Soils of the Municipality of Roblin

Report No. D92 2013

Canada

Growing Forward

Manitoba

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Part 1 General Description of the Study Area

1.1 Location and Extent

The Rural Municipality (RM) of Roblin (RBL) comprises approximately 74,160 hectares or 183,250 acres of land within townships 1, 2 and 3 in ranges of 13, 14 and 15 in the west of the Principal Meridian. The RM of RBL borders the United States of America in the south, and neighbours the RMs of Killarney-Turtle Mountain, Strathcona/Argyle and Louise in the west, north and east, respectively (Figure 1).

This report contains soil resource information and maps at a scale of 1:50,000 for an area formerly covered in the Reconnaissance Soil Survey (1:126,720) of South-Central Manitoba, Report No. 4 (Ellis and Shafer, 1943). It also includes a portion of area of previously surveyed (1:20,000) Soils of the Pelican-Rock Lake Area, Report No. D-19 (Podolsky, 1983).

1.2 Physiography

The majority of the study area is located within the Killarney Ecodistrict (765) in Aspen Parkland Ecoregion (ESWG, 1995), which was previously referred to as the Boissevain Plain (Eilers et al, 1978) or the Waskada Till Plain Area in Reconnaissance Soil Survey of South-Central Manitoba (Ellis and Shafer, 1943). The northeastern area of the RM is occurred within the Manitou Ecodistrict (766), or formerly referred to the Tiger Hills Upland. This area is also influenced by Lake Souris Outlet to some extent. The Badge Creek and the Long River in the west of the RM also played a role in modifying local landscapes. Most of the lands in the RM lie between 460 and 470 metres above sea level (a.s.l), with the southwest corner being the highest (501 m a.s.l) and the northeast corner being the lowest (450 m a.s.l), resulting in a general gradient of 0.1 percent.

Numerous incised channels and intermittent streams follow the general gradient northerly and easterly from the southwest of the RM towards the Rock Lake. Some of the larger channels are the result of glacial melt-water flow during the retreat of the ice mass approximately 10 to 12 thousand years ago.

1.3 Ecoclimatic features

The relationships that exist among climate, vegetation and soils in the study area are reflected in the ecoclimatic map shown in Figure 2. The ecoclimatic regions cover a continuous geographic area and are characterized by distinctive ecological responses to microclimate as expressed by vegetation, soil, fauna and aquatic systems (Podolsky, 1998). Soil types developed on similar parent material and under similar drainage conditions, but in different ecoclimatic regions are identified by different series or association names to indicate that many of the associated ecologic conditions are dissimilar.

The RM of Roblin is located within the Grassland Transition (Gt) ecoclimatic region. Approximately, two-thirds of the RM is covered by the Gt3 subregion, and the remaining area is within Gt2 subregion. The Gt3 subregion is characterized by a drier and warmer climatic condition such as lower mean annual precipitation and more frost-free days, compared to the Gt2 subregion.

Both the Low Boreal Subhumid subregion 2 (LBs2) and Gt2 were alternatively used in a narrow area along the southern side of the Rock Lake in an old report (Podolsky, 1983). Figure 3 shows ecoclimatic subregion changes in one section. To simplify assigning soil series and avoid any confusion with those soil series developed from similar parent materials and/or similar soil drainage conditions, but occurred in such a small area, the previous LBs2 subregion is not used in this report. Any previously considered LBs2 areas are therefore integrated into Gt2 subregion.

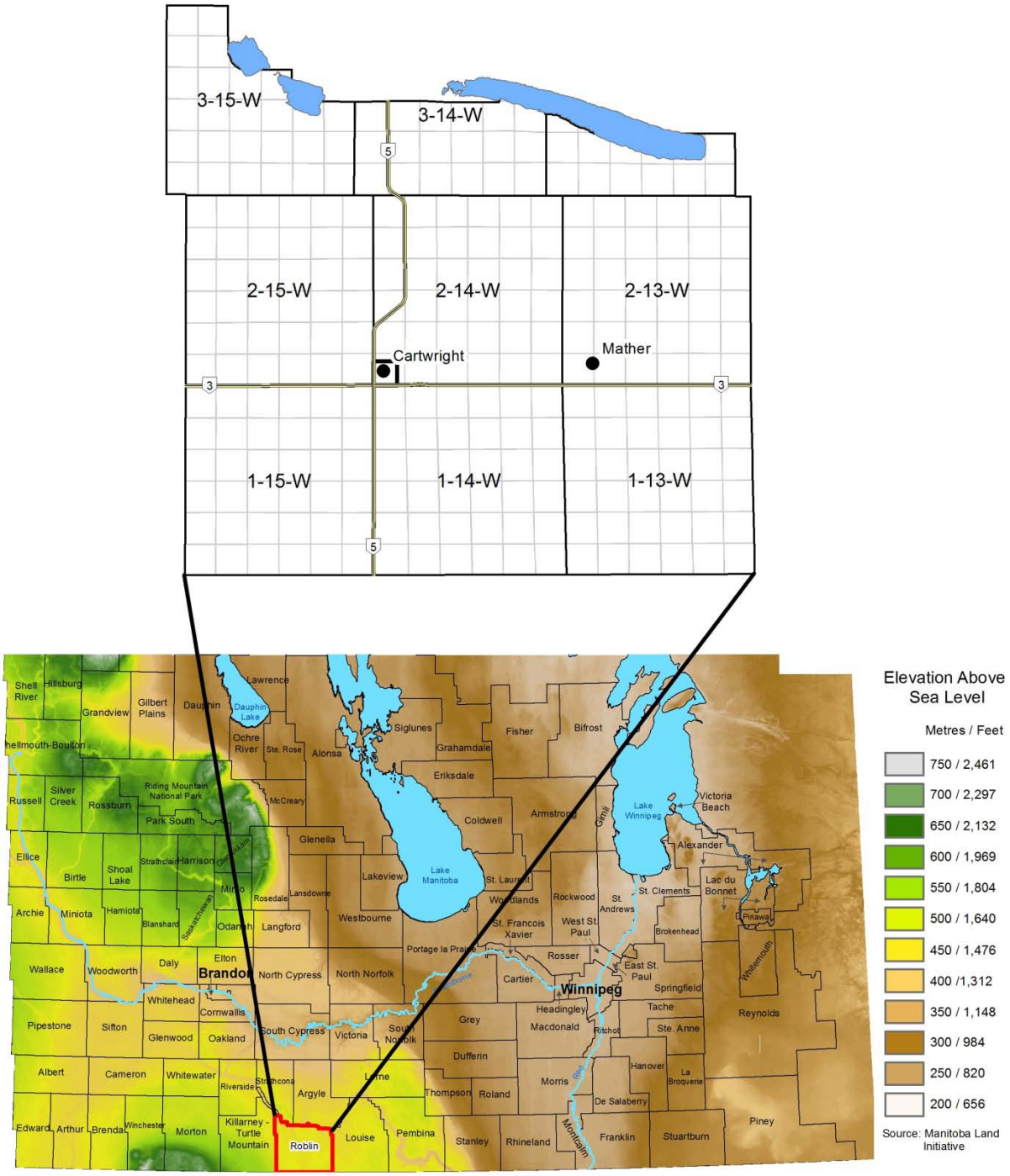


Figure 1. Location of the Study Area: The Rural Municipality of Roblin

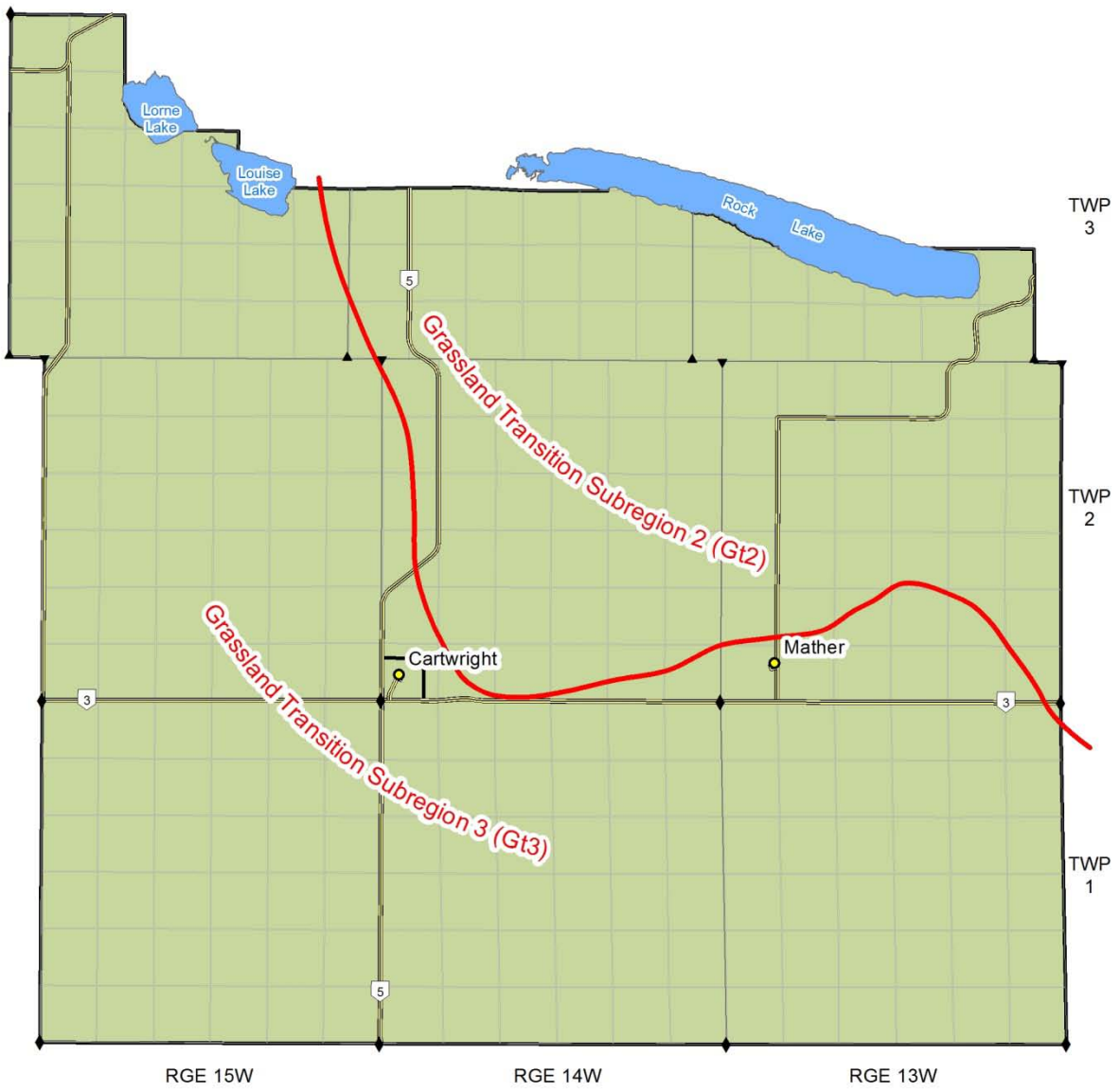


Figure 2. Ecoclimatic Subregions of the Study Area

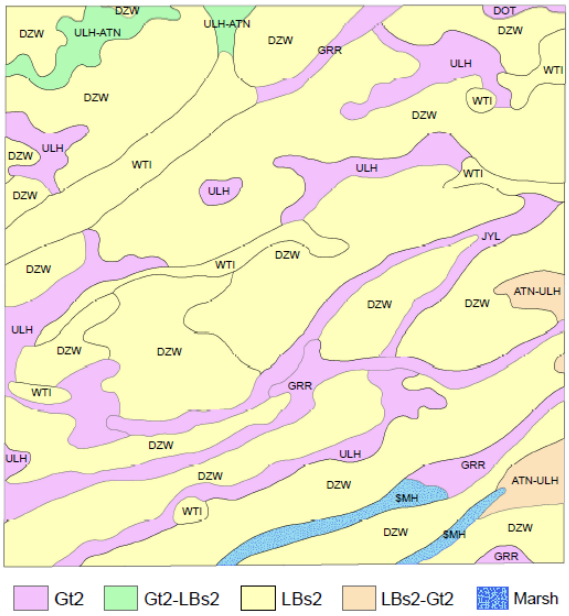


Figure 3. Ecoclimatic subregion changes in Section 8, Township 3 Range 14W.

1.4 Landforms and Surface Deposits

Four major landforms are commonly seen in the RM: hummocky, rolling, undulating and level. The hummocky landform is a very complex sequence of slopes extending from somewhat rounded depression or kettles of various sizes to irregular to conical knolls or knobs. The rolling landform has a slope greater than five percent and a slope length over 1.6 km (wavelike pattern). The undulating landform has a gentle slope that ranges from two to five percent. The level landform has a slope less than two percent.

The undulating landscape is dominant in the RM, followed by the level or nearly level and hummocky. Potholes in irregular shapes and sizes can be seen anywhere in the surveying area, but most of them are found in Township 1 Range 14 and the south parts of Township 2 Range 14 and 15.

The underlying bedrock in the study area consists of cretaceous shale of the Riding Mountain formation at depths of 25 to 30 meters below ground surface. The dominant unconsolidated deposit overlying the cretaceous shales is strongly calcareous, loamy textured glacial till from shale, granite and limestone.

During the recession and waning of the continental ice mass from the south, the ice front remained rather stationary for a period in the area immediately to the north (Michalyna and Holmstrom, 1980). Water from the melting ice and surface runoff from the east side of the Turtle Mountain flowed northeasterly toward the Pembina River and Badge Creek. Sediments were deposited as a thin veneer over glacial till, resulting in large areas of lacustrine deposits over glacial till. This also modified the glacial till landscape from the common rolling and/or hummocky to a gently undulating landform.

1.5 Soils

Soil parent material is mainly thin (25 to 100 cm) lacustrine sediments overlying strongly calcareous, mixed glacial till, comprising 41.6 percent of the surveyed area (Table 1). Soils developed directly on mixed glacial till comprises 28.8 percent of the surveyed area, whereas those derived from deep lacustrine comprise 9.8 percent of the surveyed area. Soils from lacustrine over gravelly fluvial sediments and lacustrine over fluvial sediments overlying glacial till total 8.6 percent. These soils are mostly distributed in the areas between the Long River and McGillis Creeks, and close to the Lorne Lake and Louise Lake in the northwest of the RM. Soils derived directly from fluvial sediments or fluvial over till materials are spotted in the areas close to the Badger Creek, McGillis Creek, Long River and few unnamed creeks in the north-eastern RM.

The medium-textured lacustrine overlying glacial till soils are classified as dominantly Waskada Association in Gt3 Ecoclimatic Subregion and Knudson Association in Gt2 subregion. They account for approximately 65 percent of all observed lacustrine over till parent material, or 27 percent of the soil in the study area. The Waskada Association includes three well drained soil series (Waskada - Orthic Black Chernozem, Dalny – Calcareous Black Chernozem, and Maskawata – Rego Black Chernozem), with three imperfectly drained soil series (Two Creeks – Gleyed Black Chernozem, Glenlorne – Gleyed Eluviated Black Chernozem, and Montgomery – Gleyed Rego Black Chernozem) and two poorly drained soil series (Villette and Deloraine).

The Knudson Association consists of five soil series, Knudson – well drained Orthic Black, Larrett – well drained Eluviated Black, Ullrich – imperfectly drained Gleyed Black, Joyale – imperfectly drained Gleyed Rego Black, and Guerra – poorly drained Rego Humic Gleysol.

Soils derived directly from mixed glacial till include three associations – Ryerson (Gt3), Darlingford (Gt2) and Hilton (Gt2). The Ryerson association comprises well drained Black Chernozems (Ryerson, Medora and Hathaway series), imperfectly drained Gleyed Chernozems (Coatstone and Regent soil series) and Gleyed Eluviated Black Chernozem (Hazeldean soil series), and poorly drained Gleysols (Ewart and Tilston soil series). Both Darlingford and Hilton association are in Gt2 ecoclimatic subregion, the former consists of moderately to strongly calcareous soils, while the later one comprises extremely calcareous soils. The Ryerson, Darlingford and Hilton associations account for 18.5, 9.28 and 0.94 percent in the study area, respectively.

Deep lacustrine soils consist of 9.8 percent of the total surveyed area (Table 1). These soils have a wide range in texture, ranging from loamy fine sand (coarse) to clay (fine). The most common soil texture groups of lacustrine deposits are moderately fine and medium, ex. Elva, Cameron and Wawanesa Association soils in the Gt3 ecoclimatic subregion. Both Elva and Cameron Associations are characterized by a relatively uniform texture profile, while Wawanesa has a medium over coarse textured profile. These three Associations account for 28.5, 17.7 and 15.4 percent of the total lacustrine deposit parent material in the RM, respectively. In the Gt2 ecoclimatic subregion, moderately fine Ramada Association and medium textured Fairland Association are dominant. They account for 11.5 and 8.9 percent of the lacustrine deposits.

Soils developed from fluvial related materials, either lacustrine over fluvial over till, lacustrine over fluvial, fluvial over till, or directly on fluvial sediments, are found in the areas close to rivers or creeks. Soils having fluvial parent material account for approximately 9.6 percent of the study area.

Soils derived from alluvium deposits are located in riverbeds or on terraces well above present streams. Soil texture ranges from medium to fine. Gleyed Cumulic Regosol soils including Liege and Neelin, Rego Humic Gleysol such as Graham and Leighton occur in Gt3 ecoclimatic subregion while Mowbray of Cumulic Regosol, Levine and Assiniboine of Gleyed Cumulic Regosol and Basker and Kerran of Rego Humic Gleysol are common in Gt2 subregion. All alluvium soils comprise 3.8 percent of the surveyed lands.

Table 1. Soil Parent Material and their Proportions in the Study Area

Parent material (0 to 100 cm)	Total area		% of RM
	ha	ac	
Lacustrine over glacial till	30,847	76,223	41.6
Glacial till	21,325	52,695	28.8
Lacustrine	7,296	18,029	9.84
Lacustrine over fluvial	4,746	11,728	6.40
Alluvium	2,827	6,986	3.81
Lacustrine over fluvial over till	1,634	4,038	2.20
Fluvial sediment	644	1591	0.87
Fluvial over till	128	316	0.17
Water body, eroded slope, marsh, urban & unclassified,	4,712	11,643	6.35
Total	74,159	183,249	100

Part 2 Methodology

2.1 Mapping and Map Scale

Detailed soil mapping at a 1:50,000 scale (2 cm equals one km) was completed for the Municipality of Roblin. Approximately nine inspections per section of land or one soil inspection per 28 to 30 hectares (1 site per 70 acres) was conducted and soil profiles were examined to a depth of one metre. Additional soil inspections occurred in complex soil areas to help locate boundaries between different soil series or variable soil phases.

Boundaries delineating the various soil series are completed by digitizing using Geographic Information Systems (GIS) and 3-dimensional viewing software. This allows higher positional accuracy of soil polygons and contrast features.

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 body has a similar number and arrangement of horizons whose colour, texture, structure, consistence, 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 and un-described 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, erosion or salinity. Some examples of a non-soil include water or bedrock.

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 unit 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 in a compound map unit, for example, 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 and 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 identified below the soil series symbol. They are severity of erosion, slope class, degree of stoniness and salinity. The degree or magnitude of each is designated in Figure 4.

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

If none of the above properties is observed to be significant, the map symbol representing the normal or unaffected soil series is used alone without modifiers (example in Figure 4).

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, an x is used in its appropriate designated location in the map symbol (Figure 4).

An example of a compound unit is as follows: 70 percent consists of Waskada (WKD^7) series having no erosion (x), very gently sloping topography (c), no stones at the surface (x), no salinity (x), and 30 percent Montgomery (MOT^3) series having no erosion (x), very gently sloping topography (c), no stones (x) and no (x) salinity (Figure 4). If all the phases and features have an x designation, the four (x) phases are not shown in the map symbol.

2.5 Soil Sampling and Analyzing

A total of 854 surface and subsurface soil samples were collected and analyzed for texture (particle size), pH, organic carbon, electrical conductivity (EC) and calcium carbonate content. Soil cation exchangeable capacity (CEC) was also determined in detailed soil profile samples.

The brief methodologies of lab analyses used to determine soil characteristics are:

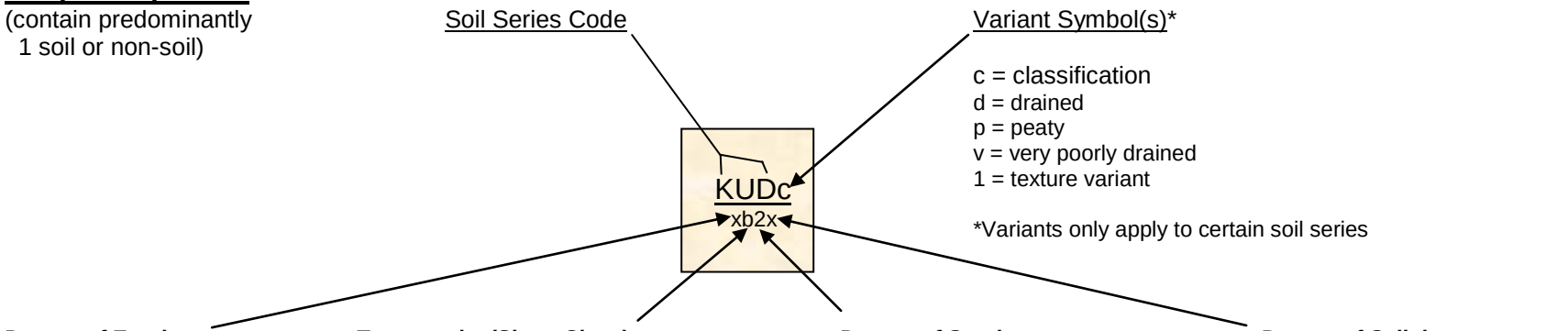
Calcium carbonate: Calcimeter using 1M HCl
CEC: Ammonia electrode
EC: Saturated paste
pH: 2:1 water to soil ratio
Organic carbon: Walkley-Black method
Particle size: Pipette method

Figure 4. Map Unit Symbol

Soil series maps contain labels similar to those shown in the pale brown boxes below. A description of each kind of label is indicated below.

Simple Map Units

(contain predominantly 1 soil or non-soil)



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

Topography (Slope Class)

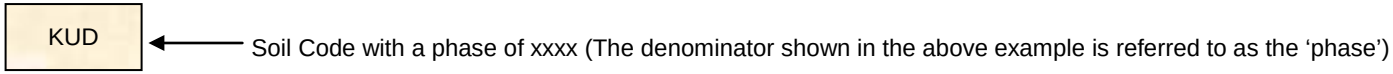
x = level to nearly level:	0 – .5%
b = nearly level:	> .5 – 2%
c = very gently sloping:	> 2 – 5%
d = gently sloping:	> 5 – 9%
e = moderately sloping:	> 9 – 15%
f = strongly sloping:	>15 – 30%
g = very strongly sloping:	>30 – 45%
h = extremely sloping:	>45 – 70%

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%

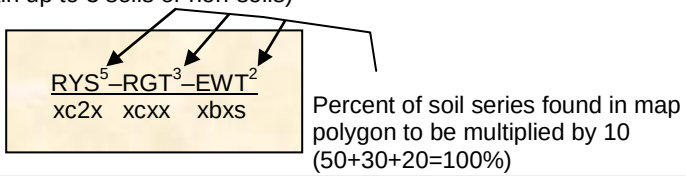
Degree of Salinity Condition (mS/cm)

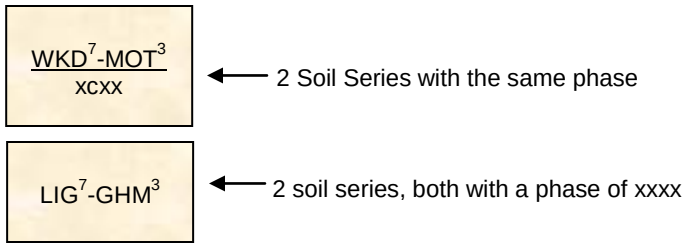
x = non-saline:	0 – 4
s = weakly saline:	>4 – 8
t = moderately saline:	>8 – 16
u = strongly saline:	>16



Compound Map Units

(Contain up to 3 soils or non-soils)





Part 3 Soil 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. Soil development is related to the regional climate and the degree of leaching, translocation and accumulation of soluble and colloidal fractions of the soil. Soil drainage also plays a significant role in soil development. Soils in the RM of Roblin have developed under a cool subhumid boreal climate (Grassland Transition of Ecoclimatic Region) which provides sufficient moisture and heat for development of aspen-oak groves, tall prairie grasses and associated herbs. Consequently, the majority of soils in the area are Chernozemic soils.

3.2 Classification

Soils in the study area are classified according to the Canadian System of Soil Classification (SCWG, 1998). This system is hierarchical employing five levels of generalization or categories of classification. Beginning with the most generalized, these categories are the order, great group, subgroup, family (association) 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 of the pedon that reflect the nature of the soil environment and the effects of the 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 translocation 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 conformity to the central concept of the great group ex. Orthic, intergrades toward soils in other orders, ex. Gleyed or special features such as carbonate accumulation 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 formed in a particular kind of material and have horizons with colour, texture, structure, consistence, thickness, reaction and chemical composition that are similar in differentiating characteristics and in arrangement in the soil profile.

The classification of soils in the study area in relation to parent material, texture and drainage is shown in the following two tables. As aforementioned, the RM covers both ecoclimatic grassland transition subregion Gt2 and Gt3. Soils derived directly from loamy till and lacustrine (fine loamy) overlying glacial till are then subdivided into Gt2-south and Gt2-north. For example, the Darlingford soil

association in the south is equivalent to the Newdale soil association in the north; and the Knudson soil association in the south is equivalent to the Clementi soil association in the north. For soil series developed from other parent materials, the same soil series names apply to both south and north Gt2 subregion. Table 2 lists soil series in Gt2 subregion while Table 3 describes soil series in Gt3 subregion. The proportion of soils in terms of land area and surface texture in the RM of RBL is listed in Table 4. Each individual soil series is described in detail in Appendix 2.

Table 2-1. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Gt2-South).

Soil Drainage	Classification	Glacial Till				Lacustrine over (< 5 cm gravelly lens) over glacial Till			
		Extremely calcareous (L, CL, SCL, SiCL)	Mixed calcareous (VFSL, L, SCL, CL, SiCL)	Loamy mixed, calc. over shale bedrock	Loamy or CL, SiCL (Shaly)	Coarse (FS, LS, LFS) Over mixed or extr.calc. Till	Mod. Coarse (VFS, LVFS, FSL) Over mixed or extr. calc. Till	Fine loamy (CL, SiCL, SCL) Over mixed till	Clayed (SiC, C) over mixed till
Well to Mod. well	Orthic Black Chernozem	Hilton (HIT)	Darlingford (DGF)	Froswick (FWK)	Manitou (MXS)	Kirkness (KKS)	Lockhart (LKH)	Knudson (KUD)	Everton (EVO)
	Eluviated Black Chernozem							Larrett (LRT)	
	Calc. Black Chernozem								
	Rego Black Chernozem	Bermont (BMN)	Hebbot (HEB)						
Imperfect	Gleyed Black Chernozem		Nikkel (NKK)		Nowell (NOW)			Ullrich (ULH)	Justice (JUC)
	Gleyed El. Bl. Chernozem								
	Gleyed Rego Bl. Chernozem	Barwood (BWO)	Ferris (FRS)	Jirose (JIS)		Killeen (KLL)	Lindstrom (LDM)	Joyale (JYL)	Forrest (FRT)
Poor	Rego Humic Gleysol	Hickson (HKS)	Cazlake (CZK)				Lonery (LOE)	Guerra (GRR)	Fenton (FET)

Soil texture abbreviations: C = clay, Co = coarse, F = fine, H = heavy, L = loam(y), S = sand(y), Si = silt(y), and V = very.

Table 2-2. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Gt2).

Soil Drainage	Classification	Lacustrine							
		Coarse (FS, LS LFS)	Mod. coarse (VFS, LVFS, FSL).	Medium (VFSL, L, SiL, Si)	Mod. Fine (SCL, CL, SiCL)	Fine (SC, SiC, C)	Medium over coarse or mod. coarse	Mod. fine over coarse or mod. coarse	Fine over coarse or mod. coarse
Well to mod. Well	Orthic Regosol	Arizona (AIZ)	Brownridge (BWD)	Knolls (KLS)	Barren (BAE)				
	Orthic Black Chernozem	Stockton (SCK)	Prosser (PSE)	Fairland (FND)	Ramada (RAM)	Janick (JIK)	Glenboro (GBO)	Wellwood (WWD)	
	Calc. Black Chernozem			Traverse (TAV)	Rempel (RMP)				
	Rego Black Chernozem	Cactus (CCS)	Porple (POR)	Durnan (DRN)	Carroll (CXF)	Bankton (BAO)			
	Orthic Dark Gray Chernozem	Dobbin (DOB)	Halstead (HAT)	Pollen (POL)	Firdale (FIR)				
Imperfect	Gleyed BL Solonetz								Oliver (OIV)
	Gleyed Black Chernozem	Lavenham (LVH)	Gateside (GTD)	Torcan (TOC)	Charman (CXV)	Harding (HRG)	Petrel (PTR)	Oberon (OBR)	
	Gleyed El. Bl. Chernozem				Gregg (GRG)				
	Gleyed Rego Black Chernozem	Hummerston (HMO)	Pleasant (PLE)	Taggart (TGR)	Prodan (PDA)	Sigmund (SGO)	Grover (GRO)	Crookdale (CKD)	
Poor	Rego Humic Gleysol	Sewell (SEE)	Poolex (POX)	Vordas (VDS)	Tadpole (TDP)	Lowton (LWN)	Grayson (GYS)	Sutton (SXP)	Landseer (LSR)

Table 2-3. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Gt2).

Soil Drainage	Classification	Alluvium		Fluvial outwash	Fluvial over Till	Lacustrine over fluvial over till		Lacustrine over fluvial		
		(L, SiL, or CL, SiCL)	(SiC, C)	Sand & Gavel	Sand & gravel over mixed or extr. Calc. Till	* (VFSL, L) over gravel lens over (L, CL)	(L, SiL, SiCL, CL) over (S & gravel) over (L, CL)	Coarse (FS, LS, LFS) over CoS, MS	Mod. coarse (VFS, LVFS, SL, FSL) over S & gravel	Medium or mod. fine (L, SiL, CL, SiCL) over S & gravel
Well to mod. Well	Cumulic Regosol	Mowbray (MOW)	Manson (MXD)							
	Orthic Black Chernozem			Dorset (DOT)		Roseisle (RSI)	Jaymar (JAY)	Wheatland (WHL)	Miniota (MXI)	Croyon (CYN)
	Calc. Black Chernozem			Marringhurst (MRH)	Chater (CXW)		Dogand (DGA)			
	Rego Black Chernozem			Floors (FLS)					Ashmore (AHO)	Zarnet (ZRT)
Imperfect	Gleyed cumulic Regosol	Levine (LEI)	Assiniboine (ASB)							
	Gleyed Black Chernozem			Dexter (DXT)		Nanton (NTO)		Hughes (HGH)	Wytonville (WVI)	Druxman (DXM)
	Gleyed El. Bl. Chernozem						Longdens (LGD)			
	Gleyed Rego Black Chernozem			Mansfield (MFI)	Barager (BAA)	Glencross (GCS)	Melland (MXT)	Gendzel (GDZ)	Kilmury (KUY)	Capell (CXT)
Poor	Rego Humic Gleysol	Basker (BKR)	Kerran (KRN)	Fortina (FTN)		Boxner (BOX)	Marsden (MDN)	Lowry (LOW)	Bornett (BOR)	Carvey (CAV)

*** Lacustrine over stony, water-worked glacial till.**

Table 3-1. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Grassland Transition Subregion 3, Gt3).

Soil Drainage	Classification	Glacial till	Lacustrine over (< 5 cm gravelly lens) over glacial till				Lacustrine and fluvial materials over glacial till			
		Medium to Mod. Fine (L, SiL, to SCL, CL, SiCL)	Coarse (FS, LS, LFS)	Mod. Coarse (VFS, LVFS, FSL)	Medium (L, VFSL, SiL, Si)	Mod. Fine (SCL, CL, SiCL)	Coarse (FS, LS, LFS)	Mod. Coarse (VFS, LVFS, FSL)	Medium (VFSL, L, SiL, Si)	Mod. Fine (SCL, CL, SiCL)
Well to Mod. well	Orthic Black Chernozem	Ryerson (RYS)	Margaret (MRE)	Langvale (LGV)	Waskada (WKD)	Bearford (BEF)	Pendennis (PDN)	Griswold (GWD)	Newstead (NWS)	Hartley (HLY)
	Calc. Black Chernozem	Medora (MDO)	Dunrea (DUR)	Nesbitt (NBT)	Dalny (DNY)					
	Rego Black Chernozem	Hathaway (HHY)	Rhodes (RHD)	Fairburn (FBU)	Maskawata (MAW)					
Imperfect	Gleyed Black Chernozem	Regent (RGT)	Ashdown (AHW)	Ashbury (AHY)	Two Creeks (TWC)	Desford (DFD)	Eramosh (EMH)		Bower (BOW)	
	Gleyed El. Bl. Chernozem	Hazeldean (HZD)			Glenlorne (GNO)				Bannerman (BNM)	
	Gleyed Rego Bl. Chernozem	Coatstone (CSE)	Terence (TRC)	Mentieth (MNH)	Montgomery (MOT)	Croll (CLL)	Carniege (CRG)	Cauldwell (CDW)	Alexander (AXD)	
Poor	Orthic Humic Gleysol	Stoney Creek (SYE)			Villette (VLT)					
	Humic Luvic Gleysol	Tilston (TLT)								
	Rego Humic Gleysol	Ewart (EWT)		Gains-borough (GGH)	Deloraine (DRI)	Wassewa (WSW)			Bella Lake (BEL)	

Table 3-2. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Grassland Transition Subregion 3, Gt3).

