillage and planting are more frequent in depressional or imperfectly to poorly drained areas of a field. Improved surface drainage and underground tile drainage are management considerations that can reduce excessive moisture conditions in soils. The majority of poorly drained soils remain in the native state supporting vegetation associated with wet-lands and marsh. Five soil drainage classes are indicated on the map (Map 6).

Rapidly drained - water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow can occur on steep slopes during heavy rainfall. Soils have low water storage capacity and are usually coarse in texture.

Well-drained - excess water is removed from the soil, flowing downward readily into underlying pervious material or laterally as subsurface flow.

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. The source of moisture includes precipitation and/or groundwater.

Poorly drained - water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time when the soil is not frozen. The main water source is subsurface flow and/or groundwater in addition to precipitation.

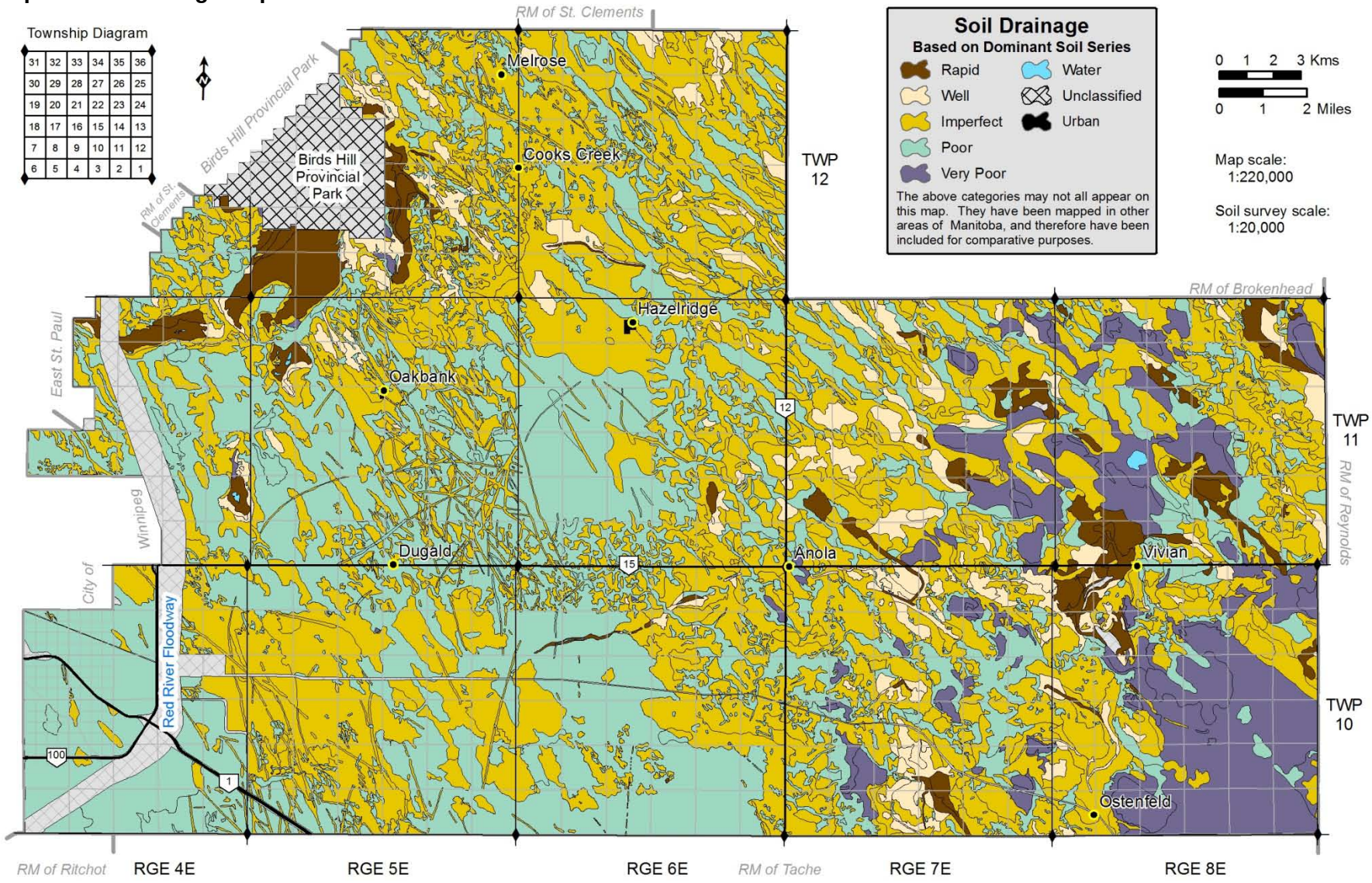
Very poorly drained - water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time that the soil is not frozen. Excess water is present in the soil throughout most of the year.

Soil Drainage classes shown on Map 6 are based on the dominant soil for each polygon.

A larger, poster-sized soil drainage map is included with this report. It contains the original 1:20,000 data but is printed at a scale of 1:50,000 in order to fit on one map sheet.

Drainage Class	Total ac	Total ha	% of RM
Rapid	6,983	2,826	2.56
Well	16,464	6,663	6.04
Imperfect	117,614	47,597	43.13
Poor	95,939	38,825	35.18
Very Poor	23,217	9,396	8.51
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 6 Soil Drainage Map



4.7 Soil Erosion

Erosion is defined as the detachment and movement of soil particles by water, wind, ice or gravity. Soil erosion by water is the main concern on undulating and hummocky soil landscapes in the agricultural region of Manitoba. Soil loss resulting from rainfall-runoff is usually due to combinations of raindrop splash, sheet, and rill, gully and channel bank erosion. Sheet and rill erosion is usually least apparent in the landscape but it is often the most damaging as it causes gradual thinning of the soil profile over the entire slope. Sheet erosion tends to occur on upper slopes and ridges, whereas, the more visible rills form in the area of concentrated runoff on mid and lower slopes. The deposition of eroded soil at the base of slopes or in ditches constitutes additional losses and costs attributed to erosion.

Wind erosion has its largest influence on sandy (coarse) textured, cultivated soils on relatively level landscapes. However, all soils are subject to wind erosion if vegetation or crop residues do not cover the soil surface. Continuous cropping and minimum or zero tillage to maximize residue cover will reduce the risk of erosion. Row crops such as potatoes produce low amounts of residue, therefore, seeding annual crops like fall rye and winter wheat will help to protect the soil surface during the critical post harvest period until the establishment of groundcover the following spring.

The impact of soil erosion on soil loss and lowered productivity is not easily measured. In addition to nutrient loss from soil erosion there is physical deterioration of the soil resulting in lower water holding and infiltration capacity and poorer surface structure. Crops are thus susceptible to more frequent and severe water stress and lower crop yields occur.

The ratings of soil erosion are generally classified into three classes:

Slightly eroded - soil with a sufficient amount of the A horizon removed that ordinary tillage will bring up and mix the B-horizon or lower horizons.

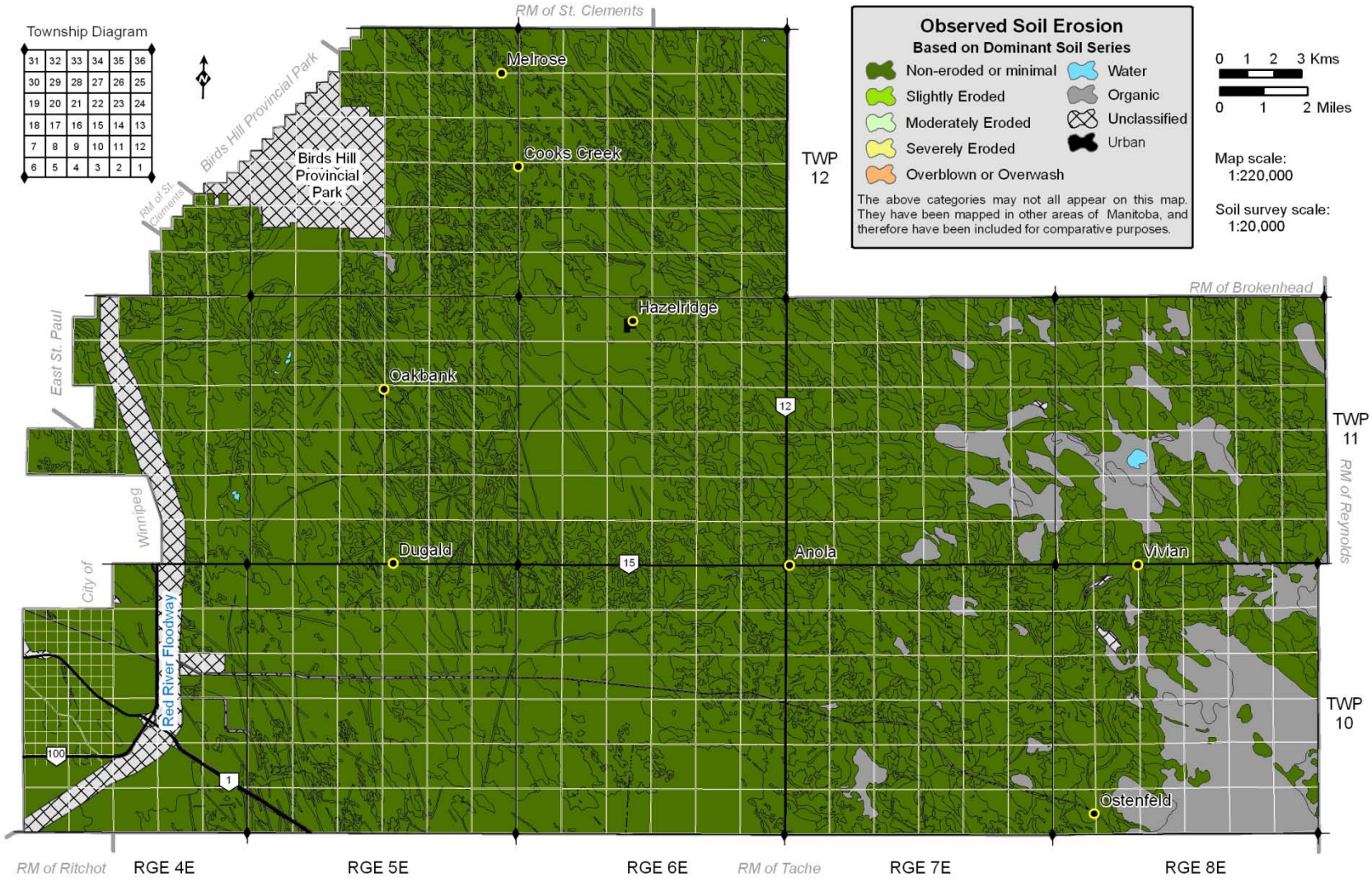
Moderately eroded - soil with the entire A horizon and a part of the B or lower horizons removed.

Severely eroded - soils which have practically all of the original surface soil removed and the tilled layer consists mainly of C-horizon material. This condition occurs on knolls and steep upper slope positions.

Soil erosion classes shown on Map 7 are based on the dominant soil for each polygon.

Observed Erosion Class	Total ac	Total ha	% of RM
Non-eroded or minimal	241,695	97811	88.64
Slightly	0	0	0
Moderately	0	0	0
Severely	0	0	0
Overblown or overwash	0	0	0
Organic	18,521	7,448	6.79
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 7. Degree of Erosion Map



4.8 Topography

Slope describes the steepness of the landscape surface. The degree and length of slope are important topographic factors affecting the potential for surface runoff and infiltration of precipitation.

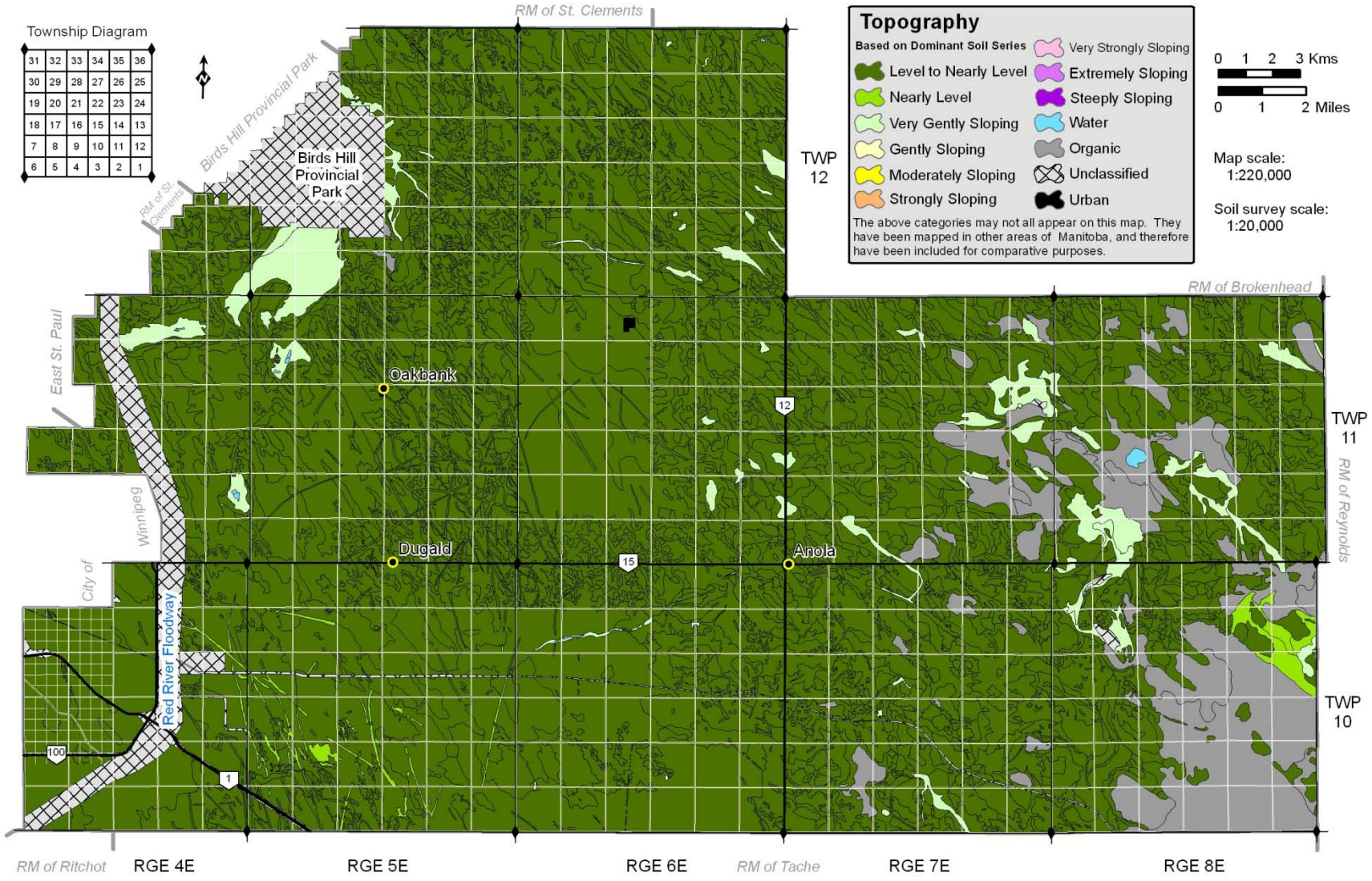
Ten slope classes are used to denote the dominant but not necessarily most severe slopes within a mapping unit.

Slope Class	Slope Description	% Slope
x	Level to nearly level	0-0.5
b	Nearly level	>0.5-2.0
c	Very gently sloping	>2.0-5.0
d	Gently sloping	>5.0-9.0
e	Moderately sloping	>9.0-15.0
f	Strongly sloping	>15.0-30.0
g	Very strongly sloping	>30.0-45.0
h	Extremely sloping	>45.0-70.0
i	Steeply sloping	>70.0-100
j	Very steeply sloping	>100

Topography classes shown on Map 8 are based on the dominant soil for each polygon.

Topography (Slope Class)	Total ac	Total ha	% of RM
Level to nearly level	249,456	100,952	91.48
Nearly level	2,281	923	0.84
Very gently sloping	8,479	3,431	3.11
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 8. Topography Map



4.9 Stoniness

Soils with stones can hinder tillage, planting and harvesting operations. The degree of stoniness is described by 5 classes. Class 1 stoniness is not considered a limitation for soil capability since there is little or no hindrance to cultivation and clearing is generally not required. Although stone clearing can be a mechanized procedure, it presents a management cost that does not occur in non-stony soils.

Size and amount describe rock fragments.

Gravel sized fragments are rounded or angular, 0.2 to 7.5 cm in diameter. **Cobbles** are 7.5 to 25 cm in diameter and **stones** are 25 to 60 cm in diameter or if flat 38 to 60 cm long. The classes of stoniness are defined as follows:

Stones 0 or x. Non-stony - Land having less than 0.01% of surface occupied by stones.

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

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

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

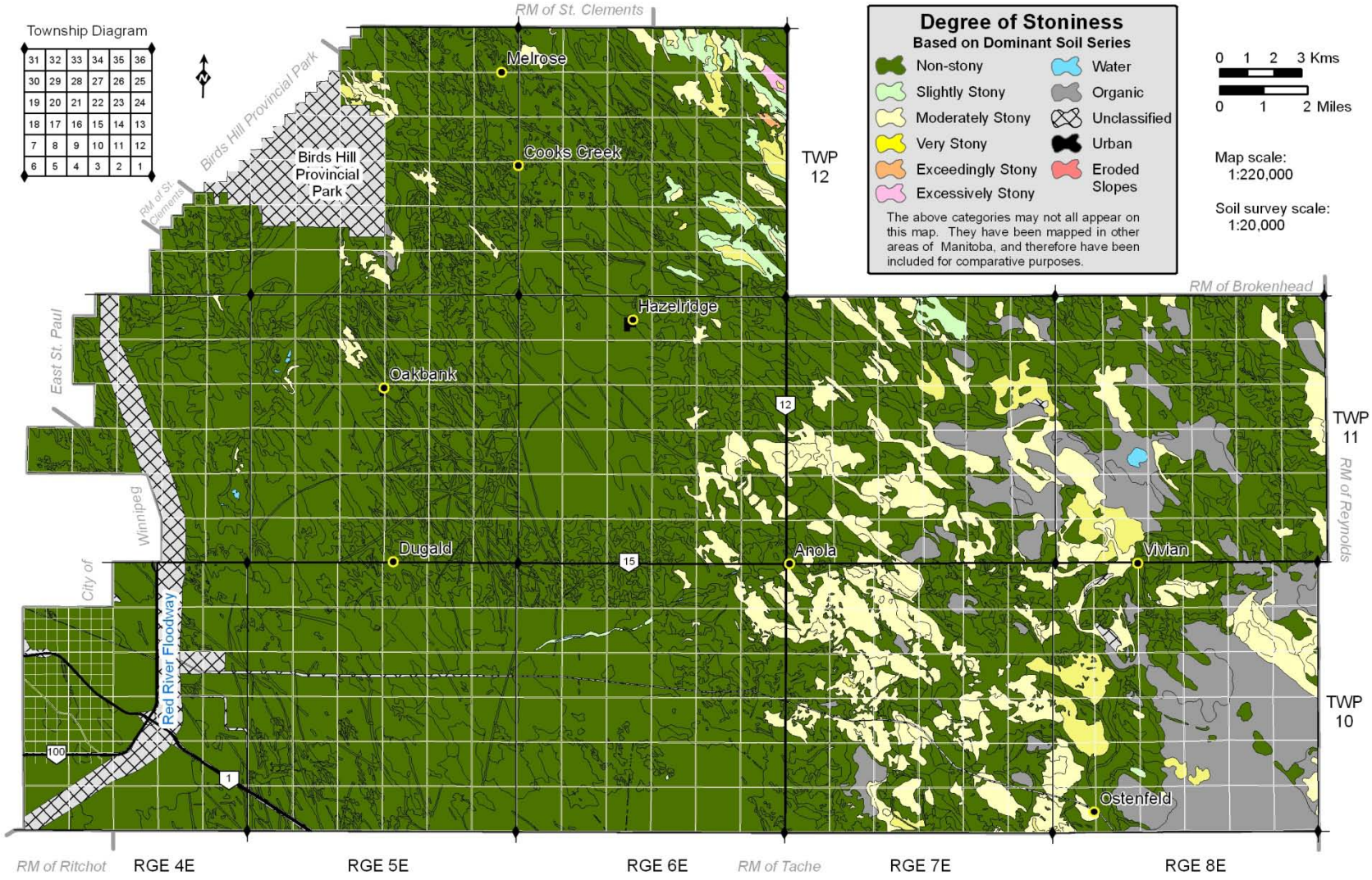
Stones 4. Exceedingly stony - Land having 15 to 50% of surface occupied by stones. Stones are 15 to 30 cm in diameter, 0.7 to 1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

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

The degree of stoniness shown on Map 9 is based on the dominant condition for each polygon.

Degree of Stoniness	Total ac	Total ha	% of RM
Non-stony	233,083	94,326	85.48
Slightly stony	2,235	904	0.82
Moderately stony	20,889	8,453	7.66
Very stony	3,764	1,523	1.38
Exceedingly stony	65	26	0.02
Excessively stony	180	73	0.07
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 9. Degree of Stoniness Map



4.10 Salinity

Saline soils have a high concentration of soluble salts (those which dissolve in water). The salts include sodium sulphate, magnesium sulphate, calcium sulphate, sodium chloride, magnesium chloride, calcium chloride and others.

The primary effect of salts in soils is the deprivation of water to plants. If the soil solution becomes too high in salts, the plants slowly starve, though the supply of water and dissolved nutrients in the soil may be sufficient.

In saline soils, crops usually grow poorly or not at all. At certain times of the year the salts may precipitate out on the surface of the soil leaving a white crust. Generally plants which are affected by soil salinity have a bluish-green appearance. Common field weeds such as Russian Thistle, Kochia, Wild Barley often occur in areas of high salt concentration. In uncultivated areas plants such as Samphire, Desert Salt Grass and Greasewood are frequently dominant species (Henry et al., 1987).

Soil salinity is difficult to manage because it is influenced by soil moisture conditions. In wet years, there is sufficient leaching and dissolving of salts that salts are not visible on the surface and some crop growth may be possible. In dry years, increased evaporation dries out the soil and draws salts up to the soil surface, producing a white crust.

Field instrumentation using a non-contacting terrain conductivity meter (EM-38) can determine whether or not soluble salts are present.

Identification of salt affected areas and the selection of a salt tolerant crop are the most important management practices that farmers have at their disposal.

A saline soil is defined as a soil with an electrical conductivity (EC) of the saturation extract greater than 4 milliSiemens/cm (mS/cm), the exchangeable sodium percentage less than 15, and the pH usually less than 8.5.

Approximate limits of salinity classes are:

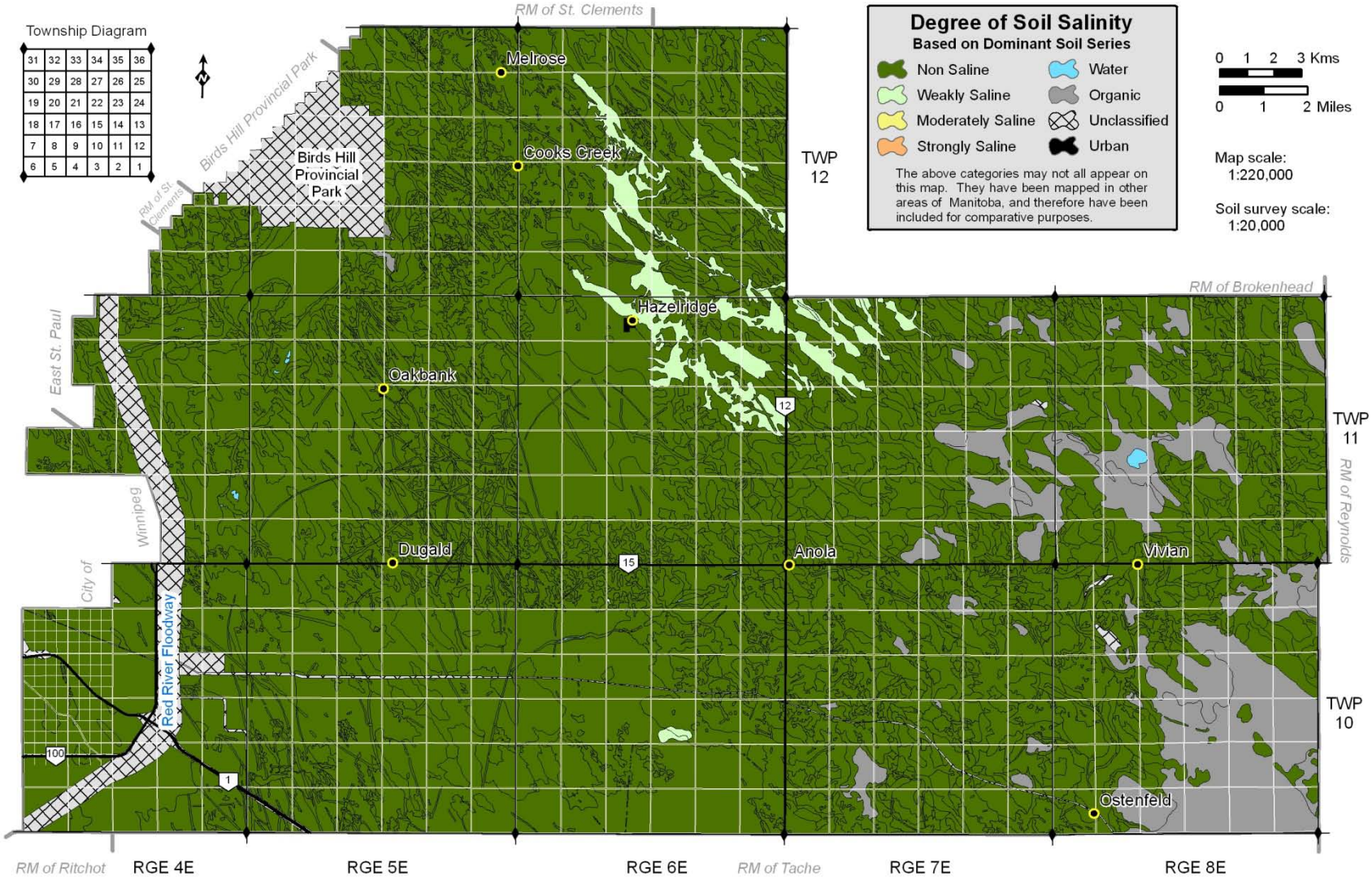
Class	EC mS/cm
Non-saline (x)	0 to 4
Weakly saline (s)	4 to 8
Moderately saline (t)	8 to 16
Strongly saline (u)	> 16

Note: mS/cm is equivalent to dS/m

Salinity classes shown on Map 10 are based on the dominant soil for each polygon.