Soil Drainage	Classification	Lacustrine							Alluvium	
		Coarse (FS, LS LFS)	Mod. Coarse (VFS, LVFS, FSL).	Medium (VFSL, L, SiL, Si)	Mod. Fine (SCL, CL, SiCL)	Fine (SC, SiC, C)	Medium over Coarse	Mod. Fine to Fine. Strongly calcareous, mod. saline	Medium (VFSL, L, SiL, Si)	Mod. Fine to Fine (SCL, CL, SiCL to SC, SiC, C)
Well to mod. Well	Cumulic Regosol								Melita (MLT)	
	Orthic Black Chernozem	Stanton (STU)	Lyleton (LYT)	Cameron (CMR)	Elva (ELV)		Mather (MTR)			
	Calc. Black Chernozem	Deleau (DLU)	Kemnay (KMY)	Schaffner (SFR)						
	Rego Black Chernozem	Scarth (SCH)	Maon (MON)	Argue (ARG)						
Imperfect	Gl. Cumulic Regosol								Liege (LIG)	Neelin (NEI)
	Gleyed Black Chernozem	Lauder (LUD)	Denbow (DBW)	Underhill (UHL)	Goodlands (GOL)	Agnew (AGW)	Badger Creek (BDC)	Marshy Lake (MYK)		
	Gleyed El. Bl. Chernozem			Hayfield (HYF)	Minto (MTO)					
	Gleyed Rego Black Chernozem	Souris (SOU)	Switzer (SWZ)	Hartney (HRY)	Cranmer (CME)	Pipestone (PPT)	Wawanesa (WWS)	Whitewater (WIW)		Coulter (COU)
Poor	Orthic Humic Gleysol	Bell creek (BEC)		Sanger (SGR)	Naples (NPS)					
	Humic Luvic Gleysol			Orthez (OHZ)	Bunclody (BCY)					
	Rego Humic Gleysol	Oak Lake (OKL)	Plum Lake (PAK)	Emblem (EBL)	Fairfax (FFX)	Cromer (CRM)	Martinville (MNV)	Rebecca (RCC)	Graham (GHM)	Leighton (LGT)

Table 3-3. Relationship between Soil Series, Soil Drainage, Parent Material and Soil Classification (Grassland Transition Subregion 3, Gt3).

Soil Drainage	Classification	Fluvial Outwash	Lacustrine over Fluvial Outwash				Fluvial Outwash over Glacial Till
		Coarse (FS, LS, LFS) gravelly deltaic & outwash materials	Coarse (FS, LS, LFS)	Mod. Coarse (VFS, LVFS, SL, FSL)	Medium (VFSL, L, SiL, Si)	Mod. Fine (SCL, CL, SiCL)	Coarse (FS, LS, LFS), gravelly outwash deposits over mixed till
Well to mod. well	Orthic Black Chernozem	Bede (BED)	Chaucer (CUC)	George Lake (GGK)	Dromore (DOM)		Bernice (BIC)
	Calc. Black Chernozem	Broomhill (BOH)			Breadon (BRO)		Adelpha (APH)
	Rego Black Chernozem	Jackson Creek (JKE)					
Imperfect	Gleyed Black Chernozem	Cartwright (CWG)	Methvin (MHV)	Ninette (NTT)	Glenview (GLN)		Turtlehead (TUA)
	Gleyed Rego Bl. Chernozem	Napinka (NPK)	Reston (RST)	Linklater (LIK)	Gopher Creek (GPE)	Leon (LEO)	Glenora (GLO)
Poor	Rego Humic Gleysol	Partridge (PDG)		Pierson (PIS)	William (WIL)		Bosshill (BSH)

Table 4. Soils and Surface Texture of the Study Area

Soil code	Soil name	Drainage	Surface texture	Textural group of soil profile	Total area		% of RM
					ha	ac	
APH	Adelpha	Well	Gravelly loamy sand	Coarse to very coarse	56	138	0.08
ARG	Argue	Well	Loam	Medium	54	132	0.07
ASB	Assiniboine	Imperfect	Clay	Fine	64	157	0.09
AXD	Alexander	Imperfect	Loam	Medium	660	1,631	0.89
BAA	Barager	Imperfect	Gravelly loamy sand	Coarse to very coarse	6	14	0.01
BDC	Badger Creek	Imperfect	Loam	Medium	113	280	0.15
BED	Bede	Rapid	Gravelly loamy sand	Coarse to very coarse	299	739	0.40
BEF	Bearford	Well	Clay loam	Moderately fine	1,890	4,669	2.55
BEL	Bella Lake	Poor	Loam	Medium	233	575	0.31
BKR	Basker	Poor	Loam to clay loam	Medium to mod. fine	79	195	0.11
BMN	Bermont	Well	Loam to clay loam	Medium to mod. fine	367	906	0.49
BNM	Bannerman	Imperfect	Loam	Medium	45	111	0.06
BOH	Broomhill	Well	Gravelly loamy sand	Coarse to very coarse	64	159	0.09
BOW	Bower	Imperfect	Loam	Medium	289	713	0.39
CAV	Carvey	Poor	Loam to clay loam	Medium to mod. fine	102	251	0.14
CCS	Cactus	Well	(Loamy) fine sand	Coarse	36	88	0.05
CLL	Croll	Imperfect	Clay loam	Moderately fine	4,610	11,392	6.22
CME	Cranmer	Imperfect	Clay loam	Moderately fine	1,413	3,492	1.91
CMR	Cameron	Well	Loam	Medium	390	963	0.53
COU	Coulter	Imperfect	Clay loam to clay	Mod. Fine to fine	91	224	0.12
CRM	Cromer	Poor	Clay	Fine	35	88	0.05
CSE	Coatstone	Imperfect	Loam to clay loam	Medium to mod. fine	2,566	6,341	3.46
CWG	Cartwright	Imperfect	Gravelly loamy sand	Coarse to very coarse	133	329	0.18
CXF	Carroll	Well	Clay loam	Moderately fine	124	307	0.17
CXT	Capell	Imperfect	Loam to clay loam	Medium to mod. fine	56	139	0.08
CXV	Charman	Imperfect	Clay loam	Moderately fine	37	92	0.05
CXW	Chater	Well	Gravelly loamy sand	Coarse to very coarse	46	114	0.06
CYN	Croyon	Well	Loam to clay loam	Medium to mod. fine	308	762	0.42
CZK	Cazlake	Poor	Loam to clay loam	Medium to mod. fine	332	820	0.45
DBW	Denbow	Imperfect	Fine sandy loam	Moderately coarse	131	323	0.18
DFD	Desford	Imperfect	Clay loam	Moderately fine	191	473	0.26
DGF*	Darlingford	Well	Loam to clay loam	Medium to mod. fine	4,366	10,790	5.89
DNY	Dalny	Well	Loam	Medium	301	743	0.41
DOM	Dromore	Well	Loam	Medium	555	1,371	0.75
DOT	Dorset	Rapid	Gravelly loamy sand	Coarse to very coarse	91	225	0.12
DRI	Deloraine	Poor	Loam	Medium	334	826	0.45
DXM	Druxman	Imperfect	Loam to clay loam	Medium to mod. fine	14	34	0.02
EBL	Emblem	Poor	Loam	Medium	155	383	0.21
ELV	Elva	Well	Clay loam	Moderately fine	212	523	0.29
EWT	Ewart	Poor	Loam to clay loam	Medium to mod. fine	362	894	0.49
FBU	Fairburn	Well	Fine sandy loam	Moderately coarse	112	278	0.15
FFX	Fairfax	Poor	Clay loam	Moderately fine	248	613	0.33
FIR	Firdale	Well	Clay loam	Moderately fine	86	212	0.12
FLS	Floors	Rapid	Gravelly loamy sand	Coarse to very coarse	23	56	0.03
FND	Fairland	Well	Loam	Medium	426	1,052	0.57

* including classification variant soils.

Table 4. Soils and Surface Texture of the Study Area (continued)

Soil code	Soil name	Drainage	Surface texture	Textural group of soil profile	Total area		% of RM
					ha	ac	
FRS	Ferris	Imperfect	Loam to clay loam	Medium to mod. fine	762	1,884	1.03
GBO	Glenboro	Well	Loam	Medium	216	533	0.29
GCS	Glencross	Imperfect	Loam	Medium	30	74	0.04
GGK	George Lake	Well	Fine sandy loam	Moderately coarse	322	796	0.43
GHM	Graham	Poor	Loam	Medium	709	1,752	0.96
GLN	Glenview	Imperfect	Loam	Medium	331	819	0.45
GNO	Glenlorne	Imperfect	Loam	Medium	119	294	0.16
GOL	Goodlands	Imperfect	Clay loam	Moderately fine	210	518	0.28
GPE	Gopher Creek	Imperfect	Loam	Medium	2,024	5,002	2.73
GRO	Grover	Imperfect	Loam	Medium over mod. coarse	6	14	0.01
GRR	Guerra	Poor	Clay loam	Moderately fine	2,208	5,456	2.98
HEB	Hebbot	Well	Loam to clay loam	Medium to mod. fine	1,334	3,295	1.80
HHY	Hathaway	Well	Loam to clay loam	Medium to mod. fine	2,926	7,230	3.95
HIT	Hilton	Well	Loam to clay loam	Medium to mod. fine	318	786	0.43
HKS	Hickson	Poor	Loam to clay loam	Medium to mod. fine	14	36	0.02
HMO	Hummerston	Imperfect	Loamy fine sand	Coarse	21	51	0.03
HRY	Hartney	Imperfect	Loam	Medium	648	1,602	0.87
JKE	Jackson Creek	Rapid	Gravelly loamy sand	Coarse to very coarse	29	72	0.04
JYL	Joyale	Imperfect	Clay loam	Moderately fine	3,353	8,285	4.52
KMY	Kemnay	Well	Fine sandy loam	Moderately coarse	83	205	0.11
KRN	Kerran	Poor	Clay	Fine	27	67	0.04
KUD*	Knudson	Well	Clay loam	Moderately fine	2,973	7,347	4.01
LEI	Levine	Imperfect	Loam to clay loam	Medium to mod. fine	250	619	0.34
LEO	Leon	Imperfect	Clay loam	Moderately fine	299	740	0.40
LGT	Leighton	Poor	Clay loam	Moderately fine	208	514	0.28
LGV	Langvale	Well	Very fine sand	Moderately coarse	68	168	0.09
LIG	Liege	Imperfect	Loam	Medium	907	2,242	1.22
LIK	Linklater	Imperfect	Fine sandy loam	Moderately coarse	223	550	0.30
LKH	Lockhart	Well	Fine sandy loam	Moderately coarse	174	429	0.23
LRT	Larrett	Well	Clay loam	Moderately fine	57	140	0.08
LYT	Lyleton	Well	Very fine sand	Moderately coarse	130	322	0.18
MAW	Maskawata	Well	Loam	Medium	434	1,072	0.58
MDN	Marsden	Poor	Loam to clay loam	Medium to mod. fine	6	16	0.01
MDO	Medora	Well	Loam to clay loam	Medium to mod. fine	308	761	0.42
MLT	Melita	Well	Loam	Medium	318	786	0.43
MNH	Mentieth	Imperfect	Loamy very fine sand	Moderately coarse	8	20	0.01
MNV	Martinville	Poor	Loam	Medium	21	51	0.03
MON	Maon	Well	Loamy very fine sand	Moderately coarse	24	61	0.03
MOT	Montgomery	Imperfect	Loam	Medium	2,264	5,595	3.05
MOW	Mowbray	Well	Loam to clay loam	Medium to mod. fine	29	72	0.04
MRE	Margaret	Well	Loamy sand	Coarse	10	26	0.01
MRH	Marringhurst	Rapid	Gravelly loamy sand	Coarse to very coarse	2	4	0.002

* including texture and classification variant soils.

Table 4. Soils and Surface Texture of the Study Area (continued)

Soil code	Soil name	Drainage	Surface texture	Textural group of soil profile	Total area		% of RM
					ha	ac	
MTR	Mather	Well	Loam	Medium	736	1,819	0.99
MXI	Miniota	Well	Sandy loam	Moderately coarse	144	357	0.19
NEI	Neelin	Imperfect	Clay loam to clay	Mod. fine to fine	154	381	0.21
NKK	Nikkel	Imperfect	Clay loam	Moderately fine	74	183	0.10
NPK	Napinka	Imperfect	Gravelly loamy sand	Coarse to very coarse	35	87	0.05
NTT	Ninette	Imperfect	Fine sandy loam	Moderately coarse	87	215	0.12
NWS	Newstead	Well	Loam	Medium	247	609	0.33
OBR	Oberon	Imperfect	Clay loam	Moderately fine	20	49	0.03
PDA	Prodan	Imperfect	Clay loam	Moderately fine	309	763	0.42
PLE	Pleasant	Imperfect	Fine sandy loam	Moderately coarse	39	95	0.05
POR	Porple	Well	Fine sandy loam	Moderately coarse	30	75	0.04
PPT	Pipestone	Imperfect	Clay	Fine	103	253	0.14
PTR	Petrel	Imperfect	Loam	Medium over mod. coarse	72	178	0.10
RAM	Ramada	Well	Clay loam	Moderately fine	165	409	0.22
RCC	Rebecca	Poor	Clay	Fine	84	208	0.11
RGT	Regent	Imperfect	Loam to clay loam	Medium to mod. fine	528	1,304	0.71
RMP	Rempel	Well	Clay loam	Moderately fine	103	254	0.14
RSI	Roseisle	Well	Loam	Medium	114	282	0.15
RYS	Ryerson	Well	Loam to clay loam	Medium to mod. fine	7,051	17,423	9.51
SCH	Scarth	Well	Loamy fine sand	Coarse	7	17	0.01
SCK	Stockton	Well	Loamy fine sand	Coarse	14	34	0.02
SEE	Sewell	Poor	Loamy fine sand	Coarse	11	28	0.02
SFR	Schaffner	Well	loam	Medium	9	23	0.01
SGO	Sigmund	Imperfect	Clay	Fine	7	18	0.01
STU	Stanton	Well	Loamy fine sand	Coarse	35	85	0.05
SWZ	Switzer	Imperfect	Fine sandy loam	Moderately coarse	108	267	0.15
SXP	Sutton	Poor	Clay loam	Moderately fine	21	53	0.03
TDP	Tadpole	Poor	Clay loam	Moderately fine	99	245	0.13
TGR	Taggart	Imperfect	Loam	Medium	178	439	0.24
TOC	Torcan	Imperfect	Loam	Medium	28	69	0.04
TUA	Turtle Head	Imperfect	Gravelly loamy sand	Coarse to very coarse	17	42	0.02
TWC	Two Creeks	Imperfect	Loam	Medium	3,013	7,444	4.06
UHL	Underhill	Imperfect	Loam	Medium	55	137	0.07
ULH	Ullrich	Imperfect	Clay loam	Moderately fine	993	2,454	1.34
VDS	Vordas	Poor	Loam	Medium	19	46	0.03
VLT	Villette	Poor	Loam	Medium	63	156	0.09
WIL	William	Poor	Loam	Medium	210	520	0.28
WIW	Whitewater	Imperfect	Clay loam to clay	Mod. Fine to fine	9	23	0.01
WKD	Waskada	Well	Loam	Medium	6,139	15,169	8.28
WSW	Wassewa	Poor	Clay loam	Moderately fine	1,554	3,840	2.10
WWS	Wawanesa	Imperfect	Loam	Medium	255	631	0.34
Others	Eroded slope, marsh, urban, water & unclassified				4,712	11,643	6.35
Total					**74,159**	**183,249**	**100**

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 single factor maps and interpretative 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 GIS uses the 1:50, 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 soil capability for agriculture and irrigation suitability.

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) (Appendix 1, Section A).

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.

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 Section B 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 two to five percent 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 to 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) or moisture limitation (5M). This Class includes the lower, depressional areas of the poorly drained soils.

Class 6 soils in the study area have an extremely severe limitation due to soil erosion (6E), which restricts their capability to producing perennial forage crops.

Class 7 soils in the RBL, which have no capability for arable culture, are resulted from severe soil erosion and steep slopes.

A summary table of agriculture capability as affected by soil characteristics and landscape is showed in Table A1 of Appendix 1. In the RM of RBL class 2 land is dominant, accounting for 68.8 percent, followed by class 3 (12.1%) and class 5 (10.5%). Class 4, 6 and class 7 total 1.30, 4.11 and 0.31 percent, respectively (Table 5).

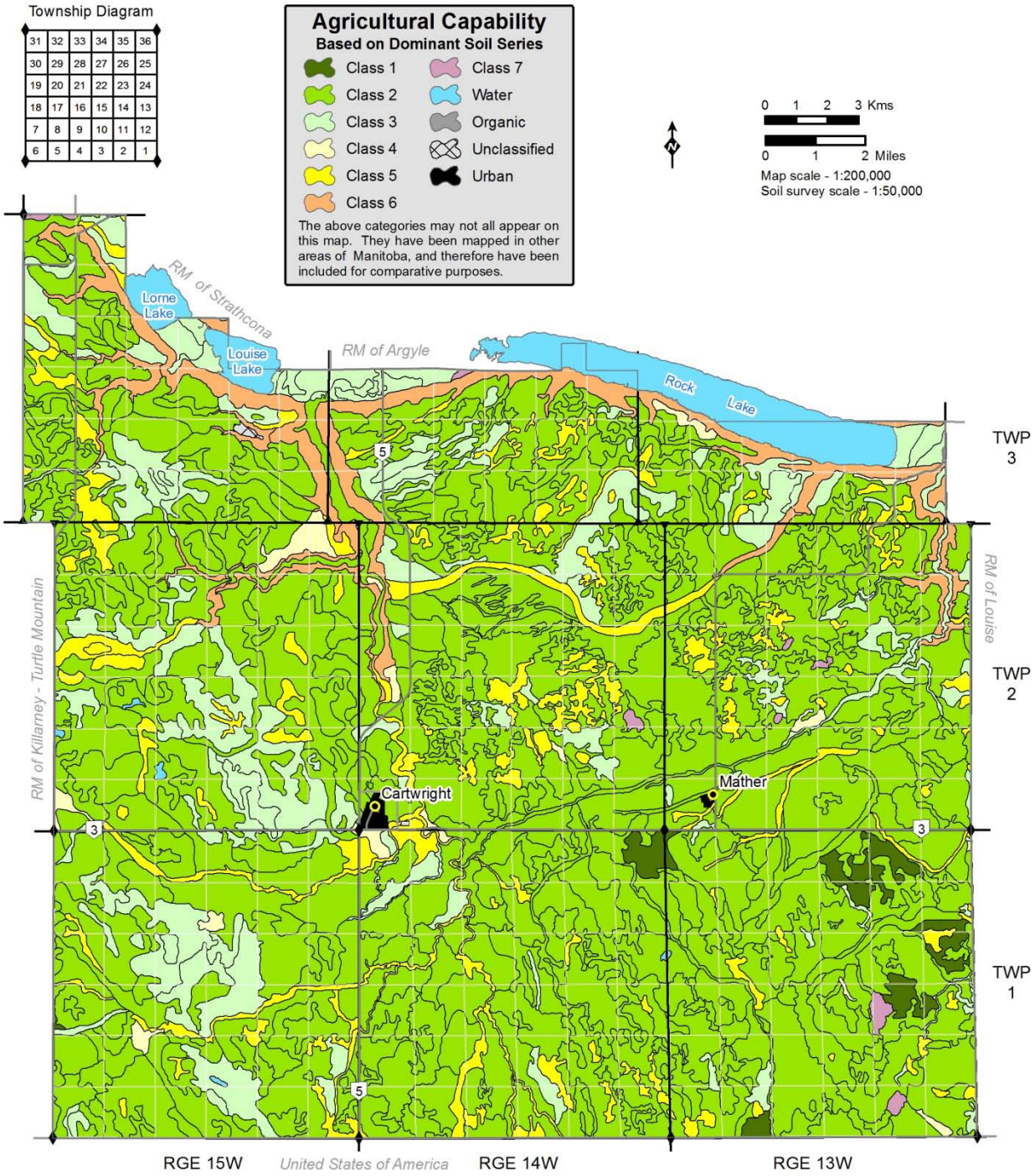
The most limiting factors in Class 2 lands are topography (2T=32.0%) and excess water (2W=15.4%), or a combination of excess water and topography (2WT=11.2%) in the study area (Table 5). Soils grouped as Class 3 are due to topography (3T=4.58%) and salinity (3N=2.87%) although other factors such as moisture limitation and inundation are also present. Class 5 is caused predominantly by excess water (5W=8.24%) in poorly drained areas. Soils in Class 6 and 7 are considered as either severely eroded lands or steep slopes (Table 5).

An interpretative map (Map 1) depicts the 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. However, subdominant soil components, the nature of the subclass limitations, and total acreage of this type of soil are indicated in Table A2 of Appendix 1. A poster-sized agricultural capability map (1:50,000) is also included with this report.

Table 5. Ag Capability of Land in the RM of RBL

Agricultural Capability Class, (%)		Total area		% of RM
		ha	ac	
1		665	1,643	0.90
2 (68.8)	2I	327	808	0.44
	2IT	20	50	0.03
	2IW	91	224	0.12
	2M	2,517	6,220	3.39
	2MT	1,574	3,890	2.12
	2T	23,697	58,555	32.0
	2TE	153	378	0.21
	2W	11,407	28,186	15.4
	2WT	8,274	20,446	11.2
	2X	2,969	7,337	4.00
3 (12.1)	3I	1,372	3,391	1.85
	3IN	3	7	0.004
	3M	1,696	4,191	2.29
	3MT	161	398	0.22
	3MW	21	51	0.03
	3N	2,128	5,258	2.87
	3T	3,400	8,402	4.58
	3TE	188	464	0.25
4 (1.30)	4M	742	1,833	1.00
	4MT	7	17	0.01
	4N	83	205	0.11
	4T	94	233	0.13
	4TE	37	91	0.05
5 (10.5)	5IW	1,023	2,529	1.38
	5M	610	1,506	0.82
	5N	77	189	0.10
	5W	6,112	15,103	8.24
6 (4.11)	6E	1,521	3,758	2.05
	6T	1,390	3,434	1.87
	6TE	139	344	0.19
7 (0.31)	7TE	20	51	0.03
	7W	210	518	0.28
Water, urban & unclassified		1,432	3,537	1.93
Total		**74,159**	**183,249**	**100**

Map 1. Agricultural Capability Map of the RM of Roblin



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.

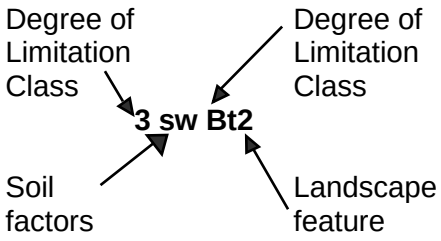
Soil properties considered important for evaluating irrigation suitability are texture, soil drainage, depth to water table, salinity and geological uniformity.

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 and landscape feature are combined to determine the placement of a land area in one of 16 classes of irrigation suitability which are grouped and described by four ratings: **Excellent, Good, Fair** and **Poor**. (Table A3 of Appendix 1). The guidelines are listed in Table A4 and A5 of Appendix 1, 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 complex topography (t2) 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 (Appendix 1, Table A3 to A5).

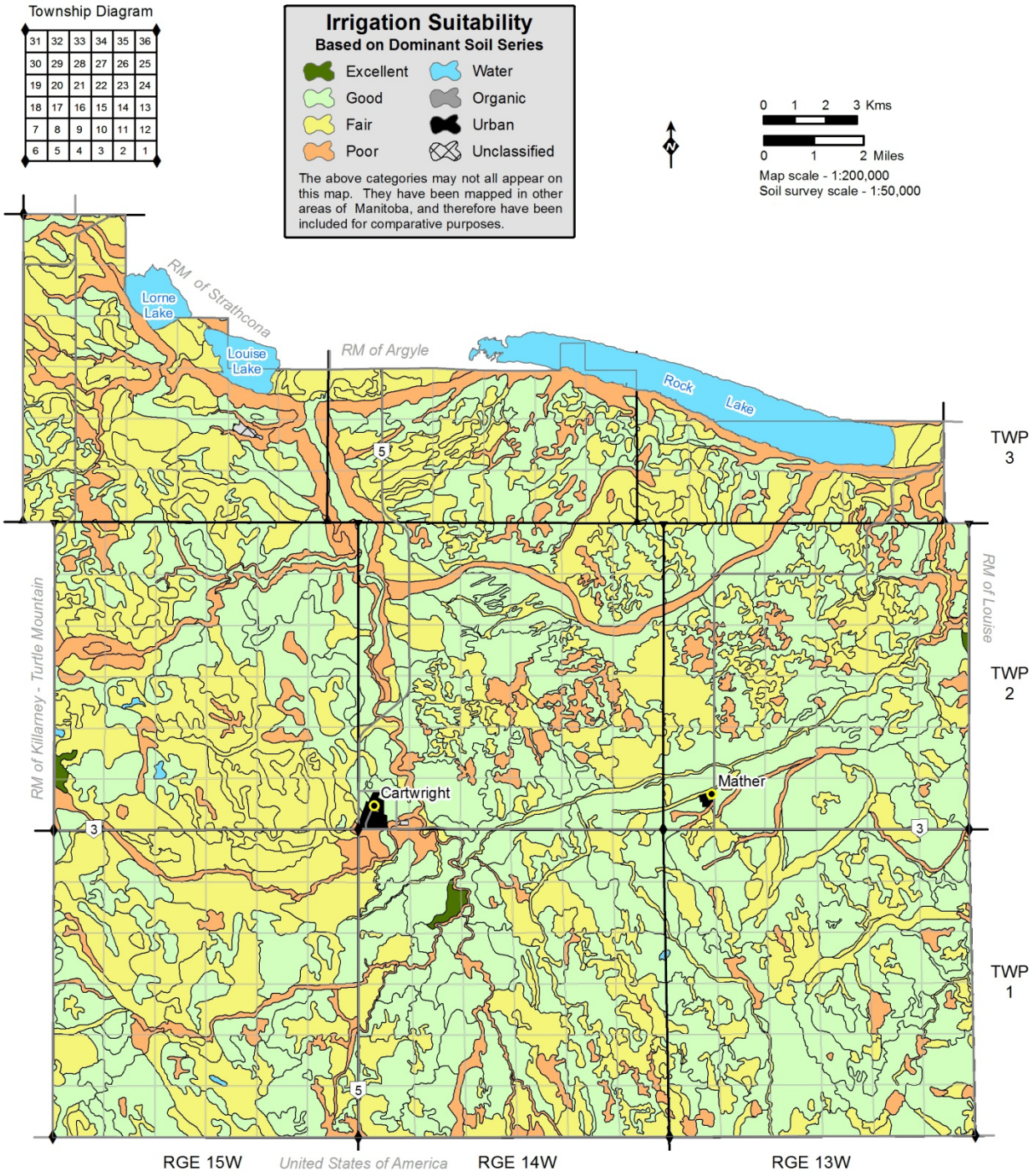
A summary of soils and their interpretive classification for irrigation suitability is provided in Table 6. The subdominant soil series and phases are considered when generating the data in Table 6. Approximately, 43 percent of the land in RBL is classified as good or excellent for irrigation suitability. Forty percent of lands are in category of “fair”. It is clearly shown that drainage problems (3w A and 3w Bt2) associated with topography (2kx Ct2) are major factors attributing to this class. If soil drainability is improved, those soils can be upgraded to the “good” category. Poor drainage also results in “poor” irrigation suitability (Table 6). Approximately, half of 15.4 percent of “poor” irrigation suitability are due to either poor drainage or rapid/very rapid drainage.

An interpretative map (Map 2) illustrates the rating of the dominant soil series and landscape features for each polygon. It shows that most lands in Township 3 Range 15 and some lands in Township 1 & 2 Range 15 are not suitable for irrigation, and these soils are classified as either “fair” or “poor”.

Table 6. Soil Irrigation Suitability in the RM of RBL

Class (%)	Soil & landscape features	Total area		% of RM
		ha	ac	
Excellent (0.28)	1 A	210	519	0.28
Good (42.5)	1 Bt2	1,135	2,806	1.53
	2g A	68	168	0.09
	2g Bt2	668	1,651	0.90
	2gm A	152	376	0.21
	2gm Bt2	539	1,332	0.73
	2k A	351	867	0.47
	2k Bt2	671	1,659	0.91
	2kx A	3,456	8,541	4.66
	2kx Bt2	21,704	53,632	29.3
	2m A	493	1,217	0.66
	2m Bt2	269	665	0.36
	2mw A	216	534	0.29
	2mw Bt2	115	283	0.15
	2w A	545	1,346	0.73
	2w Bt2	750	1,852	1.01
	2x A	204	504	0.28
	2x Bt2	200	495	0.27
Fair (39.8)	1 Ct2	17	41	0.02
	2gm Ct2	172	425	0.23
	2k Ct2	15	37	0.02
	2kx Ct2	3,302	8,158	4.45
	2mx Ct2	10	26	0.01
	2w Ct2	45	110	0.06
	2x Ct2	64	157	0.09
	3kw Bi	64	157	0.09
	3m Bt2	36	88	0.05
	3mx A	17	42	0.02
	3s A	190	469	0.26
	3s Bt2	104	257	0.14
	3sw A	932	2,302	1.26
	3sw Bi	3	7	0.00
	3sw Bt2	609	1,504	0.82
	3w A	13,331	32,942	18.0
	3w Bi	1,003	2,478	1.35
	3w Bt2	9,040	22,339	12.2
	3w Bt2i	306	756	0.41
	3w Ct2	128	315	0.17
	3ws A	136	336	0.18
	3ws Bt2	17	42	0.02
Poor (15.4%)	2m Dt2	7	17	0.01
	4gm Bt2	107	265	0.14
	4kw A	120	296	0.16
	4kw Ci	27	67	0.04
	4kx A	110	271	0.15
	4m A	114	281	0.15
	4m Bt2	527	1,303	0.71
	4m Ct2	345	852	0.46
	4m Dt2	2,761	6,823	3.72
	4s A	4	9	0.01
	4s Bt2	114	282	0.15
	4sw A	31	76	0.04
	4w A	5,401	13,347	7.28
	4w Bt2	570	1,409	0.77
	4w Ci	996	2,462	1.34
	4wx Di	210	518	0.28
Water, urban & unclassified (1.93%)		1,432	3,537	1.93
Total		**74,159**	**183,249**	**100**

Map 2. Irrigation Suitability Map of the RM of Roblin



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. The most suitable soil and landscape conditions occur in **Class 1** and the least desirable conditions occur in **Class 5**. Details regarding the criteria applied in the suitability rating are described in Tables 6A and A7 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 favourable 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.

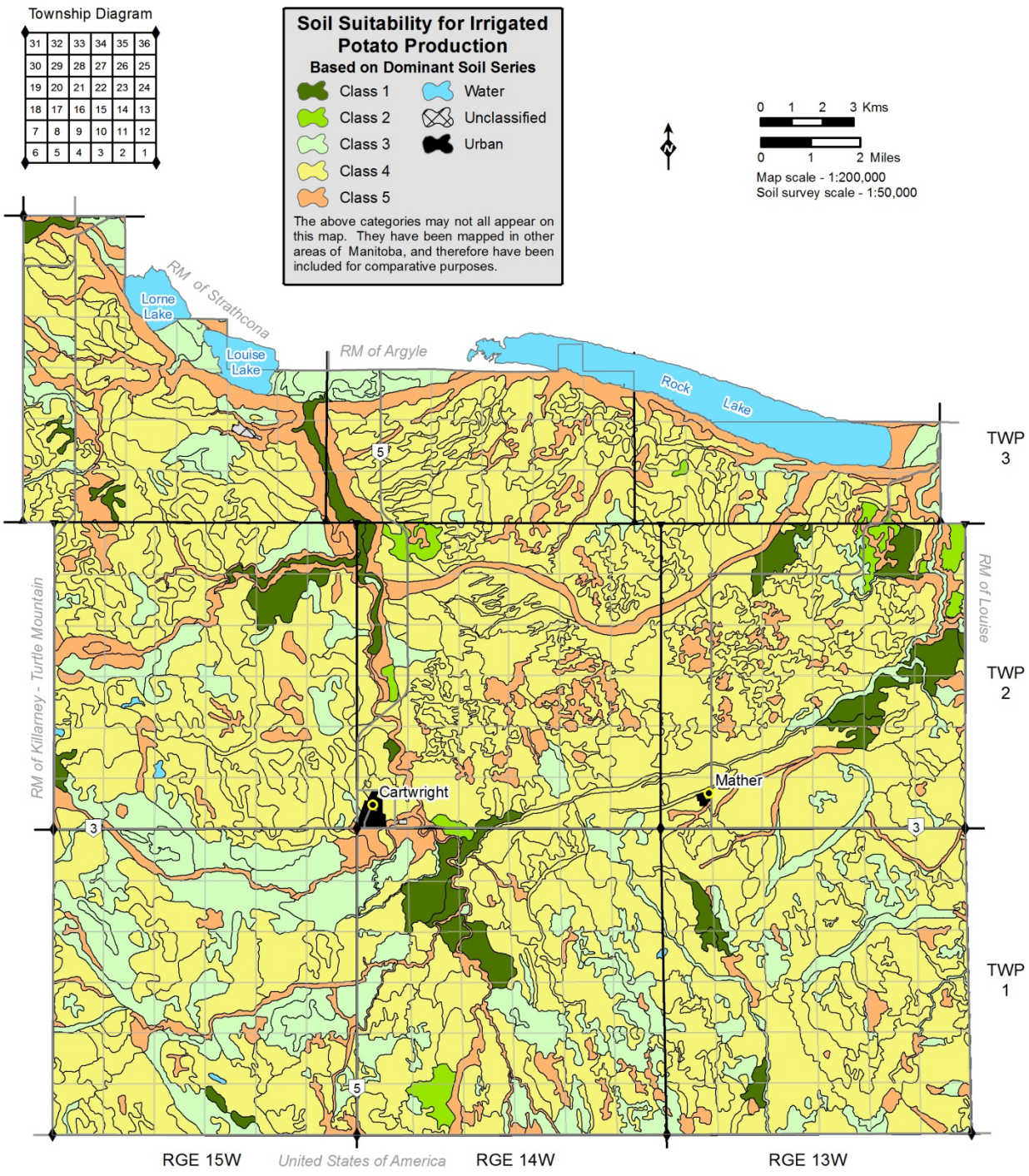
Integration of related databases in a GIS environment can be used to create a map that depicts the rating of the dominant soil and landscape feature for each soil polygon. The nature of the subclass limitations and the rating of subdominant soil and landscape components are not shown at this scale, but are indicated in Table A2 of Appendix 1. An interpretative map (Map 3) illustrates the rating of the dominant soil series and landscape features for each polygon.

Lands in the RM of RBL are not suitable for potato production (Table 7). Approximately over three quarters of soils fall into either class 4 or class 5 category. This is mainly due to unsuitable soil texture and topography. Soil salinity also plays a role in degrading soil suitability for irrigated potato production.

Table 7. Soil Irrigation Suitability for Potato Production in the RM of RBL

Potato Suitability Class	Total area		% of RM
	ha	ac	
Class 1	2,429	6,002	3.28
Class 2	759	1,876	1.02
Class 3	12,761	31,533	17.2
Class 4	45,123	111,501	60.8
Class 5	11,655	28,800	15.7
Water, urban & unclassified	1,432	3,537	1.93
Total	74,159	183,249	100.0

Map 3. Soil Suitability for Irrigated Potato in the RM of Roblin



4.5 Soil Texture

Mineral particles in soil are grouped according to size into sand (2 - 0.05 mm in diameter), silt (0.05 - 0.002 mm) 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 5). The presence of larger particles (diameter is greater than 2 mm) 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 25 cm in diameter

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

Figure 5. Soil Texture Triangle

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 are often 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 are grouped as coarse, medium and fine (Table 8).

Table 8. Soil Texture Group

Texture group		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
	Mod. 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	Mod. 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

Particle analysis showed that among 297 soil samples collected from the A horizon in the study area, 133 samples were loam, accounting for 45 percent (Table 9), and approximately 20 percent was either sandy clay loam (10.4%) or clay loam (9.4%), indicating soil texture in the RBL is suitable for holding water and retaining plant nutrients. Soil tilth is not a problem as well. Fine sandy loam account for 14.5 percent of the surveyed area. Compared to the west-neighbouring RM of Killarney-Turtle Mountain, soil surface texture is relatively sandier in the RM of RBL.

Table 9. Lab Results of Soil Surface Texture in the RM of RBL

Texture	# of samples	% of total
C	1	0.34
CL	28	9.43
CoSL	4	1.35
FSL	43	14.5
L	133	44.8
LCoS	4	1.35
LMS	19	6.40
MS	1	0.34
MSL	18	6.06
SCL	31	10.4
SiC	1	0.34
SiCL	6	2.02
SiL	8	2.69
Total	297	100

Based on soil polygons, the different texture groups and their proportions in terms of land area in the RM of RBL are listed in Table 10. Soil texture determined in the laboratory and those delineated from soil polygons show the same trend, i.e. medium soil texture is dominant in the study area, and followed by moderately fine texture.

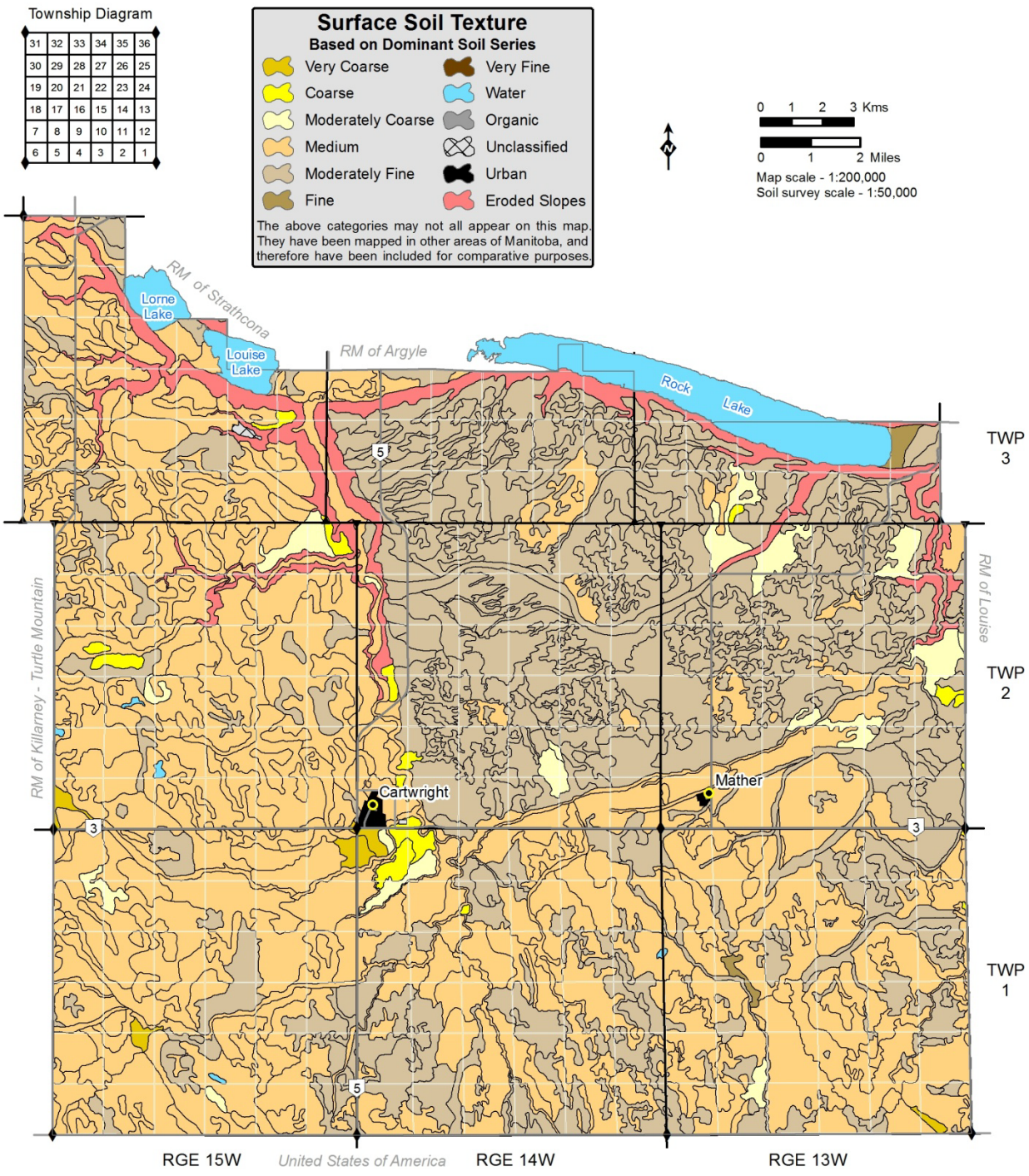
Table 10. Soil Texture Group and their Proportions in the RM of RBL

Texture group	Texture	Total area		% of RM
		ha	ac	
Very coarse	GRLS*	334	826	0.45
Coarse	GRSL	25	61	0.03
	LCoS	91	225	0.12
	LS	361	893	0.49
	LFS	231	570	0.31
Mod. coarse	LVFS	474	1,171	0.64
	SL	144	357	0.19
	FSL	1,593	3,937	2.15
Medium	VFSL	1,216	3,004	1.64
	L	34,589	85,471	46.6
	SiL	19	46	0.03
Mod. fine	SCL	542	1,340	0.73
	CL	29,429	72,719	39.7
	SiCL	79	195	0.11
Fine	SiC	98	242	0.13
	C	222	549	0.30
Unclassified, eroded slope, urban, marsh & water		4,712	11,643	6.35
Total		47,159	183,250	100

* GR = gravelly.

Surface soil texture shown in Map 4 illustrates the textural group of the dominant soil for each polygon.

Map 4. Soil Surface Texture in the RM of Roblin



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 wetlands and marsh. Five soil drainage classes are described below.

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.

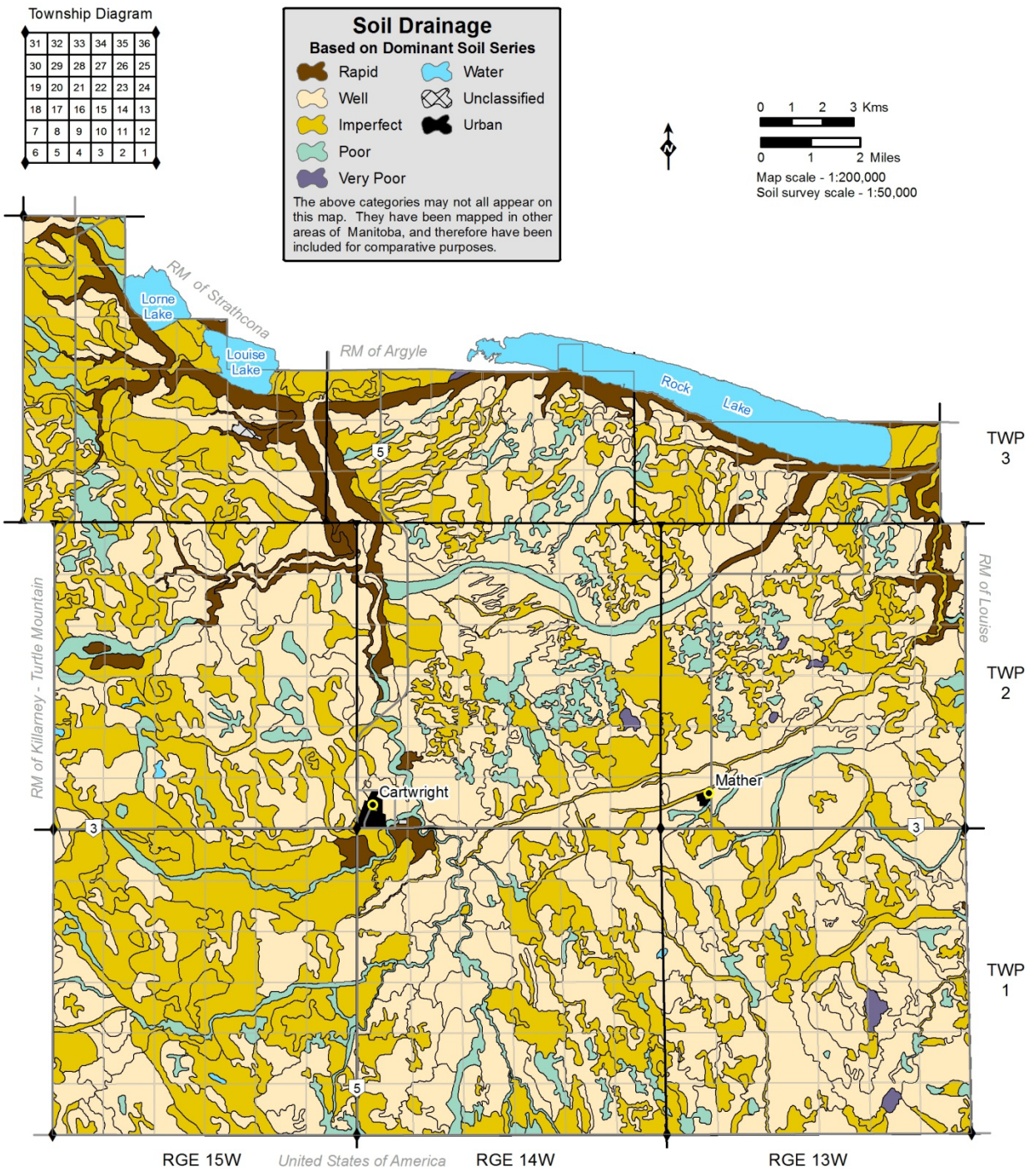
Soil drainage in Table 11 indicates that 45.6 percent of the soils in the RM of RBL are well drained. The imperfectly drained soils comprise 37.7 percent of lands in the RM. The poorly and very poorly drained soils in the RM account for approximately 10 percent.

Table 11. Soil Drainage Classes in the RM of RBL

Drainage Class	Total area		% of RM
	ha	ac	
Rapid	3,578	8,842	4.83
Well	33,845	83,632	45.6
Imperfect	27,959	69,088	37.7
Poor	7,135	17,632	9.62
Very poor	210	518	0.28
Water, urban & unclassified	1,432	3,537	1.93
Total	74,159	183,249	100.0

The soil drainage map (Map 5) shows that well drained soils can be found throughout the RM but appear concentrated in Township 1 Range 13 and south part of Township 2 Range 13. The imperfectly drained soils are concentrated in the west part of the RM, i.e. Townships 1, 2 & 3 Range 15. The drainage map illustrates only the dominant soil for each polygon.

Map 5. Soil Drainage in the RM of Roblin



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 are usually least apparent in the landscape but often the most damaging since 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.

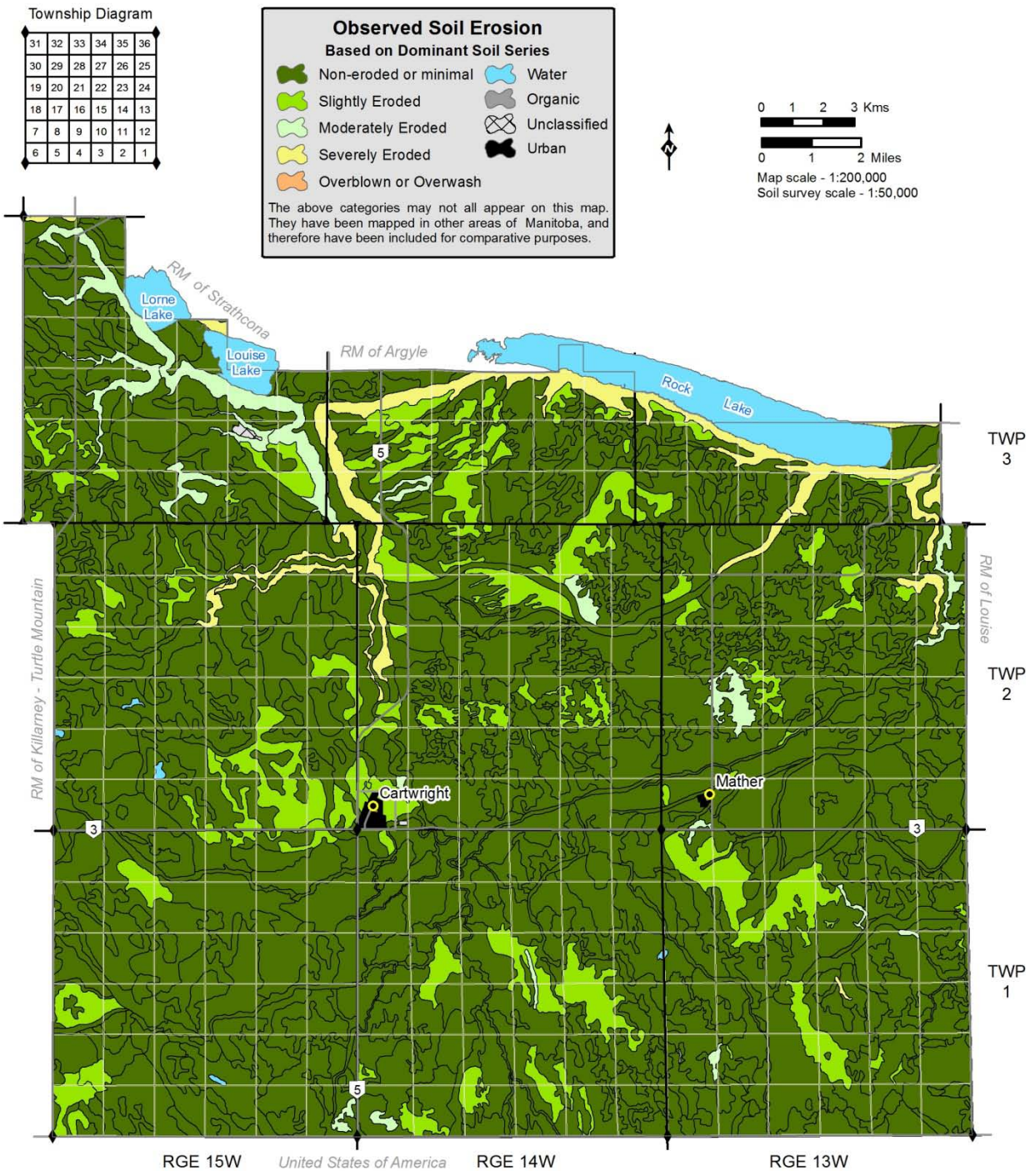
In general, soil erosion in the RBL is not severe. Approximately, 84 percent of the study area has minimal or non-eroded lands (Table 12). The slightly eroded areas comprise 9.76 percent, and moderate to severely eroded lands consist of 4.7 percent in total. The most erodible areas are occurring in or close to creeks, on steep slopes or on knolls of the glacial till.

Table 12. Soil Erosion Classes in the RM of RBL

Observed Erosion Class	Total area		% of RM
	ha	ac	
Non-eroded or minimal	62,005	153,218	83.6
Slightly	7,235	17,878	9.76
Moderately	1,495	3,693	2.02
Severely	1,992	4,923	2.69
Water, urban & unclassified	1,432	3,537	1.93
Total	74,159	183,249	100

The degree of observed soil erosion shown on Map 6 is based on the dominant soil for each polygon.

Map 6. Soil Erosion Observed in the RM of Roblin



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 (Table 13).

Table 13. Slope Classes Used in Soil Map

Slope Class	Slope Description	% Slope
x	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

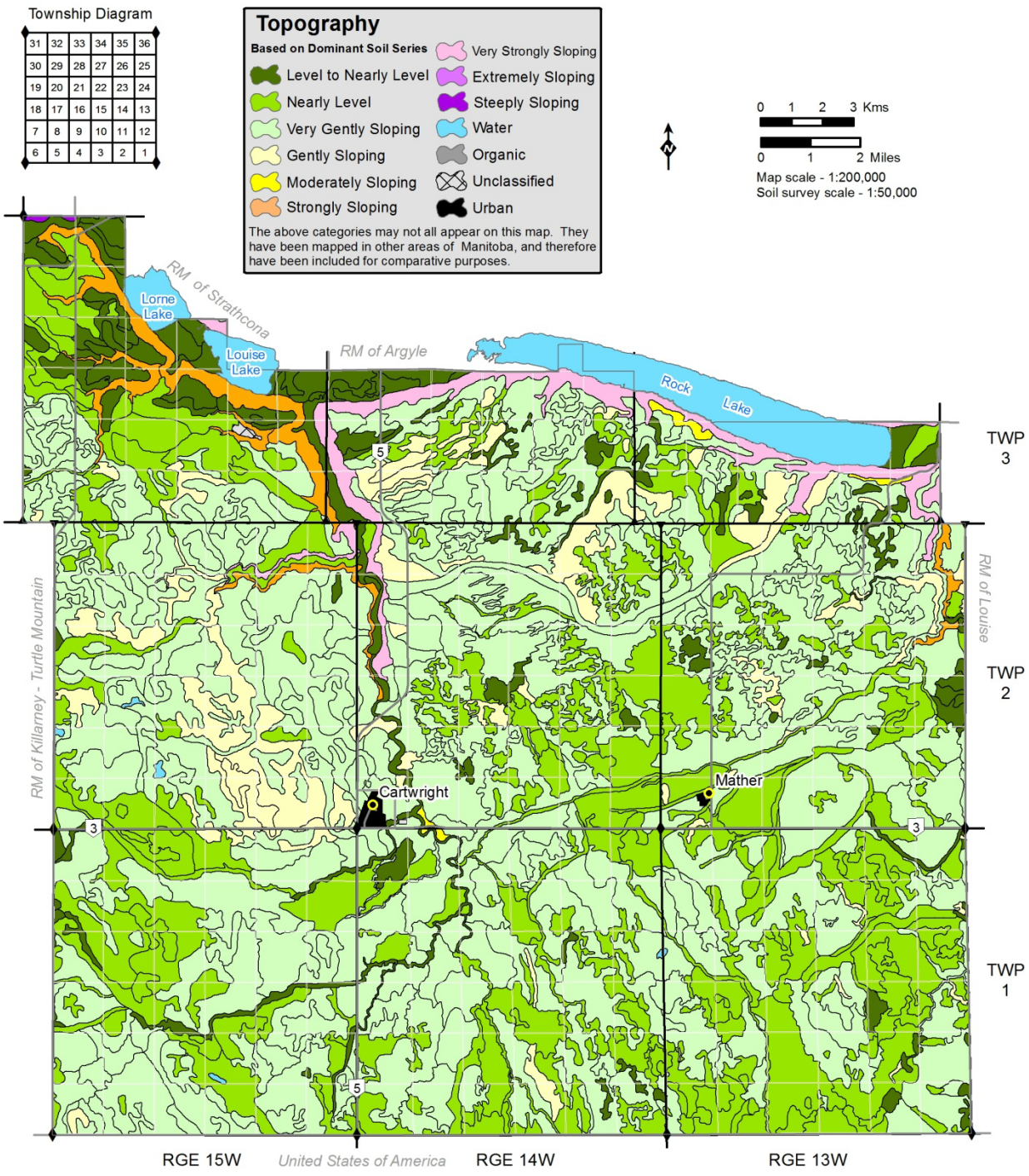
The topography in most lands of the RM of RBL is very gentle (Table 14). Nearly level and very gentle sloping lands account for approximately 30 and 50 percent of the study area, respectively. Five to nine percent gently sloping lands comprise 5.39 percent of the RM. The steeper slopes are found in the area close to Lorne Lake, Louise Lake, and Rock Lake in north of the RM and Long River and Badger Creek in the west of RM.

Table 14. Different slopes and their proportions in the RM of RBL

Topography (slope classes)	Total area		% of RM
	ha	ac	
x	5,612	13,868	7.57
b	22,503	55,607	30.35
c	37,409	92,439	50.44
d	4,001	9,886	5.39
e	231	571	0.31
f	1,212	2,994	1.63
g	1,529	3,778	2.06
i	20	51	0.03
Water, mash, urban & unclassified	1,641	4,056	2.21
Total	74,159	183,249	100.0

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

Map 7. Topography of the RM of Roblin



4.9 Stoniness

Soils with stones can hinder tillage, planting and harvesting operations. The degree of stoniness is described by five 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 occurred.

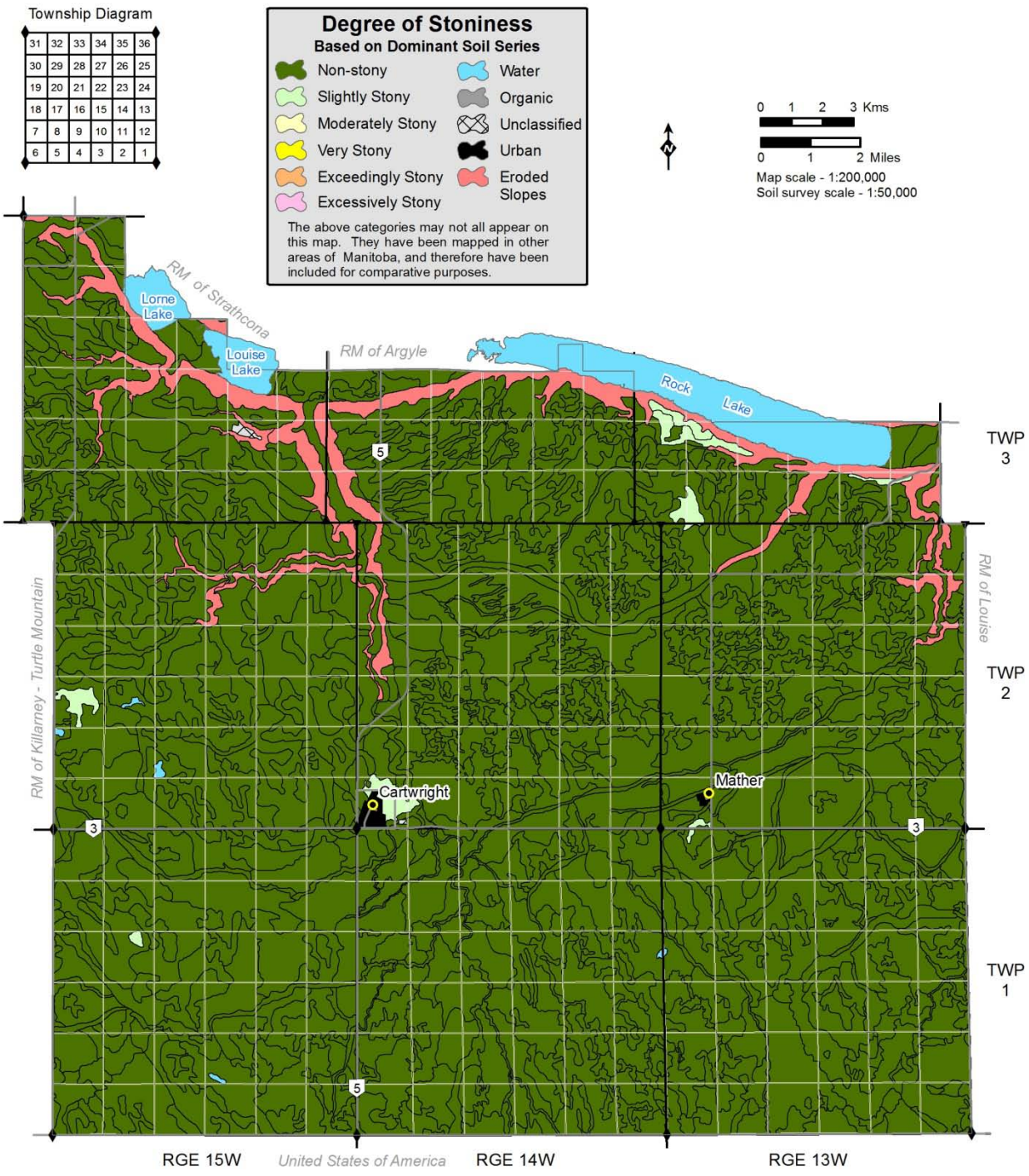
Lands in the RM of RBL are not considered stony as approximately 93 percent of the RM fall into the non-stony category. Slightly stony soils account only for one percent of the study area (Table 15), and they are scattered in small areas of Township 2 & 3 Range 15, Township 3 Range 13, and the area close to town of Cartwright. Some previous stony fields have been improved since producers have been keeping removing stones from their fields since the early 1970s.

Table 15. Stoniness Classes in the RM of RBL

Degree of Stoniness	Total area		% of RM
	ha	ac	
Non-stony	69,049	170,624	93.1
Slightly stony	607	1,501	0.82
Moderately stony	0	0	0
Very stony	0	0	0
Exceedingly stony	0	0	0
Eroded slope, water, urban, & unclassified	4,502	11,125	6.07
Total	74,159	183,249	100.0

The degree of stoniness shown on Map 8 is based on the dominant soil for each polygon.

Map 8. Degree of Stoniness of the RM of RBL



4.10 Soil chemical properties

4.10.1 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, and Foxtail 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 so 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 or a Dual EM) can determine whether or not soluble salts are present.

Identification of salt affected areas and the selection of a salt tolerant crop is the most important management practices available to farmers.

A saline soil is defined as a soil with an electrical conductivity (EC) of the saturation extract greater than 4 milli-Siemens/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:

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

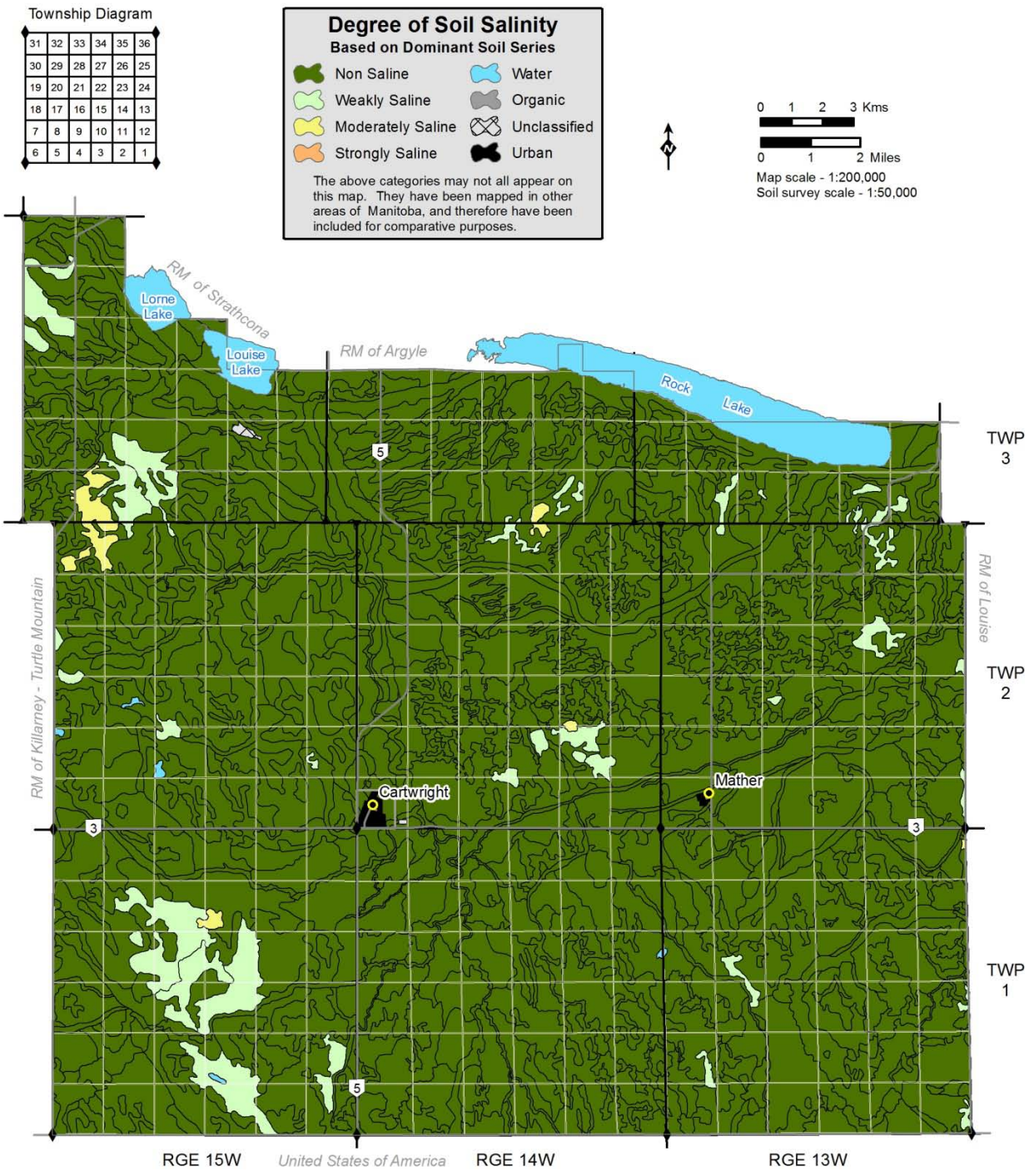
Soil salinity is not a problem for most soils in the RM of RBL (Table 16). Weakly saline soils are noted in the central areas of Township 1 Range 15, the southwest and northwest areas of Township 3 Range 15 and some areas between Township 3 and Township 2 Range 13. Small areas of moderately or strongly saline soils are spotted in far northwest corner of Township 2 Range 15W or southwest corner of Township 3 Range15W.

Table 16. Soil Salinity Classes in the RM of RBL

Class of Salinity	Total area		% of RM
	ha	ac	
Non-saline	69,620	172,034	93.9
Weakly saline	2,713	6,704	3.66
Moderately saline	318	785	0.43
Strongly saline	77	189	0.10
Water, urban & unclassified	1,432	3,537	1.93
Total	74,159	183,249	100

The class of salinity shown on Map 9 is based on the dominant soil for each polygon.

Map 9. Soil Salinity in the RM of Roblin



4.10.2 Soil organic carbon, pH and $CaCO_3$

Soil organic carbon (SOC) in A horizon is affected by several factors. One of these factors is soil texture. A summary of 230 soil samples from A horizon clearly shows that SOC increases when soil particles become finer under well-drained condition (Table 17). For example, coarse-textured soil averaged 3.24 percent in SOC (32.4 g per kg), while moderately coarse- and medium-textured SOC increased to 4.17 and 4.75 percent, respectively. The difference of SOC content between medium and moderately fine textured soils is not obvious.