Salinity Class	Total ac	Total ha	% of RM
Non-saline	254,167	102,858	93.21
Weakly saline	6,049	2,448	2.22
Moderately saline	0	0	0
Strongly saline	0	0	0
Water	148	60	0.05
Unclassified	12,251	4,958	4.49
Urban	68	27	0.02

Map 10. Degree of Salinity Map



Part 5 Soil Suitability for Selected Engineering and Recreational Uses

5.1 Introduction

This section provides information that can be used by engineers and land use planners. It is intended to supplement the information on the soil map with additional data on engineering properties of soils.

5.2 Soil Suitability for Selected Engineering Uses

The criteria used to evaluate soil suitability for selected engineering and related recreational uses are adopted from guides found in Coen et al. (1977), and from guidelines developed by the Soil Conservation Service, United States Department of Agriculture (USDA, 1971), and the Canada Soil Survey Committee (CSSC, 1973).

The evaluation of soil suitability for engineering and recreation uses is based on both internal and external soil characteristics. Four soil suitability classes are used to evaluate both mineral and organic soils. These ratings express relative degrees of suitability or limitation for potential uses of natural or essentially undisturbed soils. The long-term effects of the potential use on the behaviour of the soil are considered in the rating.

The four suitability class ratings are defined as follows:

G) Good - Soils in their present state have few or minor limitations that would affect the proposed use. The limitations can easily be overcome with minimal cost.

(F) Fair - Soils in their present state have one or more moderate limitations that would affect the proposed use. These moderate limitations can be overcome with special construction, design, planning or maintenance.

(P) Poor - Soils in their present state have one or more severe limitations that can severely affect the proposed use. To overcome these severe limitations, the removal of the limitation will be difficult and costly.

(V) Very Poor - Soils have one or more unfavourable features for the proposed use and the limitation is very difficult and expensive to overcome or the soil would require such extreme alteration that the proposed use is economically impractical.

The basic soil properties that affect soil suitability for selected engineering and recreation uses are provided in Table 5. These subclass designations identify the limitation or hazard for a particular use.

In assessing soil suitability for various engineering uses, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed soil properties. For example, if the suitability is "Good" for all but one soil property and it is estimated to be "Very Poor", then the overall rating of the soil for that selected use is "Very Poor". Suitability of individual soil properties, if estimated to be "Fair" or "Poor", can be cumulative in its effect for a particular use. Judgement is required to determine whether the severity of the combined effects of several soil properties on suitability for a particular use will result in downgrading an evaluation. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. For a selected use, therefore, only those soil properties, which most severely limit that use, are specified.

Table 5. Codes used to identify subclass limitations in evaluating soil suitability for selected Engineering uses in Table 6.

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

The suitability ratings of soils for ten selected engineering uses are shown in Table 6. When using these interpretations, considera-tion must be given to the following assumptions:

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

2. Soil ratings are based on natural, undisturbed conditions.

3. Soil suitability ratings are usually given for the entire soil depth, but for some uses, they may be based on the limitations of an individual soil horizon or layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 metres, but in some soils, reasonable estimates can be given for soil material at greater depths.

4. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the limitations.

5. 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.

Table 6. Suitability Ratings of Soils for Selected Engineering Uses

Soil Code	Phase	Soil Name	Top Soil	Sand and Gravel	Road Fill	Permanent Bldg. with Basements	Local Roads & Streets	Sanitary Trench	Land-fill Area	Cover Material	Sewage Lagoon	Septic Field
$UL	xxxx	Unclassified	-	-	-	-	-	-	-	-	-	-
$UR	xxxx	Urban areas	-	-	-	-	-	-	-	-	-	-
$ZZ	xxxx	Water	-	-	-	-	-	-	-	-	-	-
AND	xxxx	Aneda	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk
AND	xcxx	Aneda	Pb	Va	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk
AND	xc2x	Aneda	Pb	Va	Fa	Fap	Fa	Fps	G	Fps	Fkt	Pk
AND	xc3x	Aneda	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Pk
AND	xx2x	Aneda	Pb	Va	Fa	Fap	Fa	Fps	G	Fps	Fak	Pk
AND	xx3x	Aneda	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Pk
ASZ	xc1x	Agassiz	Ps	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg
BLO	xxxx	Berlo	Ps	Pa	Fw	Pw	Fw	Vks	Vk	Pq	Vk	Phg
BVR	xxxx	Beaverdam Lake	Pcs	Pax	Fw	Pw	Fw	Phw	Fwg	Fcs	Pk	Phk
BVR	xc2x	Beaverdam Lake	Pcs	Pax	Fw	Pw	Fw	Phw	Fwg	Fps	Pk	Phk
BVR	xc3x	Beaverdam Lake	Pcs	Pax	Fpw	Ppw	Fpw	Ppw	Fwg	Pp	Pk	Phk
BVR	xx4x	Beaverdam Lake	Pcs	Pax	Pp	Ppw	Pp	Ppw	Fwg	Pp	Pkp	Phk
BYD	xxxx	Berry Island	Ps	Pax	Pw	Vw	Pw	Vhw	Phw	Pw	Phk	Vh
BYDp	xxxx	Berry Island, peaty	Vw	Vah	Vw	Vw	Pw	Vhw	Vhw	Vsw	Vah	Vh
CAY	xxxx	Cayer	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vhw	Vsw	Vah	Vh
CBY	xxxx	Colby	Ps	Pax	Fw	Pw	Fw	Pw	Fw	Fs	Pk	Ph
CIO	xxxx	Caliento	Ps	Px	Fw	Pw	Fw	Pw	Fw	Fs	Pk	Ph
CKG	xxxx	Clarkleigh	Fs	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Ph	Vh
CRN	xxxx	Crane	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vhw	Vsw	Vah	Vh
DCS	xxxx	Dencross	Ps	Va	Paf	Paw	Pa	Psw	Fw	Ps	Fjk	Phk
DCS	xbxx	Dencross	Ps	Va	Paf	Paw	Pa	Psw	Fw	Ps	Fjk	Phk
DMR	xxxx	Delmar	Fb	Va	Pw	Vw	Pw	Vw	Pw	Pw	Ph	Vh
DVD	xxxx	Davidson	Ps	Fa	G	G	G	Vks	Vk	Pq	Vk	Gg
DVD	xc1x	Davidson	Ps	Fa	G	G	G	Vks	Vk	Pq	Vk	Gg
FHT	xxxx	Fisherton	Fbs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
FIH	xxxx	Fisher	Ps	Va	Fa	Piw	Pi	Piw	Pi	Fs	Pi	Pik
FMS	xxxx	Framnes	Ps	Va	Paf	Paw	Pa	Psw	Fw	Ps	Fjk	Phk
FTE	xxxx	Fortier	Ps	Va	Pa	Paw	Pai	Psw	Fw	Ps	Vi	Vk
FYLp	xxxx	Fyala, peaty	Vw	Vah	Vw	Vw	Pw	Vhw	Vhw	Vsw	Va	Vhk
GDT	xxxx	Grindstone	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vhw	Vsw	Vah	Vh
GEW	xxxx	Greenwald	G	Va	Fw	Paw	Faw	Pw	Pw	G	Fk	Phk
GFS	xxxx	Glenfields	Fs	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Ph	Vh
GFS	xxxs	Glenfields	Pn	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Ph	Vh
GHP	xxxx	Glenhope	Fb	Va	Faw	Pw	Faw	Pw	Fw	G	Fk	Ph
GNL	xxxx	Glenella	G	Va	Fw	Pw	Faw	Pw	Fw	G	Fk	Phk
GOOd	xxxx	Glenmoor, drained	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
GRH	xxxx	Garrioch	Ps	Pax	Fw	Pw	Fw	Phw	Fwg	Fcs	Pk	Phk
GRH	xx2x	Garrioch	Ps	Pax	Fw	Pw	Fw	Phw	Fwg	Fps	Pk	Phk
GSI	xx1x	Grossil	Ps	Va	Pa	Fa	Pa	Ps	G	Ps	Fjk	Pk
GSI1	xxxx	Grossil, clay till	Ps	Va	Pa	Pa	Pa	Ps	G	Ps	G	Vk

Table 6. Suitability Ratings of Soils for Selected Engineering Uses (cont'd)

Soil Code	Phase	Soil Name	Top Soil	Sand and Gravel	Road Fill	Permanent Bldg. with Basements	Local Roads & Streets	Sanitary Trench	Land-fill Area	Cover Material	Sewage Lagoon	Septic Field
GSI1	xx2x	Grossil, clay till	Ps	Va	Pa	Pa	Pa	Ps	G	Ps	G	Vk
GSO	xx2x	Garson	Pb	Va	Fa	Fap	Fa	Fps	G	Fps	Fak	Pk
GUO	xxxx	Gunton	Ps	Fax	G	Fa	G	Fsg	Gg	Fcs	Pk	Pk
GUO	xcxx	Gunton	Ps	Fax	G	Fa	G	Fsg	Gg	Fcs	Pk	Pk
GUO	xx2x	Gunton	Ps	Fax	G	Fap	G	Fps	Gg	Fps	Pk	Pk
GUO	xc2x	Gunton	Ps	Fax	G	Fap	G	Fps	Gg	Fps	Pk	Pk
GUO	xc3x	Gunton	Pps	Fax	Fp	Pp	Fp	Ppg	Gg	Pp	Pk	Pk
HDG	xxxx	Hodgson	G	Va	Fa	Fa	Fai	Fis	Fi	Fs	Fak	Pk
HDN	xxxx	Hoddinott	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
ISF	xx2x	Isafold	Pb	Va	Fa	Fap	Fa	Fps	G	Fps	Fak	Pk
ISF	xx3x	Isafold	Pbp	Va	Fap	Pp	Fap	Pp	G	Pp	Fkp	Pk
IWO	xxxx	Inwood	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
IWO	xx1x	Inwood	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
IWO	xb2x	Inwood	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fps	Fak	Phk
IWO	xc2x	Inwood	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fps	Fkt	Phk
IWO	xx2x	Inwood	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fps	Fak	Phk
IWO	xx3x	Inwood	Pbp	Va	Fpw	Ppw	Fpw	Ppw	Fw	Pp	Fkt	Phk
IWO	xc3x	Inwood	Pbp	Va	Fpw	Ppw	Fpw	Ppw	Fw	Pp	Fkt	Phk
KIC	xxxx	Kircro	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vhw	Vsw	Vah	Vhg
KLId	xxxx	Kline, drained	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLId	xxxs	Kline, drained	Pns	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLI	xxxx	Kline	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLI	xx1x	Kline	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLI	xx2x	Kline	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLI	xb2x	Kline	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLI	xxxs	Kline	Pns	Va	Paw	Vw	Paw	Vw	Pw	Psw	Ph	Vh
KLIp	xxxx	Kline, peaty	Vw	Vah	Vw	Vw	Pw	Vhw	Vhhw	Vsw	Vah	Vh
KLI1d	xxxx	Kline, clay till, drained	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	G	Vhk
KLI1	xxxx	Kline, clay till	Ps	Va	Paw	Vw	Paw	Vw	Pw	Psw	G	Vhk
KLI1	xxxs	Kline, clay till	Pns	Va	Paw	Vw	Paw	Vw	Pw	Psw	G	Vhk
KRW	xxxx	Kergwenan, clay till	Pcs	G	Fw	Pw	Fw	Vks	Vkg	Vcs	Vck	Phg
KRY	xxxx	Kerry	Ps	Pa	Pw	Vhw	Pw	Vhw	Vhk	Pqw	Vhk	Vhg
LBU	xxxx	Libau	Ps	Va	Pa	Fa	Pa	Fs	G	Ps	Fjk	Pk
LBU	xx2x	Libau	Ps	Va	Pa	Fap	Pa	Fps	G	Ps	Fjk	Pk
LBU	xx3x	Libau	Pps	Va	Pa	Pp	Pa	Pp	G	Pps	Fjk	Pk
LBU	xc3x	Libau	Pps	Va	Pa	Pp	Pa	Pp	G	Pps	Fjt	Pk
LBU1	xxxx	Libau, clay till	Ps	Va	Pa	Pa	Pa	Ps	G	Ps	G	Vk
LBU1	xx1x	Libau, clay till	Ps	Va	Pa	Pa	Pa	Ps	G	Ps	G	Vk
LBU1	xx2x	Libau, clay till	Ps	Va	Pa	Pa	Pa	Ps	G	Ps	G	Vk
LKD	xxxx	Lakeland	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
LRY	xxxx	Leary	Pcs	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg
LRY	xcxx	Leary	Pcs	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg
LRY	xc2x	Leary	Pcs	G	G	Fp	G	Vks	Vkg	Vcs	Vck	Gg

Table 6. Suitability Ratings of Soils for Selected Engineering Uses (cont'd)

Soil Code	Phase	Soil Name	Top Soil	Sand and Gravel	Road Fill	Permanent Bldg. with Basements	Local Roads & Streets	Sanitary Trench	Land-fill Area	Cover Material	Sewage Lagoon	Septic Field
LRY	xx3x	Leary	Pps	G	Fp	Pp	Fp	Vks	Vkg	Vcs	Vck	Gg
LRY	xc3x	Leary	Ppp	G	Fp	Pp	Fp	Vks	Vkg	Vcs	Vck	Gg
LSD	xxxx	Lonesand	Pbs	G	Fw	Pw	Fw	Vks	Vk	Pq	Vk	Fhg
LSW	xxxx	Lenswood	Ps	Pa	Fw	Pw	Fw	Vks	Vk	Pq	Vk	Phg
LUR	xxxx	Lundar	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
LUR	xx1x	Lundar	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
LUR	xx2x	Lundar	Pb	Va	Faw	Pw	Faw	Pw	Fw	Fps	Fak	Phk
LUR	xx3x	Lundar	Pbp	Va	Fpw	Ppw	Fpw	Ppw	Fw	Pp	Fkp	Phk
LUR	xb3x	Lundar	Pbp	Va	Fpw	Ppw	Fpw	Ppw	Fw	Pp	Fkp	Phk
LUR	xx4x	Lundar	Pbp	Va	Pp	Pp	Pp	Ppw	Fw	Pp	Pp	Phk
LUR	xx5x	Lundar	Vp	Vap	Vp	Vp	Vp	Vp	Fw	Vp	Vp	Phk
LWY	xxxx	Ledwyn	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
LYI	xxxx	Lydiatt	Fb	Va	Pw	Vw	Pw	Vw	Pw	Pw	Ph	Vh
LYW	xxxx	Ladywood	G	Va	Fw	Pw	Fw	Pkw	Pk	G	Pk	Fh
MCR	xxxx	McCreary	Fs	Va	Faw	Pw	Faw	Pw	Fw	Fs	Fak	Phk
MCR1	xxxx	McCreary, clay till	Fs	Va	Pa	Paw	Faw	Pw	Fw	Fs	G	Phk
MEB	xxxx	Meleb	Fs	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Ph	Vh
MEB	xx5x	Meleb	Vp	Vap	Vp	Vpw	Vp	Vpw	Pw	Vp	Vp	Vh
MGT	xxxx	Magnet	Fs	Va	Pw	Vw	Pw	Vhw	Pw	Pw	Ph	Vh
MNT	xxxx	Malonton	Ps	Pa	Pw	Vhw	Pw	Vhw	Vhk	Pqw	Vhk	Vhg
MRQ	xxxx	Marquette	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
MRQ	xx1x	Marquette	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
MRQ	xx2x	Marquette	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
MRQ	xb2x	Marquette	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
MRQ1	xxxx	Marquette, clay till	Ps	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
MRQ1	xx1x	Marquette, clay till	Ps	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
MRQ1	xxxs	Marquette, clay till	Pns	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
MRS	xxxx	Morris	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
MYT	xxxx	Myrtle	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Vk
MYT	xc1x	Myrtle	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	Ft	Vk
NIV	xxxx	Niverville	Fs	Va	Pa	Paw	Faw	Pw	Fw	Fs	G	Phk
NUS	xxxx	Nourse	Fb	Va	Faw	Pw	Faw	Pw	Fw	G	Fk	Phk
OBOd	xxxx	Osborne, drained	Ps	Va	Pal	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBOd	xxxs	Osborne, drained	Pns	Va	Pal	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBO	xxxx	Osborne	Ps	Va	Pal	Vw	Paw	Vw	Pw	Psw	G	Vhk
OBOp	xxxx	Osborne, peaty	Vw	Vah	Vw	Vw	Pw	Vhw	Vhw	Vsw	Va	Vhk
OKO	xxxx	Okno	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vsw	Vah	Vh	Vh
PGU	xxxx	Peguis	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Pk
PGU	xx1x	Peguis	Ps	Va	Pa	Pw	Pa	Psw	Fw	Ps	Fjk	Ph
PGU1	xx2x	Peguis, clay till	Ps	Va	Pa	Paw	Pa	Psw	Fw	Ps	G	Vk
PLN	xxxx	Pelan	Ps	Pax	Fw	Pw	Fw	Pw	Fw	Fs	Pk	Ph
PLN	xx3x	Pelan	Pps	Pax	Fpw	Ppw	Fpw	Ppw	Fw	Pp	Pk	Ph
PMG	xxxx	Plum Ridge	Fb	Va	Faf	Pw	Faw	Pkw	Pk	G	Phk	Ph

Table 6. Suitability Ratings of Soils for Selected Engineering Uses (cont'd)

Soil Code	Phase	Soil Name	Top Soil	Sand and Gravel	Road Fill	Permanent Bldg. with Basements	Local Roads & Streets	Sanitary Trench	Land-fill Area	Cover Material	Sewage Lagoon	Septic Field
PPL	xxxx	Poppleton	Ps	Pa	Fw	Pw	Fw	Vks	Vk	Pq	Vk	Phg
PRG	xxxx	Pine Ridge	Vb	G	G	G	G	Vks	Vk	Vs	Vk	Gg
PRG	xx2x	Pine Ridge	Vb	G	G	Fp	G	Vks	Vk	Vs	Vk	Gg
PRG	xc2x	Pine Ridge	Vb	G	G	Fp	G	Vks	Vk	Vs	Vk	Gg
PRG	xx3x	Pine Ridge	Vb	G	Fp	Pp	Fp	Vks	Vk	Vs	Vk	Gg
PRG	xc3x	Pine Ridge	Vb	G	Fp	Pp	Fp	Vks	Vk	Vs	Vk	Gg
RIV	xxxx	Red River	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
RIV	xbxx	Red River	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
RIV	xxxs	Red River	Pns	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
RLL	xxxx	Rochelle	Pi	Va	Pw	Viw	Vi	Viw	Viw	Pw	Vi	Vhi
RTV	xxxx	Rat River	Vw	Vah	Vah	Vaw	Vaw	Vhw	Vhw	Vsw	Vah	Vhg
SCY	xxxx	Scanterbury	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
SCY	xbxx	Scanterbury	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	G	Vk
SCY	xcxx	Scanterbury	Ps	Va	Pal	Paw	Pa	Psw	Fw	Ps	Ft	Vk
SDI	xxxx	Sandilands	Vb	G	G	G	G	Vks	Vk	Vs	Vk	Gg
SFT	xxxx	Sifton	Fbs	Va	Paw	Vw	Pw	Vw	Pw	Pw	G	Vh
SLB	xxxx	St. Labre	Ps	Px	Fa	Fa	G	Fs	G	Fs	Pk	Fk
SMA	xxxx	St. Malo	G	Va	Fa	Fa	Fa	Fs	G	G	Fk	Fk
SOR	xxxx	St. Norbert	Ps	Va	Pal	Pa	Pa	Ps	G	Ps	G	Vk
SPG	xxxx	Sprague	Ps	Pah	Pw	Vw	Pw	Vhw	Phw	Pw	Phk	Vh
SPGp	xxxx	Sprague, peaty	Vw	Vah	Vw	Vw	Pw	Vhw	Vhw	Vsw	Vah	Vh
STW	xxxx	Stonewall	Pb	Va	Fd	Pd	Fad	Vdg	Pkg	Pd	Pdg	Pd
SUW	xxxx	Sundown	Pcs	G	Pw	Vhw	Pw	Vwg	Vhk	Vcs	Vhk	Vhg
SUWp	xxxx	Sundown, peaty	Vw	Fq	Vhw	Vhw	Pw	Vwg	Vkw	Vsw	Vak	Vhg
WGE	xxxx	Wintergreen	Pbs	Pa	Fw	Pw	Fw	Vks	Vk	Pq	Vk	Fhg
WOM	xxxx	Woodmore	G	Va	Faw	Pw	Faw	Pw	Fw	G	Fk	Ph
WOM	xx2x	Woodmore	Fp	Va	Faw	Pw	Faw	Pw	Fw	Fp	Fk	Ph
WRN	xxxx	Warner	Fs	Va	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk
WRN1	xxxx	Warner, clay till	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	G	Pk
WTD	xxxx	Wentland	G	Va	Phw	Vw	Pw	Vhw	Pw	Pw	Vh	Vh
WWB	xxxx	Willowbend	Pi	Va	Pw	Viw	Vi	Viw	Viw	Pw	Vi	Vhi

5.3 Soil Suitability for Selected Recreational Uses

Soils and their properties determine 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 planned. 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 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.

The suitability of various soil series and phases for selected recreation uses is shown in Table 7. Four classes are used: Good, Fair, Poor and Very Poor and theses classes are defined in the section on Engineering Uses. Subclasses identify the limitation or hazard for a particular use. An explanation of subclass symbols is provided.

Codes used to identify subclass limitations in evaluating soil suitability for selected recreational uses in Table 7.