Table 17. SOC in A horizon Affected by Soil Texture in the RM of RBL

Texture group	Soil name, parent material(PA) & classification			SOC
	Name	PA	Sub-group	g/kg
Coarse (32.4)	Bede	F	Orthic	50.8
	Chaucer	L/F	Orthic	31.1
	Rhodes	L/T	Rego	29.0
	Stanton	L	Orthic	18.5
Mod. coarse (41.7)	George lake	L/F	Orthic	44.7
	Lockhart	L/T	Orthic	38.4
	Lyleton	L	Orthic	39.1
	Maon	L	Rego	44.7
Medium (47.5)	Cameron	L	Orthic	53.6
	Maskawata	L/T	Rego	41.4
	Newstead	L/F/T	Orthic	46.9
	Waskada	L/T	Orthic	48.2
Mod. Fine (46.1)	Bearford	L/T	Orthic	42.1
	Elva	L	Orthic	49.0
	Hartley	L/F/T	Orthic	50.7
	Knudson	L/T	Orthic	42.6

Note: Data in bracket of texture group is the average of SOC. F = fluvial, L = lacustrine, T = glacial till, / = overlying.

SOC concentration is lower in Rego soils, compared to Orthic soils developed under similar soil conditions. For example, SOC in Hathaway (Rego) soil averages 3.20 percent, while Ryerson (Orthic) soil has an average SOC of 4.22 percent (Table 18). Both soils are developed from glacial till parent material. A similar trend is found in lacustrine overlying glacial till soil series. For example, SOC content in Maskawata (Rego) soil averages 4.14 percent, lower than that of Waskada (Orthic, with 4.82 % of SOC). The A horizon in the Rego soils is either eroded away or incorporated with underlying C horizon, thus resulting in a lower SOC concentration. In contrast, Orthic soils have a B horizon which is higher in SOC (Soil Report No. D90, 2011), thus if part of A horizon is eroded, the B horizon is then incorporated with top soils, resulting in a relatively higher SOC content in Orthic soils than in Rego soils.

Imperfectly drained soils usually result in higher SOC content. For example, well-drained Hathaway and Ryerson soils derived from glacial till and Maskawata and Waskada from lacustrine overlying glacial till average 4.01 and 4.74 percent, respectively, while imperfectly drained Coatstone and Regent from glacial till and Montgomery and Two Creeks from lacustrine overlying glacial till have a mean of SOC of 4.76 and 4.85 percent, respectively.

Soil pH in A horizon ranges from 5.07 to 8.39. Large variations are due to different chemical processes occurring in the A horizon. Most soil carbonate is leached out from A horizon in well drained, Orthic Black Chernozemic soils (Darlingford, Waskada, Dromore, Hartley, Knudson, Cameron, etc.) and results in lower pH values (Table 18). While imperfectly or poorly drained soils (Ewart, Charman, Guerra, Wawanesa, etc.) have a tendency to accumulate carbonate and result in higher pH values.

Soil carbonate contents depend heavily on soil parent materials and chemical processes occurring in the A horizon. For example,

both Hathaway (7.91%) and Ewart (10.3%) soils are high in carbonate concentration, but higher carbonate levels in Hathaway soils are due to the C horizon being incorporated with the A horizon (Table 18), whereas high concentration of carbonate in Ewart soils is caused by carbonate accumulation in poorly drained conditions. None or very low concentration of carbonate is detected from A horizon in well drained Orthic Black Chernozemic soils such as Darlingford, Hartley, Cameron, Waskada, etc.

Table 18. Soil Chemical Properties in A horizon from Selected Soils in the RM of RBL

Soil name	Soil code	Organic C (%)		Soil pH		Ca carbonate (%)		EC (mS/cm)	
		#	Ave	#	Ave	#	Ave	#	Ave
Badger Creek	BDC	3	6.08	3	7.47	3	7.84	-	-
Cameron	CMR	7	5.36	8	6.87	7	0.49	1	0.58
Charman	CXV	1	4.24	1	7.97	1	4.92	1	3.56
Coatstone	CSE	6	4.86	5	7.64	7	10.83	2	3.91
Cranmer	CME	14	4.12	13	7.80	12	8.08	6	9.76
Croll	CLL	9	4.37	9	7.74	11	7.06	7	8.33
Darlingford	DGF	4	4.36	1	6.48	1	0.00	-	-
Denbow	DBW	3	3.29	1	7.90	3	3.14	1	1.42
Desford	DFD	3	4.58	2	7.69	3	2.67	1	9.96
Dromore	DOM	8	5.21	8	6.58	5	2.19	-	
Elva	ELV	3	4.90	3	7.30	3	0.68	-	-
Ewart	EWT	2	4.83	2	7.91	2	10.3	1	10.9
George Lake	GGK	4	4.47	4	7.06	1	8.58	-	-
Goodlands	GOL	4	4.59	3	7.13	3	3.45	-	-
Gopher Creek	GPE	3	4.57	3	7.66	3	5.32	1	4.21
Guerra	GRR	3	7.77	2	7.84	3	6.49	1	16.3
Hartley	HLY	2	3.75	2	6.55	2	0.00	-	-
Hartney	HRY	5	4.59	5	7.64	4	14.8	3	4.05
Hathaway	HHY	4	3.20	3	7.22	8	7.91	-	-
Hilton	HIT	2	5.43	1	7.05	1	0.00	-	-
Joyale	JYL	2	4.63	2	7.59	6	8.44	2	8.00
Knudson	KUD	9	4.26	7	6.81	7	0.06	2	0.56
Leighton	LGT	4	4.05	3	7.77	2	11.43	-	-
Leon	LEO	3	4.72	3	7.44	3	9.56	-	-
Lyleton	LYT	4	3.91	4	7.30	4	3.84	1	1.29
Maskawata	MAW	2	4.14	1	7.38	2	1.52	-	-
Mather	MTR	3	4.32	3	6.87	3	0.35	-	-
Medora	MDO	4	3.70	3	7.29	3	3.42	-	-
Montgomery	MOT	4	5.47	3	7.68	3	8.56	2	9.23
Newstead	NWS	2	4.69	2	7.43	1	0.00	-	-
Pipestone	PPT	3	3.88	3	7.31	3	1.04	1	10.0
Prodan	PDA	2	4.08	2	7.65	4	5.97	1	5.59
Regent	RGT	2	4.17	-	-	-	-	-	-
Ryerson	RYS	15	4.22	12	6.92	6	2.73	-	-
Two Creeks	TWC	4	4.22	4	7.12	3	1.29	2	8.04
Ullrich	ULH	4	5.45	4	7.72	3	0.93	2	4.87
Waskada	WKD	15	4.82	11	6.51	7	0.88	1	2.80
Wawanesa	WWS	5	4.78	5	7.80	5	7.19	1	17.1

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 would be difficult or 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 singly or in combination with others affect soil suitability for selected engineering and recreation uses are provided in Table 19. These subclass designations serve to identify the kind of 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 accumulative in their 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. This is left to the discretion of the interpreter. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. Class limits established for rating the suitability of individual soil properties take this into account. For a selected use, therefore, only those soil properties, which most severely limit that use, are specified.

Table 19. Codes Used to Identify Subclass Limitations in Evaluating Soil Suitability for Selected Engineering Uses in Table A8 of Appendix 1

Code	Description
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 A8 of Appendix 1. When using these interpretations, consideration 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.

Guides for evaluating soil suitability for engineering uses are presented in Tables of A9 to A18 of Appendix 1.

5.3 Soil Suitability for Selected Recreational Uses

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

Soils and their properties contribute to the determination of 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 many basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreational uses is shown in Table A8 of Appendix 1. The four classes, Good, Fair, Poor and Very Poor are defined in the section on Engineering Uses. Subclasses are the same as described in Table 19. Guides for evaluating soil suitability for recreational uses are presented in Tables of A19 to A22 of Appendix 1.

Appendix 1

A: 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 the addition 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 moderately severe limitations that restrict the range of crops or require special 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, fertilization 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.

B: 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 A1. Dryland Agriculture Capability Guidelines for Manitoba*

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
Subclass Limitations	No significant limitations in use for crops.	Moderate limitations that restrict the range of crops or require moderate conservation practices.	Moderately 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.

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 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 A2-1. Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Adelpha	APH/xcxx	5M	4gm Bt2	Poor	5	56	138	0.75
Alexander	AXD/xxxx	2M	3w A	Fair	4	104	257	1.40
	AXD/xxxs	3N	3sw A	Fair	4	45	111	0.60
	AXD/xbxx	2M	3w A	Fair	4	407	1,006	5.49
	AXD/xbxs	3N	3sw A	Fair	4	104	257	1.40
Argue	ARG/1cxx	2T	1 Bt2	Good	1	13	31	0.17
	ARG/xcxx	2T	1 Bt2	Good	1	41	101	0.55
Assiniboine	ASB/xxxx	3I	3kw Bi	Fair	5	64	157	0.86
Badger Creek	BDC/xbxx	2W	2w A	Good	3	13	33	0.18
	BDC/xcxx	2WT	2w Bt2	Good	3	74	184	1.00
	BDC/xdxx	3T	2w Ct2	Fair	4	26	63	0.35
Bannerman	BNM/xxxx	2M	3w A	Fair	4	45	111	0.61
Barager	BAA/xc1x	4M	4gm Bt2	Poor	5	6	14	0.08
Basker	BKR/xxxs	5IW	4w Ci	Poor	5	30	75	0.41
	BKR/xcxx	5IW	4w Ci	Poor	5	49	121	0.66
Bearford	BEF/xxxx	1	2kx A	Good	5	10	25	0.14
	BEF/xbxx	1	2kx A	Good	4	587	1,450	7.91
	BEF/xcxx	2T	2kx Bt2	Good	4	1,249	3,087	16.8
	BEF/1cxx	2T	2kx Bt2	Good	4	44	108	0.59
Bede	BED/xxxx	5M	4m A	Poor	5	30	74	0.40
	BED/xbxx	5M	4m A	Poor	5	13	33	0.18
	BED/xcxx	5M	4m Bt2	Poor	5	256	633	3.45
Bella Lake	BEL/xbxx	5W	4w A	Poor	5	233	575	3.14
Bermont	BMN/1cxx	2T	2kx Bt2	Good	4	217	536	2.92
	BMN/2cxx	2TE	2kx Bt2	Good	4	65	160	0.87
	BMN/1dxx	3T	2kx Ct2	Fair	4	39	97	0.53
	BMN/2dxx	3T	2kx Ct2	Fair	4	46	113	0.62
Bower	BOW/xxxx	2M	3w A	Fair	4	111	274	1.50
	BOW/xbxx	2M	3w A	Fair	4	123	304	1.66
	BOW/xcxx	2MT	3w Bt2	Fair	4	55	135	0.74
Broomhill	BOH/xcxx	5M	4m Bt2	poor	5	64	159	0.87
Cactus	CCS/xcxx	4M	3m Bt2	Fair	2	36	88	0.48
Cameron	CMR/xbxx	2X	1 A	Excellent	1	86	213	1.16
	CMR/xcxx	2T	1 Bt2	Good	1	270	667	3.64
	CMR/1cxx	2T	1 Bt2	Good	1	33	83	0.45
Capell	CXT/xbxx	2M	3w A	Fair	3	56	139	0.76
Carroll	CXF/xbxx	2X	2k A	Good	2	24	58	0.32
	CXF/xcxx	2T	2k Bt2	Good	2	101	249	1.36
Cartwright	CWG/xbxx	4M	4m A	Poor	5	42	103	0.56
	CWG/xcxx	4M	4m Bt2	Poor	5	92	226	1.24
Carvey	CAV/xxxx	5W	4w A	Poor	5	102	251	1.37
Cazlake	CZK/xxxx	5W	4w A	Poor	5	86	213	1.16
	CZK/xbxx	5W	4w A	Poor	5	90	223	1.22
	CZK/xbxs	5W	4w A	Poor	5	20	49	0.27
	CZK/xcxx	5W	4w Bt2	Poor	5	136	335	1.83

Table A2-2 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Charman	CXV/xxxx	2W	3w A	Fair	3	8	20	0.11
	CXV/xbxx	2W	3w A	Fair	3	10	26	0.14
	CXV/xcxx	2WT	3w Bt2	Fair	3	18	45	0.25
Chater	CXW/xcxx	5M	4gm Bt2	Poor	5	46	114	0.62
Coatstone	CSE/xbxx	2W	3w A	Fair	4	1,178	2,912	15.9
	CSE/xbxs	3N	3sw A	Fair	4	41	100	0.55
	CSE/xcxx	2WT	3w Bt2	Fair	4	1,208	2,985	16.3
	CSE/xcxs	3N	3sw Bt2	Fair	4	12	29	0.16
	CSE/xdxx	3T	3w Ct2	Fair	4	95	234	1.28
	CSE/1dxx	3T	3w Ct2	Fair	4	33	82	0.45
Coulter	COU/xbxx	2IW	3w A	Fair	3	91	224	1.22
Cranmer	CME/xbxx	2W	3w A	Fair	3	346	856	4.67
	CME/xcxs	3N	3sw Bt2	Fair	4	327	808	4.41
	CME/xcxt	4N	4s Bt2	Poor	5	37	92	0.50
	CME/xcxu	5N	4s Bt2	Poor	5	77	189	1.03
	CME/xcxx	2WT	3w Bt2	Fair	3	626	1,547	8.44
Croll	CLL/xxxx	2W	3w A	Fair	3	76	188	1.03
	CLL/xbxs	3N	3sw A	Fair	4	28	68	0.37
	CLL/xbxx	2W	3w A	Fair	3	3,595	8,883	48.5
	CLL/xc1x	2WT	3w Bt2	Fair	4	24	60	0.33
	CLL/xcxx	2WT	3w Bt2	Fair	3	887	2,193	12.0
Cromer	CRM/xxxx	5W	4kw A	Poor	5	35	88	0.48
Croyon	CYN/xxxx	3M	2gm A	Good	3	22	54	0.30
	CYN/xbxx	3M	2gm A	Good	3	69	170	0.93
	CYN/xcxx	3M	2gm Bt2	Good	3	69	171	0.93
	CYN/xdxx	3MT	2gm Ct2	Fair	4	149	367	2.00
Dalny	DNY/xbxx	2X	2kc A	Good	4	38	95	0.52
	DNY/xcxx	2T	2kx Bt2	Good	4	259	639	3.49
	DNY/xdxx	3T	2kx Ct2	Fair	4	4	9	0.05
Darlingford	DGF/xxxx	2X	2kx A	Good	4	19	47	0.26
	DGF/xbxx	2X	2kx A	Good	4	187	462	2.52
	DGF/xcxx	2T	2kx Bt2	Good	4	2,476	6,119	33.4
	DGF/xc1x	2T	2kx Bt2	Good	4	86	213	1.16
	DGF/1cxx	2T	2kx Bt2	Good	4	982	2,427	13.2
	DGF/xdxx	3T	2kx Ct2	Fair	4	83	206	1.13
	DGF/1dxx	3T	2kx Ct2	Fair	4	294	726	3.96
	DGF/2dxx	3TE	2kx Ct2	Fair	4	47	115	0.63
	DGF/1e1x	4T	2kx Ct2	Fair	5	73	181	0.99
Darlingford (a variant)	DGFc/xcxx	2T	2kx Bt2	Good	4	65	160	0.87
	DGFc/1dxx	3T	2kx Ct2	Fair	4	54	134	0.73
Deloraine	DRI/xxxx	5W	4w A	Poor	5	72	179	0.98
	DRI/xbxx	5W	4w A	Poor	5	129	318	1.74
	DRI/xcxx	5W	4w Bt2	Poor	5	133	329	1.79
Denbow	DBW/xcxx	2MT	2w Bt2	Good	3	131	323	1.76
Desford	DFD/xbxx	2W	3w A	Fair	4	83	205	1.12
	DFD/xbxs	3N	3sw A	Fair	4	99	245	1.34
	DFD/xcxx	2WT	3w Bt2	Fair	4	10	23	0.13

Table A2-3 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Dorset	DOT/xcxx	5M	4m Bt2	Poor	5	41	102	0.56
	DOT/1cxx	5M	4m Bt2	Poor	5	37	92	0.50
	DOT/xdxx	5M	4m Ct2	Poor	5	13	31	0.17
Dromore	DOM/xxxx	3M	2gm A	Good	3	46	113	0.62
	DOM/xbxx	3M	2gm A	Good	3	16	39	0.21
	DOM/xcxx	3M	2gm Bt2	Good	3	470	1,162	6.34
	DOM/1dxx	3MT	2gm Ct2	Fair	4	2	5	0.03
	DOM/xexx	4T	2gm Ct2	Fair	5	21	52	0.29
Druxman	DXM/xbxx	2M	3w A	Fair	3	14	34	0.19
Elva	ELV/xcxx	2T	2k Bt2	Good	2	212	523	2.85
Emblem	EBL/xxxx	5W	4w A	Poor	5	19	48	0.26
	EBL/xbxx	5W	4w A	Poor	5	125	309	1.69
	EBL/xcxx	5W	4w Bt2	Poor	5	10	26	0.14
Ewart	EWT/xxxx	5W	4w A	Poor	5	73	180	0.98
	EWT/xbxx	5W	4w A	Poor	5	124	307	1.68
	EWT/xcxx	5W	4w Bt2	Poor	5	164	406	2.22
Fairburn	FBU/xbxx	3M	2x A	Good	4	112	278	1.52
Fairfax	FFX/xxxx	5W	4w A	Poor	5	42	103	0.56
	FFX/xbxx	5W	4w A	Poor	5	186	460	2.51
	FFX/xcxx	5W	4w Bt2	Poor	5	20	50	0.27
Fairland	FND/xcxx	2T	1 Bt2	Good	1	409	1,011	5.52
	FND/xdxx	3T	1 Ct2	Fair	4	17	41	0.22
Ferris	FRS/xbxs	3N	3sw A	Fair	4	9	22	0.12
	FRS/xbxx	2W	3w A	Fair	4	524	1,295	7.07
	FRS/xcxx	2WT	3w Bt2	Fair	4	229	567	3.09
Firdale	FIR/xcxx	2T	2k Bt2	Good	2	86	212	1.16
Floors	FLS/xdxx	5M	4m Ct2	Poor	5	23	56	0.31
George Lake	GGK/xxxx	4M	2m A	Good	3	11	28	0.15
	GGK/xbxx	4M	2m A	Good	3	159	392	2.14
	GGK/xcxx	4M	2m Bt2	Good	3	152	377	2.06
Glenboro	GBO/xbxx	2M	1 A	Excellent	1	11	27	0.15
	GBO/xcxx	2MT	1 Bt2	Good	1	171	422	2.30
	GBO/1cxx	2MT	1 Bt2	Good	1	34	83	0.46
Glencross	GCS/xxxs	3N	3sw A	Fair	4	30	74	0.40
Glenlorne	GNO/xxxx	2W	3w A	Fair	4	60	148	0.81
	GNO/xbxx	2W	3w A	Fair	4	44	109	0.60
	GNO/xcxx	2WT	3w Bt2	Fair	4	15	37	0.20
Glenview	GLN/xbxx	2M	3w A	Fair	3	51	127	0.69
	GLN/xcxx	2MT	3w Bt2	Fair	3	280	692	3.78
Goodlands	GOL/xbxx	2W	3w A	Fair	3	72	179	0.98
	GOL/xcxx	2WT	3w Bt2	Fair	3	137	339	1.85
Gopher Creek	GPE/xbxs	3N	3ws A	Fair	4	136	336	1.83
	GPE/xbxx	2M	3w A	Fair	3	1,218	3,010	16.4
	GPE/xc1s	3N	3ws Bt2	Fair	4	17	42	0.23
	GPE/xcxx	2MT	3w Bt2	Fair	3	642	1,587	8.66
	GPE/xxxx	2M	3w A	Fair	3	11	27	0.15

Table A2-4 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Graham	GHM/xxxx	5IW	4w Ci	Poor	5	504	1,245	6.79
	GHM/xbxx	5IW	4w Ci	Poor	5	198	490	2.67
	GHM/xcxx	5IW	4w Ci	Poor	5	7	17	0.10
Grover	GRO/xbxx	2W	2w A	Good	3	6	14	0.08
Guerra	GRR/xxxx	5W	4w A	Poor	5	680	1,680	9.17
	GRR/xxxs	5W	4w A	Poor	5	169	416	2.27
	GRR/xbxx	5W	4w A	Poor	5	1,130	2,791	15.2
	GRR/xbxs	5W	4w A	Poor	5	145	359	1.96
	GRR/xbxt	5W	4w A	Poor	5	13	33	0.18
	GRR/xcxx	5W	4w Bt2	Poor	5	53	132	0.72
	GRR/xcxs	5W	4w Bt2	Poor	5	18	44	0.24
Hartney	HRY/xxxx	2W	2w A	Good	3	7	16	0.09
	HRY/xbxx	2W	2w A	Good	3	215	532	2.90
	HRY/xbxs	3N	3s A	Fair	4	190	469	2.56
	HRY/xcxx	2WT	2w Bt2	Good	3	133	329	1.80
	HRY/xcxs	3N	3s Bt2	Fair	4	104	257	1.40
Hathaway	HHY/xbxx	2X	2kx A	Good	4	149	368	2.01
	HHY/1bxx	2X	2kx A	Good	4	32	78	0.43
	HHY/xcxx	2T	2kx Bt2	Good	4	799	1,974	10.8
	HHY/1cxx	2T	2kx Bt2	Good	4	1,219	3,013	16.4
	HHY/1c1x	2T	2kx Bt2	Good	4	73	181	0.99
	HHY/2cxx	2TE	2kx Bt2	Good	4	88	217	1.19
	HHY/xdxx	3T	2kx Ct2	Fair	4	87	215	1.17
	HHY/1dxx	3T	2kx Ct2	Fair	4	325	802	4.38
	HHY/2d1x	3TE	2kx Ct2	Fair	4	21	51	0.28
	HHY/2dxx	3TE	2kx Ct2	Fair	4	97	240	1.31
	HHY/3dxx	4TE	2kx Ct2	Fair	4	10	26	0.14
	HHY/2exx	4TE	2kx Ct2	Fair	5	27	66	0.36
Hebbot	HEB/xcxx	2T	2kx Bt2	Good	4	346	856	4.67
	HEB/1cxx	2T	2kx Bt2	Good	4	705	1,741	9.50
	HEB/xdxx	3T	2kx Ct2	Fair	4	22	55	0.30
	HEB/1dxx	3T	2kx Ct2	Fair	4	260	643	3.51
Hickson	HKS/xxxs	5W	4w A	Poor	5	14	36	0.19
Hilton	HIT/xbxx	2X	2kx A	Good	4	53	131	0.71
	HIT/xcxx	2T	2kx Bt2	Good	4	214	530	2.89
	HIT/xdxx	3T	2kx Ct2	Fair	4	7	18	0.10
	HIT/1dxx	3T	2kx Ct2	Fair	4	43	107	0.58
Hummerston	HMO/xxxx	3MW	2mw A	Good	3	21	51	0.28
Jackson Creek	JKE/xbxx	5M	4m A	Poor	5	29	72	0.39
Joyale	JYL/xxxx	2W	3w A	Fair	4	148	367	2.00
	JYL/xxxs	3N	3sw A	Fair	4	12	30	0.16
	JYL/xbxx	2W	3w A	Fair	4	1,857	4,588	25.0
	JYL/xbxs	3N	3sw A	Fair	4	111	273	1.49
	JYL/xcxx	2WT	3w Bt2	Fair	4	1,158	2,862	15.6
	JYL/xcxs	3N	3sw Bt2	Fair	4	11	27	0.15
	JYL/1cxx	2WT	3w Bt2	Fair	4	56	139	0.76

Table A2-5 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Kemnay	KMY/xbxx	3M	1 A	Excellent	1	83	205	1.12
Kerran	KRN/xxxs	5IW	4kw Ci	Poor	5	27	67	0.37
Knudson	KUD/xcxx	2T	2kx Bt2	Good	4	2,376	5,871	32.0
	KUD/1cxx	2T	2kx Bt2	Good	4	109	270	1.47
	KUD/1dxx	3T	2kx Ct2	Fair	4	347	857	4.68
Knudson (a variant)	KUD1/xcxx	2T	2kx Bt2	Good	4	22	54	0.30
	KUDc/xcxx	2T	2kx Bt2	Good	4	119	295	1.61
Langvale	LGV/xcxx	3M	2x Bt2	Good	4	68	168	0.92
Larrett	LRT/xc1x	2T	2kx Bt2	Good	4	57	140	0.76
Leighton	LGT/xxxx	5IW	4w Ci	Poor	5	149	367	2.00
	LGT/xbxx	5IW	4w Ci	Poor	5	59	147	0.80
Leon	LEO/xbxx	2M	3w A	Fair	3	166	410	2.24
	LEO/xcxx	2MT	3w Bt2	Fair	3	134	330	1.80
Levine	LEI/xxxx	3I	3w Bi	Fair	3	60	149	0.81
	LEI/xbxx	3I	3w Bi	Fair	3	117	288	1.57
	LEI/xcxx	3I	3w Bt2i	Fair	3	73	181	0.99
Liege	LIG/xxxx	3I	3w Bi	Fair	3	598	1,478	8.07
	LIG/xbxx	3I	3w Bi	Fair	3	76	189	1.03
	LIG/xcxx	3I	3w Bt2i	Fair	3	233	575	3.14
Linklater	LIK/xbxx	3M	2mw A	Good	3	195	482	2.63
	LIK/xcxx	3M	2mw Bt2	Good	3	28	68	0.37
Lockhart	LKH/xbxx	2M	2x A	Good	4	92	226	1.24
	LKH/xcxx	2MT	2x Bt2	Good	4	66	163	0.89
	LKH/1cxx	2MT	2x Bt2	Good	4	16	39	0.21
Lyleton	LYT/xbxx	3M	1 A	Excellent	1	30	74	0.40
	LYT/xcxx	3M	1 Bt2	Good	1	100	248	1.36
Maon	MON/1cxx	3M	1 Bt2	Good	1	24	61	0.33
Margaret	MRE/2dxx	3MT	2mx Ct2	Fair	4	10	26	0.14
Marringhurst	MRH/xcxx	5M	4m Bt2	Poor	5	2	4	0.02
Marsden	MDN/xxxx	5W	4w A	Poor	5	6	16	0.09
Martinville	MNV/xbxx	5W	4w A	Poor	5	2	5	0.02
	MNV/xcxs	5W	4w Bt2	Poor	5	19	46	0.25
Maskawata	MAW/xbxx	2X	2kx A	Good	4	76	188	1.03
	MAW/xcxx	2T	2kx Bt2	Good	4	330	816	4.45
	MAW/1cxx	2T	2kx Bt2	Good	4	27	67	0.37
Mather	MTR/xbxx	1	2g A	Good	1	68	168	0.92
	MTR/xcxx	2T	2g Bt2	Good	1	668	1,651	9.01
Medora	MDO/xcxx	2T	2kx Bt2	Good	4	276	682	3.72
	MDO/1cxx	2T	2kx Bt2	Good	4	27	68	0.37
	MDO/xdxx	3T	2kx Ct2	Fair	4	5	12	0.06
Melita	MLT/xxxx	2I	2k A	Good	1	242	597	3.26
	MLT/xbxx	2I	2k A	Good	1	56	139	0.76
	MLT/xcxx	2IT	2k Bt2	Good	1	20	50	0.27
Mentieth	MNH/xcxx	2MT	3w Bt2	Fair	4	8	20	0.11
Miniota	MXI/xbxx	4M	2m A	Good	3	77	191	1.04
	MXI/xcxx	4M	2m Bt2	Good	3	67	166	0.91

Table A2-6 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Montgomery	MOT/xxxx	2W	3w A	Fair	4	282	696	3.80
	MOT/xbxx	2W	3w A	Fair	4	1,068	2,638	14.4
	MOT/xb1x	2W	3w A	Fair	4	29	71	0.39
	MOT/xbxs	3N	3sw A	Fair	4	35	88	0.48
	MOT/xcxx	2WT	3w Bt2	Fair	4	829	2,048	11.2
	MOT/1cxx	2WT	3w Bt2	Fair	4	22	54	0.30
Mowbray	MOW/xbxx	2I	2k A	Good	1	29	72	0.39
Napinka	NPK/xcxx	4M	4m Bt2	Poor	5	35	87	0.48
Neelin	NEI/xxxx	3I	3w Bi	Fair	3	151	374	2.04
	NEI/xxxs	3IN	3sw Bi	Fair	4	3	7	0.04
Newstead	NWS/xxxx	3M	2m A	Good	4	112	277	1.51
	NWS/xbxx	3M	2m A	Good	4	106	261	1.43
	NWS/xcxx	3M	2m Bt2	Good	4	29	71	0.39
Nikkel	NKK/xcxx	2WT	3w Bt2	Fair	4	10	24	0.13
	NKK/xc1x	2WT	3w Bt2	Fair	4	64	159	0.87
Ninette	NTT/xcxx	3M	2mw Bt2	Good	3	64	159	0.87
	NTT/1cxx	3M	2mw Bt2	Good	4	23	56	0.30
Oberon	OBR/xbxx	2W	3w A	Fair	3	20	49	0.27
Petrel	PTR/xbxx	2W	2w A	Good	3	40	98	0.53
	PTR/xbxs	3N	2w A	Good	4	32	80	0.44
Pipestone	PPT/xxxx	2W	4kx A	Poor	5	55	137	0.75
	PPT/xbxx	2W	4kx A	Poor	5	5	13	0.07
	PPT/xbxt	4N	4kx A	Poor	5	42	103	0.56
Pleasant	PLE/1cxx	2MT	2w Bt2	Good	3	39	95	0.52
Porple	POR/xcxx	3M	1 Bt2	Good	1	30	75	0.41
Prodan	PDA/xbxx	2W	3w A	Fair	3	101	250	1.36
	PDA/xcxx	2WT	3w Bt2	Fair	3	163	404	2.20
	PDA/xcxs	3N	3sw Bt2	Fair	4	44	109	0.60
Ramada	RAM/xcxx	2T	2k Bt2	Good	2	150	371	2.03
	RAM/xdxx	3T	2k Ct2	Fair	4	15	37	0.20
Rebecca	RCC/xxxs	5W	4kw A	Poor	5	47	115	0.63
	RCC/xbxs	5W	4kw A	Poor	5	38	93	0.51
Regent	RGT/xxxx	2W	3w A	Fair	4	31	78	0.42
	RGT/xbxx	2W	3w A	Fair	4	128	317	1.73
	RGT/xcxx	2WT	3w Bt2	Fair	4	348	859	4.69
	RGT/xc1x	2WT	3w Bt2	Fair	4	20	50	0.27
Rempel	RMP/xcxx	2T	2k Bt2	Good	2	103	254	1.39
Roseisle	RSI/xcxx	2T	2x Bt2	Good	4	50	125	0.68
	RSI/xdxx	3T	2x Ct2	Fair	4	64	157	0.86
Ryerson	RYS/xbxx	2X	2kx A	Good	4	676	1,671	9.12
	RYS/xcxx	2T	2kx Bt2	Good	4	4,987	12,323	67.2
	RYS/xc1x	2T	2kx Bt2	Good	4	33	81	0.44
	RYS/1c1x	2T	2kx Bt2	Good	4	16	39	0.21
	RYS/1cxx	2T	2kx Bt2	Good	4	762	1,883	10.3
	RYS/xdxx	3T	2kx Ct2	Fair	4	11	27	0.14

Table A2-7 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Ryerson	RYS/1dxx	3T	2kx Ct2	Fair	4	543	1,342	7.32
	RYS/2dxx	3TE	2kx Ct2	Fair	4	24	58	0.32
Scarth	SCH/2e1x	4MT	2m Dt2	Poor	5	7	17	0.09
Schaffner	SFR/xcxx	2T	1 Bt2	Good	1	9	23	0.13
Sewell	SEE/xxxx	5W	4w A	Poor	5	11	28	0.15
Sigmund	SGO/xbxx	2W	4kx A	Poor	5	7	18	0.10
Stanton	STU/xbxx	4M	2m A	Good	2	14	34	0.19
	STU/xcxx	4M	2m Bt2	Good	2	21	51	0.28
Stockton	SCK/1bxx	4M	2m A	Good	2	14	34	0.19
Sutton	SXP/xxxx	5W	4w A	Poor	5	5	13	0.07
	SXP/xbxx	5W	4w A	Poor	5	16	40	0.22
Switzer	SWZ/xxxx	2M	2w A	Good	3	50	123	0.67
	SWZ/xbxx	2M	2w A	Good	3	58	144	0.78
Tadpole	TDP/xxxx	5W	4w A	Poor	5	27	66	0.36
	TDP/xbxx	5W	4w A	Poor	5	42	103	0.56
	TDP/xbxt	5W	4sw A	Poor	5	31	76	0.41
Taggart	TGR/xbxx	2W	2w A	Good	3	87	214	1.17
	TGR/xcxx	2WT	2w Bt2	Good	3	91	225	1.23
Torcan	TOC/xcxx	2WT	2w Bt2	Good	3	28	69	0.37
Turtle Head	TUA/xbxx	4M	3mx A	Fair	5	17	42	0.23
Two Creeks	TWC/xxxx	2W	3w A	Fair	4	202	498	2.72
	TWC/xxxs	3N	3sw A	Fair	4	23	56	0.30
	TWC/xxxt	4N	4s A	Poor	5	4	9	0.05
	TWC/xbxx	2W	3w A	Fair	4	714	1,764	9.63
	TWC/xbxs	3N	3sw A	Fair	4	396	979	5.34
	TWC/xcxx	2WT	3w Bt2	Fair	4	1,460	3,608	19.7
	TWC/xcxs	3N	3sw Bt2	Fair	4	215	530	2.89
Ullrich	ULH/xxxx	2W	3w A	Fair	4	137	338	1.85
	ULH/xbxx	2W	3w A	Fair	4	220	544	2.97
	ULH/xcxx	2WT	3w Bt2	Fair	4	408	1,008	5.50
	ULH/xcxs	3N	3w Bt2	Fair	4	99	245	1.34
	ULH/xdxx	3T	3w Bt2	Fair	4	129	319	1.74
Underhill	UHL/xcxx	2WT	2w Bt2	Good	3	55	137	0.75
Villette	VLT/xxxx	5W	4w A	Poor	5	43	106	0.58
	VLT/xbxx	5W	4w A	Poor	5	20	50	0.28
Vordas	VDS/xbxx	5W	4w A	Poor	5	19	46	0.25
Waskada	WKD/xxxx	2X	2kx A	Good	4	166	409	2.23
	WKD/xbxx	2X	2kx A	Good	4	1,464	3,617	19.7
	WKD/xcxx	2T	2kx Bt2	Good	4	3,345	8,266	45.1
	WKD/1cxx	2T	2kx Bt2	Good	4	331	819	4.47
	WKD/xdxx	3T	2kx Ct2	Fair	4	409	1,011	5.51
	WKD/xd1x	3T	2kx Ct2	Fair	4	82	202	1.10
	WKD/1dxx	3T	2kx Ct2	Fair	4	342	846	4.62

Table A2-8 Ag Capability and Irrigation Suitability of Soils with Different Phases

Soil name	Soil code /phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Wassewa	WSW/xxxx	5W	4w A	Poor	5	360	890	4.86
	WSW/xbxx	5W	4w A	Poor	5	965	2,384	13.0
	WSW/xbxs	5W	4w A	Poor	5	22	53	0.29
	WSW/xbxt	5W	4w A	Poor	5	191	471	2.57
	WSW/xcxx	5W	4w Bt2	Poor	5	17	42	0.23
Wawanesa	WWS/xbxx	2W	2w A	Good	3	38	93	0.51
	WWS/xcxx	2WT	2w Bt2	Good	3	199	491	2.68
	WWS/xdxx	3T	2w Ct2	Fair	4	19	47	0.25
Whitewater	WIW/xxxs	3N	4w A	Poor	5	9	23	0.13
William	WIL/xxxx	5W	4w A	Poor	5	72	178	0.97
	WIL/xxxs	5W	4w A	Poor	5	34	84	0.46
	WIL/xbxx	5W	4w A	Poor	5	104	258	1.41
Eroded Slope Complex	$ER/1dxx	6E	4m Ct2	Poor	5	24	60	0.33
	$ER/2dxx	6E	4m Ct2	Poor	5	182	449	2.45
	$ER/2exx	6E	4m Ct2	Poor	5	103	255	1.39
	$ER/2fxx	6E	4m Dt2	Poor	5	1,064	2,630	14.4
	$ER/3fxx	6E	4m Dt2	Poor	5	147	364	1.99
	$ER/xgxx	6T	4m Dt2	Poor	5	1,390	3,434	18.7
	$ER/3gxx	6TE	4m Dt2	Poor	5	139	344	1.88
	$ER/3ixx	7TE	4m Dt2	Poor	5	20	51	0.28
Marsh Complex	$MH/xxxx	7W	4wx Di	Poor	5	210	518	2.83
Unclassified land	$UL/xxxx	-	- -	-	-	28	68	0.37
Urban land	$UR/xxxx	-	- -	-	-	95	234	1.27
Water	$ZZ/xxxx	-	- -	-	-	1,309	3,235	17.7
Total						74,159	183,249	1,000

Table A3. 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 A4. Landscape Features Affecting Irrigation Suitability

Symbol	Landscape Features	Degree of Limitation			
		None (A)	Slight (B)	Moderate (C)	Severe (D)
t1	Slope - Simple %	<2	2 - 9	> 9 - 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 in 10 years	1 in 5 years	Every year (annual-spring)	Every year (seasonal)

* Suitability interpretations are based on the criteria for complex slopes.

Table A5. 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 Uniformity (0 - 1.2 m) (1.2 – 3 m)	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	HC 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.

Table A6. Guidelines for Assessing Land Suitability for Irrigated Potato Production under Rapid, Well and Moderately Well Drained Soil Conditions

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/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

Table A7. Guidelines for Assessing Land Suitability for Irrigated Potato Production under Imperfectly, Poorly and Very Poorly Soil Conditions

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/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 A8-1. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Adelpha	APH	xcxx	Pcs	Fx	G	Fa	G	G	Fs	Gg	Fcs	Pk	Pk	Pq	Fms	Fs	G
Alexander	AXD	xxxx, xbxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	Fcs	Pkg	Fhg	Fw	Fw	Fw	Fw
Argue	ARG	1cxx, xcxx	G	Va	Fa	Fa	Fa	Fa	G	G	G	Fkt	Fk	Ft	G	G	G
Assiniboine	ASB	xxxx, xcxx	Ps	Va	Pa	Piw	Pai	Pai	Pis	Pi	Ps	Pi	Vk	Ps	Ps	Pis	Ps
Badger Creek	BDC	xbxx	Fb	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw
		xcxx	Fb	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fwt	Fw	Fw	Fw
		xdxx	Fbt	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Pt	Fw	Fw	Fw
Bannerman	BNM	xxxx	Fb	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	Fcs	Pkg	Fhg	Fw	Fw	Fw	Fw
Barager	BAA	xc1x	Pbs	Fx	Faw	Pw	Fw	Fw	Phw	Fwg	Fcs	Pk	Phk	Pq	Fsw	Fsw	Fw
Basker	BKR	xxxs	Pin	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Viw	Piw
	BKR	xcxx	Pi	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Viw	Piw
Bearford	BEF	1cxx, xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xbxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
Bede	BED	xxxx, xcxx	Ps	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
		xdxx	Ps	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
Bella Lake	BEL	xbxx	Fs	Va	Pw	Vhw	Phw	Pw	Vwg	Phw	Pw	Pkg	Vhg	Pw	Pw	Pw	Pw
Bermont	BMN	1cxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		2cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		2dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Bower	BOW	xxxx, xbxx	Fb	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	Fcs	Pkg	Fhg	Fw	Fw	Fw	Fw
		xcxx	Fb	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	Fcs	Pkg	Fhg	Ftw	Fw	Fw	Fw
Broomhill	BOH	xcxx	Ps	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
Cactus	CCS	xcxx	Pbs	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fst	Fms	Fs	G
Cameron	CMR	1cxx	Fb	Va	Fa	Fa	Fa	Fa	G	G	G	Fkt	Fk	Ft	G	G	G
		xbxx	G	Va	Fa	Fa	Fa	Fa	G	G	G	Fak	Fk	G	G	G	G
		xcxx	G	Va	Fa	Fa	Fa	Fa	G	G	G	Fkt	Fk	Ft	G	G	G
Capell	CXT	xbxx	Fbs	Faq	Fw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Fsw	Fsw	Fsw	Fsw
Carroll	CXF	xbxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Cartwright	CWG	xbxx, xcxx	Ps	G	Fw	Pw	Fw	Fw	Vks	Vkg	Vcs	Vck	Fhg	Pq	Fsw	Fsw	Fw
Carvey	CAV	xxxx	Fs	Fhq	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Pw	Pw	Pw	Pw
Cazlake	CZK	xbxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xxxx, xbxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Charman	CXV	xxxx, xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw

Table A8-2. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Charman	CXV	xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Chater	CXW	xcxx	Pbs	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pk	Fk	Fst	Fms	Fs	G
Coatstone	CSE	xbxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fw	Fw	Fw	Fw
		xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fw	Fw	Fw
		xdxx	Fbt	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fw	Fw	Fw
		xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fnw	Fnw	Fw
		1dxx	Pb	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fw	Fw	Fw
Coulter	COU	xbxx	Fs	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Pik	Fiw	Fsw	Pi	Fsw
Cranmer	CME	xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pn	Pn	Pn	Fsw
		xcxu	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Vn	Vn	Vn	Fsw
Croll	CLL	xxx, xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xcxx, xc1x	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Cromer	CRM	xxxx	Ps	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	G	Vhk	Psw	Psw	Psw	Psw
Croyon	CYN	Xxxx, xbxx	Fb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	G	G	G	G
		xcxx	Fb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Ft	G	G	G
		xdxx	Fbt	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Pt	G	G	G
Dalny	DNY	xbxx	G	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fak	Pk	G	G	G	G
		xcxx	G	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fkt	Pk	Ft	G	G	G
		xdxx	Ft	Va	Fa	Fa	Fa	Fa	Fs	G	G	Pt	Pk	Pt	G	G	G
Darlingford or its classification variant	DGF or DGF c	xxxx, xbxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx, xc1x	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1cxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		2dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1e1x	Pt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs

Table A8-3. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Deloraine	DRI	xxxx, xbxx xcxx	Fb	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Denbow	DBW	xcxx	Ps	Va	Fw	Pw	Fw	Fw	Pkw	Pk	Fs	Pk	Fh	Ftw	Fsw	Fw	Fw
Desford	DFD	xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Dorset	DOT	xcxx, 1cxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
		xdxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
Dromore	DOM	xxxx, xbxx	Fb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	G	G	G	G
		xcxx	Fb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Ft	G	G	G
		1dxx	Pb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Pt	G	G	G
		xexx	Pt	Faq	G	Ft	Ft	Fat	Vks	Pkg	Pcq	Vkt	Ftg	Vt	Ft	Ft	G
Druxman	DXM	xbxx	Fb	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Fw	Fw	Fw	Fw
Elva	ELV	xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Emblem	EBL	xxxx, xbxx xcxx	G	Va	Pw	Vw	Pw	Pw	Vw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Ewart	EWT	xxxx, xbxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Fairburn	FBU	xbxx	Fb	Va	Fa	Fa	G	G	G	G	G	Fk	Fk	G	G	G	G
Fairfax	FFX	xxxx, xbxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Fairland	FND	xcxx	G	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Ft	G	G	G
		xdxx	Ft	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	G	G	G
Ferris	FRS	xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xbxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Firdale	FIR	xcxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Ft	G	G	G
Floors	FLS	xdxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
George Lake	GGK	xxxx, xbxx	Fb	Fq	G	G	Fa	G	Vks	Vhk	Pcq	Vak	Gg	Fq	Fm	G	G
		xcxx	Fb	Fq	G	G	Fa	G	Vks	Vkg	Pcq	Vak	Gg	Fqt	Fm	G	G
Glenboro	GBO	xbxx	G	Faq	G	G	Fa	G	Vks	Gg	Pq	Vkg	Gg	G	G	G	G
		xcxx	G	Faq	G	G	Fa	G	Vks	Gg	Pq	Vkg	Gg	Ft	G	G	G
		1cxx	Fb	Faq	G	G	Fa	G	Vks	Gg	Pq	Vkg	Gg	Ft	G	G	G
Glencross	GCS	xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fw

Table A8-4. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Glenlorne	GNO	xxxx, xbxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Fw	Fw	Fw	Fw
		xcxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Phk	Ftw	Fw	Fw	Fw
Glenview	GLN	xbxx	Fb	Faq	Faw	Pw	Faw	Fa	Vks	Pkg	Pcq	Vak	Phg	Fw	Fw	Fw	Fw
		xcxx	Fb	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Ftw	Fw	Fw	Fw
Goodlands	GOL	xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Gopher Creek	GPE	xxxx, xbxx	Fb	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Fw	Fw	Fw	Fw
		xbxs, xc1s	Pn	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Fnt	Fnw	Fnw	Fw
		xcxx	Fb	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Ftw	Fw	Fw	Fw
Graham	GHM	xxxx, xbxx xcxx	Pi	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Vi	Piw
Grover	GRO	xbxx	G	Faq	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw
Guerra	GRR	xxxx, xbxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xxxs, xbxs xcxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xbxt	Vn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pwt	Pwt	Pw
Hartney	HRY	xxx, xbxx	G	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Ph	Fw	Fw	Fw	Fw
		xcxx	G	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Ph	Ftw	Fw	Fw	Fw
		xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Ph	Fnw	Fnw	Fnw	Fw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Ph	Fnt	Fnw	Fnw	Fw
Hathaway	HHY	xbxx, 1bxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fak	Pk	G	G	G	G
		xcxx, 1cxx 1c1x	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fkt	Pk	Ft	G	G	G
		xdxx, 1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	G	Pt	Pk	Pt	G	G	G
		2cxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		2dxx,2d1x 3dxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		2exx	Vb	Va	Fa	Fat	Fat	Fat	Fs	Ft	Ft	Vt	Pk	Vt	Fst	Fst	Fs
Hebbot	HEB	xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Hickson	HKS	xxxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw

Table A8-5. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Hilton	HIT	xbxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	G	G	G	G
Hilton	HIT	xcxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Ft	G	G	G
Hilton	HIT	xdxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	G	G	G
Hilton	HIT	1dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Hummers -ton	HMO	xxxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fsw	Fsw	Fsw	Fw
Jackson Cr.	JKE	xbxx	Ps	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
Joyale	JYL	xxxx, xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx, 1cxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xxxs, xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
Kemnay	KMY	xbxx	Ps	Va	G	G	G	G	Pk	G	G	Pk	G	G	G	G	G
Kerran	KRN	xxxx, xcxx	Pis	Va	Paw	Viw	Vi	Vi	Viw	Viw	Psw	Vi	Vhi	Viw	Piw	Viw	Piw
		xxxs	Pin	Va	Paw	Viw	Vi	Vi	Viw	Viw	Psw	Vi	Vhi	Viw	Piw	Viw	Piw
Knudson	KUD	xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1cxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Knudson (a variant)	KUD 1	xcxx	G	Va	Fa	Fa	Fa	Fa	G	G	G	Pa	Pk	Ft	G	G	G
	KUD c	xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Langvale	LGV	xcxx	G	Va	Fa	Fa	G	G	Fs	G	G	Fkt	Fk	Ft	G	G	G
Larrett	LRT	xc1x	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Ft	G	G	G
Leighton	LGT	xxxx	Pi	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Viw	Piw
		xbxx	Pi	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Viw	Piw
Leon	LEO	xbxx, xcxx	Fs	Fq	Fw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vk	Fhg	Fsw	Fsw	Fsw	Fsw
Levine	LEI	xxxx, xbxx	Fis	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Phi	Fiw	Fsw	Pi	Fsw
Liege	LIG	xxxx, xbxx	Fi	Va	Faw	Piw	Pi	Pi	Piw	Pi	G	Pi	Phi	Fiw	Fw	Pi	Fw
Liege	LIG	xcxx	Fi	Va	Faw	Piw	Pi	Pi	Piw	Pi	G	Pi	Phi	Fit	Fw	Pi	Fw
Linklater	LIK	xbxx	Fb	Fq	Fw	Pw	Faw	Fw	Vks	Vkg	Pcq	Vak	Phg	Fqw	Fw	Fw	Fw
Linklater	LIK	xcxx	Fb	Fq	Fw	Pw	Faw	Fw	Vks	Vkg	Pcq	Vak	Phg	Fqt	Fw	Fw	Fw
Lockhart	LKH	xbxx	Fb	Vax	Fa	Fa	Fa	G	Fs	G	G	Fk	Fk	G	G	G	G
Lockhart	LKH	xcxx, 1cxx	Pb	Vax	Fa	Fa	Fa	G	Fs	G	G	Fkt	Fk	Ft	G	G	G
Lyleton	LYT	xbxx	G	Va	G	G	G	G	Pk	Pk	G	Pk	G	G	G	G	G

Table A8-6. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Lyleton	LYT	xcxx	G	Va	G	G	G	G	Pk	Pk	G	Pk	G	Ft	G	G	G
Maon	MON	1cxx	G	Va	G	G	G	G	Pk	Pk	G	Pk	G	Ft	G	G	G
Margaret	MRE	2dxx	Psb	Pax	Fa	Fa	G	G	Fs	G	Fs	Pkt	Fk	Pt	Fms	Fs	G
Marringhurst	MRH	xcxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
Marsden	MDN	xxxx	Fb	Pax	Pw	Vw	Pw	Pw	Vwg	Phw	Pw	Pkg	Vhg	Pw	Pw	Pw	Pw
Martinville	MNV	xbxx	Fb	Pa	Pw	Vhw	Phw	Piw	Vwg	Pwg	Pqw	Vhk	Vh	Pw	Pw	Pw	Pw
		xcxs	Pn	Pa	Pw	Vhw	Phw	Pw	Vwg	Pwg	Pqw	Vak	Vh	Pw	Pw	Pw	Pw
Maskawata	MAW	xbxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fak	Pk	G	G	G	G
		xcxx, 1cxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fkt	Pk	Ft	G	G	G
Mather	MTR	xbxx	Fb	Pa	Fa	Fa	Fa	Fa	Vks	Fkg	Pq	Vkg	Gg	Fq	G	G	G
		xcxx	Fb	Pa	Fa	Fa	Fa	Fa	Vks	Fkg	Pq	Vkg	Gg	Ftq	G	G	G
Medora	MDO	1cxx	Fsb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Melita	MLT	xxxx, xbxx	G	Va	Fa	Fa	Fa	Fa	Fi	Fi	G	Fak	Fk	G	G	Fis	G
		xcxx	G	Va	Fa	Fa	Fa	Fa	Fi	Fi	G	Fak	Fk	Ft	G	Fi	G
Mentieth	MNH	xcxx	Fb	Va	Faw	Pw	Fw	Fw	Pw	Fw	G	Fkt	Ph	Ftw	Fw	Fw	Fw
Miniota	MXI	xbxx	Fb	Faq	G	G	G	G	Vks	Vkg	Pcq	Vak	Gg	Fq	Fms	G	G
		xcxx	Fb	Faq	G	G	G	G	Vks	Vkg	Pcq	Vak	Gg	Fqt	Fms	G	G
Montgomery	MOT	xxxx, xbxx xb1x	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Fw	Fw	Fw	Fw
		xcxx, 1cxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Phk	Ftw	Fw	Fw	Fw
		xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Fnw	Fnw	Fnw	Fw
Mowbray	MOW	xbxx	Fis	Va	Fa	Fa	Fa	Fai	Fis	Fi	Fs	Fak	Fk	Fs	Fs	Fis	Fs
Napinka	NPK	xcxx	Ps	G	Fw	Pw	Fw	Fw	Vks	Vkg	Vcs	Vck	Fhg	Pq	Fsw	Fsw	Fw
Neelin	NEI	xxxx	Fis	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Pik	Fiw	Fsw	Pi	Fsw
Newstead	NWS	xxxx, xbxx	Fb	Pax	Fa	Fa	Fa	Fa	Fg	Gg	Fc	Pkg	Gg	G	G	G	G
		xcxx	Fb	Pax	Fa	Fa	Fa	Fa	Fg	Gg	Fc	Pkg	Gg	Ft	G	G	G
Nikkel	NKK	xcxx, xc1x	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
Ninette	NTT	xcxx, 1cxx	Fb	Faq	Fw	Pw	Faw	Fw	Vks	Vkg	Pcq	Vak	Phg	Fqt	Fw	Fw	Fw
Oberon	OBR	xbxx	Fs	Faq	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Pkg	Fhg	Fsw	Fsw	Fsw	Fsw
Petrel	PTR	xbxx	G	Faq	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw

Table A8-7. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Petrel	PTR	xbxs	Pn	Faq	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fnw	Fnw	Fnw	Fw
Pipestone	PPT	xxxx, xbxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	G	Vk	Pks	Psw	Pks	Ps
		xbxt	Vn	Va	Pa	Paw	Pa	Pa	Psw	Fw	Psu	G	Vk	Pns	Pns	Pns	Ps
Pleasant	PLE	1cxx	Fb	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Ftw	Fw	Fw	Fw
Porple	POR	xcxx	G	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	Ft	G	G	G
Prodan	PDA	xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
Ramada	RAM	xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Rebecca	RCC	xxxs, xbxs	Pns	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	G	Vhk	Psw	Psw	Psw	Psw
Rempel	RMP	xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Regent	RGT	xbxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fw	Fw	Fw	Fw
		xc1x	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fwt	Fw	Fw	Fw
		xcxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fw	Fw	Fw
Roseisle	RSI	xcxx	Fb	Va	Fa	Fa	Fa	Fa	Fsg	Gg	Fs	Fkt	Fk	Ft	G	G	G
		xdxx	Fbt	Va	Fa	Fa	Fa	Fa	Fsg	Gg	Fs	Pt	Fk	Pt	G	G	G
Ryerson	RYS	xbxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	G	G	G	G
		xcxx, xc1x	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Ft	G	G	G
		1cxx, 1c1x	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Ft	G	G	G
		xdxx, 1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	G	G	G
		2dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Scarth	SCH	2e1x	Pst	Pa	G	Ft	Ft	Ft	Vks	Vk	Pq	Vkt	Ftg	Vt	Fst	Fst	G
Schaffner	SFR	xcxx	G	Va	Fa	Fa	Fa	Fa	G	G	G	Fkt	Fk	Ft	G	G	G
Sewell	SEE	xxxx	Ps	Pa	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Pw	Pw	Pw	Pw
Sigmund	SGO	xbxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	G	Vk	Pks	Psw	Pks	Ps
Stanton	STU	xbxx	Ps	Pa	G	G	G	G	Vks	Vk	Pq	Vk	Gg	Fms	Fms	Fs	G
		xcxx	Ps	Pa	G	G	G	G	Vks	Vk	Pq	Vk	Gg	Fst	Fms	Fs	G
Stockton	SCK	1bxx	Ps	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fms	Fms	Fs	G
Sutton	SXP	xxxx	Fs	Fq	Pw	Vhw	Phw	Pw	Vhw	Pwg	Pw	Vah	Vhg	Pw	Pw	Pw	Pw
		xbxx	Fs	Fq	Pw	Vhw	Phw	Pw	Vhw	Pwg	Pqw	Vhg	Vhg	Pw	Pw	Pw	Pw
Switzer	SWZ	xxxx	Fb	Va	Fw	Pw	Fw	Fw	Pkw	Pk	G	Pk	Fh	Fw	Fw	Fw	Fw

Table A8-8. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Switzer	SWZ	xbxx	Fb	Va	Fw	Pw	Fw	Faw	Pkw	Pk	G	Pk	Fh	Fw	Fw	Fw	Fw
Tadpole	TDP	xxxx, xbxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xbxt	Vn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pnw	Pnw	Pnw	Pw
Taggart	TGR	xbxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fw	Fw	Fw	Fw
		xcxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Ftw	Fw	Fw	Fw
Torcan	TOC	xcxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Ftw	Fw	Fw	Fw
Turtle Head	TUA	xbxx	Pbs	Fx	Faw	Pw	Fw	Fw	Phw	Fwg	Fcs	Pk	Phk	Pq	Fsw	Fsw	Fw
Two Creeks	TWC	xxxx, xbxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Fw	Fw	Fw	Fw
		xxxs, xbxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Fnw	Fnw	Fnw	Fw
		xxxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fak	Phk	Pn	Pn	Pn	Fw
		xcxx	Fb	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Phk	Ftw	Fw	Fw	Fw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Phk	Fnt	Fnw	Fnw	Fw
Ullrich	ULH	xxxx, xbxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xdxx	Fst	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pt	Fsw	Fsw	Fsw
Underhill	UHL	xcxx	G	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Ph	Ftw	Fw	Fw	Fw
Villette	VLT	xxxx, xbxx	Fb	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Vordas	VDS	xbxx	G	Va	Pw	Vw	Pw	Pw	Vhw	Pwg	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Waskada	WKD	xxxx, xbxx	G	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fak	Pk	G	G	G	G
		xcxx	G	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fkt	Pk	Ft	G	G	G
		1cxx	Fb	Va	Fa	Fa	Fa	Fa	Fs	G	G	Fkt	Pk	Ft	G	G	G
		xdxx, xd1x	Ft	Va	Fa	Fa	Fa	Fa	Fs	G	G	Pt	Pk	Pt	G	G	G
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	G	Pt	Pk	Pt	G	G	G
Wassewa	WSW	xxxx, xbxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xbxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xbxt	Vn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	pw	Ph	Vh	Pnw	Pnw	Pnw	Pw
Wawanesa	WWS	xbxx	Fb	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw
		xcxx	Fb	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fwt	Fw	Fw	Fw
		xdxx	Fbt	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Pt	Fw	Fw	Fw
White Water	WIW	xxxs	Pn	Va	Pa	Paw	Faw	Faw	Pw	Fw	Fs	G	Vk	Fnw	Fnw	Fnw	Fsw
William	WIL	xxxx, xbxx	Fb	Pah	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Pw	Pw	Pw	Pw

Table A9. Guide for Assessing Soil Suitability as a 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)

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 materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.
4 The remaining soil material (at least 8 cm) must be reclaimable after the uppermost soil is removed.
5 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 A10. Guide for Assessing Soil Suitability as a 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** [2]	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 cm [3]	> 75 cm [3]	
p	**Stoniness**[4]	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	

1 The symbol is used to indicate the property affecting use.
2 Shaly gravels rated as Poor (Pa). Meanings of the definition letters can be found at http://en.wikipedia.org/wiki/Unified_Soil_Classification_System
3 Rated good if it is known that the underlying gravel or sand deposit is thick (> 100 cm).
4 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).

Table A11. Guide for Assessing Soil Suitability as a 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

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 A12. 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, 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

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. Use **z** for permanently frozen soils.

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.

Table A13. 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] **b.) Unified Soil Group**	 < 5 GW, GP, GC[7], SW, SP, SM, and SC[7]	 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 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

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 A14. 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**[4,5,8]	< 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**	> 150 cm	> 150 cm	100 - 150 cm	< 100 cm
	Rippable Bedrock	> 150 cm	100 - 150 cm	100 - 150 cm	< 100 cm
p	**Stoniness**[4]	Stones > 10 m apart (Class 0 and 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
r	**Nature of Bedrock**	Impermeable			Highly permeable, fractured, easily soluble.

1 Based on soil depth (120 cm) commonly investigated in making soil surveys.
2 The 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 A15. 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)

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 A16. 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	

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 A17. 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

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 A18. 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

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 A19. 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.
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 A20. 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)

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 A21. 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)

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 A22. 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.

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.

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 (alphabetical order in soil code)

Adelpha Series (APH)

The Adelpha series consists of moderately well drained Calcareous Black Chernozem soils of the Bernice Association, developed on thin (25 to 100 cm) moderately to strongly calcareous, coarse textured gravelly deltaic deposits overlying strongly calcareous medium to moderately fine textured glacial till. The surface texture may vary from medium and moderately fine to coarse. These soils occur on nearly level topography with long, simple slopes, usually in areas between glacial tills and the deeper outwash deposits. Glacial till generally occurs within 100 cm of the surface.

These soils are characterized by a thin (0 to 10 cm) black Ap horizon, a well developed dark brown Bmk horizon, 10 to 25 cm thick, and a light brownish gray IIC horizon. The upper part of the Bmk horizon may be non-calcareous and show strong prismatic structure with clay cutans on the peds. The lower part of the Bmk horizon generally extends into the coarse textured gravel. The Adelpha series resembles the Broomhill series in the Bede Association. The only difference being the Adelpha series is underlain by glacial till.

Argue Series (ARG)

The Argue series consists of well drained Rego Black Chernozem soils of the Cameron Association, developed on deep (> 100 cm), strongly calcareous, medium textured (VFSL, L, SiL) lacustrine sediments. These soils are moderately well drained and occur in areas of level to very gently sloping topography. Surface runoff is generally slow with moderately slow permeability. Argue soils are typically non-stony and cultivated. The water table usually occurs at approximately 2.4 metres during the growing season. These soils are occasionally eroded to the extent that cultivation occurs into the Ck and Cca horizons, thereby incorporating lime into the Ap. As a result of erosion and cultivation, Argue soils can sometimes be recognized by a light or buff colored soil pattern in the field and on air photographs. The Apk horizon in cultivated soils is usually very dark gray to dark gray and 7 to 15 cm thick while in the uncultivated state the Ahk may be 20 to 30 cm thick and very dark grayish brown to light yellowish brown in color. The Ck horizon is usually dark grayish brown to light yellowish brown in color. In the native condition the vegetation consists of brome grass, willows and small shrubs. A representative profile description for the Argue series is presented below.

Apk - 0 to 13 cm, black (10YR 2/1 moist), dark gray (10YR 4/1 dry) silt loam; moderately fine granular; firm, moist; slightly hard when dry; abrupt, wavy boundary; strongly calcareous; mildly alkaline.
Ck1 - 13 to 20 cm, light gray (10YR 7/2 moist), white (10YR 8/1 dry) silty clay loam; moderately coarse granular; firm, moist, hard, dry; clear, irregular boundary; extremely calcareous; moderately alkaline.
Ck2 - 20 to 50 cm, light olive brown (2.5Y 5/4 moist), light gray (2.5Y 7/2 dry) silt loam; weak, fine granular; very friable, moist; soft, dry; clear, smooth boundary; very strongly calcareous; moderately alkaline.
Ck3 - 50 cm +, light olive brown (2.5Y 5/4 moist); light gray (2.5Y7/2 dry); silt loam; weak, fine granular; very friable.

Assiniboine Series (ASB)

The Assiniboine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, stratified, clayey (SiC, C) deposits. These soils occur in lower slope positions of very gentle slopes on flood plain landscapes and have moderately slow permeability, slow surface runoff, and a medium water table during the growing season. Assiniboine soils are slightly water eroded, non-stony, and non-saline. They have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes ash, elm, tall prairie and meadow grasses. The majority of these soils are currently cultivated.

In a representative profile of Assiniboine soil there is no solum. The profile is characterized by a dark gray to gray Ah horizon, 5 to 20 cm thick, and a dark gray Ckgj horizon, many prominent mottles. The parent material is typically stratified and may contain dark strata representing former surfaces.

Assiniboine soils have a similar profile as the Levine soils, but differ from them by having finer textured deposits.

Alexander Series (AXD)

The Alexander series consists of imperfectly drained, carbonated Gleyed Rego Black Chernozem soils of the Newstead Association developed on thin (25-96 cm) strongly calcareous, medium to moderately fine textured lacustrine sediments overlying strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to SCL, CL, SiCL) glacial till. A coarse textured (FS, LCoS, LFS) layer (5-76 cm) of gravel and sand occurs at the contact. Alexander soils are characterized by gently undulating topography, fine sandy loam surface texture, moderately slow surface runoff and moderately rapid permeability. The underlying glacial till restricts downward drainage and the coarse layer at the till contact allows for some lateral flow of water. Both conditions cause this soil to be imperfectly drained. Some iron staining and mottling occurs in the soil profile which is usually associated with restricted drainage. The occurrence of salinity in these soils is rare. It is occasionally cultivated, but most often it is left as native land or pasture. Alexander soils occur in areas of complex surface deposits usually in the transition areas between glacial till and lacustrine deposits.

Barager Series (BAA)

The Barager series consists of imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils developed on a variable mantle (30 to 90 cm) of moderately to strongly calcareous outwash and glacio-fluvial sediments of medium sand to gravel texture overlying very strongly calcareous loamy glacial till. Strongly calcareous loam to clay loam till of shale, limestone and granitic origin usually occurs within a two meter depth. The soils occur in a level to gently undulating topography. The soil drainage is imperfect because of a perched water condition above the slowly permeable till and to lateral flow and seepage from adjacent upland areas. The permeability of the upper sediments is rapid.

The Barager soil is characterized by a black to very dark gray Ah horizon 12 to 18 cm thick; and an AC horizon which grades to a carbonate accumulation (Cca) horizon. The solum is relatively shallow and varies with depth from loamy sand to sand. Yellowish brown mottles occur above the contact of the coarse materials and the till.

Badger Creek (BDC)

The badger Creek series is the imperfectly drained, Gleyed Black Chernozem member of Wawanesa Association, developed on moderately to strongly calcareous, medium (L, SiL, VFSL) overlying strongly calcareous coarse textured (FS, CoS or LFS) lacustrine deposits. This soil has a silty loam to loam surface texture, gently undulating topography, moderate permeability and slow surface runoff. The depth to water table is estimated at between 1 and 2 metres during the growing season. The proximity of the sandy subsoil causes the surface soil to remain saturated for longer periods, after rains than would normally be expected from this type of soil. The majority of these soils are cultivated.

A typical profile of the Badger Creek series has a calcareous black Apk horizon, 9 to 17 cm thick, a black Ahk horizon, 10 to 15 cm thick, and a grayish brown Bmkgj or Bmk horizon, 7 to 19 cm thick. A strongly calcareous Ckgj horizon is commonly seen above the coarser IICKgj horizon. The two Ck horizons range from 31 cm down to 110 cm depth.

Bede Series (BED)

The Bede series consists of well drained Orthic Black Chernozem soils of the Bede Association, developed on strongly calcareous, coarse textured (sand and gravel) deltaic, beach and outwash deposits. This soil commonly has complex, very gently sloping topography, good drainage, very rapid permeability and minimal surface runoff. The depth of water table is estimated to be at about 3 metres during the growing season. This soil is non-saline and when cropped, tends to be droughty for most of

the growing season. Most cereal crops and even some deep rooting forage crops can be severely affected by early summer heat and lack of moisture because of the low water holding capacity of the soil.

The surface texture of this soil ranges from a sandy loam to loamy sand grading to coarser materials with depth. The soil profile usually consists of a black Ah horizon 5 to 10 cm thick, a very dark brown Bm horizon 15 to 20 cm thick and a pale brown, very coarse textured C horizon. The Bm horizon is usually well developed as indicated by the strong prismatic to sub-angular blocky structure. A transitional BC and a prominent Cca horizon are also common in these soils. A representative Bede soil is described below (Soils of the Boissevain - Melita Area, Manitoba Soil Survey Report No. 20, 1978).