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

Table 7. Suitability Ratings of Soils for Recreational Uses

Soil Code	Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Paths and Trails	Permanent Bldg. without Basements
$UL	xxxx	Unclassified	-	-	-	-	-
$UR	xxxx	Urban areas	-	-	-	-	-
$ZZ	xxxx	Water	-	-	-	-	-
AND	xxxx	Aneda	Fs	Fs	Fs	Fs	Fa
AND	xcxx	Aneda	Fst	Fs	Fs	Fs	Fa
AND	xc2x	Aneda	Fpt	Fs	Fps	Fs	Fa
AND	xc3x	Aneda	Pp	Fp	Pp	Fps	Fap
AND	xx2x	Aneda	Fps	Fs	Fps	Fs	Fa
AND	xx3x	Aneda	Pp	Fp	Pp	Fps	Fap
ASZ	xc1x	Agassiz	Pms	Pm	Fs	G	G
BLO	xxxx	Berlo	Fs	Fs	Fsw	Fs	Pw
BVR	xxxx	Beaverdam Lake	Fq	Fsw	Fsw	Fw	Fw
BVR	xc2x	Beaverdam Lake	Fp	Fsw	Fpw	Fw	Fw
BVR	xc3x	Beaverdam Lake	Pp	Fpw	Pp	Fpw	Fpw
BVR	xx4x	Beaverdam Lake	Pp	Pp	Pp	Pp	Fpw
BYD	xxxx	Berry Island	Vw	Vw	Vw	Pw	Pw
BYDp	xxxx	Berry Island, peaty	Vw	Vw	Vw	Vsw	Vw
CAY	xxxx	Cayer	Vsw	Vsw	Vsw	Vsw	Vaw
CBY	xxxx	Colby	Fsw	Fsw	Fsw	Fw	Fw
CIO	xxxx	Caliento	Ps	Fsw	Fsw	Fw	Fw
CKG	xxxx	Clarkleigh	Vw	Vw	Vw	Vw	Pw
CRN	xxxx	Crane	Vsw	Vsw	Vsw	Vsw	Vsw
DCS	xxxx	Dencross	Ps	Ps	Ps	Ps	Pa
DCS	xbxx	Dencross	Ps	Ps	Ps	Ps	Pa
DMR	xxxx	Delmar	Pw	Pw	Pw	Pw	Pw
DVD	xxxx	Davidson	Fms	Fms	Fs	G	G
DVD	xc1x	Davidson	Fst	Fms	Fs	G	G
FHT	xxxx	Fisherton	Fsw	Fsw	Fsw	Fsw	Faw
FIH	xxxx	Fisher	Fiw	Fsw	Pi	Fsw	Pi
FMS	xxxx	Framnes	Ps	Psw	Psw	Ps	Pa
FTE	xxxx	Fortier	Ps	Ps	Ps	Ps	Pa
FYLp	xxxx	Fyala, peaty	Vsw	Vsw	Vsw	Vsw	Va
GDT	xxxx	Grindstone	Vsw	Vsw	Vsw	Vsw	Vaw
GEW	xxxx	Greenwald	Fw	Fw	Fw	Fw	Faw
GFS	xxxx	Glenfields	Pw	Pw	Pw	Pw	Paw
GFS	xxxs	Glenfields	Pnw	Pw	Pnw	Pw	Paw
GHP	xxxx	Glenhope	Fw	Fw	Fw	Fw	Faw
GNL	xxxx	Glenella	Fw	Fw	Fw	Fw	Faw
GOOd	xxxx	Glenmoor, drained	Psw	Psw	Psw	Psw	Paw
GRH	xxxx	Garrioch	Pq	Fw	Fsw	Fw	Fw
GRH	xx2x	Garrioch	Pq	Fw	Fsw	Fw	Fw
GSI	xx1x	Grossil	Fs	Fs	Fs	Fs	Fa
GSI1	xxxx	Grossil, clay till	Fs	Fs	Fs	Fs	Pa
GSI1	xx2x	Grossil, clay till	Fps	Fs	Fps	Fs	Pa
GSO	xx2x	Garson	Fp	G	Fp	G	Fa
GUO	xxxx	Gunton	Fs	G	Fs	G	G
GUO	xcxx	Gunton	Fst	G	Fs	G	G
GUO	xx2x	Gunton	Fps	G	Fps	G	G
GUO	xc2x	Gunton	Fpt	G	Fps	G	G
GUO	xc3x	Gunton	Pp	Fps	Pp	Fp	Fp
HDG	xxxx	Hodgson	Fs	Fs	Fs	Fs	Fa
HDN	xxxx	Hoddinott	Ps	Ps	Ps	Ps	Pa
ISF	xx2x	Isafold	Fps	Fs	Fps	Fs	Fa
ISF	xx3x	Isafold	Pp	Fps	Pp	Fps	Fap

Table 7. Suitability Ratings of Soils for Recreational Uses (cont'd)

Soil Code	Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Paths and Trails	Permanent Bldg. without Basements
IWO	xxxx	Inwood	Fw	Fw	Fw	Fw	Faw
IWO	xx1x	Inwood	Fw	Fw	Fw	Fw	Faw
IWO	xb2x	Inwood	Fpw	Fw	Fpw	Fw	Faw
IWO	xc2x	Inwood	Fpw	Fw	Fpw	Fw	Faw
IWO	xx2x	Inwood	Fpw	Fw	Fpw	Fw	Faw
IWO	xx3x	Inwood	Pp	Fpw	Pp	Fpw	Fap
IWO	xc3x	Inwood	Pp	Fpw	Pp	Fpw	Fap
KIC	xxxx	Kircro	Vsw	Vsw	Vsw	Vsw	Vaw
KLId	xxxx	Kline, drained	Psw	Psw	Psw	Psw	Paw
KLId	xxxs	Kline, drained	Psw	Psw	Psw	Psw	Paw
KLI	xxxx	Kline	Psw	Psw	Psw	Psw	Paw
KLI	xx1x	Kline	Psw	Psw	Psw	Psw	Paw
KLI	xx2x	Kline	Psw	Psw	Psw	Psw	Paw
KLI	xb2x	Kline	Psw	Psw	Psw	Psw	Paw
KLI	xxxs	Kline	Psw	Psw	Psw	Psw	Paw
KLIp	xxxx	Kline, peaty	Vsw	Vsw	Vsw	Vsw	Vaw
KLI1d	xxxx	Kline, clay till, drained	Psw	Psw	Psw	Psw	Paw
KLI1	xxxx	Kline, clay till	Psw	Psw	Psw	Psw	Paw
KLI1	xxxs	Kline, clay till	Psw	Psw	Psw	Psw	Paw
KRW	xxxx	Kergwenan	Pqw	Fsw	Fsw	Fw	Fw
KRY	xxxx	Kerry	Psw	Pw	Pw	Psw	Pw
LBU	xxxx	Libau	Fs	Fs	Fs	Fs	Fa
LBU	xx2x	Libau	Fps	Fs	Fps	Fs	Fa
LBU	xx3x	Libau	Pp	Fps	Pp	Fps	Fap
LBU	xc3x	Libau	Pp	Fps	Pp	Fps	Fap
LBU1	xxxx	Libau, clay till	Fs	Fs	Fs	Fs	Pa
LBU1	xx1x	Libau, clay till	Fs	Fs	Fs	Fs	Pa
LBU1	xx2x	Libau, clay till	Fps	Fs	Fps	Fs	Pa
LKD	xxxx	Lakeland	Fsw	Fsw	Fsw	Fsw	Faw
LRY	xxxx	Leary	Ps	Fs	Fs	G	G
LRY	xcxx	Leary	Vs	Pm	G	G	G
LRY	xc2x	Leary	Pcm	Pm	Fp	G	G
LRY	xx3x	Leary	Pcp	Pm	Fp	Fp	Fp
LRY	xc3x	Leary	Ppq	Pm	Pp	Fp	Fp
LSD	xxxx	Lonesand	Ps	Vs	Vs	Vs	Fw
LSW	xxxx	Lenswood	Fsw	Fsw	Fsw	Fw	Fw
LUR	xxxx	Lundar	Fsw	Fsw	Fsw	Fsw	Faw
LUR	xx1x	Lundar	Fsw	Fsw	Fsw	Fsw	Faw
LUR	xx2x	Lundar	Fpw	Fsw	Fpw	Fsw	Faw
LUR	xx3x	Lundar	Pp	Fsw	Pp	Fpw	Faw
LUR	xb3x	Lundar	Pp	Fsw	Pp	Fpw	Faw
LUR	xx4x	Lundar	Pp	Pp	Pp	Pp	Fap
LUR	xx5x	Lundar	Vp	Vp	Vp	Vp	Pp
LWY	xxxx	Ledwyn	Fsw	Fsw	Fsw	Fsw	Faw
LYI	xxxx	Lydiatt	Pw	Pw	Pw	Pw	Pw
LYW	xxxx	Ladywood	Fw	Fw	Fw	Fw	Faw
MCR	xxxx	McCreary	Fsw	Fsw	Fsw	Fsw	Faw
MCR1	xxxx	McCreary, clay till	Fsw	Fsw	Fsw	Fsw	Faw
MEB	xxxx	Meleb	Pw	Pw	Pw	Pw	Pw
MEB	xx5x	Meleb	Vp	Vp	Vp	Vp	Ppw
MGT	xxxx	Magnet	Pw	Pw	Pw	Pw	Pw
MNT	xxxx	Malonton	Psw	Pw	Pw	Psw	Pw
MRQ	xxxx	Marquette	Psw	Psw	Psw	Ps	Pa
MRQ	xx1x	Marquette	Psw	Psw	Psw	Ps	Pa

Table 7. Suitability Ratings of Soils for Recreational Uses (cont'd)

Soil Code	Phase	Soil Name	Play Ground	Picnic Area	Camp Area	Paths and Trails	Permanent Bldg. without Basements
MRQ	xx2x	Marquette	Psw	Psw	Psw	Ps	Pa
MRQ	xb2x	Marquette	Psw	Psw	Psw	Ps	Pa
MRQ1	xxxx	Marquette, clay till	Psw	Psw	Psw	Ps	Pa
MRQ1	xx1x	Marquette, clay till	Psw	Psw	Psw	Ps	Pa
MRQ1	xxxs	Marquette, clay till	Psw	Psw	Psw	Ps	Pa
MRS	xxxx	Morris	Ps	Ps	Ps	Ps	Pa
MYT	xxxx	Myrtle	Fs	Fs	Fs	Fs	Pa
MYT	xc1x	Myrtle	Fs	Fs	Fs	Fs	Pa
NIV	xxxx	Niverville	Fsw	Fsw	Fsw	Fsw	Faw
NUS	xxxx	Nourse	Fw	Fw	Fw	Fw	Faw
OBOd	xxxx	Osborne, drained	Psw	Psw	Psw	Psw	Paw
OBOd	xxxs	Osborne, drained	Psw	Psw	Psw	Psw	Paw
OBO	xxxx	Osborne	Psw	Psw	Psw	Psw	Paw
OBOp	xxxx	Osborne, peaty	Vsw	Vsw	Vsw	Vsw	Vw
OKO	xxxx	Okno	Vsw	Vsw	Vsw	Vsw	Va
PGU	xxxx	Peguis	Ps	Ps	Ps	Ps	Pa
PGU	xx1x	Peguis	Ps	Ps	Ps	Ps	Pa
PGU1	xx2x	Peguis, clay till	Ps	Ps	Ps	Ps	Pa
PLN	xxxx	Pelan	Fsw	Fsw	Fsw	Fw	Fw
PLN	xx3x	Pelan	Pp	Fsw	Pp	Fpw	Fpw
PMG	xxxx	Plum Ridge	Fsw	Fsw	Fsw	Fsw	Fw
PPL	xxxx	Poppleton	Fsw	Fsw	Fsw	Fw	Pw
PRG	xxxx	Pine Ridge	Fs	Fs	Fs	G	G
PRG	xx2x	Pine Ridge	Fs	Fs	Fs	G	G
PRG	xcxx	Pine Ridge	Fs	Fs	Fs	G	G
PRG	xc2x	Pine Ridge	Fs	Fs	Fs	G	G
PRG	xx3x	Pine Ridge	Pp	Fps	Pp	Fp	Fp
PRG	xc3x	Pine Ridge	Pp	Fps	Pp	Fp	Fp
RIV	xxxx	Red River	Ps	Ps	Ps	Ps	Pa
RIV	xbxx	Red River	Ps	Psw	Psw	Ps	Ps
RIV	xxxs	Red River	Ps	Pns	Pns	Ps	Pa
RLL	xxxx	Rochelle	Piw	Pi	Viw	Pw	Vi
RTV	xxxx	Rat River	Vsw	Vsw	Vsw	Vsw	Vaw
SCY	xxxx	Scanterbury	Ps	Ps	Ps	Ps	Pa
SCY	xbxx	Scanterbury	Ps	Ps	Ps	Ps	Pa
SCY	xcxx	Scanterbury	Ps	Ps	Ps	Ps	Pa
SDI	xxxx	Sandilands	Vs	Vs	Vs	Vs	G
SFT	xxxx	Sifton	Pw	Pw	Pw	Pw	Pw
SLB	xxxx	St. Labre	Ps	Fs	Fs	G	G
SMA	xxxx	St. Malo	G	G	G	G	G
SOR	xxxx	St. Norbert	Fs	Fs	Fs	Fs	Pa
SPG	xxxx	Sprague	Psw	Pw	Vw	Pw	Pw
SPGp	xxxx	Sprague, peaty	Vw	Vw	Vsw	Vw	Pw
STW	xxxx	Stonewall	Fd	Fs	Fs	Fs	Fd
SUW	xxxx	Sundown	Vqw	Vw	Vw	Vw	Pw
SUWp	xxxx	Sundown, peaty	Vqw	Vsw	Vsw	Vsw	Pw
WGE	xxxx	Wintergreen	Vs	Vs	Vs	Vs	Fw
WOM	xxxx	Woodmore	Fw	Fw	Fw	Fw	Faw
WOM	xx2x	Woodmore	Fpw	Fw	Fpw	Fw	Faw
WRN	xxxx	Warner	Fs	Fs	Fs	Fs	Fa
WRN1	xxxx	Warner, clay till	Fs	Fs	Fs	Fs	Fa
WTD	xxxx	Wentland	Pw	Pw	Pw	Pw	Pw
WWB	xxxx	Willowbend	Viw	Viw	Viw	Viw	Vi

Appendix 1

Guides for Evaluating Soil Conditions and Landscape Features for Selected Uses

Table 8. Definitions of the Agricultural Capability Classes

Class 1

Soils in this Class have no important limitations for crop use. The soils have level or gently sloping topography; are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility. Soils are moderately high to high in productivity for a wide range of cereal and special crops.

Class 2

Soils in this Class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3

Soils in this Class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. The limitations include one or more of the following: moderate climatic limitation, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water holding capacity or slowness in release of water to plants, stoniness and depth of soil to consolidated bedrock. Under good management, these soils are fair to moderately high in productivity for a fairly wide range of field crops.

Class 4

Soils in this Class have severe limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few crops or the yield for a range of crops may be low, or the risk of crop failure is high. The limitations may seriously affect such farm practices as the timing and ease of tillage, planting and harvesting, and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a specially adapted crop. The limitations include the adverse effects of one or more of the following: climate, accumulative undesirable soil characteristics, low fertility, reduced storage capacity or release of soil moisture to plants, structure or permeability, salinity, erosion, topography, overflow, wetness, stoniness, and depth of soil to consolidated bedrock.

Class 5

Soils in this Class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. These soils have severe soil, climatic or other limitations and are not capable of sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame perennial forage species. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control. Some soils in Class 5 can be used for cultivated field crops provided intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions unlike those needed by the common crops.

Class 6

Soils in this Class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery, or because the soils are not responsive to improvement practices, or because stock watering facilities are inadequate.

Class 7

Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

Table 9. 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 - **Undesirable 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 comprised 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 metre 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.

Table 10. Dryland Agriculture Capability Guidelines for Manitoba*

Subclass Limitations	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
	No significant limitations in use for crops.	Moderate limitations that restrict the range of crops or require moderate conservation practices.	Moderate severe limitation that restrict the range of crops or require special conservation practices.	Severe limitations that restrict the range of crops or require special conservation practices or both.	Very severe limitations that restrict soil capability to produce perennial forage crops, and improvement practices are feasible.	Soils are capable only of producing perennial forage crops, and improvement practices are not feasible.	No capability for arable culture or permanent pasture.
Climate (C)	All Ecodistricts[1] within ARDA boundary not explicitly listed under 2C and 3C.	Ecodistricts: 664, 666, 668, 670, 671, 672, 674, 675, 676, 677, 714, 715, 716	Ecodistricts: 356, 357, 358, 359, 363, 366, 663, 665	None within ARDA boundary			
Consolidated Bedrock (R)				> 50 -100 cm	20 - 50 cm	< 20 cm	Surface bedrock Fragmental over bedrock
Moisture limitation[2] (M)		Stratified loams Moderate moisture holding capacity	Loamy sands Low moisture holding capacity	Sands Very low moisture holding capacity	Skeletal sands Very severe moisture deficiency	Stabilized sand dunes	Active sand dunes
Topography[3] (T)	a, b (0 - 2%)	c (> 2 - 5%)	d (> 5 - 9%)	e (> 9 - 15%)	f (> 15 - 30%)	g (> 30 - 45%) Eroded slope complex	h (> 45 - 70%) i (> 70 - 100%) j (> 100%)
Structure and/or Permeability (D)	Granular clay	Massive clay or till soils[4] Slow permeability	Solonetzic intergrades Very slow permeability	Black Solonetz Extremely slow permeability			
Salinity[5] (N) **0 - 60 cm depth** **60 - 120 cm depth**	NONE < 2 dS/m < 4 dS/m	WEAK 2 - 4 dS/m 4 - 8 dS/m	MODERATE (s) > 4 - 8 dS/m > 8 - 16 dS/m	STRONG (t) > 8 - 16 dS/m > 16 - 24 dS/m	VERY STRONG (u) [6] > 16 - 24 dS/m > 24 dS/m		Salt Flats
Inundation[7] (I)	No overflow during growing season	Occasional overflow (1 in 10 years)	Frequent overflow (1 in 5 years) Some crop damage	Frequent overflow (1 in 5 years) Severe crop damage	Very frequent (1 in 3 years) Grazing > 10 weeks	Very frequent Grazing 5 - 10 weeks	Land is inundated for most of the season
Excess Water (W)	Well and Imperfectly drained		Loamy to fine textured Gleysols with improved drainage	Coarse textured Gleysols with improved drainage	Poorly drained, no improvements	Very Poorly drained	Open water, marsh
Stoniness (P)	Nonstony (0) and Slightly Stony (1)	Moderately Stony (2)	Very Stony (3) [8]	Exceedingly Stony (4) [9]		Excessively Stony (5)	Cobbly Beach Fragmental
Erosion[10] (E)		Moderate erosion (2)	Severe wind or water erosion (3) lowers the basic rating by one class to a minimum rating of Class 6 [11].				
Cumulative minor adverse Characteristics[12] (X)							

* Based on the Canada Land Inventory Soil Capability Classification for Agriculture (1965), with modifications made for soil application at larger mapping scales. (Rev. 2008)

1 Smith, R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, M. Santry, 1996. Terrestrial Ecoregions and Ecodistricts of Manitoba, An Ecological Stratification of Manitoba's Natural Landscapes. Agriculture and Agri-Food Canada, Research Branch, Brandon Research Centre, Manitoba Land Resource Unit, Winnipeg, MB. Report and Provincial Map at scale of 1:1.5m.

2 With the exception of Class 2, ratings as indicated are based on the assumption of a single parent material, using the most readily drained representative of each textural class. Prevailing climatic conditions within the Ecodistrict, soil drainage and stratification will affect the moisture limitation accordingly.

3 Topographic classes are based on the most limiting slope covering a significant portion of an area of complex, variable slopes. Map units with long, unidirectional slopes may be considered equivalent or one class worse due to an increased erosion hazard.

4 Extremely calcareous loamy till soils with a high bulk density (>1.7 g/cm^3) are rated 3D.

5 Soil Salinity is reported in DeciSiemens/metre (dS/m). Soil will be classed according the the most saline depth. For example, if a soil is non-saline from 0-60 cm but moderately saline from 60 - 120 cm, the soil will be classed as moderately saline (3N).

6 Strongly saline (u) soils are rated 5N with the exception of poorly and very poorly drained soils, which are rated 6NW.

7 Inundation may be listed as a secondary subclass for some fluvial soils. In this case, inundation is not class determining, but may become a limitation if the soil is otherwise improved.

8 Extremely calcareous loamy till soils with a high bulk density (>1.7 g/cm^3) and stony 3 are rated 4DP (4RP if depth to bedrock is 50 - 100 cm).

9 Stony 4 soils will be rated 4P unless their primary physical composition is sandy skeletal or their parent material is till. In either or both of these cases, the soil will be rated 5P.

10 If erosion is moderate, a subclass of E is assigned as a secondary limitation, but the basic rating is not lowered. If erosion is severe, the basic soil rating is downgraded by one class, and E becomes the primary limitation. For example, if a soil has a basic rating of 4T, the presence of moderate erosion will result in a rating of 4TE. If erosion is severe, the rating will be lowered to 5ET. Erosion will be the sole limitation only if the basic rating has a subclass of X. For example, a soil with a rating of 3X will be assigned a rating of 3E if moderate erosion is present.

11 The rating is not lowered from Class 6 based on erosion. A rating of 6TE indicates a soil with g topography and either moderate or severe erosion.

12 Use only for soils with no other limitation except climate. The subclass represents soils with a moderate limitation caused by the cumulative effect of two or more adverse characteristics which are singly not serious enough to affect the rating. Because the limitation is moderate, soils may only be downgraded by one class from their initial climate limitation. Therefore, a soil with a climate limitation of 2C and 2 or more minor adverse characteristics will be rated as 3X. This symbol is always used alone.

Table 11. Description of Irrigation Suitability Classes

General Rating	Class	Degree of Limitation	Description
Excellent	**1A**	No soil or landscape limitations	These soils are medium textured, well drained and hold adequate available moisture. Topography is level to nearly level. Gravity irrigation methods may be feasible.
Good	**1B** **2A** **2B**	Slight soil and/or landscape limitations	The range of crops that can be grown may be limited. As well, higher development inputs and management are required. Sprinkler irrigation is usually the only feasible method of water application.
Fair	**1C** **2C** **3A** **3B** **3C**	Moderate soil and/or landscape limitations	Limitations reduce the range of crops that may be grown and increase development and improvement costs. Management may include special conservation techniques to minimize soil erosion, limit salt movement, limit water table build-up or flooding of depressional areas. Sprinkler irrigation is usually the only feasible method of water application.
Poor	**1D** **2D** **3D** **4A** **4B** **4C** **4D**	Severe soil and/or landscape limitations	Limitations generally result in a soil that is unsuitable for sustained irrigation. Some land may have limited potential when special crops, irrigation systems, and soil and water conservation techniques are used.

Table 12. Landscape Features Affecting Irrigation Suitability

Symbol	Landscape Features	Degree of Limitation			
		None (A)	Slight (B)	Moderate (C)	Severe (D)
t1	Slope - Simple %	<2	2 - 10	10 - 20	>20
t2	- Complex %	<5		5 - 15	>15
E	Relief m (Average Local)	<1	1 - 3	3 - 5	>5
P	Stoniness -Classes -Cover (%)	0, 1 & 2 (0 to 3%)	3 (3 to 15%)	4 (15 to 50%)	5 (>50)
I	Inundation -Frequency of Flooding (period)	1:10 (yr)	1:5 (yr)	1:1 (annual-spring)	1:<1 (seasonal)

* Suitability interpretations are based on the criteria for Complex slopes

Table 13. Soil Features Affecting Irrigation Suitability

Symbol	Soil Feature	Degree of Limitation			
		None (1)	Slight (2)	Moderate (3)	Severe (4)
d	Structure	Granular, Single Grained, Prismatic, Blocky, Subangular Blocky	Columnar, Platy	Massive	Massive
k	Ksat (mm/hr) (0 - 1.2 m)	> 50	50 - 15	< 15 - 1.5	< 1.5
x	Drainability (mm/hr) (1.2 - 3 m)	> 15	15 - 5	< 5 - 0.5	< 0.5
m	AWHC subhumid (mm/1.2 m) (% by volume) Subarid (mm/1.2 m) (% by volume)	 > 120 (> 10) > 150 (> 12)	 120 - 100 (10 - 8) 150 - 120 (12 - 10)	 < 100 - 75 (< 8 - 6) < 120 - 100 (< 10 - 8)	 < 75 (< 6) < 100 (< 8)
q	Intake Rate (mm/hr)	> 15	15 - 1.5	15 - 1.5	< 1.5
s	Salinity (mS/cm or dS/m) 0 - 0.6 m depth 0.6 - 1.2 m depth 1.2 - 3 m depth	 < 2 < 4 < 8	 2 - 4 4 - 8 8 - 16	 > 4 - 8 > 8 - 16 > 16	 > 8 > 16 > 16
n	Sodicity (SAR) 0 - 1.2 m depth 1.2 - 3 m depth	 < 6 < 6	 6 - 9 6 - 9	 > 9 - 12 > 9 - 12	 > 12 > 12
g	Geological (0 - 1.2 m) Uniformity (1.2 - 3m)	1 Textural Group 2 Textural Groups	2 Textural Groups Coarser below 3 Textural Groups Coarser below	2 Textural Groups Finer below 3 Textural Groups Coarser below 3 Textural Groups Finer below	3 Textural Groups Finer below
r	Depth to Bedrock (m)	> 3	3 - 2	< 2 - 1	< 1
h	Depth to Water Table (m)	> 2	2 - 1.2 (if salinity is a problem)	2 - 1.2 (if salinity is a problem)	< 1.2
w	Drainage Class	Well, Moderately Well	Imperfect	Imperfect	Poor, Very Poor, Excessive, Rapid
	*Texture (Classes) (0 - 1.2 m)	L, SiL, VFSL, FSL	CL, SiCL, SCL, SL, LVFS	C, SC, SiC VFS, FS, LS, CoSL	HvC GR, CoS, LCoS, S
	*Organic Matter %	> 2	2 - 1	2 - 1	< 1
	*Surface Crusting Potential	Slight	Low	Low	Moderate

* Other important factors used to interpret type and degree of limitation but which do not present a limitation to irrigation themselves. No symbol is proposed for these factors since they will not be identified as subclass limitations. Rev. (2008)

Table 14a. Guide for Assessing Land Suitability for Irrigated Potato Production on Rapid, Well and Moderately Well Drained Soils

In assessing suitability of land for irrigated potato production, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed characteristics or properties.