Ah - 0 to 13 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry) loamy sand; structureless single grained to weak medium granular; loose; abrupt, smooth boundary; non-calcareous; pH 7.3.
Bm - 13 to 30 cm, dark brown (10YR 3/3 moist), dark brown to brown (10YR 4/3 dry) sandy loam; weak, medium prismatic breaking to medium subangular blocky; very friable, moist; loose, dry; abrupt, smooth boundary; non-calcareous; pH 7.1.
BC - 30 to 38 cm, reddish brown (5YR 4/4 moist), yellowish brown (10YR 5/6 dry) gravelly sandy loam; weak medium prismatic breaking to weak, medium subangular blocky; very friable, moist; loose, dry; clear, smooth boundary; moderately calcareous; pH 7.4.
Cca - 38 to 48 cm, grayish brown to light brownish gray (10YR 5/2 to 6/2 moist), light gray (10YR 7/2 dry) gravelly, sandy loam; weak, fine granular; very friable, moist; loose, dry; clear, smooth boundary; strongly calcareous; pH 7.5.
Ck - 48 cm +, yellowish brown (10YR 5/4 moist), light gray (10YR7/2 dry) gravelly coarse sand; structureless to amorphous; loose; moderately calcareous; pH 7.6.

Bearford Series (BEF)

The Bearford series consists of well drained Orthic Black Chernozem soils of the Croll Association, developed on thin (25 to 100 cm), strongly calcareous, moderately fine textured, lacustrine deposits overlying strongly calcareous, medium to moderately fine textured glacial till. A very thin (less than 5 cm) pebble line may be evident at the contact. This soil has simple very gently sloping topography, a clay loam or sandy clay loam surface texture, moderate permeability and moderate surface runoff. The depth to water table is estimated to be 3 metres during the growing season. This soil is non-stony and is generally cultivated. An increase in the concentration of soluble salts near the contact zone of the underlying till is an occasional feature of these soils.

A detailed morphologic description and analytical data for a weakly saline profile of the Bearford series is presented:

Ap - 0 to 18 cm, black (10YR 2/1 moist), very dark gray to dark gray (10YR 3.5/1 dry) clay loam; amorphous; friable, moist; abrupt, smooth boundary; pH 7.4.
Bm - 18 to 43 cm, very dark grayish brown(10YR 3/2 moist), grayish brown to dark grayish brown (10YR 4.5/2 dry) silty clay loam; moderate medium prismatic breaking to moderate medium subangular blocky; friable, moist; clear, wavy boundary.
BC - 43 to 53 cm, grayish brown to dark grayish brown (10YR 4.5/2 moist), brown to pale brown (10YR 5.5/3 dry) clay loam; moderate medium prismatic breaking to moderate medium subangular blocky; friable when moist; clear, wavy boundary; moderately calcareous; pH 8.0.
Ccas - 53 to 71 cm, brown to pale brown (10YR 5.5/3 moist), light gray (10YR 7/2 dry) clay loam; amorphous; friable when moist; gradual wavy boundary; strongly calcareous; pH 8.1.
II Csk1 - 71 to 109 cm, light olive brown (2.5Y 5/4 moist), very pale brown (10YR 7/3 dry) clay loam; amorphous; friable when moist; strongly calcareous; pH 9.2.
II Csk2 - 109 cm +, light olive brown (2.5Y 5/4 moist), light gray (10YR 6.5/2 dry) clay loam; amorphous; friable when moist; strongly calcareous; pH 8.1.

Bella Lake Series (BEL)

Bella Lake series consists of poorly drained, Rego Humic Gleysol carbonated soils of the Newstead Association developed on thin (25 to 95 cm), strongly calcareous, medium to moderately fine textured

lacustrine sediments overlying strongly calcareous, medium to moderately fine textured glacial till. A coarse textured layer (5 to 75 cm) occurs at the contact. This soil is characterized by a fine sandy loam surface texture, nearly level to depressional topography, a water table at approximately 1.5 m during the growing season, slow surface runoff and moderate permeability. The proximity of the less permeable underlying till and the depressional topography cause this soil to be poorly drained for most of the year. This weakly carbonated soil is rarely saline. The natural vegetation is hydrophytic. Bella Lake soils commonly occur in drainage channels of creeks and streams.

The Bella Lake series closely resembles the Deloraine series of the Waskada Association. The major difference from the Deloraine series is the presence of the coarse gravelly layer at the till contact.

Basker Series (BKR)

The Basker series consists of poorly to very poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous, stratified, loamy (FSL, VFSL, L, SiL, CL, SiCL), recent alluvial deposits. These soils occur in depressional positions of nearly level slopes on flood plain landscapes and have slow permeability, very slow surface runoff, and a high water table during the growing season. Basker soils are slightly water eroded, non-stony, and occasionally slightly saline. They have a high available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes sedges, rushes and willows. The majority of these soils are currently in native vegetation because they are subject to flooding and saturated conditions in the spring.

In a representative profile of Basker soil there is no soil solum. The profile is characterized by light grayish brown Ahk horizon, 5 to 20 cm thick, with iron stains, and a stratified, olive brown Ckg horizon, with prominent iron mottles in the sandy strata. A typical profile also contains thin organic layers indicating former surfaces.

Basker soils occur in close association with Levine soils. They are similar to Kerran soils by having a poorly drained profile developed in recent alluvium but differ from them in having mostly loam rather than clay textures. Basker soils were previously mapped as Meadow associates of the Assiniboine Complex in the South-Central (1943) and Carberry (1957) reports.

Bermont Series (BMN)

The Bermont series consists of well drained Rego Black Chernozem soils developed on a thin mantle (50 to 75 cm) of very strongly to extremely calcareous loamy glacial till of limestone and granitic origin overlying strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur in the upper slope and knoll positions of gently undulating to moderately rolling topography. Runoff is rapid; permeability is moderate to moderately slow in the upper till and slow in the lower till, which generally is more compact and weakly fissile.

The Bermont soil is characterized by a shallow Ah or a Ahk horizon 10 to 16 cm thick and an AC horizon of 4 to 8 cm. This soil profile is similar to the Stewart series. It is associated with the well drained, Hilton series; the imperfectly drained, Barwood series and the poorly drained Hickson series.

Bannerman Series (BNM)

The Bannerman series consists of Gleyed Eluviated Black Chernozem soils of the Newstead Association developed on thin (25 to 95 cm), strongly calcareous, medium to moderately fine textured, lacustrine sediments overlying strongly calcareous, medium to moderately fine textured, glacial till. A coarse textured layer (5 to 75 cm) occurs at the contact. Bannerman soils are generally found in depressional areas. The topography is nearly level with simple slopes. The permeability is moderate; surface runoff is moderate and drainage is imperfect to poor. The water table is estimated to be within 1.5 m of the surface during the growing season.

Bannerman soils are characterized by a very dark gray Ah horizon 5 to 12 cm thick, a weakly stained gleyed gray Aegj horizon 5 - 7.5 cm thick, and a gleyed dark brown Btgj horizon 10 to 15 cm thick. A prominently stained, gleyed, coarse textured IICgj horizon 5 to 75 cm thick occurs between the profile

and the underlying gleyed gray brown IIICgj horizon. Glacial till generally occurs within 100 cm of the surface of these soils. The Bannerman series resembles the Glenlorne series with the exception of the very coarse gravelly stratum which occurs at the contact between the overlay and the glacial till.

Broomhill Series (BOH)

The Broomhill series consists of well drained Calcareous Black Chernozem soils of the Bede Association, developed on strongly calcareous, deep coarse textured (FS, LCoS, LS, LFS) gravelly deltaic, beach and outwash deposits. A thin (0 to 25 cm) variable textured material may be present on the surface. These soils occur in areas of nearly level topography usually at the outflow of prominent creeks and intermittent stream channels. These soils have moderately rapid permeability, and low surface runoff. They are well drained with an estimated depth of water table of 3 metres during the growing season. Most Broomhill soils are used for native hay and pasture and some are left undisturbed with xerophytic native vegetation.

Broomhill soils are characterized by a dark gray Ap horizon 13 to 18 cm thick, a dark grayish brown Bmk horizon 8 to 13 cm thick with a grayish brown Cca horizon 5 to 8 cm thick occurring at or above the grayish brown IIC horizon. In some soils the very thin profiles are almost wholly developed in the surface 25 cm; in other soils the profile may extend well into the coarse gravel parent material.
The Broomhill series resembles the Adelpha series of the Bernice Association. The only difference being the Adelpha series is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978). A description of a representative profile for the Broomhill series is given below.

Ap - 0 to 15 cm, very dark grayish brown (10YR 3/2 moist), dark gray (10YR 4/1 dry) loam; weak fine granular; very friable, moist; clear, smooth boundary; weakly calcareous.
Bmk - 15 to 25 cm, dark grayish brown (10YR 4/2 moist), grayish brown to grayish brown (10YR 4.5/2 dry) loam; moderate medium prismatic breaking to weak: fine granular; friable, moist; clear, wavy boundary; moderately, calcareous.
II Cca - 25 to 33 cm, grayish brown (10YR 5/2 moist), light brownish gray (10 R 6/2 dry) loamy gravel; structureless; loose; diffuse boundary; very strongly calcareous.
II Ck - 33 cm + , dark grayish brown, to grayish brown (10YR 4.5/2 moist), grayish brown to light brownish gray (10YR 5.5/2 dry) loamy gravel, structureless; loose; strongly calcareous.

Bower Series (BOW)

The Bower series consists of imperfectly drained Gleyed Black Chernozem soils of the Newstead Association, developed on thin (25 to 100 cm), strongly calcareous, medium to moderately fine textured, lacustrine sediments overlying strongly calcareous, medium to moderately fine textured, glacial till. A coarse textured layer (5 to 75 cm) thick occurs at the contact. Bower soils are characterized by a fine sandy loam surface texture, gently undulating topography, moderately slow permeability and slow surface runoff. Bower soils are imperfectly drained and generally occur in areas adjacent to creeks and ephemeral stream channels. The coarse textured layer may impede downward percolation and facilitate lateral water flow both of which will affect the moisture status of this soil. Although many of these soils are used for cereal crops, crop growth is more variable than on soils of uniform texture. This variability is attributed to the presence of the coarse textured layer which may inhibit root development and thereby render the plants more susceptible to moisture stress during dry periods. The degree to which the crops are affected will likely increase with increasing thickness of this coarse stratum.

Carvey Series (CAV)

The Carvey series consists of poorly drained Rego Humic Gleysol soil developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (SiL, L, CL, SCL) lacustrine sediments over moderately to strongly calcareous, sandy to sandy skeletal glaciofluvial deposits. These soils occur in depressional positions of nearly level slopes on level landscapes and have moderate permeability slow surface runoff and a high water table during the growing season. Carvey soils are occasionally slightly saline. They have medium over low available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation often includes sedges and meadow grasses. The majority of these soils are currently used for natural grazing. In a representative profile of Carvey soil the solum

is approximately 20 cm thick. The profile is characterized by a thin (2 to 5 cm) moderately decomposed LFH horizon a very dark gray, calcareous Ah horizon, 7 to 15 cm thick and a dark gray, calcareous, transition ACgj horizon, 10 to 20 cm thick, and a pale brown, calcareous II Ckgj horizon with yellowish brown mottles. A typical profile also contains manganese concretions in the subsoil and shells at the surface.

Carvey soils occur in close association with Capell, and Croyon soils. They are similar to Tadpole soils by having a Rego Humic Gleysol profile developed in loamy lacustrine deposits, but differ from Tadpole soils by having a sandy to sandy-skeletal substrate within a meter of the mineral surface. Carvey soils were previously mapped as a Meadow associate with a loamy veneer of the Agassiz Association in the Carberry (1957) soil report.

Cactus Series (CCS)

The Cactus series consists of well drained Rego Black Chernozem soil developed on moderately calcareous, deep, stratified, coarse (FS, LFS, LS), lacustrine and deltaic deposits. These soils occur in upper slope and crest positions of gentle slopes on undulating duned landscapes and have moderately rapid to rapid permeability, minimal surface runoff, and a low water table during the growing season. Cactus soils are highly prone to wind erosion, and are non-stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes aspen, bur oak and tall prairie grasses. The majority of these soils are currently used for natural grazing.

In a representative profile of Cactus soil the solum is approximately 15 cm thick. The profile is characterized by a very dark gray Ah horizon, 12 to 16 cm thick, a dark gray AC horizon, 4 to 8 cm thick which is calcareous, a thin Cca horizon, 5 to 10 cm thick with lime accumulation and a light gray to pale brown Ck horizon. Cactus soils occur in close association with Stockton and Arizona soils. They are similar to Stockton soils by having a well drained profile developed in sandy deposits but differ from them in having no Bm horizon. Cactus soils were previously mapped as minor Blackearth associates of the Stockton Association in the Carberry (1957) soil report.

Croll Series (CLL)

The Croll series consists of imperfectly drained Gleyed Carbonated Rego Black Chernozem soils of the Croll Association developed on thin (25 to 100 cm), strongly calcareous, moderately fine textured (SCL, CL, SiCL), discontinuous aeolian and lacustrine mantle overlying strongly calcareous, medium to moderately fine textured, glacial till. The surface texture is dominantly clay loam, the topography is gently undulating, permeability is slow and runoff is moderate. This soil is imperfectly drained and may be weakly saline. The estimated depth to water table during the growing season is 2 metres. The Croll series is associated with the imperfectly drained Gleyed Calcareous Black Chernozem Desford series and the well drained Bearford series.

Cranmer Series (CME)

The Cranmer series consists of imperfectly drained Gleyed Rego Black Chernozem (carbonated) soils, developed on deep, strongly calcareous, moderately fine lacustrine sediments. These soils usually have a clay loam surface texture, nearly level to very gently sloping topography, and slow to moderate permeability and surface runoff. This soil can be weakly to moderately saline and is imperfectly drained. The estimated depth to water table during the growing season is less than 2 m. Most of these soils are cultivated and, depending on the degree of salinity, produce good crops.

The soil is characterized by black Ap horizons 10 to 20 cm thick, black to dark gray AC horizons 18 to 25 cm thick and brown to yellowish brown Ccagj horizons. The C horizons are occasionally stratified and banded.

The Cranmer series resembles the imperfectly drained soils of the Elva Association except that the Cranmer series is not underlain by glacial till. Cranmer is equal to the Prodan series of climatic subregion Gt2.

Cameron Series (CMR)

The Cameron series consists of well drained, Orthic Black Chernozem soils of the Cameron Association, developed on deep, strongly calcareous, medium textured lacustrine sediments. These soils have dominantly a loam surface texture, very gently sloping to gently undulating topography, moderately rapid permeability, and moderate surface runoff. This soil is moderately to well drained with an estimated depth to water table of 3 m during the growing season. These soils are non-saline, non-stony, fertile agricultural soils.

Cameron soils generally occupy slightly higher landscape positions than the Hartney and Denbow soils and are commonly found in close association with Lyleton soils. Cameron soils with low amounts of crop residue are quite susceptible to erosion.

A modal Cameron soil has a black Ap horizon 5 to 15 cm thick, a very dark gray Ah horizon 5 to 12 cm thick, a dark grayish brown Bm horizon 15 to 20 cm thick, a light gray Cca horizon 7 to 12 cm thick and an olive yellow Ck horizon. In Gt2 climatic subregion these soils equal the Fairland series.

Coulter Series (COU)

The Coulter series consists of imperfectly drained, Gleyed Carbonated Rego Black Chernozem soils developed on deep, moderately calcareous, moderately fine to fine textured (SCL, CL, SiCL to SiC, C), recent alluvial sediments. These soils have nearly level to depressional topography, clay loam surface texture, moderately slow permeability and a moderate surface runoff. The Coulter series is associated with the poorly drained Leighton series. Drainage is imperfect and the estimated depth to water table during the growing season is 2 to 3 metres. These soils may be weakly saline and non-stony and are used for crop production. A detailed description of a representative profile is presented below (Soils of the Boissevain - Melita Area, 1978).

Apk - 0 to 23 cm, black to very dark gray (10YR 2.5/1 moist), very dark gray to dark gray (10 3.5/1 dry) clay to clay loam; weak, medium prismatic breaking to moderate medium blocky; friable when moist; clear, smooth boundary; moderately calcareous.
Ahkgj - 23 to 46 cm, black to very dark gray (10YR 2.5/1 moist), very dark gray to dark gray (10YR 3.5/1 dry); clay loam; medium prismatic breaking to moderate medium blocky; friable when moist; clear, smooth boundary; moderately calcareous.
Ccagj - 46 to 56 cm, gray to light gray (10YR 6/1 moist), very pale brown (10YR 7/3 dry) clay loam; structureless; friable when moist; clear, smooth boundary; strongly calcareous.
Ckg - 56 cm +, grayish brown (2.5Y 5/2 moist); gray (10YR 5.5/1 dry); clay loam; structureless; friable when moist; moderately calcareous; moderately alkaline.

Coatstone Series (CSE)

The Coatstone series consists of imperfectly drained, Gleyed Rego Black Chernozem, carbonated soils of the Ryerson Association, developed on deep, strongly calcareous, medium to moderately fine textured, glacial till. The till is composed of material derived from shale, limestone and granitic rock. The surface 25 cm may vary slightly in texture. Coatstone soils usually have a clay loam surface texture, very gently sloping topography, moderately slow permeability, and moderate surface runoff. They are imperfectly drained and occasionally slightly stony. They may be weakly to moderately saline. The estimated depth to water table is 1.5 m. Coatstone soils usually occur in intermediate to level positions between the better drained Ryerson and Medora soils and the poorer drained Ewart, Tilston and Stoney Creek soils. Gleyed Calcareous Black Chernozem soils are closely associated with Coatstone soils and may be found in the same vicinity. In undisturbed areas where native vegetation exists aspen is quite common.

Coatstone soils are characterized by black Apk horizons 8 to 13 cm thick, dark gray AC horizons 5 to 10 cm thick, weakly mottled light brownish gray Ccagj horizons 10 to 13 cm thick, and gleyed prominently iron mottled, brown to yellowish brown Ckgj horizons.

Cartwright Series (CWG)

The Cartwright series consists of imperfectly drained Gleyed Black Chernozem soils of the Bede Association developed on strongly calcareous, deep, coarse textured (FS, LCoS, LS, LFS), gravelly, deltaic, beach and outwash deposits. The solum is usually developed in a thin coarse sandy loam to loamy sand surface layer. The soil has gently undulating topography, rapid permeability and very slow surface runoff. These soils have imperfect drainage as a result of a high water table which is estimated at less than 1 metre for much of the growing season. These soils commonly occur in level areas of large kettled, outwash deposits or in stream channels. Some of these soils are cultivated but most are used for native hay and pasture (Soils of the Boissevain - Melita Area, 1978). A representative profile description is presented below.

Ah - 0 to 23 cm, very dark gray (10YR 3/1 moist), very dark grayish brown to dark grayish brown (10YR 3.5/2 dry) sand; weak, fine granular; loose; mildly alkaline; non-calcareous; clear, smooth boundary.
Bmgj - 23 to 46 cm, dark grayish brown (10YR 4/2 moist), dark yellowish brown (10YR 4/4 dry) gravelly, sand; weak, fine granular; loose; some dark brown (7.5YR 4/4 dry) iron concretions; moderately alkaline; non-calcareous; clear, smooth boundary.
BC - 46 to 61 cm, brown (10YR 5/3 moist), light gray (10YR7/2 dry) gravelly sand; structureless single grained; loose; moderately alkaline; moderately alkaline; moderately calcareous; diffuse, wavy boundary.
Ckgj - 61 cm +, brown (10YR 5/3 moist), light gray (10YR7/2 dry) gravelly fine sand; structureless; loose; moderately alkaline; moderately calcareous.

Carroll Series (CXF)

The Carroll series is a Rego Black Chernozem soil developed on moderately well to well drained, strongly to very strongly calcareous, moderately fine (SCL, CL, SiCL), lacustrine deposits. These soils occur in the Upper Assiniboine Delta and Brandon Lakes Plain on very gently sloping to undulating topography, in association with Ramada, Charman, Prodan and Tadpole soils. Surface runoff is moderately slow, and permeability is moderate. Careful management is required to reduce water and/or wind erosion, especially in undulating topography.

The Carroll soil profile has a very dark gray to black Ah or Ahk horizon, 15 to 20 cm thick; a dark gray AC horizon, 10 to 15 cm thick and a Cca horizon of lime carbonate accumulation, 8 to 14 cm thick. The silty textured, pale brown Ck horizon is very erosive. This soil differs only slightly from the Ramada soil in not having a prominent Bm horizon. Carroll soils were previously mapped as the well drained associate of the Carroll Association in both the South-Central (1943) and Carberry (1957) soil reports.

Capell Series (CXT)

The Capell series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, loamy (SiL, L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep stratified, sandy to sandy-skeletal (GrS, GrLS), glaciofluvial deposits. These soils occur in lower slope positions of gentle to moderate slopes on hummocky landscapes and have moderate to rapid permeability, moderate surface runoff and a medium water table during the growing season. Capell soils are occasionally slightly saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for grain crop production.

In a representative profile of the Capell soil the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to black Apk or Ahk horizon, 15 to 25 cm thick, a dark gray to gray, calcareous AC horizon, 5 to 15 cm thick, a light gray IICca horizon, 5 to 10 cm thick with secondary carbonate accumulation and a light yellowish brown IICkgj horizon with common, distinct iron mottles.

Charman Series (CXV)

The Charman series consists of imperfectly drained Gleyed Black Chernozem soils developed on strongly to very strongly calcareous, fine loamy (CL, SiCL), lacustrine deposits. In areas of seepage or

discharge, soluble salts in the subsoil can be translocated near the surface in sufficient quantities to affect crop growth. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate permeability, slow surface runoff, and a medium high water table during the growing season. Charman soils are non-eroded, non-stony, and frequently slightly saline. They have a moderately high available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes aspen, willows, shrubs and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile of Charman soil the solum is approximately 40 cm thick. The profile is characterized by very dark gray to black Ah horizon, 15 to 25 cm thick, a dark grayish brown Bmgj horizon, 12 to 30 cm thick, a transitional BC horizon, 5 to 8 cm thick and a pale brown, silty textured Ckgj horizon, with iron mottles and frequently gypsum crystals.

Charman soils occur in close association with Ramada, Carroll and Tadpole soils. They are similar to Prodan soils by having an imperfectly drained profile and fine loamy deposits but differ from them in having a Bmgj horizon. Charman soils were previously mapped as Black-Meadow associates of the Holland Association in the Carberry (1957) soil report.

Chater Series (CXW)

The Chater series is a Calcareous Black Chernozem soil developed on moderately well to well drained, moderately to strongly calcareous, sandy (S, CoS) to sandy-skeletal (GrS, GrCoS) outwash and glaciofluvial deposits, less than one meter in depth, overlying moderately to strongly calcareous loamy (L, CL) glacial till deposits. These soils occur in gently undulating to moderately rolling topography. Surface runoff is low, while permeability is rapid in the coarser deposits and moderate to moderately slow in the underlying till material. These soils are in favourable topographic positions to allow excess water above the till to flow laterally to downslope positions.

The Chater soil profile is characterized by a 12 to 18 cm thick, very dark gray Ah horizon and a grayish brown to brown Bmk horizon 8 to 15 cm thick, with a lime accumulation horizon (Cca) in the coarser stratum. Chater soils are coarser textured and tend to be droughtier than glacial till soils like Kleysen series.

Croyon Series (CYN)

The Croyon series consists of moderately well to well drained Orthic Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, loamy (L, SiL, CL) lacustrine sediments over moderately to strongly calcareous, stratified, deep sandy-skeletal (GrS, GrLS), glacio-fluvial deposits. These soils occur in middle and upper slope positions of very gentle slopes on undulating landscapes and have medium over rapid permeability, moderately rapid surface runoff and a low water table during the growing season. Croyon soils have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

In a representative profile of Croyon soil the solum is approximately 35 cm thick. The profile is characterized by a very dark gray Ah or Ap horizon, 10 to 15 cm thick, a dark brown Bm horizon, 10 to 25 cm thick, a yellowish brown II Cca horizon, 10 to 20 cm thick with secondary carbonate accumulation and a light yellowish brown IICk horizon. The parent material is typically stratified with thin (< 5 cm) layers of SiL, CoS, GrS and SL textures.

Cazlake Series (CZK)

The Cazlake series consists of poorly drained Rego Humic Gleysol soil developed on moderately to strongly calcareous (L, SCL, CL, SiCL), deep uniform till of mixed limestone, granite and shale origin. These soils occur in level to depressional positions of gentle to moderate slopes on hummocky landscapes and have slow permeability very slow surface runoff and a very high water table during the growing season. Cazlake soils are non-eroded, slightly stony and slightly saline. They have a high

available water holding capacity, high organic matter content, and low natural fertility. Native vegetation often includes sedges, cattails and reeds. The majority of these soils are currently in their natural state due to restricted drainage and high water tables.

In a representative profile of Cazlake soil the solum is approximately 25 cm thick. The profile is characterized by a black Ah or Ap horizon, 15 to 50 cm thick, a light olive gray carbonated AC horizon, 5 to 10 cm thick and a light gray Ckg horizon, with many prominent iron mottles. A typical profile also contains up to 40 cm of wash at the surface from upslope soil erosion.

Cazlake soils occur in close association with Darlingford, Nikkel and Ferris soils. They are similar to Horose soils by having the same soil development and parent material but differ from Horose soils because Cazlake soils are associated with Black Chernozems and Horose soils are associated with Dark Gray Chernozems. Cazlake soils were previously mapped as minor poorly drained associates of the Darlingford association in the reconnaissance soil survey of South-Central Manitoba (1943).

Denbow Series (DBW)

The Denbow series is the imperfectly drained, Gleyed Black Chernozem member of the Lyleton Association, developed on deep, moderately calcareous, coarse loamy, lacustrine sediments. This soil occurs in areas of complex very gently sloping topography and is characterized by imperfect drainage, moderately rapid permeability and slow surface runoff. The estimated depth to water table during the growth season is 2 m. This soil is non-saline, non-stony and cultivated. It often occurs in close association with the Switzer series.

Denbow soils are characterized by a black Ap horizon 10 to 12 cm thick, a weakly stained gleyed very dark grayish brown Bmgj horizon 10 to 12 cm thick, an olive gray to grayish brown iron stained Ccagj horizon 25 to 30 cm thick and a gleyed, iron stained and mottled, light yellowish brown Ckg horizon.

Desford Series (DFD)

The Desford series consists of imperfectly drained, Gleyed Black Chernozem soils of the Croll Association, developed on thin (25 to 100 cm), strongly calcareous, moderately fine textured, discontinuous lacustrine mantle overlying strongly calcareous medium to moderately fine textured glacial till. A very thin (less than 5 cm) gravelly stratum may occur at the contact. This soil has a clay loam surface texture, depressional to gently undulating topography, slow permeability and slow surface runoff. The estimated depth to water table is 2 metres during the growing season. It is occasionally saline, non-stony and generally cultivated.

Associated soils are the well drained Bearford series, the imperfectly drained Croll series, and the poorly drained Wassewa series. The Desford series resembles the Goodlands series of the Elva Association. The only difference is the Desford series is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978). Analytical data and a representative profile description are presented below.

Ap - 0 to 15 cm, very dark gray (10YR 3/1 moist), very dark gray to dark gray (10YR 3.5/1 dry) clay loam; strong, moderate platy; friable when moist, very hard when dry; abrupt, smooth boundary; pH 7.3.
Bmgj - 15 to 38 cm, black (10YR 2/1 moist), dark gray to gray (10YR 4.5/1 dry) silty clay; moderate medium granular; firm when moist, hard when dry; gradual, wavy boundary; pH 7.3.
II Cksgj - 38 cm +, dark gray (2.5Y 4/2 moist), grayish brown (10YR 5/2 dry) silty clay loam; amorphous.

Darlingford Series (DGF)

The Darlingford series consists of well drained Orthic Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform, loamy (L, CL, SiCL), mixed till deposits. These soils occur in middle to upper positions of very gentle to gentle slopes on undulating to rolling landscapes and have medium to moderately slow permeability, moderate surface runoff and a medium water table during the growing season. Darlingford soils are slightly eroded and slightly stony. They have moderate available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often

includes tall prairie grasses interspersed with aspen poplar stands. The majority of these soils are currently used for crop production.

In a representative profile of Darlingford soil the solum is approximately 60 cm thick. The profile is characterized by a very dark gray Ap or Ah horizon, 15 to 20 cm thick, a black Ah horizon, 5 to 10 cm thick, a brown to dark brown Bm or Btj horizon, 20 to 30 cm thick and a pale brown Cca horizon 10 to 15 cm thick. The parent material is typically yellowish brown mixed till with few coarse fragments.

Darlingford soils occur in close association with Dezwood, Nikkel and Cazlake soils. They are similar to Nikkel soils by having a dark surface layer and well developed B horizon but differ from Nikkel soils by being well drained while Nikkel soils are imperfectly drained. Darlingford soils were previously mapped as the dominant associate of the Darlingford association in the reconnaissance soil survey of South-Central Manitoba (1943).

Dalny Series (DNY)

The Dalny series consists of well drained, Calcareous Black Chernozem soils of the Waskada Association developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL), discontinuous eolian and lacustrine sediments overlying strongly calcareous, medium to moderately fine textured, glacial till; a very thin (< 5 cm) gravelly stratum may occur at the contact. These soils have a very fine sandy loam to loam surface texture, gently undulating topography, slow permeability, and moderate surface runoff. The soil is non-stony and is used for crop production. This series is associated with the well drained Maskawata and Waskada series and the imperfectly drained Two Creeks and Montgomery series of the Waskada Association. The Dalny series resembles the Schaffner series of the Cameron Association; the only difference is that the Dalny series is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978). A morphological description of a representative profile is presented below.

Ap - 0 to 15 cm, black (10YR 2/1 moist), very dark gray to dark gray (10YR 3.5/1 dry) very fine sandy loam; moderate fine granular; friable when moist, slightly hard when dry; abrupt, smooth boundary.
Ah - 15 to 20 cm, black (10YR 2/1 moist), very dark gray to dark gray (10YR 3.5/1 dry) very fine sandy loam; moderate fine granular; friable when moist, slightly hard when dry; clear, wavy boundary.
Bmk - 20 to 41 cm, very dark grayish brown (10YR3/2 moist), dark gray (10YR 4/1 dry) very fine sandy loam; strong fine granular; friable when moist, slightly hard when dry; abrupt, wavy boundary; weakly calcareous.
II Cca - 41 to 56 cm, pale brown (10YR 6/3 moist), white (10YR 8/2 dry) silt loam; weak fine granular; firm when moist, hard when dry; gradual, smooth boundary; very strongly calcareous.
II Ck - 56 cm +, light olive brown (2.5Y 5/4 moist), very pale brown (10YR 7/3 dry) silt loam; firm when moist, slightly hard when dry; strongly calcareous.

Dromore Series (DOM)

The Dromore series consists of well drained, Orthic Black Chernozem soils of the Dromore Association, developed on thin (25 to 100 cm), strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to SCL, CL, SiCL), lacustrine sediments overlying coarse textured (FS, LCoS, LS, LFS), gravelly, deltaic beach and outwash deposits. This soil has a fine sandy loam to loam surface texture, gently undulating topography, moderately rapid permeability, and low surface runoff. This soil is very slightly stony, well drained, and non-saline. This soil occurs in areas adjacent to outwash deposits and is usually cultivated. The presence of the underlying gravel tends to make these thin soils somewhat droughty during periods of low precipitation.

Dromore soils are characterized by black Ap horizons 10 to 15 cm thick, very dark brown Bm horizons 15 to 25 cm thick overlying a coarse textured II C horizon. The Dromore series resembles the Newstead series of the Newstead Association. The difference is the Newstead Association is underlain by glacial till.

Dorset Series (DOT)

The Dorset series consists of moderately well to well drained Orthic Black Chernozem soils developed on moderately to strongly calcareous, deep , stratified, sandy to sandy skeletal (S, GrS, GrCoS), outwash and glaciofluvial deposits. These soils occur in upper positions of gentle slopes on hummocky landscapes and have very rapid permeability, low rapid surface runoff, and a low water table during the growing season. Dorset soils are non-eroded, non-stony, and non-saline. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes aspen-oak stands and tall prairie grasses. The majority of these soils are currently used for grazing or are excavated for gravel deposits.

In a representative profile the solum is approximately 30 cm thick. The profile is characterized by a very dark gray Ah horizon, 12 to 18 cm thick, a dark brown Bm horizon, 15 to 22 cm thick, a Cca (lime accumulation) horizon, 6 to 12 cm thick and a light brown Ck horizon, with stratified sand and gravel.

Dorset soils occur in close association with Mansfield soils. They are similar to Marringhurst soils by having well drained profile in glaciofluvial deposits but differ from them in having a Bm horizon. Dorset soils were previously mapped as Blackearth associates of the Marringhurst Association in the Carberry (1957) soil report.

Deloraine Series (DRI)

The Deloraine series consists of poorly drained, carbonated Rego Humic Gleysol soils of the Waskada Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL), discontinuous eolian and lacustrine sediments overlying strongly calcareous, medium to moderately fine textured, glacial till. These soils have a loam surface texture, nearly level topography, slow permeability, and very slow runoff. They occur in depressions and stream channels. The estimated depth to water table during the growing season is usually less than 1 metre. Flooding and surface ponding are a common occurrence. They are rarely cultivated and usually support hydrophytic vegetation such as cattails, bullrushes and horsetail.