Characteristic or Property	Suitability Rating				
	Class 1	Class 2	Class 3	Class 4	Class 5
Texture Group*	CL CL/SF CL/SF/SC CL/FL/SF CL/LY LY/SF LY	SY,SY/SC, SY/CL, SY/LY, SY/FL, SY/SS/LY, SF, SY/UD/LY,SF/CS, SF/SC, SF/LY, SF/FL, SC/LY, SC, SF/SS/FL, CL/FL, SC/FL, CL/SS/FL, LY/FL, LY/SC, LY/LS, LY/SS/SF, LY/SS/SC, LY/FL/SF, LY/SS/LY, LY/SS/FL, FL, FL/SF, FL/LY, FL/FL, FL/SY/SF, FL/SS/LY, FL/SS/FL, FL/CL	SY/SS, SY/CY/LY, SF/SS, CL/SS, SF/CY, CL/CY, SF/CY/LY, CL/CY/LY, CL/SS/CY, LY/CY, LY/SS, FL/SS	FL/CY, FL/CY/SF	SK, SS, SS/RK, SS/LY, SS/FL, SS/CY, SC/RK, SF/RK, CS, CL/RK, CL/FR, CL/FR/RK, LS/RK, LY/RK, LY/SY/RK, FL/LY/RK, CY, CY/SS, CY/SC, CY/SY, CY/SF, CY/CL, CY/LY, CY/FL, CY/CY, CY/RK, CY/TX, CY/SS/CY, CY/LY/CY, CY/FL/CY, CY/LY/RK, CY/FL/RK, RK, TX, TX/LY, UD, UD/LY
Topography[1] (Slope)	0 - 5% (a, b, c)			> 5 - 9% (d)	> 9% (e, f, g, h, i, j)
Stoniness[2] Class	-			St. 1	St. 2, 3, 4, 5
Salinity[3] (mS/cm)	< 2		2 - 4	> 4 - 8	> 8
Soil Order and / or Subgroup			Orthic Regosol		Organic Order, Solonetzic Order, Solonetzic Subgroups

Topography[1]	Stoniness[2] (Surface covered)		Salinity[3] (mS/cm)	
< 5 % level to very gently sloping	- non-stony	< 0.01 %	very low	0 - 2
5 - 9 % gently sloping	1 slightly stony	0.01 - 0.1 %	low	> 2 - 4
> 9 % mod. to extremely sloping	2 moderately stony	> 0.1 - 3 %	weakly (s)	> 4 - 8
	3 very stony	> 3 - 15 %	moderately (t)	> 8 - 16
	4 exceedingly stony	> 15 - 50 %	strongly (u)	> 16
	5 excessively stony	> 50 %		

* SK = Skeletal
SS = Sandy Skeletal
LS = Loamy Skeletal
CS = Clayey Skeletal
SC = Sandy Coarse
SY = Sandy
SF = Sandy Fine
CL = Coarse Loamy
LY = Loamy
FL = Fine Loamy
CY = Clayey
RK = Bedrock
FR = Fragmental
UD = Undifferentiated
TX = Texture Complex

Table14b. Guide for Assessing Land Suitability for Irrigated Potato Production on Imperfectly, Poorly and Very Poorly Drained Soils

In assessing suitability of land for irrigated potato production, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed characteristics or properties.

Characteristic or Property	Suitability Rating				
	Class 1	Class 2	Class 3	Class 4	Class 5
Texture Group*			SY, SY/SS, SY/SC, SY/CL, SY/LY, SC/LY, SY/SS/LY, SY/UD/LY, SC, SF, SF/SS, SF/CS, SF/LY, SF/SC, SF/FL, SY/FL, SF/SS/FL, CL, CL/SS, CL/SF, CL/LY, CL/FL, CL/SF/SC, CL/SS/FL, CL/FL/SF, LY/SS, LY/SC, LY/SF, LY/LS, LY/SS/SF, LY/SF/SC, SC/FL, LY, LY/FL, LY/SS/LY, LY/SS/FL, FL, FL/SF, FL/SS, FL/CL, FL/LY, FL/FL, FL/SY/SF, FL/SS/LY, FL/SS/FL	SF/CY, SY/CY/LYSF/CY/LY, SF/CY/FL, CL/CY, CL/CY/LY, CL/SS/CY, LY/CY, FL/CY/SF, FL/CY	SK, SS, SS/RK, SS/LY, SS/FL, SS/CY, SC/RK, SF/RK, CS, CL/RK, CL/FR, CL/FR/RK, LS/RK, LY/RK, LY/SY/RK, FL/LY/RK, CY, CY/SS, CY/SC, CY/SY, CY/SF, CY/CL, CY/LY, CY/FL, CY/CY, CY/RK, CY/TX, CY/SS/CY, CY/LY/CY, CY/FL/CY, CY/LY/RK, CY/FL/RK, RK, TX, TX/LY, UD, UD/LY
Topography[1] (Slope)			0 - 5%	> 5 - 9%	> 9%
Stoniness[2] Class				St. 1	St. 2, 3, 4, 5
Salinity[3] (mS/cm)			< 4	4 - 8	> 8
Soil Order and / or Subgroup					Organic Order, Gleysolic Order, Solonetzic Order, Solonetzic Subgroups

Topography[1]	Stoniness[2] (Surface covered)		Salinity[3] (mS/cm)	
< 5 % level to very gently sloping	- non-stony	< 0.01 %	very low	0 - 2
5 - 9 % gently sloping	1 slightly stony	0.01 - 0.1 %	low	> 2 - 4
> 9 % mod. to extremely sloping	2 moderately stony	> 0.1 - 3 %	weakly (s)	> 4 - 8
	3 very stony	> 3 - 15 %	Moderately (t)	> 8 - 16
	4 exceedingly stony	> 15 - 50 %	Strongly (u)	> 16
	5 excessively stony	> 50 %		

* SK = Skeletal
SS = Sandy Skeletal
LS = Loamy Skeletal
CS = Clayey Skeletal
SC = Sandy Coarse
SY = Sandy
SF = Sandy Fine
CL = Coarse Loamy
LY = Loamy
FL = Fine Loamy
CY = Clayey
RK = Bedrock
FR = Fragmental
UD = Undifferentiated
TX = Texture Complex

Table 15. 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 characteristic 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]	Property 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 (every year)	Constantly flooding
w	**Wetness**[2]	Wetness is not determining if better than very poorly drained.			Very poorly drained and permanently wet soils
t	**Slope**	5% (a, b, c)	> 5 - 9% (d)	> 9 - 15% (e)	> 15% (f, g, h, i, j)
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] **(% by volume)**	3%	> 3 - 15%	> 15 - 35%	> 35%
s	**Texture**[2]	SL, FSL, VFSL, L, SiL; SC if 1:1 clay is dominant	SCL, CL, SiCL; SC if 2:1 clay is dominant; C and SiC if 1:1 clay is dominant	S, LS; SiC and C 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]	EC < 1	EC 1 - 4	EC > 4 - 8 (s)	EC > 8 (t, u)

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1 The symbol is used to indicate the property affecting use.
2 For an explanation of texture, consistence, stoniness, coarse fragments and soil drainage classes, see the Manual for describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
3 Non-woody organic aterials 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 EC = Electrical Conductivity (milliSiemens/cm).

Additional Notes:
Well drained Till soils with erosion 1, rated as **Fb** for depth of topsoil; erosion 2 rated as **Pb** for depth of topsoil; and erosion 3 rated as **Vb** for depth of topsoil.
Well drained Luvisols and Dark Gray Chernozems with erosion 2 or 3 rated as **Vb** for depth of topsoil.
Regosols rated as **Vb** for depth of topsoil.
Poorly drained Organic soils rated as **Vw** for topsoil and Organic soils, drained phase, are rated as **Ps** for topsoil.

Table 16. 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 substratum to a depth of 150 cm, augmented by observations made in deep cuts as well as geological knowledge where available.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	**Unified Soil Group**[4]	GW GP SW SP	GW - GM GP - GM SW - SM SP - SM	GM GW - GC GP - GC SM SW - SC SP -SC	All other groups and bedrock (ML, CL, OL, MH, CH, OH, PT)
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 cm²	> 75 cm²	
p	**Stoniness**[3]	Not class determining if stones > 0.5 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	
x	**Thickness of sand and gravel**	> 100 cm	50 - 100 cm	< 50 cm	

Revised 2011

1 The symbol is used to indicate the property affecting use.
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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
4 Shaly gravels rated as Poor (Pa).

Table 17. Guide for Assessing Soil Suitability as Source of Roadfill

Fill material for building 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]	Property Affecting Use[2]	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	**Subgrade[3]** **a.) AASHO Group Index[4]** **b.) Unified Soil Group**	< 5 GW, GP, SW, SP SM, GC[5] and SC[5]	5 - 8 CL (with P.I.[6] <15) and ML	> 8 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**	15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
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 exposure < 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

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1 The symbol is used to indicate the property affecting use.
2 The first, three properties pertain to soil after it is placed in a fill; the last six properties pertain to soil in its natural condition before excavation for road fill.
3 This property 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 property 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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

Table 18. 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 as well. Also considered are soil properties, particularly depth to bedrock, which influence excavation and corosivity, landscaping and septic tank absorption fields.

Symbol[2]	Property 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 drained Without Basements: Poorly drained	With Basements: Poorly, and very poorly drained Permanently wet soils Without Basements: Very poorly drained 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 or ponding (once in 5 years)	Frequent flooding or ponding (every year)
t	**Slope**[5]	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
a	**Subgrade**[6] **a.) AASHO Group Index**[7] **b.) Unified Soil Group**	< 5 GW, GP, SW, SP, GC, SM and SC	5 - 8 CL (with P.I.[8] < 15) and ML	> 8 CL (with P.I.[8] of 15 or more), CH and MH	 OH, OL and PT
f	**Potential Frost Action**[9, 13]	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 exposure > 100 m apart and cover < 2% of the surface	Rock exposure 30 - 100 m apart and cover 2 - 10% of the surface	Rock exposure < 30 m apart and cover > 10% of the surface	Rock exposure 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

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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 symbol is used to indicate the property affecting use.
3 Some soils are assessed as fair or poor 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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
5 Reduce the slope limits by one half for those soils subject to hillside slippage.
6 This property 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 Soil Groups 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 building 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.
12 Moderately well to well drained soils rate one class better.
13 Use **z** for permanently frozen soils

Table 19. 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, lime or soil cement, stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They are also 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 metres. 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 bedrock, stoniness, rockiness, and wetness affect the ease of excavation, and the amount of cut and fill to reach an even grade.

Symbol[2]	Property 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**	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
d	**Depth to Bedrock**[4]	> 100 cm	50 - 100 cm	< 50 cm	
a	**Subgrade**[5] **a.) AASHO Group Index**[6]	< 5	5 - 8	> 8	
	b.) Unified Soil Group	GW, GP, GC[7], SW, SP, SM, 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 and loose sand with high organic matter
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

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1 These guidelines, with some adjustment of slope and rockiness limits, will also be useful for assessing soils for use as parking lots.
2 The symbol is used to indicate the property affecting use.
3 For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
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 property 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 Soil Groups 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 and moisture movement by capillary action 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 20. Guide for Assessing Soil Suitability for Trench-type Sanitary Landfills[1]

The trench-type sanitary landfill, involves the daily burial of dry garbage and trash in an open trench that is 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 supplemented 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]	Property 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 deeper 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 (Once in 2 - 4 years)	Frequent (Every year)
k	**Permeability[4,8]**	< 5 cm/hr	< 5 cm/hr	5 - 15 cm/hr	> 15 cm/hr
t	**Slope**	15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
s	**Soil Texture[4,6] (dominant to a depth of 150 cm)**	Si, SiL, L, SCL, VFSL, SL, LVFS, LFS, VFS	SiCL[7], CL, SC, LS	SiC, C	Muck, peat, sand (CoS, MS, FS) and gravel
d	**Depth to Hard Bedrock** **Rippable Bedrock**	> 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.

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1 Based on soil depth (120 cm) commonly investigated in making soil surveys.
2 The symbol is used to indicate the property affecting use.
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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
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, moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.
7 Soil high in expansive clays may need to be given a suitability rating of poor.
8 Contamination hazard (g) may apply at high permeability.

Table 21. 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 is generally 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 to determine the probability that leachates from the landfill may penetrate the soil and thereby pollute water supplies.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	**Depth to Seasonal Water Table[2]**	> 150 cm	> 100 - 150 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 (Once in 2 - 4 years)	Frequent (Every year)
k	**Permeability[4,5,6]**	Not class determining if less than 5 cm/hr		5 - 15 cm/hr	> 15 cm/hr
t	**Slope**	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)

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1 The symbol is used to indicate the property affecting use.
2 Reflects influence of wetness on operation of equipment.
3 For an explanation of drainage, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
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.
6 Contamination hazard (g) may apply at high permeability and/or proximity of the site to water supplies.

Table 22. 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 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]	Property 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]	Si, SiL, SCL, L, VFSL, FSL, LVFS, VFS	SiCL, CL, SC, LFS, 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] **(% by volume)**	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% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
w	**Wetness**[2]	Not class determining if better than poorly drained.		Poorly drained	Very poorly drained or permanently wet soils.
q	**Depth to Sand and Gravel**	> 1.5 m	1 - 1.5 m	< 1 m	

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1 The symbol is used to indicate the property affecting use.
2 For an explanation of consistence, texture, coarse fragments, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
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 23. 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 the suitability of soils 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]	Property 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**	< 0.05 cm/hr	0.05 - 0.5 cm/hr	> 0.5 - 5 cm/hr	> 5 cm/hr
t	**Slope**	2% (a, b)	> 2 - 5% (c)	> 5 - 9% (d)	> 9% (e, f, g, h, i, j)
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, (% 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	**Sub-grade Unified Soil Group**	CH	GC, SC and CL	GM, SM, ML & MH	GW, GP, SW & SP, OL, OH & PT

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1 The symbol is used to indicate the property affecting use.
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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
5 Surface exposures of non rippable rock are rated poor. If underlying bedrock is impermeable, rating should be one class better.

Table 24. 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]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
k	**Permeability**[2,7]	Rapid to moderately rapid	Moderate	Slow	Very Slow
	Percolation Rate[3] **(Auger hole method)**	8 - 18 min/cm (> 3.3 - 7.5 cm/hr)	> 18 - 24 min/cm (2.5 - 3.3 cm/hr)	> 24 min/cm (< 2.5 cm/hr)	
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**	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
d	**Depth to Hard Rock, bedrock or other impervious materials**	> 150 cm	> 100 - 150 cm[6]	50 - 100 cm	< 50 cm

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1 The symbol is used to indicate the property affecting use.
2 The suitability ratings should be related to the permeability of soil layers at and below depth of the graded filter bed (50 - 75 cm depth).
3 Soils having a percolating 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.
7 Contamination hazard (g) may apply at high permeability, e.g. (Gg).

Table 25. Guide for Assessing Soil Suitability for Playgrounds

This guide applies to soils to be used intensively for playgrounds, 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 provide 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]	Property 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 ponding or seepage for short duration and imperfectly drained soils. Water table below 50 cm during season use.	Imperfectly drained soils subject to ponding or seepage, 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**	2% (a, b)	> 2 - 5% (c)	> 5 - 9% (d)	> 9% (e, f, g, h, i, j)
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]	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL, LFS, LS, FS	SiC, C, SC[5], Si, S	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	
n	**Salinity**[9]	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

1 The symbol is used to indicate the property affecting use. Revised 2011
2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada 2007).
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 SiC, C and SC soils may be rated fair.
6 Depth to sand or gravel is considered a limitation if the levelling operations 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 property 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.
9 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table 26. 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]	Property 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 seepage or ponding. Water Table above 50 cm for short periods during season of use	Imperfectly drained soils subject to seepage or ponding. Poorly drained soil. 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**	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
s	**Surface Soil Texture**[2,3]	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL, LFS, LS, FS and sand other than loose sand.	SiC, C, SC[4], Si	Peaty soils; loose sand subject to blowing.
c	**Coarse Fragments on Surface**[2]	< 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 exposure roughly > 30 - 100 m or more apart and cover < 10% of the surface.	Rock exposure roughly 10 - 30 m apart and cover 10 - 25 % of the surface.	Rock exposure < 10 m apart and cover > 25% of the surface.	Rock exposure 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.	
n	**Salinity**[9]	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

Revised 2011

1 The symbol is used to indicate the property affecting use.

2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada 2007). Coarse fragments for the purpose of this rating include gravel 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 SiC, C and SC 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 property 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.

9 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table 27. 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 tent sites may allow rock exposures greater than 10 m apart to be considered slight limitations.

Symbol[1]	Property 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	Moderately slow and slow	Very slow	
t	**Slope**	9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
s	**Surface Soil Texture**[2,3]	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL,LFS, LS, FS and sand other than loose sand.	SiC, C, SC[4], Si	Peaty soils: loose sand subject to blowing.
c	**Coarse Fragments on Surface**[2,5]	< 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% or less of the area.	Rock exposures < 10 m apart and cover > 25% of the area.	Rock exposures too frequent to permit campground location.
n	**Salinity**[7]	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

Revised 2011

1 The symbol is used to indicate the property affecting use.
2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
3 Surface soil texture influences soil rating as it affects foot trafficability, dust, and soil permeability.
4 Moderately well and well drained SiC, C and SC 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.
7 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table 28. 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]	Property[2] Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
s	**Texture**[3,4]	L, VFSL, FSL, SL, LVFS, LFS, LS, VFS	CL, SiCL, SiL, SCL	SiC, C, SC[5], Si, FS, S	Peaty soils; loose sand subject to blowing
c	**Coarse Fragment Content**[4,6]	< 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 trials.
t	**Slope**[8]	15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
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.

Revised 2008

1 The symbol is used to indicate the property affecting use.

2 The properties 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 (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

5 Moderately well and well drained SiC, C and SC 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 2 Soil Series Descriptions

Agassiz Series (ASZ)

The Agassiz series consists of well to excessively drained Orthic Black Chernozem soils developed on strongly calcareous, stratified, sandy skeletal (GrS, S, GrLS) beach deposits. These soils occur in upper and middle positions of gentle to moderate slopes on ridged landscapes and have rapid permeability and a low water table during the growing season. Agassiz soils are slightly eroded, slightly stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes prairie grasses, shrubs and bur oak. The majority of these soils are currently excavated as a source of sand and gravel for road construction.

In a representative profile the solum is approximately 40 cm thick. The profile is characterized by a very dark gray Ah horizon, 7 to 15 cm thick, with single grain to weak granular structure, a brownish gray Bm horizon, 15 to 25 cm thick which is weakly developed, and a very pale brown Ck horizon, with stratified sand and gravel. Agassiz soils are similar to Leary soils by having a well drained profile in beach sands but differ from them in having a more weakly developed profile. Agassiz soils were mapped as Blackearth associates of the Agassiz Association in the Carberry (1957) soil report.

Aneda Series (AND)

The Aneda series consists of well to moderately well drained Orthic Dark Gray Chernozem soils developed on loamy (L, CL, SiCL) very strongly to 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 bur 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 Bt horizon of 6 to 12 cm thick. The extremely calcareous ($CaCO_3$ > 40 %) C horizon is very pale brown and may be somewhat platy.

Beaverdam Series (BVR)

The Beaverdam series consists of imperfectly drained Gleyed Dark Gray soils developed on thin, moderately to strongly calcareous, sandy skeletal outwash (GrS, S, GrLS) deposits overlying extremely calcareous and stony, loamy (L, CL, SiCL) glacial till. The surface texture ranges from loamy fine sand to loam. A gravelly layer from 10 to 50 cm thick is present above the extremely calcareous till. The topography is level to very gently sloping. Soil drainage is imperfect because of perched water table conditions above the slowly permeable till and lateral flow and seepage of water from adjacent upland areas. The vegetation consists of dominantly trembling aspen, with some dogwood and occasional bur oak.

The soil is characterized by a dark gray Ahe horizon of 10 to 18 cm thick, and a dark grayish brown Bmgj or Btgj within the coarse gravelly layer; the Btgj if present commonly occurs at the contact of the gravelly layer and the till; yellowish brown mottles of iron are present at this contact. The underlying, extremely calcareous loamy till is usually quite compact and often very slowly permeable.

Berlo Series (BLO)

The Berlo series consists of imperfectly drained Gleyed Dark Gray Luvisol soils developed on sandy (FS, LFS), strongly calcareous deltaic sediments. Surface textures are fine sand to fine sandy loam. These soils occur in small scattered areas, generally bordering gravel beaches or on the margin of lacustrine plains. The topography is level to irregular, very gently sloping. Soil permeability is rapid, but internal drainage is impeded by finer textured substrate of clay or glacial till generally below one metre. A perched water table is present in wet seasons and often reaches the surface during the spring thaw or after prolonged summer rains. The native vegetation consists of aspen-black poplar woods with an undergrowth of willow, meadow-prairie grasses and herbs.

The soils are weakly to moderately degraded. The A horizon consists of a thin dark gray Ah horizon of 5 to 7 cm, and a light gray Ae horizon. The B horizon is dark grayish brown, fine granular and contains a slight accumulation of clay and humus. The lower portion of the A and B are mottled with iron. The soil may be weakly alkaline in reaction or contain lime carbonate due to recharge with lime by period saturation with lime charged water.

Berry Island Series (BYD)

The Berry Island series consists of poorly drained carbonated, Rego Humic Gleysol soils developed on moderately to strongly calcareous sandy and gravelly outwash or beach deposits overlying extremely calcareous glacial till. The surface textures are variable and range from loamy fine sand to clay loam depending on the amount of in-washing from surrounding areas. The topography is level to depressional; runoff is very slow; permeability is slow. Vegetation consists of sedges, willow, meadow grasses and some black spruce and tamarack.

A partially decomposed organic layer 10 to 15 cm. thick is underlain by a carbonated dark gray Ah horizon 5 to 15 cm. thick. A lime enrichment layer (Cca) may be present below the Ah horizon, depending on the depth of occurrence of the gravelly layers; the sandy and gravelly deposits are stratified and usually have yellowish brown iron mottles. The underlying loamy till deposits are usually light gray and may have fine to medium yellowish brown mottles. A description of a Berry Island soil is given below.

L-H - 3 to 0 cm, very dark gray (10YR 3/1 dry, 2.5YR 2/0 moist), partially decomposed sedge, grasses and leaves; mildly alkaline, very strongly calcareous.
Ahk - 0 to 5 cm, dark gray (10YR 4/1 dry, 5.0Y 2/1 moist), clay loam; weak fine granular; sticky when wet, friable when moist, plastic; mildly alkaline; extremely calcareous; clear smooth boundary.
AC1 - 5 to 17 cm, light gray to gray (10YR 6/1 dry, 5YR 4/2 moist), loam; weak to moderate coarse prismatic breaking to weak to moderate fine platy; slightly sticky when wet, friable when moist; slightly plastic; moderately alkaline; very strongly calcareous; clear, smooth boundary.
AC2 - 17 to 22 cm, light brownish gray (2.5Y 6/2 dry, 5Y 5.5/3.5 moist), sandy clay loam; weak, fine granular; slightly sticky when wet, friable when moist, slightly plastic; moderately alkaline; very strongly calcareous; many, coarse, distinct yellowish brown (10YR 5/8 moist), mottles; abrupt, smooth boundary.
II Ckg1 - 22 to 50 cm, light gray (2.5Y 7/2 dry, 5.0Y 6.5/2 moist), gravelly sand; single grained; loose when moist; moderately alkaline; extremely calcareous; clear, smooth boundary.
II Ckg2 - 50 to70 cm, light gray (2.5Y 7/2 dry, 5Y 6.5/2.5 moist), gravelly sand; single grained;

loose when moist; moderate alkaline; extremely calcareous; common, medium, distinct reddish yellow (7.5YR 6/6 moist), mottles, abrupt, smooth boundary.
III Ckg - 75 to 100 cm, white (2.5Y 8/2 dry, 2.5Y 5.5/4.5 moist), sandy clay; weak fine platy to fine granular; moderately alkaline; extremely calcareous.

Berry Island, peaty phase, is similar to the Berry Island but has a thicker peat layer (15 to 40 cm. of mixed peat) on the surface.

Cayer Series (CAY)

The Cayer series consists of very poorly to poorly drained Terric Mesisols developed on 40 to 160 cm of mesic fen peat overlying moderately to strongly calcareous loamy to clayey lacustrine sediments. Little or no (less than 15 cm) Sphagnum moss overlies the mesic fen peat. Cayer soils occur in high nutrient (eutrophic), very poorly to poorly drained, depressional to level areas. Native vegetation is dominantly sedges, reed grasses and meadow grasses and aquatic mosses; a woody herbaceous cover of willow and swamp birch occurs in areas of better drainage.

Minor areas of the Volga series, a Terric Humic Mesisol, the Howell series, a Terric Mesisol, sphagnic phase, and the Wapah series, a Terric Limno Mesisol may be included in some map units represented by the Cayer series. The Cayer series is also often associated in map units with soils of the Howell, Katimik, and Stead series. The Crane and Kircro series are similar, but are underlain by loamy till and sand respectively. A representative profile of the Cayer series is described.

Om1 - 0 to 30 cm, yellowish red (5YR 4/6 moist) moderately decomposed non woody fibrous material composed of mosses, and sedgy herbaceous remains, very strongly acid.
Om2 - 30 to 80 cm, dark reddish brown (5YR 3/2 moist); moderately decomposed, non woody fibrous material composed of mosses and sedgy herbaceous remains, strongly acid.
Om3 - 80 to 90 cm, dark reddish brown (5YR 2/2 moist) moderately decomposed nonwoody fibrous material composed of mosses and sedgy herbaceous remains, strongly acid, abrupt wavy lower boundary.
II Ckg - 90+ cm, greenish gray (5GY 5/1 moist); clay; massive; sticky and very plastic when wet; mildly alkaline.

Caliento Series (CIO)

The Caliento series consists of imperfectly drained Gleyed Gray Luvisol soils developed on a mantle of weakly to strongly calcareous sandy (FS, LFS) sediments overlying very strongly to extremely calcareous loamy glacial till. Surface textures vary from fine or medium sand to loamy fine sand. These soils occur on irregular, gently sloping terrain. Permeability is rapid in the upper sandy sediments and moderate to moderately slow in the till; runoff is slow. A perched water condition exists above the till for short periods in the spring and following heavy rains. These soils are slightly to moderately stony; the degree of stoniness is dependent on the depth of sandy sediments over the till. Native vegetation consists of trembling aspen, rose, wild strawberry, and grasses. The soils are characterized by an LH, Ahe, Aeg, Btg, IIBCkg and IICkg horizon sequence. The iron stained Aeg varies in thickness depending on the depth of sandy sediments over the till. The Btg occurs in the base of the sandy layer if the sandy sediments are deep or in the upper till if the sandy sediments are shallow.

Clarkleigh Series (CKG)

The Clarkleigh series is a carbonated, Rego Humic Gleysol soil developed on poorly drained, extremely calcareous, loamy (L, SiL, CL), stony till deposits and includes soils developed on a thin (less than 25 cm) mantle of loamy sediments over the till. These soils occur associated with Lundar soils in irregular to depressional topography. Surface runoff is slow to very slow, and permeability is impeded by a high water table. These soils are frequently saline in areas of groundwater discharge or where lateral seepage occurs. Native vegetation consists dominantly of meadow grasses, sedges, reeds, some willow, black popular or swamp birch. In addition to being stony these soils are severely affected by wetness due to slow permeability and a high water table.

The Clarkleigh soil has a moderately to strongly calcareous, partially decomposed organic Om horizon, 5 to 10 cm thick; a strongly calcareous, very dark gray Ah horizon, 7 to 20 cm thick usually with remnant shells of aquatic organisms; a transitional AC horizon, 10 to 15 cm thick, and an extremely calcareous, light gray Ckg horizon. A thin layer of lime accumulation (Cca horizon) is also common below the transitional AC horizon.

Colby Series (CBY)

The Colby series is a Gleyed Rego Black Chernozem soil developed on imperfectly drained, thin (25 to 100 cm), strongly to very strongly calcareous, sandy (FS, LFS) lacustrine sediments, overlying loamy (L, CL, SiCL) to clayey (SiC, C) extremely calcareous till. A gravelly or cobbly lens usually occurs at the sand-till contact. These soils occur on gently sloping to level topography in association with Sprague soils. Surface runoff is slow. Permeability in the sandy sediments is moderately rapid, but can be restricted by a perched water table above the till sediments in spring or after intense rainfall. The tall prairie grasses and trembling aspen native to these soils have been mostly replaced by field crops. Colby soils are subject to moderate droughtiness and if not protected are susceptible to wind erosion. Also, their very dense highly calcareous till substrate can hinder deep root penetration and reduce the availability of some nutrients.

The Colby soil profile has a very dark gray to black, carbonated Ah (Ap) horizon, 15 to 25 cm thick; a carbonated, pale brown AC horizon, 20 to 40 cm thick, a very pale brown, distinctly mottled Ckg horizon, 25 to 50 cm thick, and a prominently mottled, grayish brown, II Ckg horizon. A layer of lime accumulation (Cca horizon), 15 to 25 cm thick, is often present when the depth to till is more than 70 cm.

Crane Series (CRN)

The Crane series is a Terric Mesisol composed of organic soils developed on 40 to 160 cm of mesic fen peat with less than 15 cm of fibric Sphagnum moss peat at the surface. Extremely calcareous, loamy, moderately stony till occurs within 160 cm of the surface. These poor to very poorly drained soils are located in high nutrient (eutrophic), depressional to level areas. Native vegetation on these soils is sedge and reed grasses with interspersed clumps of swamp birch, brown moss, and tamarack.

Minor areas of the Waterhen series, a Terric Humic Mesisol, the Halcrow series, a Terric Mesisol, sphagnic phase, and the Shiel series, a Terric Limno Mesisol, may be included in some map units represented by the Crane series. The Crane series is often associated in map units

with soils of the Halcrow and Stead series. The soils of the Crane series differ from the Cayer and Kircro series only in the nature of the underlying mineral substrate.

Davidson Series (DVD)

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

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 (Cca) may be present at 30 to 50 cm depth. Internal drainage is satisfactory as indicated by the absence of iron mottling within the meter depth or at the sand-clay or sand-till contact.

Delmar Series (DMR)

The Delmar series is a poorly drained, carbonated Rego Humic Gleysol developed on moderately coarse (VFS, LCoS, LFS) to medium (VFSL, L, SiL) textured sediments overlying fine (SiC, C) textured lacustrine clay. The surface texture is variable ranging from very fine sandy loam, sandy clay loam to silt loam. The topography is depressional, level or gently sloping. The soil drainage is poor because of the lack of runoff, high water table or lateral seepage above the clay layer. Permeability is moderate to moderately slow in the moderately coarse textured deposits and slow to very slow in the lacustrine clay below. Native vegetation consists of sedges, rushes, and willow. In areas where there is upward flow of groundwater, salinity maybe a problem. Delmar, slightly saline phase soils are similar in profile characteristics to the Delmar series but have an accumulation of soluble salts other than gypsum within the effective rooting zone of plants in sufficient quantity to affect crop growth. These soils either have an inflow of near surface water that contains appreciable soluble salts or occurs in discharge areas with a near surface static water level and saline waters.

The soil is characterized by a very dark gray, carbonated Ah horizon 15 to 20 cm thick, and a gray carbonated AC horizon. Prominent yellowish brown iron mottles are present in the subsoil. In virgin sites up to 15 cm of fibric to humic peat may be present. A description of the Delmar series is given below.

Ahk1 - 0 to 8 cm, dark gray (10YR 4/1 dry, 10YR 2.5/1 moist); mucky loam; moderate, fine granular; friable when moist, soft when dry; mildly alkaline, moderate effervescence; clear, smooth boundary.
Ahk2 - 8 to 20 cm, gray (2.5Y 5/0 dry, 2.5Y 2.5/0 moist), loam; weak to moderate, fine platy to fine granular; friable when moist, soft when dry, slightly plastic, mildly alkaline; moderate effervescence; clear, smooth boundary.
AC1 - 20 to 28 cm, white (10YR 8/1 dry, 2.5Y 5/2 moist), silt loam, moderate, fine platy to weak fine granular; friable when moist, slightly hard when dry, slightly plastic, mildly alkaline; moderate effervescence; numerous, coarse, distinct light gray (2.5Y 7/2 moist), carbonate mottles; clear, smooth boundary.
AC2 - 38 to 40 cm, gray (10YR 5.5/1 dry, 10YR 3.5/1 moist), loam; very weak fine granular; very friable when moist, soft when dry, slightly plastic; mildly alkaline; moderate effervescence; clear, smooth boundary.

Ckg1 - 40 to 46 cm, light gray (2.5Y 7/2 dry, 2.5Y 6/2 moist), fine sand; single grained; loose when moist or dry, non-plastic; mildly alkaline, moderate effervescence; few, fine, distinct yellowish brown (10YR 5/8 moist), mottles; clear, smooth boundary.
Ckg2 - 46 to 66 cm, light gray (2.5Y 7/2 dry, 2.5Y 6/2 moist), fine sand; single grained; loose when moist or dry, non-plastic; mildly alkaline; moderate effervescence; numerous, coarse, prominent yellowish brown (10YR 5/8 moist), and few, medium, prominent black (10YR 2.5/1 moist), mottles; clear, smooth boundary.
Ckg3 - 66 to 99 cm, light gray (2.5Y 7/2 dry, 2.5Y 6/2 moist), fine sand; single grained; loose when moist or dry, non-plastic; non-sticky when wet; mildly alkaline; moderate effervescence; few, fine, distinct, yellowish brown (10YR 5/6 moist), mottles; abrupt, smooth boundary.
II Ckg - 90 to 100 cm, gray (5Y 5/1 dry, 2.5Y 4/2 moist), clay; weak, medium platy (varved); very sticky when wet; very plastic; mildly alkaline; moderate effervescence; few, medium, prominent white (2.5Y 8/2 moist), carbonate mottles.

Dencross Series (DCS)

The Dencross series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on (<1 m) of moderately to strongly calcareous, shallow clayey, lacustrine, deposits over very strongly to extremely calcareous, silty, lacustrine deposits. These soils occur in mid to upper positions of level to very gentle slopes on level to undulating landscapes and have slow to moderate permeability, slow surface runoff and a medium water table during the growing season. Dencross soils are non to slightly eroded, non stony and may be saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes prairie grasses, aspen and willow. The majority of these soils are currently used for crop production.

In a representative profile of Dencross soil the solum is approximately 40 cm thick. The profile is characterized by a thin, very dark gray, clay Ah horizon, 15 to 25 cm thick; a moderately calcareous, dark gray, clay, AC horizon, 15 to 20 cm thick; a light gray, clay to silty clay, moderately calcareous, Ckgj horizon, 20 to 30 cm thick and a light olive brown, very strongly calcareous, SiL to SiCL, II Ckgj horizon. The parent material is typically clayey over silty. A typical profile also contains an underlay of clay below the silty strata at or below 1 m.

Dencross soils occur in close association with Hodinott and Red River soils. They are similar to Hoddinott soils by having a silty subsoil but differ from Red River soils which are more uniformly clayey throughout. Dencross soils were previously mapped as, part of the Emerson (heavy) Association in the Morris Map Sheet (Report No. 5, 1953).

Fisher Series (FIH)

The Fisher series consists of imperfectly drained Gleyed Cumulic Regosols developed on strongly to very strongly calcareous, stratified dominantly medium to moderately fine textured alluvial sediments. These immature soils occur on the flood plain and levees of the Icelandic and Fisher Rivers. The surface texture is dominantly silty clay loam to clay loam, but silt loam or silty clay may be encountered. The topography is very gently to gently sloping. Native vegetation consists of aspen, black poplar and willow. The soil profile is characterized by a thin, weakly expressed Ah horizon of 6 to 10 cm that grades sharply into the stratified alluvial sediments. The A horizon has fine granular structure, is mildly alkaline and weakly calcareous. Under cultivation, the surface colors range from light gray to dark gray. The C horizon is strongly to very strongly calcareous, stratified, and may contain darker materials representing former surfaces which have been covered by more recent deposition of sediments.

Fisherton Series (FHT)

The Fisherton series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on strongly calcareous, dominantly moderately fine textured (SCL, CL, SiCL) lacustrine sediments overlying extremely calcareous loamy glacial till within 1 metre. The topography is level to very gently sloping; runoff is moderately slow and permeability is moderately slow. Native vegetation consists dominantly of aspen, white spruce with occasional willow.

The Fisherton soil is weakly degraded and is characterized by a thin dark gray Ahej horizon, 4 to 10 cm thick and a weakly developed Bt horizon. A thin gravel or cobble strata may occur at the contact of the extremely calcareous loamy till. Fine to medium yellowish brown iron mottles may be observed at or below this contact. The chemical and physical properties are similar to the Warner series.

Fortier Series (FTE)

The Fortier series is a Gleyed Cumulic Regosol soil developed on imperfectly drained, moderately to strongly calcareous, clayey (SiC, C) fluvial sediments. These soils occur in smooth, level topography beyond the levees of the Whitemud River, and Pine and Squirrel Creeks in association with Dufresne, Willowbend, Gervais and La Salle soils. Periodic overflow or ponding occurs with spring runoff or during periods of high rainfall. Surface runoff is slow. Permeability is slow due to the clay textures and downward movement can be restricted by a high water table, especially in spring. Although Fortier soils are cultivated, small remnant stands of native vegetation support tall prairie and prairie-meadow grasses with some deciduous trees.

The Fortier soil profile has a weak, dark gray to gray Ah horizon, 10 to 20 cm thick which is slightly darker in color than the underlying mottled C horizon. Thin layers of very fine sandy loam, silt loam and silty clay loam are often present in the dominantly clayey profile. Buried Ah horizons occur in profiles in some areas. Fortier soils are finer textured and less permeable than the coarser textured Gervais soils. These soils have moderately severe agricultural limitations due to wetness and the possibility of seasonal inundation. Fortier soils take longer to warm up in spring and take longer to become trafficable after rain than coarser textured soils.

Framnes Series (FMS)

The Framnes series consists of imperfectly to moderately well drained Gleyed Dark Gray Chernozem soils developed on 15 to 90 cm of moderately to strongly calcareous lacustrine clay underlain by very strongly to extremely calcareous medium textured (L, SiL) sediments. The topography is smooth, nearly level; permeability is moderately slow in the lacustrine clay strata and variable from moderate to slow in the silty strata. The medium textured strata vary in thickness from 40 to 90 cm or deeper and are usually underlain by lacustrine clay. The native vegetation consists of aspen, balsam poplar, ash, dogwood and grass species.

The soil is characterized by a thin, slightly acid, leaf mat underlain by a variable dark gray to gray A horizon, 5 to 15 cm thick, and a very dark grayish brown Btj horizon 25 to 40 cm thick and usually extends (or tongues) into the calcareous C horizon.

Fyala Series (FYL)

The Fyala series consists of poorly drained Peaty Rego Humic Gleysol soils developed on weakly to moderately calcareous lacustrine clay deposits. Surface texture of cultivated soils is clay, but usually contains a high percentage of peaty material that has been incorporated with the mineral material. Fyala series are clay textured throughout the profile. Internal drainage in these soils is impeded by fine textures and a high ground water table. The soils are stone free.

The Fyala soils have a surface layer of fibrous, medium acid to neutral peat and muck that is 0 to 15 cm thick, underlain by a thin, very dark gray Ah horizon high in organic matter and neutral to mildly alkaline in reaction. The Ah horizon is from 5 to 15 cm thick, but frequently tongues into the Ckg horizon to depths of 20 to 30 cm. The Ckg horizon is grayish brown to olive gray, contains numerous, large concretions of lime carbonate and is iron stained.

Garrioch Series (GRH)

The Garrioch series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on sandy skeletal outwash or beach deposits overlying extremely calcareous loamy till. The surface texture varies from loamy fine sand to sandy clay loam and is underlain by a gravelly layer that varies from 50 to 100 cm thick. The topography is level to very gently sloping. Imperfectly drained soil conditions are due to perched water conditions above the slowly permeable till and also because of lateral flow and seepage from adjacent upland areas. Native vegetation consists dominantly of tall prairie grasses with some aspen and willow.

The soil is characterized by very dark gray Ah horizon 15 to 20 cm thick and a carbonated and gravelly, loamy coarse sand AC horizon 10 cm thick. The solum has variable thickness depending on the depth of the sandy surface sediments to the coarser gravelly strata. These soils are similar in physical characteristics to the associated well drained, East Bay and Gunton series, the imperfectly drained Beaverdam series, and the poorly drained Eddystone and Berry Island series. Garrioch soils were previously mapped in the Agassiz, till substrate phase, soil association in the reconnaissance survey of soils in the Winnipeg map sheet area.

Garson Series (GSO)

The Garson series consists of moderately well to well drained Orthic Gray Luvisol soils developed on very strongly to 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 (L-F-H), 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 be somewhat compact and platy.
These soils are similar in physical characteristics to the associated well drained, Aneda series, the imperfectly drained Inwood and Lundar series, and the poorly drained Clarkleigh and Meleb series. Garson soils were previously mapped in the Garson soil association in the reconnaissance survey of soils in the Winnipeg map sheet area.

Glenella Series (GNL)

The Glenella series consists of imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils developed on dominantly coarse loamy sediments overlying clayey lacustrine sediments. Surface texture is dominantly very fine sandy loam, but may vary from loamy very fine sand to sandy clay loam. The topography is level to very gently sloping; runoff is moderately slow to slow; permeability is moderate in upper coarse loamy sediments and slow in the underlying clay. In some areas, lateral flow of water may occur through the very fine sand strata above the clay. Salinity may be present in some soils. The native vegetation consists of tall prairie grasses, some aspen or willow.

The soil is characterized by a very dark gray, strongly to very strongly carbonated Ah horizon 10 to 20 cm thick, a thin 7 to 10 cm, transitional AC horizon. The underlying stratified sediments often contain less carbonates than the near surface horizons and are mottled; they may have coarser strata of loamy very fine to fine sand. Associated soils are the imperfectly drained Greenwald series and the poorly drained Delmar series. The soil description is similar to Plum Ridge series except that moderately calcareous clay occurs within a depth of 1 metre. Glenella soils were previously mapped in the Lakeland soil association in the reconnaissance survey of soils in the Winnipeg map sheet area.

Glenfields Series (GFS)

The Glenfields series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on strongly to very strongly calcareous, dominantly fine loamy (CL, SiCL) lacustrine and alluvial sediments. These deposits are stratified and may be underlain by clay or glacial till at a depth below 1 metre. Surface textures range from loam to clay loam. Movement of water through the profile is impeded by a high water table and by alternating sandy to fine loamy strata. In some areas, the saline phase of these soils may contain sufficient soluble salts within the profile to affect crop growth.

The cultivated Glenfields series is characterized by a black organic layer or mixed organic and mineral material, 10 to 12 cm thick, that is friable when moist and moderately calcareous; and a black (moist) Ah horizon of 8 to 15 cm thick with variable carbonate content. A dark gray transitional AC horizon, 9 to 15 cm thick and a Ckg horizon with distinct, yellowish brown mottles are present. Within the Glenfields areas, dry surface color varies from black to grays; the gray colors are due to high carbonate content in the Ah horizon.

The Glenfields, peaty phase consists of soils with a similar profile except that a thick organic layer (15 to 40 cm) occurs at the surface. Glenfields soils were previously mapped in the Lakeland soil association in the reconnaissance survey of soils in the Winnipeg map sheet area.

Glenhope Series (GHP)

The Glenhope series consists of imperfectly drained, carbonated Gleyed Rego Black Chernozem soils developed on strongly calcareous coarse loamy (LVFS, FSL, VFSL) lacustrine sediments, overlying extremely calcareous loamy glacial till. The surface texture ranges from loamy very fine sand to sandy clay loam. The topography is level to very gently sloping. Runoff is slow, and permeability in the upper strata is moderate when moist. Permeability may be restricted due to a perched water table above the slowly permeable till during the spring runoff or following heavy rains. In some areas where lateral flow of saline water occurs, the soils may

be sufficiently saline to affect crop growth. The native vegetation is meadow-prairie grasses and herbs with scattered groves of aspen, black poplar and willow.

The Glenhope soil is characterized by very dark gray to black carbonated granular Ah horizon 10 to 20 cm thick and a thin transitional AC horizon 5 to 10 cm thick. A white layer of calcium carbonate accumulation (Cca) may be present. Underlying sediments are stratified, pale brown to white in color, and generally become slightly coarser with depth. Extremely calcareous loamy till usually occurs at 60 to 80 cm depth, but ranges from 40 to 100 cm.

The soil profile, texture and drainage are similar to the Plum Ridge, however the Plum Ridge series consists of coarse loamy stratified sediments to a depth of 1 metre or more; the Glenella soils are similar to the Glenhope, but are underlain by clayey sediments within the 1 metre depth. Glenhope soils were previously mapped in the Woodlands soil association in the reconnaissance survey of soils in the Winnipeg map sheet area.

Glenmoor Series (GOO)

The Glenmoor series consists of poorly drained Rego Humic Gleysol soils developed on a thin mantle (< 1 m) of moderately to strongly calcareous, clayey lacustrine deposits over very strongly to extremely calcareous, silty, lacustrine deposits. An underlay of lacustrine clay generally occurs below the silty deposits. These soils occur in low to depressional positions of level to nearly level landscapes and have slow to moderate permeability, very slow surface runoff and a high water table during the growing season. Glenmoor soils are non-eroded, non-stony and may be saline. Native vegetation often includes sedges, grasses and willow. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. With adequate drainage, the majority of these soils are currently used for crop production.

In a representative profile the solum is approximately 10 to 25 cm thick. The profile is characterized by a thin, very dark gray (10YR3/1 dry), weakly calcareous, clay to silty clay A horizon 0 to 22 cm thick. A moderately to very strongly calcareous, olive gray (5Y6/2 dry), silty clay, Ckg horizon 22 to 45 cm and a pale olive to olive, very strongly to extremely calcareous, SiL to SiCL, mottled, II Ckg horizon are also present. The parent material is a silty sediment underlain by a clayey substrate.

Greenwald Series (GEW)

The Greenwald series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on moderately to strongly calcareous coarse loamy (VFS, LVFS, SL, FSL, VFSL) sediments over moderately to strongly calcareous lacustrine clay. These soils are similar to Ladywood series except they have a clay strata occurring within 1 metre of the surface. Surface textures are variable ranging from very fine sand to clay loam. Topography is level to irregular, very gently sloping; runoff is moderately slow and permeability is moderately rapid in the upper strata and slow in the underlying clay strata. A temporary saturated condition occurs above the clay strata during the spring and following intense rains. Native vegetation consists of aspen, hazel, rose, forbs and grasses; some willow or occasional bur oak.

A thin leaf and forb layer overlying a dark gray A horizon 10 to 15 cm thick that contains light gray blotches characterizes the soil. The dark grayish brown B horizon is loamy very fine sand to fine sandy loam, fine to medium granular and may contain some translocated clay. The B

horizon may also contain some carbonates, mainly as small carbonate sand grains. Weak iron mottles may be present in the solum, but are more distinct in the lower portions of the profile. The underlying light brownish gray (10 YR 6/2 dry) II Ckgj horizon is variable silty clay loam to clay.

L-H - 5 to 0 cm, dark reddish brown (5YR 3/1 moist), partially to well-decomposed leaf litter; neutral; abrupt, smooth boundary.
Ahe - 0 to 12 cm, dark gray (10YR 4/1 dry, 10YR 2/1 moist); sandy loam; very weak fine granular; very friable when moist, soft when dry, non-plastic; mildly alkaline, clear, smooth boundary.
Bm - 12 to 24 cm, dark grayish brown (10YR 4/2 dry, 10YR 4/3 moist), fine sandy loam; weak fine granular; very friable when moist, soft when dry non-plastic: mildly alkaline; weakly calcareous, mainly on sand grains: clear, smooth boundary.
BC - 24 to 36 cm, light yellowish brown (10YR 6/4 dry, 10YR 6/4 moist), loamy very fine sand, very weak fine platy; loose when moist or dry; moderately alkaline; very strongly calcareous, very fine faint mottles; abrupt smooth boundary.
II BC - 36 to 39 cm, brown to dark brown (10YR 4/3 moist), clay loam; weak fine platy, friable when moist, slightly hard when dry, plastic; moderately alkaline; very strongly calcareous; common, medium, distinct brownish yellow (10YR6/8 moist), mottles: clear smooth boundary.
II Cca - 39 to 54 cm, light gray to white (10YR 7/1 dry, 10YR 6/3 moist), variable silty clay loam and clay; moderate, medium granular; firm when moist, hard when dry, plastic; moderately alkaline, extremely calcareous; few, fine, faint yellowish brown (10YR 5/6 moist) mottles; clear smooth boundary.
II Ckgj1 - 54 to 80 cm, light brownish gray (10YR 6/2 dry, 10YR 5/4 moist), variable silty clay loam and clay; moderate, medium granular; firm when moist, hard when dry, plastic; moderately alkaline; strongly calcareous; common, medium distinct white (I0YR 8/1 moist) mottles; clear, smooth boundary.
II Ckgi2 - 80 to 100 cm, light brownish gray (10YR 6/2 dry, 10YR 5/3 moist), variable silty clay loam and clay; moderate, medium granular; firm when moist, hard when dry, plastic; moderately alkaline; strongly calcareous; common, medium, distinct white (10YR 8/1 moist) mottles.

Grindstone Series (GDT)

The Grindstone series consists of poorly drained Terric Mesisol organic soils developed on shallow deposits (40 to 160 cm) of moderately well to well decomposed forest peat. These soils are underlain by very stony, extremely calcareous, medium textured till within 160 cm of the surface. These soils are composed dominantly of mesic forest peat which is usually slightly acidic and layered with woody logs and debris. Feathermosses, the dominant peat in these soils decomposes rapidly and more completely, than other materials and imparts a very dark brown to black color to the matrix. The organic portion of this soil is similar to the Okno series, but differs from the Okno due to the stony till mineral substrate rather than a fine textured lacustrine substrate.

The native vegetation consists mainly of black spruce forest with some larch; the under story is characterized by ericaceous shrubs (Labrador tea and leather leaf) and feathermosses. Sphagnum species however do occur in some very poorly drained less productive sites. A description of the Grindstone series is given below.

Of1 - 0 to 5 cm, light gray fibrous sphagnum peat (10YR 7/2 natural, 10YR 7.5/2 pressed, 10YR7/2 rubbed), fine fibered, fibrous, non-sticky when wet, abrupt wavy boundary.

Of2 - 5 to 20 cm, grayish brown (10YR 5/2 natural, 10YR 6/3 pressed, 10YR 2.5/2 rubbed), sphagnum and mixed moss; fine fibered, moderate wood content; non-sticky when wet; neutral; abrupt smooth boundary.
Om1 - 20 to 82 cm, very dark brown (10YR 2/2 natural, 10YR 4/3 and 3/2 pressed), mesic forest peat, very fine fibered, low wood content, slightly sticky when wet; medium acid; abrupt, smooth boundary.
II Ckg - 82 cm +, greenish gray (5GY 6/1 moist), sandy loam till, moderately alkaline; very strongly calcareous.

Grossil Series (GSI)

The Grossil series consists of moderately to well drained Calcareous Black Chernozemic soils developed on a thin layer of clay textured lacustrine sediment overlying extremely calcareous loamy glacial till. The clay layer varies from 15 to 75 cm in thickness. The topography is very gently to gently sloping and runoff is moderate. Permeability is slow in the clay layer and moderately slow in the loamy glacial till. In some areas, a clayey textured till (a mixture of clay and extremely calcareous loamy till) occurs below the surface clay layer. Whenever this till is encountered the soil is referred to as a variant (GSI1) of the Grossil series. Native vegetation consists of tall prairie grasses, aspen, and bur oak.