Druxman Series (DXM)

The Druxman series consists of imperfectly drained Gleyed Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, fine loamy (SiL, L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep, sandy-skeletal (GrS, GrLS), glacio-fluvial deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have medium over rapid permeability, low surface runoff and a medium water table during the growing season. Druxman soils have medium available water holding capacity, medium organic matter content and medium natural fertility. Native vegetation often includes meadow and tall prairie grasses interspersed with willow clumps. The majority of these soils are currently used for grain crop production.

In a representative profile the solum is approximately 50 cm thick. The profile is characterized by a very dark gray Ah or Ap horizon, 15 to 25 cm thick, a dark yellowish brown to olive brown Bmgj horizon, 20 to 30 cm thick with many, fine, distinct, yellowish brown iron mottles, a transitional dark yellowish brown BC, 5 to 10 cm thick, occasionally a yellowish brown II Ccagj horizon, 5 to 10 cm thick and light yellowish brown II Ckgj horizon with many, large prominent iron mottles.

Druxman soils occur in close association with Croyon and Carvey soils. They are similar to Capell soils by having an imperfectly drained Black profile developed in loamy over sandy-skeletal deposits but differ from Capell soils because Capell soils lack a Bm horizon. Druxman soils were previously mapped as imperfectly drained associates of the Agassiz Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Emblem Series (EBL)

The Emblem series consists of poorly drained carbonated Rego Humic Gleysols of the Cameron Association developed on deep, strongly calcareous, medium textured lacustrine sediments. These

soils usually have depressional to level topography, loam surface textures; moderate permeability and very slow surface runoff. These soils are poorly drained due to a combination of depressional topography and high groundwater levels. The estimated depth to water table is less than 1.5 m during the growing season. These soils occur in drainage channels and depressions and are frequently flooded by ponded or flowing water. Emblem soils support hydrophytic vegetation, are non-stony and rarely cultivated.

Elva Series (ELV)

The Elva series consists of well drained, Orthic Black soils of the Elva Association, developed on deep, strongly calcareous, moderately fine textured (SCL, CL, SiCL), lacustrine sediments. This soil has a clay loam surface, nearly level to gently undulating topography, slow to moderate permeability, and moderate surface runoff. Elva soils are non-saline, non-stony, generally cultivated and have an estimated depth to water table of 2 to 3 m during the growing season. These are highly productive soils. They occur generally in the Souris Basin in the vicinity of Elva and Hartney and have a limited occurrence in the Whitewater Basin area. This soil is associated with the imperfectly drained Goodlands, Cranmer, Minto and Ninga series; and the poorly drained Naples, Bunclody and Fairfax series (Soils of the Boissevain - Melita Area, 1978).

Ewart Series (EWT)

The Ewart series consists of poorly drained, carbonated Rego Humic Gleysol soils of the Ryerson Association, developed on deep, strongly calcareous, medium to moderately fine textured glacial till, composed of material derived from shale, limestone, and granitic rock. This soil is usually developed in a considerable thickness of sediments which have been washed into the bottom of depressions. The surface texture, although variable is dominantly clay loam; the topography is depressional to nearly level; permeability is slow and surface runoff if any, is very slow. These soils are poorly drained with a very high water table which occurs at or near the surface most of the year. Surface vegetation usually consists of water hemlock (Cicuta spp.), Mint (Mentha arvensis), slough grass (Beckmannia syzigachne), Cattails and Reeds. This soil is occasionally moderately to strongly saline, depending on location, non-stony and is rarely cultivated.

Ewart soils are characterized by black, Ah horizons 10 to 20 cm thick, light gray Ccag horizons 20 to 28 cm thick and gray brown iron mottled Ckg horizons. These soils are commonly, weakly stratified.

Fairburn Series (FBU)

The Fairburn series consists of well drained, Rego Black Chernozem soils of the Mentieth Association, developed on thin (25 to 100 cm) moderately calcareous, moderately coarse textured (VFS, LVFS, SL, FSL), lacustrine sediments overlying strongly calcareous, medium to moderately fine textured, glacial till.

A very thin (less than 5 cm) gravelly stratum may occur at the contact. Fairburn soils have loamy very fine sandy surface textures, nearly level topography, moderate permeability and moderate surface runoff. Drainage is good and the estimated depth to water table is 3 metres. These soils are non-stony, non-saline, usually cultivated, somewhat droughty and moderately susceptible to erosion. Fairburn soils are commonly found in close association with Nesbitt soils (Soils of the Boissevain - Melita Area, 1978).

Fairfax Series (FFX)

The Fairfax series consists of poorly drained, Carbonated Rego Humic Gleysols of the Elva Association; developed on deep, strongly calcareous, moderately fine textured (SCL, CL, SiCL), lacustrine sediments. These soils have a clay loam surface texture, nearly level to depressional topography, slow permeability, and very slow surface runoff. These soils are poorly drained with the water table at or near the surface most of the year. Surface ponding and flooding are very common. These soils are not cultivated and generally support a lush growth of hydrophytic vegetation such as Cattails, Reeds, and Slough Grass; some Willows may also occur (Soils of the Boissevain - Melita Area, 1978).

Firdale Series (FIR)

The Firdale series consists of moderately well to well drained Orthic Dark Gray Chernozem soils developed on moderately to strongly calcareous, deep, moderately fine (SCL, CL, SiCL), lacustrine deposits. These soils occur in upper positions of gentle to moderate slopes on undulating to dissected landscapes and have rapid permeability, moderate to rapid surface runoff, and a low water table during the growing season. Firdale soils are often moderately eroded, non-stony, and non-saline. They have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes aspen, oak and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 60 cm thick. The profile consists of a dark gray Ap horizon, 20 to 30 cm thick, a yellowish Bt horizon, 30 to 45 cm thick with clay accumulation, a Cca horizon, 5 to 10 cm thick, and a calcareous C horizon. Firdale soils are associated with Danlin and Tadpole soils. They are similar to Halstead soils by having a well drained Orthic Dark Gray Chernozem profile but differ from them in having fine loamy rather than coarse loamy deposits. Firdale soils were previously mapped as Degraded Black associates of the Firdale Association in the Carberry (1957) soil report.

Ferris Series (FRS)

The Ferris series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous deep, uniform, fine loamy, slightly stony mixed till deposits. These soils occur in lower positions of very gentle slopes on undulating landscape and have moderately slow permeability slow surface runoff and a medium water table during the growing season. Ferris soils are non-eroded, non-stony and slightly saline. They have high available water holding capacity, high organic matter content, and high natural fertility.

In a representative profile the solum is approximately 30 cm thick. The profile has a black, carbonated Ap horizon, 25 to 35 cm thick, a dark gray, transitional ACgj horizon, 15 to 30 cm thick with iron mottles, and a light gray to pale yellow Ccagj horizon 10 to 15 cm thick with lime accumulation. The parent material is light yellowish brown mixed till with iron mottles.

Ferris soils occur in close association with Nikkel soils. They are similar to Joyale soils by having a Gleyed Rego Black Chernozem profile and mixed till at depth but differ because of a fine loamy lacustrine veneer (30 to 90 cm thick) overlying the mixed till. Ferris soils were previously mapped as imperfectly drained Blackearth associates of the Pembina association in the reconnaissance soil survey of South-Central Manitoba (1943).

Glenboro Series (GBO)

The Glenboro series consists of moderately well to well drained Orthic Black Chernozem soil developed on a mantle (25 to 90 cm) of moderately to strongly calcareous, shallow, medium (VFSL, L, SiL) textured lacustrine deposits over moderately calcareous, stratified, deep, sandy (FS, LFS, LS) deposits. These soils occur in upper positions of gentle slopes on sloping to undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a low water table during the growing season. Glenboro soils are often slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses and aspen-oak groves. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 30 cm thick. The profile is characterized by a very dark gray to black Ah horizon, 12 to 18 cm thick, with granular structure, a dark brown to brown Bm or Btj horizon 10 to 16 cm thick with subangular blocky structure, a brown to pale brown BC horizon, 6 to 14 cm thick and a light gray to very pale brown Cca horizon, 5 to 8 cm thick. The parent material is typically pale brown to light yellowish brown sandy. Some stratified sands to loams may occur in the loam/sand transition.

Glenboro soils occur in close association with Grover and Grayson soils. They are similar to Fairland soils by having an Orthic Black Chernozem profile and loamy surface mantle but differ from them in having a sandy substrate. Glenboro soils were previously mapped as Blackearth associates of the Glenboro Association in the Carberry (1957) soil report.

Glencross Series (GCS)

The Glencross series are imperfectly drained Gleyed Rego Black Chernozem (carbonated) soils developed in thin, medium (VFSL, L, SiL) to moderately fine (SCL, CL, SiCL) textured, moderately to strongly calcareous lacustrine, sediments that overlie strongly calcareous, stony, water-worked glacial till. Shale bedrock may occur below the till at about 1 to 1.5 m. The change from loamy sediments to stony, loam to clay loam textured till is abrupt and usually occurs at 0.3 to 1 m below the surface. A gravelly or cobbly lens (<10 cm in thickness) usually occurs at the contact of the unconforming layers. Glencross soils occur in a few scattered small areas on level terrain where runoff is slow and in association with the well drained Roseisle soils.

These slightly to moderately stony soils have thin black to very dark gray Ah horizons that are granular, friable, mildly alkaline in reaction and calcareous; thin transitional, grayish brown, strongly calcareous, moderately alkaline, granular AC horizons; and light gray to light brownish gray, strongly calcareous Ckgj horizons having a granular-like structure, friable to slightly hard consistence and numerous, faint to distinct, medium to fine sized, brown mottles. Flakes of dark gray shale with white calcium carbonate coatings occur near the contact of the underlying till. The grayish brown to light brownish gray, loamy textured till is granular, moderately alkaline, moderately to strongly calcareous, gypsiferous and stained with brown mottles. The Glencross soil occurs in association with the Roseisle soils. They were previously mapped as part of the Blumenstein Complex in the South-Central (1943) report.

George Lake Series (GGK)

George Lake series consists of Orthic Black Chernozem soils of the George Lake Association, developed on thin (25 to 100 cm), weakly to moderately calcareous, moderately coarse textured (VFS, LVFS, FSL), lacustrine sediments overlying coarse textured, deltaic, beach and outwash deposits. This soil has a loamy very fine sand surface texture, very gently sloping, complex topography, good drainage, rapid permeability and low surface runoff. This soil is non-saline, non-stony and usually cultivated. This soil is closely associated with Bede soils but is not as coarse and generally has a deeper profile. The Ap horizon is dark gray to dark grayish brown and ranges from 15 to 20 cm thick. Occasionally an Ah horizon is present and is usually black to very dark gray and 3 to 5 cm thick. A deep, dark brown Bm horizon 20 to 30 cm thick is common overlying a coarse, stratified yellowish brown II Ck horizon. The George Lake series is associated with the imperfectly drained Ninette and Linklater series, and the poorly drained Pierson series. The George Lake series resembles the Griswold series except that it is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978). A description of a representative profile is presented below.

Ap - 0 to 20 cm, very dark gray (10YR 3/1 moist), dark brown to brown (10YR 3.5/1 dry) fine sandy loam; weak, medium granular; slightly plastic; loose when dry; friable when moist; abrupt, smooth boundary; non-calcareous.
Ah - 20 to 23 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry) sandy loam; weak, medium granular; slightly plastic, loose when dry, friable when moist; clear, smooth boundary; non-calcareous.
Bm - 23 to 51 cm, dark brown to brown (10YR 3.5/3 moist), dark grayish brown to grayish brown (10YR 4.5/2 dry) sandy loam; weak, medium prismatic to weak, fine granular; slightly plastic; friable when moist; clear, wavy boundary; non-calcareous.
II Ck1 - 51 to 101 cm, yellowish brown (10YR 5/4 moist), light brownish gray (10YR 6/2 dry) course sandy, gravel; structureless; non-plastic; moderately calcareous; abrupt, smooth boundary.
II Ck2 - 101 cm +, pale brown (10YR 6/2 moist), very pale brown (10YR 7/3 dry), gravel; moderately calcareous; some staining and iron concretions present.

Graham Series (GHM)

The Graham series consists of poorly drained, carbonated, Rego Humic Gleysols of the Melita Association, developed on deep, moderately calcareous, medium textured (VFSL, L, SiL), recent alluvial sediments. These deposits are stratified and contain numerous dark colored bands of former surface horizons in the profile. Graham soils generally occur the channels of Pembina and Long Rivers and in the Souris River channel south of Melita and in the vicinity of Gainsborough, Antler and Graham Creeks that empty into the Souris River from the west. Graham soils have complex gently undulating topography, a silt loam surface texture, slow permeability and very slow surface runoff. Surface ponding and flooding are a common occurrence on Graham soils. The vegetation consists mainly of hydrophytic species and many of these soils are used only for pasture.

Associated soils are the well drained Melita series and the imperfectly drained Liege series. The Graham series of the Melita Association resembles the Leighton series of the Coulter Association. They are both alluvial deposits. The major difference between the two is that the Melita Association consists of stratified medium textured sediments while the Coulter Association consists of more uniform, moderately fine textured.

Glenview Series (GLN)

The Glenview series consists of imperfectly drained Gleyed Black Chernozem soils of the Dromore Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL), lacustrine sediments overlying coarse textured (FS, LCoS, LFS), gravelly deltaic outwash deposits. The dominant surface texture is loam; the topography is nearly level; permeability is moderate; and runoff is moderate. These soils are non-saline and cultivated.

The Glenview is associated with the well drained Dromore series and resembles the Bower series except that the Bower series is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978).

Glenlorne Series (GNO)

The Glenlorne series consists of imperfectly drained Gleyed Eluviated Black Chernozem soils of the Waskada Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured, discontinuous eolian and lacustrine sediments overlying stronger calcareous medium to moderately fine textured glacial till. A very thin (less than 5 cm), gravelly stratum or pebble line may occur at the contact. This soil has smooth to level topography, very fine sandy loam to loam surface texture, slow permeability, and slow surface runoff. The estimated depth to water table during the growing season is less than 2 metres. This soil is non-saline non-stony and usually cultivated. It is frequently flooded and ponded in the spring and after heavy rains. Although these soils are cultivated, they are generally not productive as the crops are adversely affected by periodic, excessive wetness.

Glenlorne soil is characterized by a black Ap horizon, 13 to 15 cm thick, a gray to light gray Ae horizon, 3 to 5 cm thick, a very dark grayish brown, gleyed, Bt horizon, 20 to 30 cm thick, a grayish brown, gleyed, iron stained and mottled Ccagj horizon, 13 to 18 cm thick. A grayish brown, gleyed, weakly mottled II Ckgj is also present. Associated soils include the well drained Waskada and Maskawata series, the imperfectly drained Montgomery and Two Creeks series, and the poorly drained Deloraine series. The Glenlorne series resembles the Hayfield series of the Cameron Association. The only difference is the Glenlorne series is underlain by glacial till. A description of a representative profile is presented below:

Ap - 0 to 15 cm, black (10YR 2/1 moist), very dark gray to dark gray (10YR 3/1 dry) silt loam; medium granular; friable when moist, soft when dry; abrupt, smooth boundary; weakly calcareous; pH 7.4.
Ae - 15 to 20 cm, dark gray (10YR 4/1 moist), gray to light gray (10YR 6/1 dry) silt loam; weak, fine platy; very friable when moist, soft when dry; clear, wavy boundary; pH 7.3.
Btgj1 - 20 to 25 cm, very dark grayish brown (2.5Y 3/2 moist); grayish brown (2.5Y 5/2 dry); clay loam; weak, fine granular; firm when moist; slightly hard when dry; smooth boundary; pH 7.2.

Btgj2 - 25 to 36 cm, very dark brown (10YR 2/2 moist), very dark grayish brown (10YR 3/2 dry) clay loam; medium blocky breaking to weak, fine subangular blocky; very firm when moist, hard when dry; clear, wavy boundary; pH 7.3.
Btgj3 - 36 to 43 cm, gray grayish brown (2.5Y 4/2 moist); olive gray (5Y 5/2 dry) clay loam; weak, fine granular; firm when moist; slightly hard when dry; clear, smooth boundary; pH 7.3.
Ckgj - 43 to 61 cm, dark grayish brown to grayish brown (2.5Y 4.5/2 moist), grayish brown (2.5Y 5/2 dry) loam; few, fine, faint iron and manganese mottles; weak, fine granular; friable when moist, soft when dry; abrupt, smooth boundary; moderately calcareous; pH 7.5.
Ccagj - 61 to 76 cm, grayish brown (2.5Y 5/2 moist), light gray (2.5Y 7/2 dry) silt loam; few, fine, faint iron mottles; moderate fine granular; firm when moist, soft when dry; abrupt, smooth boundary; few, gypsum crystals present; strongly calcareous; pH 7.6.
II Ckgj - 76 cm +, grayish brown (2.5Y 5/2 moist), light brownish gray (2.5 6/2 dry) loam, few, fine faint light yellowish brown (2.5Y 6/6 dry), iron mottles; weak, fine granular; firm when moist, slightly hard when dry; moderately calcareous; pH 7.5.

Goodlands Series (GOL)

The Goodlands series consists of imperfectly drained, Gleyed Black Chernozem soils of the Elva Association, developed on deep, strongly calcareous, moderately fine textured (SCL, CL, SiCL), lacustrine sediments. The surface texture is clay loam, the topography is nearly level to gently sloping, permeability is slow and runoff is slow. Depth to water table is estimated at 2 metres during the growing season. This soil is usually non-stony, and may be weakly to moderately saline in subsurface horizons.

This soil is characterized by black to very dark gray Ap horizons 10 to 25 cm thick, black to very dark brown gleyed Bmgj horizons 13 to 20 cm thick, very dark gray to dark gray gleyed BCgj horizons 18 to 25 cm thick and gleyed, light olive brown to pale olive Cgj horizons (Soils of the Boissevain - Melita Area, 1978). Analytical data and a representative profile description are presented:

Ap - 0 to 25 cm, very dark gray (10YR 3/1 moist), very dark gray to dark gray (10YR 3.5/1 dry) clay loam; moderate medium subangular blocky breaking to moderate fine subangular blocky; friable when moist; abrupt, smooth boundary; non-calcareous; pH 6.7.
Btjgj - 25 to 41 cm, black to very dark brown (10YR 2/1.5 moist), very dark gray to dark gray (10YR 3.5/1 dry) silty clay loam; weak medium prismatic breaking to weak fine subangular blocky; friable when moist; irregular boundary; pH 7.6.
BC - 41 to 64 cm, very dark gray to dark gray (10YR 3.5/1 moist), gray (10YR 5/1 dry) silty clay loam; weak fine subangular blocky; friable when moist; diffuse irregular boundary; moderately calcareous; pH 8.3.
Cksgj - 64 cm +, light olive brown (2.5Y 5/4 moist), pale olive (5Y 6/3 dry); silty clay loam; weak fine granular; friable, when moist; very strongly calcareous; weakly saline; pH 8.5.

Gopher Creek Series (GPE)

The Gopher Creek series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils of the Dromore Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL), lacustrine sediments overlying coarse textured (FS, LCoS, LFS), gravelly deltaic and outwash deposits. This soil is characterized by nearly level topography, moderately slow permeability, and low surface runoff. The dominant surface texture is very fine sandy loam. Some of these soils are cultivated and some are used as pasture. The estimated depth to water table during the growing season is 2 metres.

Associated soils are the well drained Dromore and Breadon series, the imperfectly drained Glenview series, and the poorly drained William series. The Gopher Creek series resembles the Alexander series except that the Alexander series is underlain by glacial till (Soils of the Boissevain - Melita Area, 1978).

Grover Series (GRO)

The Grover series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a mantle (25 to 75 cm) of moderately to strongly calcareous, shallow, medium (VFSL, L, SiL) textured,

lacustrine deposits over moderately calcareous, deep, sandy (FS,LFS,LS), lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Grover soils are non-eroded, non-stony, and non-saline. They have medium available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes aspen oak, ash and tall prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a very dark gray to black Ah or Ahk horizon, 15 to 25 cm thick, a dark grayish brown ACgj horizon, 15 to 20 cm thick with faint mottles, a Ccagj horizon, 5 to 8 cm thick, and a light yellowish brown, sandy Ckgj horizon, with yellowish brown mottles. Grover soils occur in close association with Glenboro and Grayson soils. They are similar to Crookdale soils by being imperfectly drained with a sandy substrate but differ from them by having loamy rather than fine loamy surface. Grover soils were previously mapped as Black Meadow associates of the Glenboro Association in the Carberry (1957) soil report.

Guerra Series (GRR)

The Guerra series consists of poorly drained Rego Humic Gleysol soils developed on a mantle (35 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (L, CL, SiCL), lacustrine deposits over moderately to strongly calcareous, deep, uniform, fine loamy (L, CL, SiCL), mixed till deposits. These soils occur in level to depressional positions of very gentle slopes on hummocky landscapes and have slow permeability, very slow surface runoff and a high water table during the growing season. Guerra soils are occasionally slightly saline. They have a medium available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation often includes sedges, rushes and willows. The majority of these soils are currently used for natural grazing.

In a representative profile the soil solum is approximately 25 cm thick. The profile is characterized by a black Ah or Ahk horizon, 15 to 30 cm thick, a very dark gray transitional ACg horizon, 5 to 15 cm thick with many prominent iron mottles, and a dark olive gray Ckg horizon with many prominent iron mottles. The parent material is relatively free of coarse fragments.

Guerra soils occur in close association with Knudson, Joyale and Ullrich soils. They are similar to Narish soils by having a Rego Humic Gleysol profile developed in mixed calcareous till but differ from Narish soils because Narish profiles are associated with Dark Gray soils while Guerra profiles are associated with Black soils. Guerra soils were previously mapped as the poorly drained Blackearth associate of the Altamont association, in the reconnaissance soil survey of South-Central Manitoba (1943).

Hebbot Series (HEB)

The Hebbot series consists of well drained Rego Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, fine loamy (L, CL, SiCL), glacial till deposits derived from limestone, granite and shale. These soils occur in upper and crest positions of moderate to strong slopes on hummocky landscapes and have moderate to moderately rapid permeability, moderate surface runoff, and a low water table during the growing season. Hebbot soils are severely water eroded, slightly stony, and non-saline. They have a medium available water holding capacity, low organic matter content, and medium natural fertility. Native vegetation includes scrub oak, aspen, shrubs and prairie grasses. The majority of these soils are currently cultivated for crop and forage production.

In a representative profile of Hebbot soil the solum is eroded. The profile is characterized by a dark gray to very dark gray Ah horizon, 10 to 15 cm thick, a brown to pale brown Cca horizon, 10 to 15 cm thick, and a yellowish brown Ck horizon.

Hebbot soils occur in close association with Darlingford, Nikkel and Cazlake soils. They are similar to Darlingford soils by having a well drained profile but differ from them by having no Bm horizon. Hebbot soils were previously mapped as Calcareous Black Chernozem associates of the Darlingford Association in the South Central (1943) soil report.

Hathaway Series (HHY)

The Hathaway series consists of well drained Rego Black Chernozem soils of the Ryerson Association, developed on deep, strongly calcareous, medium to moderately fine textured glacial till. The till is composed mainly of mixed materials derived from shale, limestone and granitic rocks. The surface horizons are usually very thin as a result of erosion by wind, water and cultivation. These soils have a loam to clay loam surface texture, gently undulating topography, moderate permeability and rapid surface runoff. Hathaway soils usually occur in the upper slope and knoll positions, and usually have a lighter gray surface color than adjacent, deeper soils. The light color is due to carbonates. Depth to water table ranges from 2 to 3 metres. These soils are usually strongly calcareous and low in organic matter. This soil is characterized by a gray non-leached Apk horizon 10 to 20 cm thick, a dark gray to gray AC horizon 20 to 50 cm thick overlying a light yellowish brown Ck horizon. Morphological data for a representative profile are presented below.

Apk - 0 to 20 cm, black (10YR 2/1, moist), gray (10YR 5/1, dry), loam; weak, fine, subangular blocky, very friable; clear smooth boundary; strongly calcareous; pH 7.8.
AC - 20 to 50 cm, dark gray (10YR 4/1, moist), gray (10YR 5/1, dry), loam; weak, fine subangular blocky, very friable; clear irregular boundary; strongly calcareous; pH 8.2.
Ck - 50 to 76 cm, yellowish brown to light yellowish brown (10YR 5.5/4, moist), light yellowish brown (10YR 6/4, dry), loam; weak fine subangular blocky, very friable; clear smooth boundary; strongly calcareous; pH 8.1.
Ckgj1 - 76 to 100 cm, dark yellowish brown to yellowish brown (10YR 7/4, dry), loam; weak fine subangular blocky, very friable; clear smooth boundary; strongly calcareous; pH 7.9.
Ckgj2 - 100 to 160 cm, dark yellowish brown to yellowish brown (10YR 4.5/4, moist), pale brown (10YR 6/3, dry), loam; weak medium subangular blocky, friable; strongly calcareous; common, medium prominent, dark red (10YR 3/6), iron concretions; pH 7.8.

Hilton Series (HIT)

The Hilton series consists of well drained Orthic Black Chernozem soils developed on strongly to extremely calcareous, thin, uniform, fine loamy (L, CL, SiCL) glacial till of limestone, shale and granite origin. These soils occur in upper slope positions of moderate slopes on hummocky landscapes and have moderate permeability rapid surface runoff and a low water table during the growing season. Hilton soils are moderately eroded, moderately stony and non-saline. They have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for forage crop production and improved pasture.

In a representative profile the solum is approximately 30 cm thick. The profile is characterized by a very dark gray Ah or Ap horizon, 10 to 20 cm thick, a dark brown Bm horizon, 5 to 15 cm thick, a very pale brown Cca horizon, 10 to 40 cm thick and a yellowish brown Ck horizon.

Hilton soils occur in close association with the imperfectly drained Barwood series and the poorly drained Hickson soils. They are similar to Tiger Hills soils by having a well drained, very thin soil profile developed in strongly to extremely calcareous glacial till but differ from them in having a less strongly leached soil profile. Tiger Hills soils have Ae or Ahe horizons and Bt horizons while Hilton soils do not. Hilton soils were previously mapped as dominant associates of the Hilton association in the reconnaissance soil survey of South-Central Manitoba (1943).

Hickson Series (HKS)

The Hickson series consists of poorly drained carbonated Rego Humic Gleysol soils developed on a thin mantle (50 to 75 cm) of very strongly to extremely calcareous loamy (L, SiL, SiCL, CL) glacial till of limestone and granitic origin overlying strongly calcareous loam to clay loam glacial till of shale, limestone, and granitic origin. They occur in level to depressional (pothole) topography and are subject to ponding and prolonged saturation. Runoff is negligible, and permeability is very slow. Soluble salts may occur in the soil in areas of seepage or upward movement of groundwater containing appreciable soluble salts toward the surface.

The soil is characterized by a moderately decomposed organic layer 2 to 5 cm thick, a very dark gray, carbonated Ah horizon, and a thin gray to olive gray ACg horizon with mottles. The Ckg horizon is pale olive and may contain yellowish brown mottles.

Hummerston Series (HMO)

The Hummerston series consists of imperfectly drained Gleyed Rego Black Chernozem soil developed on weakly to moderately calcareous, deep, uniform, coarse (FS, LFS, LS) textured, lacustrine deposits. These soils occur in middle to lower positions of very gentle slopes on undulating landscapes and have moderately rapid permeability, low surface runoff, and a high water table during the growing season. Hummerston soils are often slightly wind eroded, non-stony, and slightly saline. They have a low available water holding capacity, medium to low organic matter content, and medium to low natural fertility. Native vegetation includes aspen-oak groves, shrubs, tall prairie and meadow grasses. The majority of these soils are currently cultivated for forage and grain crops.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 20 cm thick, a dark gray ACgj horizon, 10 to 18 cm thick with moderate calcareousness, and a yellowish brown Ckgj horizon, with prominent yellow mottles.

Hummerston soils occur in close association with Stockton, Lavenham and Sewell soils. They are similar to Lavenham soils by having an imperfectly drained profile in sandy deposits but differ from them in having no diagnostic Bm Horizon. Hummerston soils were previously mapped as Black Meadow associates of the Stockton Association in the Carberry (1957) soil report.

Hartney Series (HRY)

The Hartney series consists of the imperfectly drained, Gleyed Rego Black Chernozem carbonated member of the Cameron Association developed on deep, strongly calcareous, medium textured lacustrine sediments. This soil has level to very gently sloping complex topography, moderate permeability, slow surface runoff and a loam surface texture. The estimated depth to water table is less than 2 m during the growing season. This soil is used for crop production.

Hartney soils are characterized by black Apk horizons 10 to 12 cm thick, dark gray AC horizons 5 to 7 cm thick, light olive gray Cca horizons 7 to 10 cm thick overlying a pale olive to pale yellow Ckgj, horizon.

Jackson Creek Series (JKE)

The Jackson Creek series is the well drained Rego Black Chernozem member of the Bede Association, developed on strongly calcareous, deep, coarse textured gravelly deltaic, beach and outwash deposits. This soil has gently sloping to gently undulating topography, good drainage, rapid permeability and very slow surface runoff. The depth to water table is estimated at 2 to 3 metres during the growing season. The native vegetation consists of drought resistant herbs, grasses and shrubs. These soils are not usually cultivated; most are used as unimproved pasture. Jackson Creek soils are found in close association with Broomhill soils.

The soil is characterized by a thin, very dark gray Ah horizon 0 to 8 cm thick, a dark gray AC horizon, 5 to 8 cm thick, a white Cca horizon, 15 to 20 cm thick, overlying a pale brown, stratified parent material. A representative profile description follows:

Ahk - 0 to 8 cm, very dark gray (10YR 3/1, moist), very dark gray to dark gray (10YR 3.5/1, dry), medium sandy loam; structureless; loose when moist and dry; clear smooth boundary; moderately calcareous; pH 7.9.
AC - 8 to 13 cm, very dark grayish brown (10YR 3/2, moist), dark gray (10YR 4/1, dry), fine sandy loam; structureless; loose when moist and dry; clear smooth boundary; strongly calcareous; pH 8.0.
Cca - 13 to 38 cm, light brownish gray (2.5Y 6/2, moist), white (2.5Y 8/1, dry), coarse sandy loam; structureless; loose when moist and dry; clear smooth boundary; strongly calcareous; pH 8.1.
Ck1 - 38 to 66 cm, pale brown (10YR 6/3, moist), very pale brown (10YR 7/3, dry), coarse sand;

structureless; loose when moist and dry; clear smooth boundary; strongly calcareous; pH 8.1.
Ck2 - 66 to 97 cm, strong brown to reddish brown (7.5YR 5.5/6, moist), light brownish gray (10YR 6/2, dry), coarse sand; few fine faint iron mottles; structureless; loose when moist and dry; clear smooth boundary; strongly calcareous; pH 8.0.
Ck3 - 97 cm +, yellowish brown (10YR 5/6, moist), very pale brown (10YR 7/4, dry), coarse sand; structureless; loose when moist and dry; moderately calcareous; pH 8.1.

Joyale Series (JYL)

The Joyale series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, loamy (L, CL, SiCL), lacustrine deposits over moderately to very strongly calcareous, deep uniform, fine loamy (CL, SiCL), mixed till deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have moderate permeability slow surface runoff and a medium water table during the growing season. Joyale soils are usually slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for crop production.

In a representative profile the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to black Apk or Ahk horizon, 15 to 25 cm thick, a light gray Ccagj or ACgj horizon, 5 to 15 cm thick with distinct iron mottles, and a very pale brown II Ckgj horizon with many prominent iron mottles. A typical profile also contains a thin pebble line at the lacustrine/till contact.

Joyale soils occur in close association with Knudson, Ullrich and Guerra soils. They are similar to Prodan soils by having a Gleyed Rego Black Chernozem profile developed dominantly in imperfectly drained fine loamy deposits but differ from Prodan soils because of the presence of a compact till substrate within a meter of the mineral surface. Joyale soils were mapped as minor, imperfectly drained Blackearth associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Kemnay Series (KMY)

The Kemnay series is the well drained, Calcareous Black Chernozem member of the Lyleton Association, developed on deep, moderately calcareous, coarse to moderately coarse textured lacustrine deposits. This soil has a sandy loan surface texture, a complex, very gently sloping topography, moderately good drainage, moderately rapid permeability and moderate surface runoff. The depth of the water table is estimated at 2 to 3 metres during the growing season. Kemnay soils can be found in close association with Lyleton soils. The Nesbitt series of the Mentieth Association resembles the Kemnay series. The only difference is the Nesbitt series is underlain at shallow depth by glacial till.

Kemnay soils are characterized by a thick black Ah horizon 10 to 28 cm thick of which the upper 15 cm constitute the Ap horizon. The dark brown Bmk horizon is 25 to 30 cm thick and the Cca horizon when present is grayish brown and 8 to 13 cm thick. The parent material or Ck horizon is pale brown, stratified and has a few faint iron mottles. Morphological data for a representative profile is presented below.

Apk - 0 to 15 cm, black to very dark gray (10YR 2.5/1, moist), very dark gray to dark gray (10YR 3.5/1, dry), very fine sandy loam; weak fine granular; very friable when moist; soft when dry; abrupt smooth boundary; weakly calcareous; pH 7.6.
Bmk - 15 to 23 cm, very dark grayish brown (10YR 3/2, moist), grayish brown (10YR 5/2, dry), loam; weak fine granular; friable when moist, slightly hard when dry; abrupt wavy boundary; strongly calcareous; pH 7.7.
Cca - 23 to 33 cm, light gray (10YR 7/2, moist), very pale brown (10YR 8/2, dry), silt loam; moderate fine granular; firm when moist, hard when dry; clear smooth boundary; extremely calcareous; pH 8.0.
Ck - 33 cm +, very pale brown (10YR 7/3, moist), very pale brown (10YR 8/3, dry), silt loam; weak fine granular; friable when moist, soft when dry; very strongly calcareous; pH 8.2.