The soil is characterized by a granular very dark gray Ahk horizon 10 to 20 cm thick and a pale brown Bm horizon 10 to 15 cm thick. The B horizon grades sharply into a moderately calcareous Ck horizon. In some cases, a thin accumulation of carbonates (Cca horizon) is present. Where the clay sediment is thin, part of the B horizon extends into the loamy till, water modified till or to a gravelly lens. In areas where the clay till (GSO1) occurs below the lacustrine clay, it is often difficult to differentiate the contact of the lacustrine clay and the clay till, except for the pockets of extremely calcareous cobbly till.

The upper clay layer is similar in properties in both the Grossil series and its variant (GSO1). However, the subsoil of the normal Grossil series has chemical and physical properties similar to that described for the parent material for the Aneda and Isafold series.

Gunton Series (GUO)

The Gunton series consists of well to moderately well drained Orthic Dark Gray Chernozem soils developed on thin sandy and gravelly outwash or water-worked, moderately to strongly calcareous deposits overlying extremely calcareous stony glacial till. The profile is similar to the Leary series with a surface texture ranging from loamy fine sand to fine sandy loam; the thickness of the sandy to coarse loamy upper layer is 15 to 40 cm and changes abruptly to stratified gravelly and sandy deposits which vary in thickness from 10 to 60 cm. Topography is irregular, very gently to gently sloping; surface runoff is moderate to moderately slow in underlying sediments. 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 and grass vegetation, a dark gray Ah or Ahe horizon of variable thickness depending on the uniformity of the sandy to coarse loamy layer, and a brown to dark yellowish brown Bm or Bt horizon which usually terminates at a layer which contains coarser fragments. The underlying loamy glacial till is pale brown and varies in structure from weak fine granular to somewhat platy or fissile.

L-H - 4 to 0 cm, dark grayish brown (10YR4/2 dry) leaf mat and twigs in the surface and moderately decomposed above the mineral soil; neutral; abrupt, smooth boundary.
Ahe - 0 to 3 cm, dark grayish brown (10YR 4/2 dry) sandy loam; very weak, fine to very fine granular; loose; non-plastic; neutral; non-calcareous; abrupt, smooth boundary.
Ae - 3 to 6 cm, brown (10YR 5/3 dry) loamy sand; single grained; loose; non-plastic; neutral; non-calcareous; clear smooth boundary.
Bt - 6 to 16 cm, dark brown (7.5YR 3/2 dry) gravelly sandy loam; moderate, medium sub-angular blocky; slightly hard when dry; slightly plastic; neutral; contains sand and pebbles grains of carbonate mineral; abrupt, smooth boundary.
Ck1 - 16 to 46 cm, light yellowish brown (10YR 6/4 dry) gravelly sand; single grained; loose; non-plastic; mildly alkaline; very strongly calcareous; abrupt, smooth boundary.
II Ck1 - 46 to 100 cm, pale brown (10YR 6/3 dry) loam; moderate, fine platy; hard when dry; plastic; mildly alkaline; extremely calcareous.

Hoddinott Series (HDN)

The Hoddinott series consists of imperfectly drained Gleyed Black Chernozem soils developed on a thin clayey strata over a very strongly to extremely calcareous silty lacustrine strata, which vary in thickness from 20 to 75 cm and in turn overlies calcareous clay. Surface texture may vary from clay loam to clay. The topography is level to very gently sloping; runoff is slow; and permeability is moderately slow in the upper clay strata, and variable from moderately rapid to slow in the silty strata due to the variability of the silt content, stratification and thickness. Permeability of the underlying clay is slow. Native vegetation consisted of tall prairie grasses and dispersed clumps of aspen and willow.

The soil is characterized by a dark granular Ah horizon 12 to 20 cm thick and a dark grayish brown Bmgj horizon 10 to 18 cm thick. The structure is medium prismatic to fine granular. The solum is developed in the upper clay strata with an abrupt change at the extremely calcareous silty strata, although some tonguing of the clay into the silty strata may be noted. Hoddinott soils occur in close association with Dencross and Glenmoor soils. They were previously mapped as the Blackearth-Meadow associate of the Emerson (heavy) association in the Winnipeg-Morris Report No. 5, 1953.

Hodgson Series (HDG)

The Hodgson series consists of moderately well drained Cumulic Regosol soils developed on strongly to very strongly calcareous stratified dominantly medium to moderately fine textured (VFSL, L, SiL to SCL, CL SiCL), alluvial deposits. These soils occur on the upper parts of the floodplain and levees. Topography is ridged, with gentle to steep short slopes. Runoff is moderate, and permeability varies from moderate to slow depending on the texture of the layers. Native vegetation consists principally of elm, ash, basswood, hazel, rose, forbs and grasses.

The soil is characterized by a thin, weakly developed dark gray to gray Ah horizon 5 to 15 cm thick which is fine granular, friable, neutral to mildly alkaline and may contain lime carbonate. The underlying material is stratified, strongly calcareous and may contain dark colored bands representing former surface layers. These soils occur in close association with Fisher soils and are difficult to separate in levee-dominated units. The chemical and physical analysis of the Hodgson soil is similar to the Fisher soil.

Inwood Series (IWO)

The Inwood series consists of Gleyed Dark Gray Chernozem soils developed on extremely calcareous, medium textured (VFSL, L, SiL) till. The dominant surface texture is loam but may have loamy fine sand to fine sandy loam in water-worked areas. They occur on the intermediate and lower landscape position on very gently to irregular very gently undulating topography. Runoff is slow; permeability is moderately slow. Near surface water table may be high during the spring of the year. The areas are generally stony; the frequency of stones increases in areas of more severe water working. Native vegetation is dominantly aspen, with some rose, willow, meadow-prairie grasses and herbs.

The Inwood soils are characterized by a shallow solum with a thin LH horizon, a thin Ahe horizon 3 to 8 cm thick, a weakly developed Bt horizon 4 to 15 cm thick which grades sharply into the extremely calcareous till. Inwood soils have loamy glacial till that is quite variable in thickness, ranging from a metre thick to greater than 15 metres.

Isafold Series (ISF)

The Isafold series is a moderately well drained Rego Black Chernozem soils developed on extremely calcareous, medium textured (VFSL, L, SiL), stony till. While the dominant surface texture is loam, textures range from very fine sandy loam to clay. These soils occupy the well drained ridges and knolls; topography is level to irregular, gently sloping. Runoff is moderate and permeability is moderate. Isafold soils are usually very stony; exceedingly stony areas occur on the higher more severely water-worked portions of the ridges. These soils have developed under mixed prairie grasses, but most virgin sites now support near continuous stands of stunted aspen with some bur oak.

The solum of the Isafold soils is thin (8 to 20 cm). Most Isafold soils have a thin leaf and sod mat underlain by a thin, very dark gray to black Ah horizon usually free of carbonates and alkaline in reaction. A gray carbonated transitional AC horizon separates the Ah horizon from the extremely calcareous C horizon. Water-working of the parent material of these soils is evident in a concentration of cobbles, stones and gravel, usually between the AC horizon and the C horizon. Cultivation of the shallow solum incorporates the surface horizons with the calcareous C horizon. The resulting plow layer is dark gray to gray in color and calcareous to the surface. Isafold soils occur in association with the Lundar and Clarkleigh soils. A description of the Isafold series is given below:

L-H - 3 to 0 cm, very dark brown (10YR 2/2 dry) leaf and sod mat; neutral in reaction; abrupt, smooth boundary.
Ah - 0 to 14 cm, black (10YR 2/1 moist) clay loam, moderate, fine to medium granular; friable when moist, slightly hard when dry; neutral in reaction; noncalcareous; clear, wavy boundary.
AC - 14 to 20 cm, gray (10YR 6/1 dry, 10YR 5/2 moist) loam; weak, fine granular; very friable when moist, soft when dry; mildly alkaline; very strongly calcareous; gradual, wavy boundary.
Cca - 20 to 43 cm, light gray (10YR 7/2 dry, 10YR 6/2 moist) silty clay loam; weak, fine granular; very friable when moist, slightly hard when dry; moderately alkaline; extremely calcareous; diffuse, smooth boundary.
Ck - 43 to 100 cm, very pale brown (10YR 7/3 dry, 10YR 5/5 moist) silt loam; weak fine granular; very friable when moist; slightly hard when dry; moderately alkaline; extremely calcareous.

Kergwenan Series (KRW)

The Kergwenan series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on strongly calcareous, sandy and gravelly out wash or beach deposits. Surface texture is usually finer ranging from a fine sandy loam to loam. The topography is very gently sloping to level. Surface runoff is slow; permeability is rapid. Drainage is imperfect because of a fluctuating water table that rises within 50 cm of the surface during the spring or due to lateral seepage. Vegetation consists dominantly of aspen and grasses with some dogwood, balsam poplar and willows.

The Kergwenan soil is characterized by a thin layer of decomposing leaf litter and grasses, a dark gray Ah to Ahe horizon, 10 to 24 cm thick, and a dark grayish brown to very dark grayish brown Bmgj or Btgj horizon which contains dark yellowish brown mottles. Below the B horizon mottles are common, and a lime carbonate enrichment (Cca) may occur.

Kerry Series (KRY)

The Kerry series consists of poorly drained, Peaty Rego Gleysol soils developed on sandy outwash deposits. They occur adjacent to the numerous sandy moraines. They occupy small, level to depressional areas where surface drainage is very slow and internal drainage is impeded because of a high water table.

Kerry soils are characterized by a thin, acid fibrous to mucky peat surface layer 15 to 30 cm thick, underlain by a strongly iron stained Cg horizon. Some profiles have a thin (less than 5 cm) Ah horizon; others have a thin leached or bleached surface horizon that is strongly gleyed and lacks mottling. A representative soil profile of Kerry series is described below.

L-H - 15 to 0 cm, dark brown to black (10YR 3/2 to 2/1 dry) partially to well decomposed sedges, reed-grasses and forbs; neutral; abrupt, smooth, lower boundary.
Ahg - 0 to 5 cm, very dark gray (10YR 3/1 dry) fine sandy loam; weak, fine granular; very friable when moist; soft when dry; neutral; horizon is often discontinuous.
Cg1 - 5 to 35 cm, light gray (2.5Y 7/2 dry) fine sand; loose; mildly alkaline; numerous iron mottles; gradual, smooth, lower boundary.
Cg2 - 35 to 75 cm, pale yellow gray (2.5Y 7/4 to 7/2 dry) fine sand; loose; mildly alkaline; strongly iron stained.

Kircro Series (KIC)

The Kircro series consists of very poorly to poorly drained Terric Mesisol soils developed on shallow (40 to 160 cm) deposits of moderately decomposed fen peat. Little or no (< 15 cm) fibric Sphagnum moss occurs on the surface. Kircro soils are underlain by strongly calcareous sandy or gravelly sediments within 160 cm of the surface. The Kircro soils occur in high nutrient (eutrophic), very poorly to poorly drained, depressional to level areas. Native vegetation is dominantly sedges, brown mosses, and reeds, with willow and swamp birch on local sites having better drainage.

Minor areas of Waldersee series, a Terric Humic Mesisol, and Sturgeon Gill series a Terric Mesisol, sphagnic phase may be included in some map units mapped as the Kircro series. The Kircro series is often associated with soils of the Sand River and the Whithorn complexes. Cayer and Crane series are similar, but are underlain by clay and loamy till respectively.

Kline Series (KLI)

The Kline series consists of poorly drained Rego Humic Gleysol soils developed on thin, fine textured (SiC, C), moderately to strongly calcareous lacustrine deposits overlying stony, extremely calcareous loamy glacial and water-modified till deposits. They occupy the level to depressional sites in the transition belt between the lacustrine and high lime glacial till soils. Runoff is very slow, and permeability is very slow. Natural vegetation is dominantly meadow grasses, sedge with some willow and balsam poplar. Kline soils are characterized by a thin partially decomposed organic layer 5 to 15 cm thick, a very dark gray to dark gray Ah horizon 10 to 15 cm thick and a dark gray to olive gray calcareous C horizon; a thin pebble line may be present at the contact of the high lime glacial till in some areas.

The solum is similar in properties to the Osborne clay, and the subsoil is similar to the Ckg horizon of the Meleb and Inwood series. The Kline, clay till variant, KLI1, consists of soil similar in profile characteristics to the normal Kline clay except that the substrate is a clay till (a mixture of clay material with a color of 5Y 5/3 and loamy, extremely calcareous deposits with a color of 5Y 7/2).

Ladywood Series (LYW)

The Ladywood series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on moderately to strongly calcareous, stratified dominantly loam textured alluvial and lacustrine deposits. These soils are similar to the Greenwald or Woodmore series, but do not have the clay or till within a meter of the surface. Surface textures are variable ranging from very fine sand to clay loam. Topography is level to irregular very gently sloping. Surface runoff is moderately slow; and permeability is moderate, but often restricted due to a high water table.

The Ladywood soils are characterized by a thin leaf and forb layer overlying a thin dark gray Ah horizon which contains patches of light gray material. The very dark gray to dark gray B horizon usually contains some translocated clay. For an example of the properties of the solum, refer to the Greenwald or Woodmore series; the parent materials to a depth of 1.2 m are similar to the Ladywood series.

Lakeland Series (LKD)

The Lakeland series consists of imperfectly drained Gleyed Rego Black carbonated soils developed on moderately to extremely calcareous, dominantly fine loamy (CL, SiCL) sediments. Surface textures range from loam to clay loam and occasionally silty clay. The topography is level to very gently sloping; runoff is slow; and permeability is moderate to moderately slow. The native vegetation consists of meadow grasses with clumps of willow. In some areas, there is an upward flow of groundwater containing soluble salts. Where the salt content in the rooting zone is sufficient to affect crop growth, the Lakeland slightly saline phase is mapped. Lakeland soils like most soils developed on extremely calcareous parent material have shallow soil profiles. The thin 15 to 25 cm very dark gray Ah horizon is granular, and usually moderately to strongly calcareous. This horizon is usually separated from the pale yellow, extremely calcareous Ckgj horizon by a thin (15 to 20 cm) transitional, AC or Cca layer that is usually very strongly calcareous.

These soils were formerly mapped as the imperfectly drained Blackearth-Meadow associates of the Emerson (silty clay loam) Association in the Winnipeg-Morris (1953) report.

Leary Series (LRY)

The Leary series consists of well to rapidly drained Orthic Dark Gray Chernozem soils developed on moderately to strongly calcareous, deep, stratified, sandy to sandy-skeletal (LCoS, GrLS), glaciofluvial deposits. These soils occur in middle to upper slope positions of moderate slopes on hummocky landscapes and have very rapid permeability and a low water table during the growing season. Leary soils have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation often includes forests of dominantly bur oak. The majority of these soils are currently excavated for road construction material and the aggregate industry.

In a representative profile the solum is approximately 50 cm thick. The profile is characterized by a dark gray Ah or Ap horizon, 10 to 20 cm thick, a dark brown Bt or Btj horizon, 5 to 20 cm thick, a brown transitional BC horizon, 15 to 30 cm thick and a light yellowish brown Ck horizon with thin layers of coarse sand, fine sand and gravel.

Ledwyn Series (LWY)

The Ledwyn series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on very strongly to extremely calcareous, dominantly moderately fine textured (SCL, CL, SiCL) sediments. Surface textures range from very fine sandy loam to silty clay loam; the soils commonly become slightly coarser with depth and are often stratified with very fine sand. The topography is level to very gently sloping; runoff is slow and internal drainage may be impeded by a high water table. Native vegetation is dominantly aspen and white spruce.

The soil is characterized by a thin, dark gray Ahej horizon with areas of gray patches in the lower portion. The B horizon is grayish brown, granular, iron stained and has a slight clay accumulation. The solum is shallow, generally less than 25 cm thick. Occasional flooding by lime-charged water causes these soils to be carbonated in the A and B horizons. A representative profile is described below.

L-H - 3 to 0 cm, very dark brown (10YR 2/2 dry) leaf mat of partially decomposed aspen leaves, mildly alkaline; abrupt, smooth boundary.
Ahej - 0 to 7.5 cm, very gray (10YR 3/1 dry) with locales of gray (10YR 5/1 dry) clay loam; moderate fine granular; friable when moist; slightly hard when dry; mildly alkaline; gradual smooth boundary.
Btg - 7.5 to 15 cm, grayish brown (10YR 5/2 dry) silty clay loam; moderate fine granular; friable when moist; slightly hard when dry; mildly alkaline; iron stained; gradual, smooth boundary.
BC - 15 to 23 cm, light brownish gray (2.5Y 6/2 dry); silty clay loam; weak fine granular; friable when moist; slightly hard when dry; moderately alkaline; calcareous; iron stained; gradual, smooth boundary.
Ckg - 23 to 90 cm, light gray (2.5Y 7/2 dry) stratified very fine sandy loam to silty clay loam; friable when moist; weakly cemented when dry; moderately alkaline and strongly calcareous; iron stained.

Lenswood Series (LSW)

The Lenswood series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately calcareous, dominantly coarse textured (FS, LS, LFS), deltaic sediments. The surface textures range from loamy fine sand to fine sandy loam. The

topography is level to very gently sloping; runoff is moderate to moderately slow; and permeability is moderately rapid, but may be impeded due to a high water table during part of the year. Clay or till deposits occurring below the one metre depth are partially responsible for the impediment of downward water movement, but some lateral movement from better drained soils also occurs. Native vegetation is mainly aspen, balsam poplar, grasses and willow. The majority of these soils are currently used for crop production.

In a representative profile the solum is generally about 50 cm thick. The profile is characterized by a 35 cm thick very dark gray fine sandy loam Ap and Ah horizon overlying loamy fine sand textured calcareous transitional AC horizon, and a pale yellow strongly calcareous fine sand mottled Ckgj horizon.

Libau Series (LBU)

The Libau series consists of well to moderately well drained Orthic Dark Gray soils developed on a thin mantle of lacustrine clay over extremely calcareous medium to moderately fine textured (L, SiL, CL), till within 75 cm of the surface. The underlying till is usually very stony and ranges in texture from loam to clay loam. Terrain on which they occur is irregular, gently sloping. Surface runoff is moderate and internal drainage is moderately slow to slow. Native vegetation is dominantly trembling aspen with bur oak, hazel and native grasses.

The Libau soil is characterized by a dark gray to gray Ahe horizon 6 to 9 cm thick and a very dark grayish brown Bt 20 to 30 cm thick with subangular blocky to coarse granular structure. The Bt horizon usually occurs within the clay deposits but where the till is within 40 cm of the surface, the Bt may extend into the underlying light gray extremely calcareous till. In some cases the till may consist of a mixture of strongly calcareous, fine (SiC, C) and extremely calcareous medium (silt loam to silty clay loam) material, this soil is described as the Libau, mixed till variant, LBU1. The properties of this till are variable depending on the proportion of the fine and medium material.

Lonesand Series (LSD)

The Lonesand series consists of imperfectly drained Gleyed Degraded Dystric Brunisol soils developed on siliceous sandy outwash. The surface texture is loamy fine sand to fine sand. The topography is generally level to irregular, very gently sloping. Surface drainage is slow and internal drainage is impeded by a high water table. The Lonesand soil profile has a light gray, iron stained, strongly acid, Aeg horizon and a loose to very friable, brown, strongly acidic, iron stained B horizon with a weak concentration of iron and organic matter. The C horizon is acid to a depth of about 80 to 110 cm where traces of lime carbonate are encountered.

Lundar Series (LUR)

The Lundar series consists of imperfectly drained Gleyed Rego Black Chernozem 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 loam. The soil occupies the intermediate position between the ridge and swale sequence in the Isafold Association. 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.

Ahk - 0 to 13 cm, very dark gray (10YR3/1 dry), loam to clay loam; moderate fine granular; firm when dry, slightly hard when moist; mildly alkaline and calcareous; diffuse, irregular boundary.
AC - 13 to 28 cm, grayish brown (10YR 5/2 dry), sandy clay loam to clay loam; weak fine granular; firm when moist, slightly hard when dry, plastic and sticky when wet; moderately alkaline and strongly calcareous; iron stained, gradual, irregular boundary.
Ckgj - 28 + cm, blotched light gray (2.5 Y 7/2 dry), loam to silt loam, iron stained with mottles, moderately alkaline and extremely calcareous.

Lydiatt Series (LYI)

The Lydiatt series consists of poorly drained, carbonated Rego Humic Gleysol developed on thin moderately to strongly calcareous dominantly moderately coarse to medium textured sediments overlying a significant lacustrine clay strata over extremely calcareous, loamy glacial till. The solum is similar to the Delmar series, but the clay strata of the Delmar series is thicker and extends below the one metre depth. Topography is level to depressional; runoff is slow; and permeability is slow due to the underlying clay strata. The native vegetation consists of sedge, reed grasses and willow.

The soil is characterized by a thin moderately decomposed peat layer (Om) 6 to 15 cm thick, and a carbonated, friable very dark gray Ah horizon 10 to 20 cm thick; a thin transition horizon between the Ahk and Ckg may tongue into the underlying C horizon. The clay strata usually occur between the 50 and 75 cm depth and have a thickness of 15 to 30 cm; the extremely calcareous loamy till occurs below 75 cm depth. Chemical and physical properties of the underlying clay and loamy till materials are similar to those of Nourse series.

Magnet Series (MGT)

The Magnet series is a carbonated Rego Humic Gleysol soil developed on poorly drained, moderately to strongly calcareous, thin 25 to 100 cm, fine loamy (CL, SiCL, SCL) deltaic and lacustrine sediments overlying extremely calcareous, loamy (SiL, L, CL) till. These soils occur in association with McCreary soils on level to depressional topography. Surface runoff is slow, and permeability is impeded for much of the year by a high water table. In areas where groundwater contains high salt concentrations, salt sensitive crops can be adversely affected. Native vegetation consists of sedges, meadow grasses and willows. These soils are wet for much of the year which causes a very severe agricultural limitation that restricts their capability to produce perennial forage.

The Magnet soil profile has a carbonated, very dark gray Ah horizon, 10 to 25 cm thick; a transitional gray to light gray carbonated AC horizon, 20 to 40 cm thick; a light gray to white, carbonated Ckg horizon 20 to 35 cm thick, and a light gray, extremely calcareous II Ckg horizon with prominent iron mottles. The surface mantle of these soils is coarser textured than the clayey mantle of the Kline soils, and finer textured than the sandy mantle of the Sprague soils.

Malonton Series (MNT)

The Malonton series consists of carbonated, poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous deltaic and lacustrine sandy sediments. Finer

textured sediments may be present near the 1 m depth. The surface texture ranges from loamy fine sand to loam and the topography is depressional, level or very gently sloping. Soil drainage is poor because of a lack of runoff, high water table or lateral seepage above the finer textured sediments below. Vegetation consists of sedges, reed grasses, with areas of balsam poplar, willow, and dogwood.

The soil is characterized by a very dark gray, carbonated Ah horizon 15 to 20 cm thick and a gray, carbonated AC horizon. Prominent yellowish brown iron mottles are present in the Ckg horizon. In native sites, up to 15 cm of fibric to humic peat may be present. Malonton, peaty phase soils have a 15 to 40 cm fibric to humic peat surface. Malonton, drained phase soils have had significant drainage to lower the high seasonal water table to make these soils somewhat similar to the Poppleton series.

Marquette Series (MRQ)

The Marquette series consists of imperfectly drained Gleyed Rego Black soils developed on thin (< 1 m), fine textured, moderately to strongly calcareous lacustrine deposits overlying extremely calcareous, medium to moderately fine textured stony glacial till. They occupy the very gently sloping sites in the transition belt between the lacustrine and high lime glacial till soils. Runoff is moderately slow; and permeability is slow. Natural vegetation consisted of tall prairie grasses, herbs and some aspen.

The Marquette soils are characterized by a very dark gray Ah horizon 20 to 40 cm thick, a dark gray to gray AC horizon 8 to 20 cm thick, and an olive gray Ckgj horizon in which gypsum crystals may be present. Where the clay mantle is shallow the AC horizon may be partly in the extremely calcareous till. A thin pebbly horizon may be present at the contact of the lacustrine and till deposits. The solum is similar to the Red River clay soil where the clay is deeper; the subsoil is similar to the Ck horizon of the Inwood, Aneda or Garson soils. The Marquette, clay till variant, MRQ1, is similar to the normal Marquette series except for the subsoil which consists of a clay till (a mixture of clay and extremely calcareous loamy sediments) instead of the extremely calcareous loamy till.

McCreary Series (MCR)

The McCreary series is a carbonated Gleyed Rego Black Chernozem soil developed on imperfectly drained, moderately to strongly calcareous, thin 25 to 100 cm, fine loamy (CL, SiCL, SCL) deltaic and lacustrine sediments overlying extremely calcareous, loamy (SiL, L, CL) till. These soils occur in association with Magnet soils on level to very gently sloping topography. Surface runoff is slow, and permeability is moderate to moderately slow. In areas where groundwater contains high salt concentrations, salt sensitive crops can be adversely affected. Native vegetation on undisturbed sites consists of prairie grasses, aspen and willows.

The McCreary soil profile has a carbonated, very dark gray Ah or Ap horizon, 15 to 25 cm thick; a calcareous, gray AC horizon, 15 to 25 cm thick; a calcareous C horizon with many prominent mottles 25 to 40 cm thick, and an extremely calcareous, light gray to white IIC horizon. A layer of lime accumulation (Cca horizon), 10 to 15 thick, often occurs below the AC horizon. The solum is usually developed in the fine loamy sediments which normally range from 55 to 90 cm thick with a thin (5 cm), water modified pebble lens at the till surface. These soils have a finer textured surface mantle than the similar Colby soils, and a coarser textured mantle than Marquette soils. They also differ from the somewhat similar Lakeland soils in having a loamy till

substrate within a metre of the soil surface. The McCreary clay till variant, MCR1, consists of a mixture of strongly calcareous, fine (SiC, C) and extremely calcareous medium (SiL, SiCL) material.

Meleb Series (MEB)

The Meleb series consists of poorly drained Rego Humic Gleysol, carbonated phase soils developed on very strongly to extremely calcareous, stony glacial till. A thin peat covering of 0 to 15 cm may be present and underlain by textures ranging from sandy loam to clay due to some wash or sorting 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 consists of thin layer of fen peat overlying a thin black to dark gray (10YR 2/1 moist, 10YR 4/1 dry) Ah horizon 6 to 10 cm thick, alkaline and calcareous, and underlain by a light gray to white (2.5 Y 7/2 moist, 10YR 7/1 dry), very strongly to extremely calcareous Ckg horizon. In soils that have had some wash or sorting, the Ah horizon terminates at the contact of the modified sediments and the till. If the surface mantle is thicker, a thin gravelly or cobble lens may occur at the contact. The Meleb carbonated, peaty phase has a 15 to 40 cm layer of mesic fen peat on the surface.

Morris Series (MRS)

The Morris series consists of imperfectly drained Gleyed Solonetzic Black Chernozem soils developed on moderately to strongly calcareous fine textured (C, HC) lacustrine deposits. They occur on level to very gently sloping topography usually adjacent to or intermediate between poorly drained Osborne clay soils and the imperfectly drained Red River or Scanterbury clay soils. Runoff is moderately slow to slow; permeability is very slow and restricted by the columnar and fine subangular blocky to massive, high swelling B horizons.

In the virgin state, these soils are characterized by a shallow dark gray to gray Ah or Ahej horizon 5 to 8 cm thick, a dark gray to gray columnar Bnjgj1 horizon 10 to 15 cm thick and an amorphous dark gray to black, waxy Bnjgj2 horizon that breaks into coarse subangular blocky peds. Gypsum may be present in the olive gray to grayish brown weakly mottled Ckgj horizon. Under cultivation, most of the columnar Bnjgj1 horizon is incorporated with the Ap horizon. In the moist condition, the Ap is sticky and massive and breaks under pressure into weak, medium to fine granular peds; in the dry condition, the Ap is cloddy and hard, and breaks with difficulty into coarse clods or rounded blocks. The Morris soils occur in close association with the Red River, Scanterbury and Osborne soils. They were previously mapped as the alkalinized associate of the Red River Association in the Winnipeg-Morris (1953) soil report.

Myrtle Series (MYT)

The Myrtle series consists of well to moderately well drained Orthic Black Chernozem soils developed on moderately to strongly calcareous clayey (SiC, C, HC) lacustrine deposits. The surface texture ranges from silty clay to clay. Topography is very gently to gently sloping; runoff is moderate; and permeability is moderate in the solum due to granular structure, but moderately slow to slow at greater depths.

The Myrtle soil is characterized by a deep dark gray Ah horizon 30 to 45 cm thick, with friable

fine granular structure, a dark brown to dark grayish brown Bm horizon, 25 to 40 cm thick, with moderate medium prismatic breaking to medium granular structure. The Ck horizon is light brownish gray to pale brown and has a pseudo-subangular blocky structure. The Myrtle soil is differentiated from the Scanterbury soil by a deeper, friable Ah horizon, brighter chroma in the B horizon and lack of any mottles in the B or upper part of the Ck horizon. The chemical and physical analyses of the Myrtle soil are similar to the Scanterbury series.

Niverville Series (NIV)

The Niverville series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to SCL, CL, SiCL), alluvial and lacustrine deposits overlying lacustrine clay within a metre of the surface. The surface texture is variable ranging from loam, silty loam, silty clay loam and silty clay. Topography is level, runoff is slow, and permeability is moderately slow. Some areas are prone to flooding following the spring snow melt. These soils are similar to the Lakeland series, but differ due to the underlying clay strata.

The soil is characterized by a carbonated, very dark gray Ah horizon 15 to 22 cm thick and a carbonated AC horizon 6 to 15 cm thick which may tongue into the Ckgj horizon. Occasionally, former surface horizons may be present within the control section. The silty stratum usually contains a greater proportion of carbonates than do the layers with less silt.

Nourse Series (NUS)

The Nourse series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on thin (< 40 cm) moderately to strongly calcareous, moderately coarse to medium textured (VFS, LVFS, FSL, L) sediments overlying a significant lacustrine clay strata (50 to 80 cm) over extremely calcareous loamy glacial till. These soils are similar to the Greenwald series which has a thicker lacustrine clay strata and absence of the loamy till at or below 1 metre. The surface texture varies from loamy very fine sand to loam. Topography is very gently to gently sloping; runoff is moderate; and permeability is moderately rapid in the surface strata and moderately slow to slow in the clay and till substrata. Native vegetation consists of trembling aspen, balsam poplar, hazel, dogwood, and native grasses.

The soil is characterized by a dark gray A horizon 15 to 25 cm thick, and a brown to dark brown prismatic to granular Bt horizon 10 to 18 cm thick. The solum is usually developed within the moderately coarse to medium textured sediments, but in some cases the Bt may extend into the fine textured sediments. Some pebbles are commonly encountered at the contact below the coarse to moderately coarse textured sediments and below the fine textured sediments.

Okno Complex (OKO)

The dominant soil within the Okno complex is the Okno series, a Terric Mesisol with less than 15 cm of fibric Sphagnum peat at the surface. The Okno complex is composed of a group of poorly to very poorly drained organic soils developed on mesic forest peat, frequently a thin (0 to 65 cm) discontinuous layer of fibric Sphagnum moss peat overlies the mesic forest peat. Moderately to strongly calcareous loamy to clayey lacustrine sediments occur within 160 cm of the surface. Okno areas are depressional to level. Permeability and runoff are very slow to nil on these soils. Native vegetation is dominantly black spruce with an understory of feather mosses, ericaceous shrubs and Sphagnum moss.

The soils of the Orok complex are commonly associated with the Okno complex. This is due to the hummocky nature of the Sphagnum moss layer overlying the mesic forest peat. The soils of the Orok complex are similar to the Okno series but possess a thicker (15-65 cm) layer of fibric Sphagnum moss peat at the surface. These include dominantly the Orok series, a Terric Mesisol, sphagnic phase, with minor areas of the Kalevala series, a Terric Fibric Mesisol, and the Baden series, a Terric Mesic Fibrisol. The soils of the Okno complex are similar to those of the Grindstone and Rat River complexes, differing from them only in the nature of the mineral substrate. Okno soils occur often in association with soils of the Molson complex and the Orok complex and Howell series. The profile of a representative Okno series may be described as follows:

Om1 - 0 to 15 cm, very dark brown to dark reddish brown (10YR 2/2, to 5YR 2/2, wet), amorphous granular; woody; unrubbed fiber content approximately 46 percent; neutral.
Om2 - 15 to 36 cm, very dark brown to dark brown (10YR 2/2, to 3/3, wet), mixture of coarse woody fibered and moderately coarse non-woody fibered mossy material; unrubbed fiber content approximately 64 percent; medium acid.
Om3 - 36 to 60 cm, very dark brown to dark reddish brown (10YR 2/2 to 5YR 2/2, wet), mixture of mossy, herbaceous and woody material; compacted; unrubbed fiber content approximately 63 percent; medium acid.
II Ahg - 60 to 66 cm, black (2.5Y 2/1, wet), silty clay; massive, plastic and very sticky when wet; medium acid.

Osborne Series (OBO)

The Osborne series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, deep uniform, clayey (C, HC), lacustrine deposits. These soils occur in lower to depressional positions of level to nearly level landscapes and have very slow permeability, slow to very slow surface runoff and a high water table during the growing season. Osborne soils are non-eroded, non-stony and may be saline. They have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes meadow grasses, reeds, sedges and willow. Most of these soils are currently used for crop production and have improved surface drainage.

In a representative profile the solum is approximately 30 cm thick. The profile is characterized by a very dark gray, noncalcareous, clay, Ap horizon, 15 to 20 cm thick, with a thin transitional, dark gray to olive gray weakly calcareous AC horizon, 8 to 10 cm thick and an olive gray, moderately to strongly calcareous, clayey, mottled Ckg horizon. The parent material is typically a uniform clayey lacustrine deposit.

Osborne soils occur in close association with Red River, Morris and Scanterbury soils. They are similar to these soils by having developed on the same parent material but differ because of poorer drainage. Osborne soils were previously mapped as Osborne clay in the Winnipeg-Morris Map Sheet (Report No. 5, 1953).

Peguis Series (PGU)

The Peguis series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on a moderately to strongly calcareous lacustrine clay strata underlain by extremely calcareous loamy glacial till within a metre of the surface. The topography is level to very gently

sloping; runoff is moderately slow; permeability is moderately slow in the upper clay strata and moderate to moderately slow in the loamy substrata. Native vegetation consists mainly of aspen, white spruce, hazel, and native grasses.

The soil is characterized by a thin leaf mat 2 to 4 cm, and a dark gray, granular A horizon 3 to 10 cm, and a medium granular dark gray Bt horizon 12 to 25 cm thick, and a gray Ck horizon. An increase in pebble and stone content may be noticeable at the contact of the clay and loamy till strata.

The Peguis, clay till variant, PGU1, has similar profile characteristics as the normal Peguis series, differing from it in the composition and texture of the underlying till. This till consists of a mixture of strongly calcareous clayey and extremely calcareous loamy materials. This till is less compact and less stony than than the extremely calcareous till.

Pelan Series (PLN)

The Pelan series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on thin moderately to strongly calcareous, coarse textured (FS, LS, LFS) deltaic or lacustrine deposits overlying stony, extremely calcareous glacial till. The surface texture ranges from loamy fine sand to fine sand. A thin stone lime or pebble layer may be present at the contact of the overlay and the extremely calcareous till. The topography is level to very gently sloping; permeability is moderate in the surface layers and moderately slow in the subsoil; this results in impeded internal drainage and temporary saturated conditions, following the snow melt period or above normal precipitation. Runoff is slow. Native vegetation consists of dominantly aspen with some balsam poplar, dogwood or willow.

The Pelan soils are characterized by a thin partially decomposed leaf mat and a dark gray Ah or Ahe horizon 8 to 15 cm thick and a brown to pale brown B horizon of variable thickness from 15 to 40 cm thick that may have slight accumulation or coatings of clay on the sand grains. The solum usually is developed within the overlay, but where the overlay is shallow, part of the B horizon occurs at the contact of the extremely calcareous till. A thin pebble layer or stone line is common at this contact; mottles of iron are common at or above this contact zone.

Pine Ridge Series (PRG)

The Pine Ridge series consists of well drained Eluviated Eutric Brunisol soils developed on moderately calcareous, sandy, deltaic and lacustrine deposits. Surface textures are loamy fine sand to sand. The topography is very gently sloping to irregular, gently sloping and permeability is rapid. Native vegetation consists dominantly of jack pine.

The Pine Ridge soils are developed on sandy deposits with a very low clay content and consequently, the accumulation of clay in the B horizon is usually very low. Frequently the B horizon is developed in a thin gravel lense comprised of decomposing dolostones coated with silt and clay. Very often, the B horizon is not continuous. The horizon appears as an Aej and Btj or Bm horizon and the Aej is thick, often extending to 50 cm or more below the surface.

Plum Ridge Series (PMG)

The Plum Ridge series is a carbonated, Gleyed Rego Black Chernozem soil developed on imperfectly drained, very strongly to extremely calcareous, dominantly coarse loamy (VFSL, L,

SiL) lacustrine sediments. These soils occur on level to very gently sloping topography, in the Red River Valley physiographic region associated with the poorly drained, Wentland soils. Surface runoff is slow, and soil permeability is moderate but may be impeded by a high water table. In areas where the groundwater contains high salt concentrations, sufficient soluble salt can be present in the profile to interfere with plant growth. Tall-prairie grasses with scattered groves of aspen, black poplar and willow once indigenous to Plum Ridge soils have been mostly replaced by cultivated fields.

The Plum Ridge soil profile has a very dark gray to black, Apk or Ahk horizon, 10 to 15 cm thick, separated by a transitional AC horizon, 20 to 30 cm thick, from an extremely calcareous, very pale brown to white Ck horizon. Iron mottling begins in the AC horizon and becomes prominent in the Ckgj horizon. These soils have a moderate agricultural limitation due to moderate surface and internal drainage problems.

Poppleton Series (PPL)

The Poppleton series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on moderately to strongly calcareous, coarse textured (FS, LS, LFS) deltaic and lacustrine deposits. The surface texture is fine sand to loamy fine sand. Topography is level to very gently sloping; runoff is moderately slow and permeability is moderately rapid in the surface, but decreases with depth because of the influence of a capillary fringe above a water table. The native vegetation consists dominantly of aspen with some balsam poplar, dogwood or willow.

The Poppleton soil is characterized by a partially decomposed leaf mat 5 to 12 cm thick, a dark gray to gray Ahe horizon 7 to 12 cm thick; a pale brown B horizon that may have slight accumulation or coating of clay on the sand grains. Iron mottles are common in the lower B horizon, generally increasing in size and abundance with depth. Extremely calcareous, loamy glacial till may occur immediately below the metre depth; some small areas of Pelan soils may be present in areas mapped as Poppleton.

Rat River Series (RTV)

The Rat River series consists of poorly drained Terric Mesisol soils developed on shallow (40 to 160 cm) deposits of mesic forest peat underlain by coarse to moderately coarse textured (FS, LS, LFS, LVFS, FSL) lacustrine sediments. The organic portion has a very thin (<15 cm) fibric moss peat layer, and underlain by dominantly mesic grading into humic forest peat. The mesic forest peat is very dark brown, slightly acid to neutral, fine fibered, sticky material layered with variable amounts of woody debris. This layer grades into black, highly decomposed peat which may be of fen or forest origin. The native vegetation consists of productive stands of black spruce with some tamarack and understory of Labrador Tea, and feathermosses. Sphagnum moss is of limited occurrence being found as small raised hummocks.

Red River Series (RIV)

The Red River series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform, clayey (C, HC), lacustrine deposits. These soils occur in level to upper positions of level to very gentle slopes on level landscapes and have slow permeability, slow to moderate surface runoff and a medium water table during the growing season. Red River soils are non-eroded, non-stony and may be saline.

They have a high available water holding capacity, medium organic matter content, and medium natural fertility. The majority of these soils are currently used for crop production.

In a representative profile the solum is approximately 30 cm thick. The profile is characterized by a black, to very dark gray, clayey Ap horizon, 15 to 20 cm thick, a very dark gray, clayey Ah horizon, 8 to 10 cm thick, a thin, dark gray, calcareous, clay, AC horizon, 6 to 10 cm thick and a dark grayish brown, calcareous, clay Ckgj horizon with faint mottles. The parent material is typically a clay texture. A typical profile contains frequent tonguing of the A horizon into the C horizon.

Red River soils occur in very close association with Scanterbury, Morris and Osborne soils. They are similar to the above soils by having developed on the same parent material but differ because of drainage and profile development. Red River soils were previously mapped as the Red River Association in the Winnipeg-Morris Map Sheet, Report No. 5, 1953.

Rochelle Series (RLL)

The Rochelle series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on moderately to very strongly calcareous, stratified dominantly moderately fine textured (SCL, CL, SiCL), fluvial sediments. They occur in the lower slope position of the stream channels. The upper 25 to 50 cm usually contains layers high in organic matter; textures may range from fine sandy loam to clay loam. Carbonated shell fragments of aquatic organisms are usually present. These soils are subject to seasonal inundation, and subsequent high water table levels. Native vegetation consists of willow, sedge, reeds, and aquatic grasses. The soils are characterized by a partially decomposed leaf and fen layer 8 to 15 cm thick; a thin dark gray, strongly calcareous Ah horizon 10 to 20 cm thick and a light brownish gray to light olive gray Ckg horizon with prominent mottles.

Sandilands Series (SDl)

The Sandilands series consists of moderately well to well drained Degraded Dystric Brunisols developed on siliceous sandy outwash deposits. These deposits are usually quite thick and appear to have been reworked by water and wind. The topography is irregular, gently sloping. Internal drainage is very rapid and runoff is negligible. The native vegetation consists dominantly of Jack-pine forest with an under story of low ericaceous shrubs, lichens, herbs and grass species.

Sandilands soils have weakly developed horizons distinguished by faint changes in color and reaction. They have a thin discontinuous organic layer, a thin, light brownish gray A horizon, and an indefinite Bm (Bfj) that grades gradually into very pale brown fine sand which may contain slight amounts of lime carbonate below a metre of the surface. A representative Sandilands soil profile is described below.

L-H - 1 to 0 cm, brownish gray to very dark brown (10YR 5/2 to 2/2 dry) partially to well decomposed pine needle and forb litter; very strongly acid; abrupt, broken, lower boundary.
Aej - 0 to 5 cm, light brownish gray to light (10 YR 6/2 to 7/1 dry) sand; loose; medium acid; clear, smooth boundary.
AB - 5 to 10 cm, very pale brown (10YR 7/3 dry) fine sand, loose; medium acid; gradual, smooth boundary.
Bm - 10 to 45 cm, very pale brown (10YR 8/4 dry) fine sand; loose; medium acid; gradual, smooth boundary.
C - 45 to 150 cm, very pale brown (10YR 8/3 dry) fine sand; loose; medium acid.

Scanterbury Series (SCY)

The Scanterbury series is a Gleyed Black Chernozem soil developed on imperfectly drained, moderately to strongly calcareous, clayey (SiC, C, HC), lacustrine deposits. These soils occur on level to very gently sloping topography on the Red River Plain in association with Red River, Morris and Osborne soils. Surface runoff is slow and permeability is very slow. Tall prairie and prairie-meadow grasses once found associated with these soils have been mostly replaced by cultivated fields.

The Scanterbury soil profile has a very dark gray Ah horizon, 15 to 30 cm thick that frequently tongues through the B horizon; a very dark gray to dark grayish brown Bmgj horizon, 12 to 40 cm thick; a very dark grayish brown BC, 10 to 15 cm thick, and an olive gray calcareous Ckgj horizon with many, fine, faint mottles. This soil differs from the similar Plum Coulee soil series in having more uniform textures in the subsoil. It differs from Red River soils in having a prominent Bmgj horizon. Scanterbury, Red River and Morris soils are usually found together in such close and intricate association with each other that all three can occur in the same field. Scanterbury soils were part of the Red River Association in the Winnipeg-Morris (1953) soil report.

Sifton Series (SFT)

The Sifton series consists of carbonated, Rego Humic Gleysol soils developed on thin, very strongly to extremely calcareous, moderately fine textured (CL, SiCL) sediments underlain by fine textured (SiC, C) lacustrine deposits. The upper deposits may be stratified and surface textures range from clay loam to silty clay. Topography is smooth and level and the soils are dominantly poorly drained as surface runoff and internal percolation are slow. The Sifton soils mapped as the saline phase are affected by the discharge of saline groundwaters. The surface distribution of salts is variable and sporadic so that the native vegetation consists of sedges and meadow grasses and patches of salt tolerant species.

Profile development in the Sifton saline phase soils is similar to that described for the Glenfields series. The dark colored surface Ah horizon is thin, 8 to l5 cm, usually carbonated and saline. A transitional gray colored AC horizon commonly separates the surface horizon from the light gray to pale yellow extremely calcareous, weakly saline C horizon. This soil differs from the Glenfields soil mainly in that the moderately fine textured C horizon is variably saline and grades into clay sediments usually within 1 m of the surface.

Sprague Series (SPG)

The Sprague series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on moderately to strongly calcareous sandy lacustrine and outwash deposits overlying extremely calcareous, loamy glacial till within one metre of the surface. The texture of the surface horizon varies from sand to fine sandy loam. Surface drainage is slow and the water table is at or near the surface for the greater part of the growing season. Some scattered surface stones may be present within the map unit. Native vegetation consists of sedge, reeds, and willow.

The Sprague soils have a fibrous to mucky organic surface layer of 6 to 15 cm and a thin very dark gray, moderately alkaline Ahg horizon 7 to 12 cm thick, which overlies the iron stained calcareous parent material. The extremely calcareous loamy till occurs at depths ranging from

30 to 100 cm. The solum is similar to the Malonton series. The underlying loamy till substrates is similar to that described for the related Colby, Pelan and Caliento series. With a greater depth of peat surface (15 to 40 cm), the peaty phase of the Sprague soil is encountered.

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 deltaic and lacustrine deposits overlying strongly to extremely calcareous loam textured till deposits. The surface layers range from a fine sand to loamy sand and averages about 30 to 60 cm in thickness. Topography is irregular, very gently sloping. Runoff is moderately rapid and permeability is moderately rapid. The native vegetation consists of bur oak, grasses, some aspen, choke cherry, and saskatoon.

The soil is characterized by a thin, moderately decomposed leaf mat; a thin (4 to 8 cm) dark gray friable 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 Bt 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.

St. Malo Series (SMA)

The St. Malo series consists of well to moderately well drained Orthic Dark Gray Chernozem soils developed on a thin, moderately to strongly calcareous, moderately coarse to medium textured (VFS, LVFS, SL, FSL to VFSL, L, SiL) deltaic and lacustrine sediments over extremely calcareous stony till. The surface texture varies from a fine sandy loam to loam and occasionally clay loam. The topography is very gently sloping; runoff is moderate; and permeability decreases from moderate in the near surface to very slow in the underlying compacted fissile lodgement till. A thin gravelly layer may be present at the contact of the two deposits.

St. Norbert Series (SOR)

The St. Norbert series consists of moderately well to well drained Orthic Dark Gray Chernozem soils developed on moderately calcareous, fine textured (SiC, C) lacustrine and alluvial deposits. They occur on the well drained upper slope of the floodplain. They have moderate runoff, and moderately slow to slow permeability. The native vegetation is dominantly bur oak, with some maple, elm, aspen, herbs, and grasses.

The soils are characterized by a thin leaf mat 2 to 3 cm thick, a granular, gray Ahe 5 to 8 cm thick, a coarse prismatic, dark gray Btj 30 to 60 cm thick, and an olive gray clay Ck horizon.

Stonewall Series (STW) or (SWW)

The Stonewall series consists of moderately well to well drained Orthic Dark Gray Chernozem soils developed on less than one metre (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.

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.

Sundown Series (SUW)

The Sundown series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on thick, stratified, strongly calcareous sand and gravel deposits which are greater than a metre thick and usually underlain by loamy glacial till. Usually a thin (<15 cm) strata of moderately coarse to fine textured sediments occurs at the surface. They occur in level to depressional areas bordering gravelly beach ridges or in narrow swales. Runoff is very slow, but lateral movement of water through the gravelly layers is common. The vegetation is mainly sedges, meadow grasses and reeds, with scattered clumps of willow, tamarack and black spruce.

The soil is characterized by a moderately decomposed black fen peat layer, 6 to 15 cm thick, and thin (10 to 15 cm) granular, black A horizon grading abruptly into the light gray sand and gravel Ckg horizon. The sand and gravel deposits may extend for a considerable depth. Sundown peaty phase, has a 15 to 40 cm layer of mesic fen peat which covers the mineral soil surface.

Warner Series (WRN)

The Warner series consists of moderately well to well drained, Rego Black Chernozem soils developed on thin, strongly calcareous, dominantly moderately fine textured (SC, SiC, C), lacustrine deposits over extremely calcareous loamy till or clay till of mixed clay and loam materials. The surface textures range from loam to light clay. The topography is irregular, very gently to gently sloping; runoff is moderate; and permeability is moderate to moderately slow in the moderately fine sediments and variable from moderate to slow in underlying till. Native vegetation consists of tall prairie grasses, trembling aspen and bur oak.

The Warner soil is characterized by a very dark gray, granular A horizon 15 to 25 cm thick, a grayish brown to brown, granular AC horizon 8 to 12 cm thick and pale brown Ck horizon. The depth of moderately fine textured overlay is normally 40 to 80 cm. Stones may be present at the surface. Associated with the Rego Black Chernozem soils are the Calcareous Black and some Orthic Black Chernozem soils depending on the depth of overlay. Soils with the underlying clay till, a mixture of loam and clay textured till deposits, are referred to as the Warner, clay till variant, WRN1.

Wentland Series (WTD)

The Wentland series is a carbonated, Rego Humic Gleysol soil developed on poorly drained, very strongly to extremely calcareous, dominantly coarse loamy (VFSL, L, SiL) lacustrine sediments. These soils occur on level to depressional topography associated with Plum Ridge soils. Surface runoff is slow, and soil permeability is impeded by a high water table. In areas where the groundwater contains high salt concentrations, sufficient soluble salt can be present in the soil profile to reduce plant growth. Native vegetation consists of sedges, meadow grasses and willows.

The Wentland soil profile has a gray to dark gray Ap horizon, 15 to 20 cm thick; a light gray, calcareous transition AC horizon with prominent mottles, 10 to 20 cm thick and a very pale brown, calcareous Ckg horizon with many prominent mottles. This profile has a lighter matrix color and is more calcareous than the similar Osterwick soils. With adequate surface drainage, the soils have moderately severe seasonal wetness limitations that reduce the choice of crops or require special management.

Willowbend Series (WWB)

The Willowbend series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, stratified, deep, loamy (SL, FSL, L, SiL, CL, SiCL), recent alluvial deposits. Strata can very in texture from FS to CL depending on source area and position relative to stream channels. These soils occur in level to depressional positions of very gentle slopes on flood prone terraces and meander landscapes and have moderately slow permeability, very slow surface runoff, and a high to ponded water table during the growing season. Willowbend soils are non-eroded, non-stony, and often moderately saline. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently in native vegetation.

In a representative profile the solum is not developed. The profile is characterized by a moderately decomposed LH horizon, 5 to 10 cm thick, a very dark gray Ah horizon, 15 to 20 cm thick with moderate calcareousness, and a light brownish gray to very pale brown Ckg horizon with many prominent mottles. Buried Ah horizons often occur throughout the soil profile.

Willowbend soils occur in close association with La Salle and Gervais soils. They are similar to Basker soils by having stratified loamy alluvium and poor drainage but differ from them by occurring in a warmer soil climate. Willowbend soils were previously mapped as inclusions of the Assiniboine Complex in the Carberry (1957) soil report.

Wintergreen Series (WGE)

The Wintergreen series consists of imperfectly drained, Gleyed Gray Luvisol soils developed on moderately to strongly calcareous, sandy lacustrine and outwash deposits. Surface textures are fine sand to fine sandy loam. The topography is level to irregular, very gently sloping. Soil permeability is rapid, but internal drainage is impeded by a high ground water table. Native vegetation is comprised of pure stands of jack pine, mixed jack pine, aspen, balsam poplar, birch; a dense understory of tall and short shrubs like dogwood, rose, alder, raspberry, currant and saskatoon; and some herbs and grasses. The soils are stone-free.

The soil is characterized by a thin 2 to 5 cm leaf litter, and a 8 to12 cm dark yellowish brown Btgj with clay coating on the peds and grades through a thin transition area to the Ckg horizon and then to the II Ckg.

Woodmore Series (WOM)

The Woodmore series consists of imperfectly drained Gleyed Dark Gray Chernozem soils developed on thin, strongly calcareous, medium to moderately coarse lacustrine deposits over extremely calcareous loamy till. Topography is level to irregular, very gently sloping; runoff is moderate; and permeability is moderate in the moderately coarse to medium deposits and variably moderate to moderately slow in the underlying till. The surface texture ranges from

loamy fine sand to loam. Native vegetation consists of trembling aspen, balsam poplar, hazel, native grasses, and occasional willow.

The soil is characterized by a dark gray granular Ap or Ahe horizon 10 to 18 cm thick and a moderately developed dark grayish brown Btj horizon 7 to 10 cm thick with some thin discontinuous organic and clay coatings on the peds, and grades through a thin transition area to the Ckgj horizon or IICkgj.

Appendix 3 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. See pH and Reaction, soil.

Alkali soil - (i) A soil having a high degree of alkalinity (pH of 8.5 or higher), or having a high exchangeable sodium content (15 % or more of the exchangeable capacity), or both**.** (ii) A soil that contains enough alkali (sodium) to interfere with the growth of most crop plants.

Alkaline soil - A soil having a pH greater than 7. See pH and Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams. Sediments can be different sizes depending upon the location in the floodplain of the river.

Arable soil - Soil suitable for plowing and cultivation.

Association - A sequence of soils of about the same age, derived from similar parent material, and occurring 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 at field capacity for loam textured soils.

Atterberg limits - See **liquid limit** and **plastic limit**.

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

Available water - 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 against a pressure of up to approximately 15 atmospheres. See also **field capacity** and **wilting point**.

Bearing capacity - Capacity of soil (in moist to wet conditions) to support loads such as buildings, people, vehicles, and animals. The average load per unit area that is required to rupture a supporting soil mass.

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

Blocky structure - Aggregates arranged with faces rectangular and flattened, vertices sharply angular.

Bog - A peat-covered or peat-filled area, generally nutrient-poor, in which mosses and especially sphagnum are dominant. The water table is at the surface for most of the year.

Boulders - Rock fragments larger than 60 cm (2ft) in diameter.

Brunisolic - An order of soils whose horizons are developed sufficiently to exclude the soils from the Regosolic order, but that lack the degrees or kinds of horizon development specified for soils of the other orders.

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 (1N) 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:

non-calcareous. . . . . .< 1%
weakly calcareous. . . . . 1 - 5%
moderately calcareous. . . . . 6 - 15%
strongly calcareous. . . . . .16 - 25%
very 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. It is expressed in milliequivalents per 100g of soil.

Channery - A descriptive term used for thin and flat limestone, sandstone, or schist fragments up to 15 cm (6 inches) in length.

Chernozemic - An order of soils that have developed under grassland or grassland-forest transition vegetation, in cool to cold, subarid to subhumid climates. The soils have a dark-colored surface horizon and a B or C horizon, or both, of high base saturation.

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 clay, less than 45 % sand and less than 40 % silt.

Clod - A compact, coherent mass of soil produced by digging or plowing. Clods usually slake easily with repeated wetting and drying.

Coarse fragments - Rock or mineral particles greater than 2 mm in diameter.

Cobbles - Rock fragments 8 to 25 cm (3 to 10 inches) 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.

Columnar structure - Having prism-like aggregates with vertical edges near the top of columns, not sharp.

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

Concretion - Hard grains, pellets or nodules from concentration of chemical compounds, such as calcium carbonate or iron oxide, in the soil that cement soil grains together.

Conductivity, electrical - A physical quantity that measures the readiness with which a medium (irrigation water and soil extracts) transmits electricity. It expresses the concentration of salt in terms of the conductance (reciprocal of the electric resistance in ohms) in milliSiemens per cm (mS/cm) or deciSiemens per meter (dS/m).

Consistence (soil) - The mutual attraction of the particles in a soil mass, or their resistance to separation or deformation. Terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented are used to describe consistence at various soil moisture contents.

Consumptive use factor (CU) - The ratio of consumptive use of water by a crop to potential evapo-transpiration 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 evapo-transpiration.

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:

(i) Vegetation or other material providing protection; (ii) In forestry, low growing shrubs and herbaceous plants under trees (i.e., ground cover vs. tree cover); (iii) 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.

Crotovina - A former animal burrow in one soil horizon that has become filled with organic matter or material from another horizon. It is also spelled “krotovina”.

Crust - A surface layer of soil, from a few millimetres to 2.5 cm (1 inch) thick, that when dry is much more compact, hard, and brittle than the soil material below.

Cryic layer - A perennially frozen layer.

Cryosolic - An order of mineral or organic soils that have permafrost either within 1 m of the surface or within 2 m if the soil has been strongly cryoturbated laterally within the active layer, as indicated by disrupted, mixed, or broken horizons.

Cryoturbation - Frost action, including frost heaving.

Cultivation - Tillage to prepare land for seeding or transplanting, and later to control weeds and loosen the soil.

Decile portion - A one-tenth portion. As used in the soil map symbol A^7- B^3 means that soil A soil covers seven tenths and soil B covers three tenths of the map unit.

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.

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

Deposit - Material left in a new position by a natural transporting agent such as water, wind, ice, or gravity, or by the activity of man.

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) - (i) The rate and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (ii) 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 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 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 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 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 equalled by losses. Soil horizons are usually bright colored. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth.

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 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 the main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the 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. Poorly drained soils have a wide range in available water storage capacity, texture, and depth.

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. These soils have a wide range in available water storage capacity, texture, and depth.

Drained phase - Soils with extensive surface or subsurface (tile) drainage improvements.

Drumlin - An elongate or oval hill of glacial drift, commonly glacial till, deposited by glacier ice and having its long axis parallel to the direction of ice movement.

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

Dunes - Wind-built ridges and hills of sand formed in the same manner as snowdrifts.

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.

Esker - A winding ridge of irregularly stratified sand, gravel, and cobbles deposited under the ice by a rapidly flowing glacial stream.

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.

Exchange acidity - The amount of hydrogen and aluminium that can be replaced from the adsorption complex by a neutral salt solution. It is usually expressed as milliequivalents per 100 g of soil (meq/100 g soil).

Exchangeable sodium percentage - The extent to which the adsorption complex of a soil is occupied by sodium. It is expressed as:

$$ESP = \frac{\text{exchangeable sodium (meq/100 g soil)}}{\text{cation exchange capacity (meq/100 g soil)}} \times 100.$$

Extract, soil - The solution separated from a soil suspension or from a soil by filtration, centrifugation, suction, or pressure.

Fen - A peat-covered or peat-filled area, generally not acidic, in which grasses, sedges, or reeds are dominant. The water table is at the surface for most of the year.

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

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.

Field capacity - The percentage of water remaining in the soil 2 or 3 days after the soil has been saturated and free drainage has practically ceased. It is also defined as the maximum amount of water that will normally be held in the soil and be useful to plants. The percentage may be expressed in terms of weight or volume.

Fifteen - atmosphere percentage - The percentage of water contained in a soil that has been saturated, subjected to, and is in equilibrium with, an applied pressure of 15 atm. Pressure is applied in a pressure membrane or ceramic pressure plate apparatus. This moisture content approximates the permanent wilting point of a soil.

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

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

Fragipan - A natural subsurface horizon having a higher bulk density than the solum above; seemingly cemented when dry, but showing moderate to weak brittleness when moist.

Friable - A consistence term pertaining to soil aggregates that are soft and easily crushed between thumb and forefinger.

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

Glacio-fluvial 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.

Glacial-lacustrine deposits - Silt and clay sediments formed in the quiet waters of lakes that received meltwater from glaciers.

Glacial outwash -Well sorted sand, or sand and gravel, deposited by meltwater from a glacier.

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.

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

Granular structure - The arrangement of soil particles into spheroidal aggregates characterized by rounded vertices.

Ground moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till; most 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 ablation. 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 hills and enclosed depressions.

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

Grumic - Very fine textured soils with self-mulching horizons (A and B), that occur in the Chernozemic, Gleysolic, and Solonetzic orders. Redefined as vertic features in 1998, Third Edition of the Canadian System of Soil Classification.

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

Heavy soil - A soil having a high content of fine particles, particularly clay, or a soil having a high drawbar pull and therefore hard to cultivate.

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 soil forming processes. It differs from adjacent layers in properties such as color, structure, texture, consistence, and chemical, biological and mineralogical composition.

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	Form
abrupt - less than 2 cm	smooth - nearly plain
clear - 2 to 5 cm	wavy - pockets are wider than deep
gradual - 5 to 15 cm	irregular - pockets are deeper than wide
diffuse - more than 15 cm	broken - parts of the horizon are unconnected with other parts

Humic - Highly decomposed organic soil material; small amounts of fibre are present that can be identified as to their botanical origin. Fibres are easily destroyed by rubbing.

Humus - The fraction of the soil organic matter that remains after most of the added plant and animal residues have decomposed. It is usually dark colored.

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. The classes are described in general or specific terms as:

High	>15	cm/hr
Medium	0.5 -15	cm/hr
Low	< 0.5	cm/hr

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.

Hydromorphic soil - A general term for soils that develop under conditions of poor drainage in marshes, swamps, seepage areas, or flats.

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 as a layer of accumulation.

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

Impervious - Resistance to penetration by fluids or roots.

Inclusion - Soil type (series) 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.

Kame - An irregular ridge or hill of stratified glacial drift deposited by glacial meltwater.

Kettle - Depression left after the melting of a detached mass of glacier ice buried in drift.

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).

Land classification - The arrangement of land units into various categories based on the properties of the land or its suitability for some particular purpose.

Landforms -The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation. Mineral landforms are described by terms such as apron, blanket, fan, hummocky, level, pitted, ridged, rolling, terrace, undulating, veneer, inclined and steep.

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

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

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

Hummocky - A very complex sequence of slopes extending from somewhat rounded depression or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls and depressions. Slopes are generally 5 to 70% (3 to 35°).

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°).

Pitted - A level to gently undulating surface containing a number of pits or hollows.

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

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

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

Undulating - A very regular sequence of gentle slopes that extend 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 slope gradient is 2 to 5% (1 to 3°).

Veneer - Unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface. A veneer ranges from 10 cm to 1 m in thickness and possesses no form typical of the materials' genesis.

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

Steep - Erosional slopes, greater that 70% (35°), on both consolidated and unconsolidated materials. The form of steep erosional slopes on unconsolidated materials is not related to the initial mode of origin of the underlying material.

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

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

Lime, agricultural - A soil amendment consisting principally of calcium carbonate, and including magnesium carbonate and perhaps other materials. It is used to supply calcium and magnesium as essential elements for growth of plants and to neutralize soil acidity.

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 l.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.

Lithic phase - Soils having a lithic contact (consolidated bedrock) within the control section below a depth of 10 cm.

Luvisolic - An order of soils that have eluvial (Ae) horizons, and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest or forest-grassland transition in a moderate to cool climate.

Mapping Unit - Any delineated area shown on a soil map that is identified by a symbol. A mapping 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 dominantly with sedges, cattails, rushes or other hydrophytic plants. The waters are rich in nutrients, varying from fresh to highly saline.

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

Mesic - Organic material in an intermediate stage of decomposition; intermediate amounts of fibre are present that can be identified as to their botanical origin.

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 (meq) - 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.

Mineral soil - A soil consisting predominantly of, and having its properties by mineral matter. It contains less than 17% organic carbon except for an organic layer that may be up to 40 cm (16 inches) thick if formed from mesic and humic peat or 60 cm (24 inches) if of fibric peat.

Monolith, soil - A vertical section of a soil profile removed from the soil and mounted for display or study.

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.

Neutral soil - A soil in which the surface layer, to plow depth, is neither acid nor alkaline in reaction.

Organic carbon - Carbon derived from plant and animal residues.

Organic - An order of soils that have developed dominantly from organic deposits. The majority of Organic soils are saturated for most of the year, unless artificially drained. They contains more than 17% organic carbon and the organic layer must extend be up to 40 cm (16 inches) if formed from mesic and humic peat or 60 cm (24 inches) if of fibric peat.

L, F, and H - These organic horizons developed primarily from the accumulation of leaves, twigs and woody materials with or without a minor component of mosses. They are normally associated with upland forested soils with imperfect drainage or drier conditions.

Organic matter - The fraction of the soil which consists of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is determined on soils that have been sieved through a 2.0 mm sieve. It is estimated by multiplying the organic carbon by a factor of 1.72.

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 to 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 to 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 to 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 to 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 to 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 to 35% clay in the fine earth fraction.

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

Fine-clayey - A clayey particle size that has 35 to 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.

Peat - Soil material consisting largely of undecomposed, or slightly decomposed organic matter.

Peaty phase - Any mineral soil having a surface horizon 15 to 60 cm thick of fibric organic material or 15 to 40 cm of mesic or humic organic material.

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 dealing with the origin, morphology, genesis, distribution, mapping, 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 - (i) Perennially frozen material underlying the solum. (ii) 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. See hydraulic conductivity.

pH - The intensity of acidity and alkalinity, expressed as the negative logarithm of the hydrogen ion concentration. A pH of 7 is neutral, lower values indicate acidity and higher values alkalinity (see Reaction, soil).

Phase, soil - A soil phase is used to characterize soil and landscape properties that are not used as criteria in soil taxonomy. The major phase components are: erosion, slope, stones, salinity, texture, deposition, 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 in moisture content within which a soil exhibits plastic properties.

Platy structure - Consisting of soil aggregates that have developed predominantly along the horizontal axes; laminated; flaky.

Podzolic - An order of soils having B horizons (Bh, Bhf, Bf) in which amorphous combinations of organic matter, Al, and usually Fe are accumulated.

Pore space - The part of the bulk volume of soil not occupied by soil particles, interstices or voids.

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.

Prismatic structure - A soil structure type having prism-like aggregates that have vertical axes longer than the horizontal axes.

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

Reaction, soil - The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Soil reaction classes are characterized as follows:

	pH value
extremely acid	<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
neutral	6.6 to 7.3
mildly alkaline	7.4 to 7.8
moderately 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.

Regosolic - An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other soil orders.

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 that contains enough soluble salts to interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 millisiemens/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
weakly saline	4 to 8 mS/cm
moderately saline	8 to 16 mS/cm
strongly saline	>16 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 - (i) A soil particle between 0.05 and 2.0 mm in diameter. (ii) Any one of five soil separates: very coarse sand, coarse sand, medium sand, fine sand, or very fine sand. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

Saturation extract - The extract from a soil sample that has been saturated with water.

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

Seepage - (i) The escape of water downward through the soil. (ii) 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 corresponding change in moisture content. It equals the apparent specific gravity of the dried soil.

Silt - (i) Individual mineral particles of soil that range in diameter between 0.05 to 0.002 mm. (ii) Soil of the textural class silt contains greater than 80 percent silt and less than 12 percent clay.

Single-grained structure - A soil structure in which the soil particles occur almost completely as individual or primary particles. It is usually found in coarse (sandy) textured soils.

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

Sodic soil - (i) A soil containing sufficient sodium to interfere with the growth of most crop plants. (ii) A soil having an exchangeable-sodium percentage of 15 or more.

Sodium-Adsorption Ratio (S.A.R.) - A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with other cations in the soil. SAR = $Na/((Ca+Mg)/2)^{1}/^{2}$ where the 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.

Solonetzic - An order of soils thought to have developed from parent materials that were more or less uniformly salinized with salts high in sodium. The soils have a stained brownish solonetzic B (Bnt or Bn) horizon and a saline C horizon.

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

Stones - Rock fragments greater than 25 cm (10 inches) in diameter.

Stoniness - The percentage of land surface occupied by stones. 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 to 0.1% of surface occupied by stones. Stones are 15 to 30 cm in diameter and 10 to 30 m apart. The stones offer only slight to no hindrance to cultivation.

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

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

Stones 4. exceedingly stony - Land having 15 to 50% of surface occupied by stones. Stones are 15 to 30 cm in diameter and 0.7 to 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 are 15 to 30 cm in diameter and 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% 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. 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.

Structure, soil - The combination or arrangement of primary soil particles into aggregates of secondary soil particles, units or peds, which are separated from each other by surfaces of weakness. Structure is expressed in terms of grade, size class and shape type. Grade refers to the distinctness of aggregate development, and is described as structureless, weak, moderate or strong. Structureless refers to the absence of observable aggregation of definite orderly arrangement; the term amorphous is used if soil is massive or coherent, single-grained if noncoherent. The weak to strong aggregates vary in size and are described by class as fine, medium, coarse, and very coarse depending on the shape types. The shape types refer to the dominant configuration of the aggregates and the way they are accommodated. The general shape types are plate-like, block-like and prism-like. The terms are:

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

Prismatic - Having prism-like aggregates with tops and edges, appear plane, level and somewhat angular.

Columnar - Having prism-like aggregates with vertical edges near the top of columns, not sharp.

Granular - Having block-like aggregates that appear as spheroids or polyhedrons having plane or curved surfaces which have slight or no accommodation to the faces of the surrounding peds.

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. In the parent material of soils the material with structural shapes may be designated as pseudo-blocky, pseudo-platy, etc.

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

Subangular blocky structure - Having block-like aggregates with rounded and flattened faces and rounded corners.

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.

Swamp - A mineral wetland or peatland with standing water or water gently flows through pools or channels. The watertable is usually at or near the surface. The vegetation is characterized by a cover of deciduous or coniferous trees or shrubs, herbs, and some mosses.

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.

Name of separate	**Diameter (mm)**
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	< 0.002
Fine clay	< 0.0002

Textural Classes

Sand - Sand is a soil material that contains 85% or more sand; the percentage of silt, plus 1.5 times the percentage of clay does not exceed 15.

Coarse sand - 25% or more very coarse and coarse sand, and less than 50% any other one grade of sand.

(Medium) Sand - 25% or more very coarse, coarse, and medium sand (but less that 25% very coarse and coarse sand), and less that 50% of either fine or very fine sand.

Fine sand - 50% or more fine sand, or less than 25% very coarse, coarse, and medium sand and less that 50% very fine sand.

Very fine sand - 50% or more very fine sand.

Loamy sand - Loamy sand is a soil material that contains at the upper limit 85 to 90% sand, and the percentage of silt plus 1.5 times the percentage of clay is not less than 15; at the lower limit it contains not less than 70 to 85% sand, and the percentage of silt plus twice the percentage of clay does not exceed 30.

Loamy coarse sand - 25% or more very coarse and coarse sand, and less that 50% any other one grade of sand.

Loamy sand - 25% or more very coarse, coarse, and medium sand (but less that 25% very coarse and coarse sand), and less that 50% fine or very fine sand.

Loamy fine sand - 50% or more find sand, or less than 50% very fine sand and less than 25% very coarse, coarse, and medium sand.

Loamy very fine sand - 50% or more very fine sand.

Sandy loam - Sandy loam is a soil material that contains either 20% clay or less, with the percentage of silt plus twice the percentage of clay exceeding 30, and 52% or more sand; or less than 7% clay, less that 50% silt, and 43 to 52% sand.

Coarse sandy loam - 25% or more very coarse and coarse sand and less than 50% any other one grade of sand.

(Medium) Sandy loam - 30% or more very coarse, coarse, and medium sand (but less than 25% very coarse and coarse sand), and less than 30% of either very fine or fine sand.

Fine sandy loam - 30% or more fine sand and less than 30% very fine sand; or between 15 to 30% very coarse, coarse, and medium sand; or more than 40% fine and very fine sand, at least half of which is fine sand, and less that 15% very coarse, coarse and medium sand.

Very fine sandy loam - 30% or more very fine sand, or more than 40% fine and very find sand, at least half of which is very fine sand, and less that 15% very coarse, coarse, and medium sand.

Loam - Loam is a soil material that contains 7 to 27% clay, 28 to 50% silt, and less than 52% sand.

Silt loam - Silt is a soil material that contains 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

Silt - Silt is a soil material that contains 80% or more silt and less than 12% clay.

Sandy clay loam - Sandy clay loam is a soil material that contains 20 to 35% clay, less than 28% silt, and 45% or more sand.

Clay loam - Clay loam is a soil material that contains 27 to 40% clay and 20 to 45% sand.

Silty clay loam - Silty clay loam is a soil material that contains 27 to 40% clay and less than 20% sand.

Sandy clay - Sandy clay is a soil material that contains 35% or more clay and 45% or more sand.

Silty clay - Silty clay is a soil material that contains 40% or more clay and 40% or more silt.

Clay - Clay is a soil material that contains 40% or more clay, less that 45% sand, and less that 40% silt.

Heavy clay - Heavy clay is a soil material that contains more that 60% clay.

In addition to these thirteen basic soil textural classes, three of which are modified according to the predominant sand fraction, other modifiers are added. The word "mucky" is used as an adjective modifying the textural class name for horizons of mineral soils, especially of Humic Gleysols, that contain 15 to 30% organic matter (9 to 17% organic carbon).

Rock fragments in the soil are also used to modify the textural class name. These are gravel, cobbles, stones, and boulders (see the descriptions of size classes). The adjective form of the rock fragment class name is used as a modifier according to the following rules:

Less than 15% by volume: No special term is used; or "non-gravelly" and "non-stony" are used in writing for contrast with soils having more that 15% pebbles, cobbles, stones, or boulders.

15 to 35% by volume: The adjective term of the dominant kind of rock fragment is used as a modifier of the textural terms: "gravelly loam", "stony loam", "bouldery loam".

35 to 60% by volume: The adjectival term of the dominant kind of rock fragment is used with the word "very" as a modifier to the textural terms: "very gravelly loam", "very bouldery loam".

More than 60% by volume: If enough fine earth is present to determine the texture class (approximately 5 percent or more by volume) the adjectival term of the dominant kind of rock fragment is used with the word "extremely" as a modifier of the textural terms: "extremely gravelly loam", "extremely bouldery loam". If there is too little fine earth to determine the texture class (less than about 5% by volume) the terms "gravel", "cobbles", "stones", and "boulders" are used in the place of fine earth texture.

Table 29. Soil Textural Groups and Soil Texture Classes

Texture Group		Texture Class	Texture Class Symbol
Coarse	**Very Coarse**	Very coarse sand	VCoS
		Coarse sand	CoS
		Medium sand	S or MS
	Coarse	Fine sand	FS
		Loamy coarse sand	LCoS
		Loamy sand	LS or LMS
		Loamy fine sand	LFS
	Moderately Coarse	Very fine sand	VFS
		Loamy very fine sand	LVFS
		Coarse sandy loam	CoSL
		Sandy loam	SL or MSL
		Fine sandy loam	FSL
Medium	**Medium**	Very fine sandy loam	VFSL
		Loam	L
		Silt loam	SiL
		Silt	Si
Fine	**Moderately Fine**	Sandy clay loam	SCL
		Clay loam	CL
		Silty clay loam	SiCL
	Fine	Sandy clay	SC
		Silty clay	SiC
		Clay	C
	Very Fine	Heavy clay (>60 %)	HC

Figure 1. Soil Texture Triangle

Till, glacial - Unstratified glacial drift deposited by ice and 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.

Slope Class	Slope Name	Percent slope	Approximate degrees
1	level	0 - 0.5	0
2	nearly level	0.5 - 2.5	0 .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 table depths	(cm)
Generally High	< 100
Very High	0 - 50
Moderately High	250 - 100
Medium High	100 - 150
Generally Low	> 150
Medium Low	150 - 200
Low	> 200
Moderately Low	200 - 300
Very Low	> 300

Water-holding capacity - The ability of a soil to hold water against the force of gravity in a freely drained soil.

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

Wilting point - The moisture content of a soil at which plants wilt and fail to recover their turgidity when placed in a dark, humid atmosphere. The wilting point is commonly estimated by measuring the 15-atmosphere moisture content of a soil.

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

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