Kerran Series (KRN)

The Kerran series consists of poorly to very poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, deep, stratified, clayey (SiC, C), recent alluvial deposits with strata of silty clay loam and clay loam textures. These soils occur in depressional positions of level slopes on flood prone terraced landscapes and have very slow permeability, very slow surface runoff, and a high water table during the growing season. Kerran soils are non-eroded, non-stony, and frequently moderately saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes reeds, rushes, sedges 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 thin organic horizon, 2 to 4 cm thick, a weakly developed dark gray Ahk horizon, 10 to 15 cm thick, and a pale brown to light gray Ckg horizon, with prominent iron mottles. The parent material is typically stratified, mottled, and may contain buried former Ah horizons. Kerran soils occur in close association with Assiniboine soils. They are similar to Basker soils by having a poorly drained profile in recent alluvium but differ from them in having finer textures throughout the profile. Kerran soils were previously mapped as associates of the Assiniboine Complex in the Carberry (1957) soil report.

Knudson Series (KUD)

The Knudson series consists of moderately well to well drained Orthic Black Chernozem soils developed on a shallow deposits (30 to 100 cm) of weakly to moderately calcareous, uniform, fine loamy to clayey, glacio-lacustrine deposits, over moderately to strongly calcareous, deep, uniform, fine loamy to fine silty mixed till deposits. These soils occur in middle positions of very gentle slopes on undulating landscape and have medium permeability, moderate surface runoff and a medium water table during the growing season. Knudson soils have moderate available water holding capacity, moderate organic matter content, and high natural fertility.

In a representative profile the solum is approximately 60 cm thick. The profile is characterized by a black Ap horizon, 15 to 25 cm thick, with a brown to grayish brown Bm horizon 8 to 12 cm thick with medium subangular blocky structure, a very pale brown Cca horizon 6 to 10 cm thick, and a yellowish brown II Ck horizon. A typical profile also contains a thin pebble line at the lacustrine-till interface. Knudson soils occur in close association with Joyale and Guerra soils. They are similar to Darlingford soils by having similar profile characteristics but differ from them in having a thin mantle of fine loamy to clayey glacio-lacustrine deposits overlying glacial till. Knudson soils were previously mapped as Blackearth associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Levine Series (LEI)

The Levine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, deep, stratified, loamy (VFSL, L, CL) recent alluvial deposits. These soils occur in flood plains on level slopes in level landscapes. They have rapid permeability, moderately slow surface runoff and a medium water table during the growing season. Levine soils are occasionally slightly saline and are subject to periodic inundation during spring runoff or after heavy rains. They have a moderate to low available water holding capacity, low 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 15 cm thick and the profile is characterized by a dark gray Apk or Ahk horizon 10 to 20 cm thick and a light yellowish brown Ckgj horizon. The underlying strata may vary in colour from light to dark. The thin dark colored mineral and organic layers are former surface horizons that have been exposed to soil forming processes for a significant period before burial by alluvial deposits. Medium, distinct yellowish brown iron mottles occur through the soil. Levine soils were previously mapped as inclusions of Eroded Slope Complexes in the reconnaissance soil survey of South-Central Manitoba.

Leon Series (LEO)

The Leon series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem member of the Leon Association, developed on thin (25 to 100 cm) moderately to strongly calcareous, moderately fine textured lacustrine sediments overlying coarse textured, gravelly deltaic beach and outwash deposits. These soils have a clay loam to light clay textured surface, nearly level topography, moderately slow to slow permeability and moderate surface runoff. The depth to water table is estimated to be less than 2 m during the growing season. Imperfectly drained Leon soils are usually cultivated. Leon soils occur in areas adjacent to the outwash deposits in the eastern part of the Rural Municipality of Killarney-Turtle Mountain and western part of the Boissevain-Melita map area.

Leighton Series (LGT)

The Leighton series is the poorly drained carbonated Rego Humic Gleysol member of the Coulter Association, developed on deep moderately calcareous, moderately fine to fine textured (SCL, CL, SiCL to SiC, C), recent alluvial sediments. These soils generally have a clay loam to clay surface texture, nearly level to depressional topography, slow to very slow permeability and very little surface runoff. These soils occur in channels usually in the low lying alluvial flood plains. They are poorly drained and have a water table within 1 metre for most of the growing season. Leighton soils are very susceptible to spring flooding from high river levels and after heavy rains. A few areas of Leighton soils are cultivated, but many are left as natural sites with native hydrophytic vegetation.

Langvale Series (LGV)

The Langvale series is the well drained, Orthic Black Chernozem member of the Mentieth Association, developed on thin (25 to 100 cm), moderately calcareous, moderately coarse (VFS, LVFS, SL, FSL) textured, lacustrine sediments overlying strongly calcareous, medium to moderately fine textured glacial till. The profile may contain a very thin (<5 cm), gravelly stratum or pebble line at the till contact. Langvale soils usually have a loamy very fine sand surface texture, gently undulating topography, moderate permeability and moderately slow surface runoff. The estimated depth to water level is 2 to 3 metres during the growing season. They usually occur in the well drained middle and upper slope positions in the landscape. These soils are cultivated, non-stony and non-saline. The Langvale series resembles the Lyleton series, except that the Langvale soils are underlain by glacial till.

Liege Series (LIG)

The Liege series is the imperfectly drained Gleyed Cumulic Regosol member of the Melita Association, developed on deep, moderately calcareous, medium textured alluvial sediments. These deposits are stratified and contain numerous dark colored bands of former surface horizons. These soils generally have a silt loam to very fine sandy loam surface texture, nearly level to gently undulating topography, moderate permeability and moderate surface runoff. The drainage is imperfect and the estimated depth to water table is less than 2 m. These soils are very susceptible to spring flooding due to high water levels in the creeks and Souris River. Some of these soils are cultivated and produce excellent crops.

This soil is characterized by dark gray Ap horizons 7 to 12 cm thick, gleyed carbonated dark gray Ahkgj horizons 5 to 7 cm thick, gleyed gray brown Ckgj horizons overlying recurring dark gray brown Ahk horizons and light brownish gray to gray brown Ckgj horizons.

Linklater Series (LIK)

The Linklater series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem member of the George Lake Association, developed on thin (25 to 100 cm) weakly to moderately calcareous, moderately coarse textured lacustrine sediments overlying coarse textured gravelly deltaic beach and outwash deposits. This soil has nearly level topography with small complex slopes, imperfect drainage, moderate permeability and slow surface runoff. The estimated depth to water level is less than 2 metres. The surface is slightly to moderately stony and may cause some hindrance to cultivation. These soils occur in the Township 1 Range 15 of the Roblin map area.

These soils consist of black, calcareous, Ahk horizons 5 to 10 cm thick, dark gray AC horizons 5 to 8 cm thick, light gray Ccagj horizons 13 to 18 cm thick and sandy light brown Ckgj horizons overlying a very

coarse gravelly II Ck horizon. The Linklater series resembles the Cauldwell series of the Griswold Association. The only difference is the Cauldwell series is underlain by glacial till. A profile description is presented below.

Ahk - 0 to 10 cm, black to very dark gray (10YR 2.5/1, moist), very dark gray to dark gray (10YR 3.5/1, dry), sandy loam; massive; friable when moist; abrupt boundary; weakly calcareous.
AC - 10 to 15 cm, sandy loam; friable when moist; abrupt boundary; weakly calcareous.
Ccagj - 15 to 33 cm, light gray to white (10YR 7.5/1, dry), sandy loam; friable when moist; abrupt boundary; strongly calcareous.
Ckgj - 33 to 64 cm, sandy loam; friable when moist; abrupt boundary; moderately calcareous.
II Ck - 64 cm +, gravel and coarse sand.

Lockhart Series (LKH)

The Lockhart series consists of moderately well to well drained Orthic Black Chernozem soils developed on a thin mantle (25 to 60 cm) of moderately coarse sediments (VFS, LVFS, FSL) over a thin strata (10 to 50 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin, over a strongly calcareous loam to clay loam glacial till of shale, limestone, and granitic origin. These soils occur on gently sloping to undulating topography. Runoff is moderate to moderately rapid; permeability is moderately rapid in the upper sandy strata and moderately slow in the underlying till. These soils have been slightly eroded.

The soil is characterized by a very dark gray Ah horizon 18 to 25 cm thick and a grayish brown to brown Bm horizon 12 to 20 cm thick. The depth of solum varies with the depth of the sandy overlay with the BC terminating at the contact of the sandy surface and very strongly calcareous till.

Larrett Series (LRT)

The Larrett series consists of well to moderately well drained Eluviated Black Chernozem soils developed on a mantle (25 to 100 cm) of weakly to moderately calcareous, uniform, fine loamy (L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep fine loamy (L, SiL, CL) mixed till deposits. These soils occur in middle to upper slope positions of very gentle to undulating landscapes. Surface runoff is moderate, permeability is also moderate and the water table is below 2 m during the growing season. Larrett soils are non-eroded, non-stony and non-saline. They have a high water holding capacity, medium organic matter, and high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are used for crop production.

The solum is approximately 60 cm thick with a dark gray Ap or Ah horizon, 15 to 20 cm thick; an eluvial Ae horizon, 2 to 5 cm thick. A brown to pale brown Bt horizon, 10 to 25 cm thick, is underlain by a transition pale brown II BC horizon, 10 to 20 cm thick. Occasionally a white, II Cca horizon 4 to 6 cm thick is present. The parent material is typically pale brown to very pale brown, strongly calcareous mixed till. Larrett soils occur in close association with Kingsley, Knudson and Tellier soils. Larrett soils were mapped as an associate of the Altamont Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Lyleton Series (LYT)

The Lyleton series is the well drained Orthic Black Chernozem member of the Lyleton Association, developed on deep, moderately calcareous, moderately coarse (VFS, LVFS, FSL) lacustrine sediments. This soil usually has sandy loam to loamy very fine sand surface texture, complex gently sloping to gently undulating topography, moderately rapid permeability and moderate surface runoff. The depth to groundwater is estimated at 2 m during the growing season. The surface is non-stony and non-saline. Under cultivation these soils are moderately susceptible to erosion, somewhat droughty and generally low in natural fertility.

The profiles are often deep and consist of black to very dark brown Ap horizons 12 to 15 cm thick, very dark gray to black Ah horizons 18 to 25 cm thick, very dark grayish brown Bm horizons 12 to 18 cm

thick, light brownish gray Cca horizons 15 to 20 cm thick and calcareous, light brownish gray Ck horizons.

Maskawata Series (MAW)

The Maskawata series consists of well-drained Rego Black Chernozem soils of the Waskada Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured, discontinuous eolian and lacustrine sediments overlying strongly calcareous, medium to moderately fine textured glacial till. The dominant surface texture is a loam or very fine sandy loam, topography is gently undulating, permeability and surface runoff moderate. They are moderately well drained soils and usually occur in the upper mild slope position. Maskawata soils are found in close association with Waskada soils. The estimated depth to water level is 3 metres during the growing season. In the cultivated state these soils are moderately eroded and in many of these soils, most of the Ah horizon has been eroded by accelerated removal by wind and water as a result of cultivation. The surface soils have a general gray color due to the incorporation of AC and Ck horizons in the Ap.

Recognition of the overlay in these soils is sometimes difficult because the underlying till is relatively stone free. The Maskawata series is similar to the Argue series of the Cameron Association, except for the underlying glacial till.

Marsden Series (MDN)

The Marsden series consists of poorly drained Rego Humic Gleysol, carbonated soils developed on a sequence of strata consisting of a thin lacustrine mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments (VFSL to SiCL) over thin (10 to 40 cm) of medium sand to gravel strata over strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. The topography is level to depressional; runoff is negligible, and permeability is restricted during periods when free water is at or near the surface.

The soils are characterized by a thin, moderately decomposed organic layer, 1 to 4 cm, a very dark gray Ah horizon, 12 to 18 cm and an olive brown AC frequently developed in the sand strata. The Cg horizon is olive gray with many prominent mottles and usually occurs at the till contact. Marsden soils were previously mapped as minor associates of the Heaslip complex in the Reconnaissance soil survey of South-Central Manitoba (1943).

Medora Series (MDO)

The Medora series is the well to moderately well drained, Calcareous Black Chernozem member of the Ryerson Association, developed on deep, strongly calcareous, fine loamy glacial till composed of mixed materials derived from shale, limestone and granitic rock. These soils usually have loam to clay loam surface textures, complex gently sloping to undulating topography, moderate permeability and rapid surface runoff. The depth to water table is estimated at 3 to 4 metres during the growing season. The surface is cultivated and occasionally slightly stony. These soils are moderately susceptible to erosion and in many cases much of the Ah horizon has been removed. Cultivation has incorporated some of the calcareous Bmk into the Apk horizon resulting in a light brownish gray coloring to the land surface. Medora soils commonly occur in the middle, upper slope and knoll positions.

The soil is characterized by weakly calcareous, very dark gray Apk horizons 10 to 15 cm thick, calcareous very dark grayish brown Bmk horizons 8 to 13 cm thick, light brownish gray Cca horizons 13 to 18 cm thick and light yellowish brown Ck horizons. A representative profile description of the Medora series is presented.

Apk - 0 to 10 cm, very dark brown (10YR 2/2 moist), very dark gray to dark gray (10YR 3.5/1 dry), loam; weak, fine granular; very friable when moist; soft when dry; abrupt, smooth boundary; weakly calcareous.
Bmk - 10 to 20 cm, very dark grayish brown (10YR 3/2), loam; coarse, granular breaking to fine granular; friable when moist; soft when dry; abrupt, wavy boundary; moderately calcareous.

Ck1 - 20 to 51 cm, dark grayish brown (10YR 4/2 moist), loam; weak, fine granular; firm when moist; slightly hard when dry; abrupt, smooth boundary; moderately calcareous.
Cca - 51 to 66 cm, light olive brown (2.5Y 4/4 moist), loam; weak, fine granular; firm when moist; soft when dry; abrupt, smooth boundary; strongly calcareous.
Ck2 - 66 cm +, light yellowish brown (2.5Y 6/4 moist), loam; weak, fine granular; firm when moist; slightly hard when dry; strongly calcareous.

Melita Series (MLT)

The Melita series is the well drained, Cumulic Regosol member of the Melita Association developed on deep, moderately calcareous, medium textured, recent alluvial sediments. These deposits are stratified and contain numerous dark colored bands of former Ah horizons in the profile. The soil has a very fine sandy loam to silt loam surface texture, nearly level to depressional topography, moderate permeability and moderate surface runoff. They are moderately well drained soils and have an estimated depth to water table of 2 m. In the uncultivated state they are covered by lush growth of native vegetation such as western snowberry, (Symphoricarpus occidentalis), elm, (Ulmus americana), maple, (Acer negundo), forbs, grasses and chokecherry. In the cultivated state these soils produce excellent crops.

The soil usually consists of thick dark gray brown Ah horizons 15 to 30 cm thick and very dark grayish brown C horizons. They also have buried surface horizons as indicated by dark bands in the profile. The Melita series corresponds with the Mowbray series in ecoclimatic subregion Gt2.

Mentieth Series (MNH)

The Mentieth series is the imperfectly drained, Gleyed Rego Black Chernozem, carbonated member of the Mentieth Association, developed on thin moderately calcareous, coarse loamy lacustrine sediments overlying strongly calcareous loamy glacial till. A very thin (< 5 cm) gravelly pebble line may occur at the contact. This soil has a very fine sand to loamy very fine sand surface texture, nearly level topography, moderate permeability and moderately slow surface runoff. These soils are imperfectly drained because of their position in the landscape and the proximity of the underlying less permeable till. Although ponded surface waters are not common the profile is frequently saturated due to the high water table. The surface is non-stony and cultivated.

The Mentieth series resemble the Switzer series of the Souris Association, the difference is that Mentieth series is underlain by glacial till.

Martinville Series (MNV)

The Martinville series is the poorly drained, carbonated Rego Humic Gleysol member of the Wawanesa Association developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL) lacustrine deposits overlying moderately calcareous, coarse textured (FS, LCoS, LFS) lacustrine deposits. These soils have a silt loam to loam surface texture, nearly level to depressional topography, moderate permeability and virtually no surface runoff. The water table is usually at or very near the soil surface. Most of these soils have hydrophytic native vegetation and may be used as pasture or left undisturbed.

Maon Series (MON)

The Maon series is the well drained Rego Black Chernozem member of the Lyleton Association, developed on deep, moderately calcareous, coarse loamy lacustrine sediments. This soil has a loamy very fine sand surface texture, gently sloping to gently undulating topography, moderate permeability and slow surface runoff. The drainage is moderately good and the estimated depth to water table is 2 m. In the cultivated state this soil is moderately susceptible to erosion as is indicated by the gray white buff colored spots in the field where C material has been incorporated into the Ap horizon.

Montgomery Series (MOT)

The Montgomery series is the imperfectly drained, carbonated Gleyed Rego Black Chernozem member of the Waskada Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured,

discontinuous aeolian and lacustrine sediments overlying strongly calcareous medium to moderately fine textured glacial till. A very thin (<5 cm), pebbly stratum may occur at the contact. This soil has a loamy surface texture, gently sloping to depressional topography, moderate permeability and moderate surface runoff. This soil has an estimated depth to water table within 2 metres. The cultivated surface may be slightly stony. The soil consists of very dark gray Apk horizons 10 to 20 cm thick, light gray Ccagj horizons 20 to 30 cm thick, light gray Ckgj horizons 25 to 33 cm thick overlying light brownish gray, loam to clay loam, II Ckgj horizons.

Mowbray Series (MOW)

The Mowbray series consists of a well drained, Cumulic Regosol soils developed on deep, moderately to strongly calcareous, loamy (L, SiL, CL, SiCL) recent alluvial sediments. These deposits are stratified and contain dark colored bands of former Ah horizons in the profile. The soils are located in upper terrace and flood plain areas that have been inundated during years of high flood waters. Topography is very gently to moderately sloping, runoff is moderate and permeability is moderate.

The soil is characterized by a dark gray to gray surface horizon (Ah or Ap) 8 to 20 cm thick and a lighter colored (C) substratum with dark bands consisting of former organic layers or buried Ahb horizons. These soils may exhibit weak profile development. They occur in association with the Levine and Basker soils.

Margaret Series (MRE)

The Margaret series is the moderately well drained, Orthic Black Chernozem member of the Terence Association, developed on thin (25 to 100 cm) weakly to moderately calcareous, coarse textured (FS, LCoS, LS, LFS) lacustrine sediments overlying strongly calcareous, medium to moderately fine textured (VFSL, L, CL, SiCL) glacial till. A very thin (< 5 cm) gravelly stratum or pebble line may occur at the contact. This soil has a loamy fine sandy surface texture, very gently sloping topography, moderately rapid permeability and moderate surface runoff. In the uncultivated condition the native vegetation consists chiefly of grasses, poplar, and western snow bush. The Margaret series resembles the Stanton series of the Souris Association. The only difference is that the Margaret series is underlain by glacial till.

The soil profile consists of black Ah horizons 5 to 25 cm thick, dark gray brown Bm horizons 15 to 30 cm thick, occasionally a thin stone line and an underlying light olive brown II Ck horizon with a few prominent iron concretions. A representative profile is presented.

Ah - 0 to 25 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry), loamy fine sand; single grained; loose, dry; clear wavy boundary; pH 6.1.
Bm - 25 to 56 cm, dark brown (10YR 3.5/3 moist), dark grayish brown to grayish brown (10YR 4.5/2 dry), loamy fine sand; weak medium prismatic breaking to weak fine subangular blocky; loose when moist; clear, smooth boundary; pH 6.4.
IICk - 56 to 61 cm, stone line, gravelly sandy loam; single grained; loose, moist, clear, smooth boundary; strongly calcareous; pH 7.8.
IIICK - 61 cm +, olive brown to light olive brown (2.5Y4.5/4 moist), very pale brown (10YR 7/3 dry), clay loam till; amorphous; friable when moist; strongly calcareous; pH 8.1.

Marringhurst Series (MRH)

The Marringhurst series consists of moderately well to well drained Calcareous Black Chernozem soils developed on moderately strongly to strongly calcareous, stratified, deep, sandy (CoS, S, LS) and sandy skeletal (GrS, GrCoS) glaciofluvial deposits. These soils occur in upper positions of very gentle slopes on rolling to irregular landscapes and have very rapid permeability, low surface runoff, and a low water table during the growing season. Marringhurst soils are often moderately eroded, non-stony, and non-saline. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes shrubs, bur oak, and prairie grasses. The majority of these soils are currently excavated for gravel or used for grazing.

In a representative profile soil the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to very dark grayish brown Ah horizon, 14 to 18 cm thick, a dark brown to brown Bmk horizon, 10 to 18 cm thick, a Cca horizon, 20 to 30 cm thick with coarser gravelly strata and a Ck horizon.

Mather (MTR)

The Mather series consists of well drained, Orthic Black Chernozem soils of the Wawanesa Association, developed on thin (25 to 100 cm), weakly to moderately calcareous, medium textured (VFSL, L, SiL) lacustrine sediments overlying moderately to strongly calcareous, coarse textured (FS, LCoS, LS, LFS) lacustrine deposits. These soils have dominantly a loam surface texture, very gently sloping to gently undulating topography, moderately rapid permeability, and moderate surface runoff. These soils are non-saline and non-stony agricultural soils. The majority of these soils are cultivated.

The Mather soil has an average Ap horizon, 17 cm thick, ranging from 9 to 22 cm, a dark grayish brown Bm horizon, 6 to 34 cm thick, and two or three C horizons. The two C horizons are very common in this soil, as a coarser C horizon underlying a finer one.

Miniota Series (MXI)

The Miniota series consists of moderately well to well drained Orthic Black Chernozem soils developed on a thin mantle (<1 m) of moderately to strongly calcareous very fine sand to fine sandy loam textured sediments over moderately to strongly calcareous, medium sand to gravelly textured deposits. The topography varies from gently sloping to irregular, moderately rolling. Runoff is moderate to moderately rapid, and permeability is rapid in the sandy strata and very rapid in the lower coarser strata. They occur in close association with the imperfectly drained Wytonville and Kilmury soils and the poorly drained Bornett series.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 12 to 20 cm thick, a dark brown to brown Bm horizon, 10 to 18 cm thick, and a pale brown BC horizon. The depth of solum varies with the depth of the sandy strata; the lime accumulation (Cca) horizon usually occurs at the transition from sandy to coarser sediments. Miniota soils are less permeable and less droughty than the very similar coarser textured Wheatland and Dorset soils. The similar, finer textured Croyon soils are less droughty.

Neelin Series (NEI)

The Neelin series is the imperfectly drained, Gleyed Cumulic Regosol member of the Coulter Association, developed on deep, moderately calcareous, moderately fine to fine (CL, SiCL SCL to SiC, C) textured recent alluvial sediments. Neelin soils are frequently stratified with layers ranging in texture from very fine sand to clay. The topography is level to depressional, surface runoff is very slow, and permeability is slow. The depth to water table is estimated to be within 2 metres. Some of these soils are cultivated; others are still in their native state with vegetation consisting of Elm, Oak, Poplar, and various shrubs and grasses. Soluble salts may occur to a moderate degree in some of the Neelin soils. This soil usually consists of dark gray Ah horizons less than 20 cm thick, and light brownish gray, stratified and banded Ckg horizons.

Nikkel Series (NKK)

The Nikkel series consists of imperfectly drained Gleyed Black Chernozem soils developed on moderately to strongly calcareous deep, uniform, fine loamy and coarse loamy (L, CL, SiCL), mixed till deposits of granite, limestone and shale origin. These soils occur in lower slope positions of hummocky landscapes and have moderate permeability moderately slow surface runoff and a medium water table during the growing season. Nikkel soils are non-eroded, slightly stony and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for crop production.

In a representative profile the solum is approximately 45 cm thick. The profile is characterized by a black Ap or Ah horizon, 20 to 25 cm thick, a dark grayish brown Bmgj horizon, 5 to 15 cm thick with many, faint, fine iron mottles, a light gray Ccagj horizon, 5 to 10 cm thick of lime accumulation and a pale brown Ckgj horizon with many, fine, distinct iron mottles. The parent material is typically relatively stone-free.

Nikkel soils occur in close association with Darlingford, Ferris and Cazlake soils. They are similar to Ullrich soils by having Gleyed Black Chernozem profile and a fine-loamy till substrate but differ from them in not having 25 to 100 cm of lacustrine veneer overlying the till substrate. Nikkel soils were previously mapped as imperfectly drained Blackearth associates of the Pembina association in the reconnaissance soil survey of South-Central Manitoba.

Napinka Series (NPK)

The Napinka series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem member of the Bede Association, developed on deep, strongly calcareous, coarse textured (FS, LCoS, LS, LFS) gravelly deltaic, beach and outwash deposits. The topography varies from nearly level to gently sloping; permeability is rapid and surface runoff is slow. Drainage is imperfect due to seasonally high water tables estimated to be between 1 to 2 m during the growing season. Few of these soils are cultivated due to their low moisture holding capacity and low fertility. Many Napinka soils are used for pastures; however the carrying capacity for animals is low because of the poor growth of native grasses.

A typical profile consists of black Ahk horizons 13 to 20 cm thick, light gray Ccagj horizons 20 to 30 cm thick and light yellowish brown Ckgj horizons. Analytical and morphological data are presented below.

Apk - 0 to 13 cm, black (10YR 2/1 moist), dark gray (10YR 4/1 dry), medium sandy clay loam; friable, moist, abrupt smooth boundary; moderately calcareous; pH 7.9.
Ccagj - 13 to 15 cm, gray to light gray (10YR 6/1 moist), white (10YR 8/1 dry), sandy clay loam, friable when moist; clear wavy boundary: very strongly calcareous; pH 8.1.
II Ccagj - 15 to 23 cm, gray (10YR 6/1 moist), white (10YR 8/1 dry), gravelly coarse sandy clay loam, common mottles: friable, moist, very strongly calcareous; clear, wavy boundary; pH 8.1.
II Ckgj - 23 cm +, gravelly loamy very coarse sand; single grained, loose when moist, strongly calcareous: pH 8.0.

Ninette Series (NTT)

The Ninette series is the imperfectly drained Gleyed Black Chernozem member of the George Lake Association, developed on thin (25 to 100 cm), weakly to moderately calcareous, moderately coarse textured (VFS, LVFS, SL, FSL) lacustrine sediments overlying coarse textured (FS, LCoS, LFS) gravelly deltaic beach and outwash deposits. This soil has simple, very gently sloping topography, a fine sandy loam surface texture, moderately rapid permeability and very little surface runoff. The depth to water table is estimated at 1.5 m during the growing season. The surface is non-stony and cultivated. The profile consists of black Ap - Ahgj horizons 10 to 20 cm thick, usually with prominent iron staining and concretions, gleyed dark brown Bmgj horizons 5 to 8 cm thick, light gray Ccagj horizons 15 to 25 cm thick, may be present and gleyed light gray, coarse textured II Ckgj horizons. Analytical and morphological data are presented below.

Ahgj - 0 to 18 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry), sandy loam; weak fine to weak medium granular; friable when moist, soft when dry; clear smooth boundary; non-calcareous pH 7.2.
Bmgj - 18 to 41 cm, very dark grayish brown (10YR 3/2 moist), dark grayish brown to grayish brown (10YR 4.5/2 dry), sandy loam; medium coarse prismatic breaking to weak medium subangular blocky; friable when moist, soft when dry; clear smooth boundary; non- calcareous; few prominent brown (7.5YR 4/4) iron concretions; neutral; pH 7.6.
BC - 41 to 43 cm, dark brown (10YR 3.5/3 moist), sandy loam; pseudo fine granular; friable when moist; soft when dry; mildly alkaline; moderately calcareous; clear, smooth boundary.

Ccagj - 43 to 71 cm, very pale brown (10YR 7/3 moist), light gray (10YR 7/2 dry) sandy loam; pseudo fine granular; friable when moist, slightly hard when dry; strongly calcareous; clear, smooth boundary; pH 7.9.
II Ckgj - 71 cm +, light gray (10YR 7/1, moist & dry) sand; single grained; loose when moist and dry; moderately calcareous; pH 7.9.

Newstead Series (NWS)

The Newstead series is the well drained, Orthic Black Chernozem member of the Newstead Association, developed on thin (25 to 95 cm), strongly calcareous, medium textured lacustrine sediments overlying strongly calcareous, medium to moderately fine textured glacial till. A coarse textured layer (5 to 75 cm) occurs at the contact. Newstead soils commonly have loam to very fine sandy loam surface textures, gently sloping to very gently sloping topography; moderate permeability and slow surface runoff. The depth to water table is at about 3 metres during the growing season. These soils commonly occur in areas adjacent to the channels where outwash material deposited on the till is covered by finer textured alluvial and lacustrine material.

A typical profile has a black Ap horizon 5 to 13 cm thick, a very dark grayish brown Bm horizon 20 to 30 cm thick, very coarse textured pale brown II Ck horizon and a light yellowish brown III Ck horizon.

Oberon Series (OBR)

The Oberon series consists of imperfectly drained Gleyed Black Chernozem soils developed on a thin mantle (<1 m) of strongly calcareous clay loam to sandy clay loam sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. They occur on level to gently sloping topography. Runoff is moderate to moderately slow; permeability is moderate in the upper loamy strata and moderately rapid in the sandy subsoil when not restricted by a high water table in early spring or summer.

The soil is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a subangular blocky brown to olive brown Bmgj horizon, 12 to 22 cm thick with yellowish brown mottles in the lower part of the horizon; a BC horizon, 8 to 16 cm thick. Carbonate accumulation (Ccagj horizon) is usually present within the loamy strata. The sandy substrata are light yellowish brown with yellowish brown to strong brown mottles of iron.

Prodan Series (PDA)

The Prodan series is a Gleyed Rego Black Chernozem, carbonated soil developed on imperfectly drained, strongly to very strongly calcareous, moderately fine (SCL CL, SiCL), lacustrine sediments. These soils occur in the Upper Assiniboine Delta and Brandon Lakes Plain on gently sloping topography in association with Ramada, Charman, Carroll and Tadpole soils. Surface runoff is moderately slow, and permeability is moderate to moderately slow. A seasonal water table frequently occurs within 70 cm of the surface.

The Prodan soil profile has a very dark gray Ah horizon, 18 to 25 cm thick; a dark gray to gray AC horizon, 8 to 15 cm thick, and a Ccagj horizon. The Ckgj horizon is light brownish gray with yellowish brown mottles. This soil differs from the similar Charman series in not having a prominent Bmgj horizon. Prodan soils are finer textured and less permeable than the similar loamy textured Taggart and Torcan soils. The very similar Capell soils have coarse, sandy and gravelly textured subsoils that are very rapidly permeable. Prodan soils were previously mapped as Black Meadow associates of the Holland Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Pleasant Series (PLE)

The Pleasant series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform, moderately coarse (VFS, LVFS, FSL), lacustrine deposits. These soils occur in middle positions of irregular to undulating landscapes and have moderate permeability, moderately slow surface runoff, and a high water table during the growing season. Pleasant soils are non-eroded, non-stony, and frequently slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation

includes tall prairie grasses, prairie-meadow grasses, shrubs and aspen-oak groves. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark grayish brown AC horizon, 6 to 10 cm thick, a Ccagj horizon, 10 to 15 cm thick and a light olive brown Ckgj horizon, with yellowish brown mottles. A typical profile also contains gypsum crystals below the Cca horizon.

Pleasant soils occur in close association with Prosser, Gateside and Poolex soils. They are similar to Taggart soils by having an imperfectly drained Gleyed Rego Black Chernozem profile but differ from them in having coarse loamy rather than loamy deposits. Pleasant soils were previously mapped as Black Meadow associates of the Holland Association in the Carberry (1957) soil report.

Porple Series (POR)

The Porple series is a Rego Black Chernozem soil developed on moderately well to well drained, moderately to strongly calcareous, moderately coarse (VFS, LVFS, FSL, SL), lacustrine sediments. These soils occur on the upper slope positions of gently undulating topography associated with Prosser and Pleasant soils. Surface runoff is moderately rapid, and permeability is moderate to moderately rapid. These soils have had some erosion and susceptible to both wind or water erosion if not protected. Included with this series are some of the moderately eroded Prosser soils.

The Porple series is characterized by a very dark gray Ap and Ah horizon 15 to 20 cm thick and a calcareous AC horizon 8 to 15 cm thick. A layer of lime carbonate accumulation (Cca horizon) may be present. This soil differs from the similar Prosser soils in not having a prominent Bm horizon. Porple soils are finer textured and less permeable than the sandy Stockton soils, and in turn, are coarser textured and more permeable than the very similar loamy textured Durnan and Fairland soils.

Pipestone Series (PPT)

The Pipestone series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem member of the Pipestone Association, developed on deep (> 100 cm), weakly to moderately calcareous, fine textured (SC, SiC, C) lacustrine and alluvial sediments. These soils have nearly level topography, light clay surface texture, very slow permeability and slow surface runoff. This soil has an estimated depth to water table of 2 to 3 metres. These soils are usually cultivated and produce excellent crops. Weak to moderate salinity may be present in some areas.

Petrel Series (PTR)

The Petrel series consists of imperfectly drained Gleyed Black Chernozem soils developed on a mantle (25 to 75 cm) of moderately to strongly calcareous, shallow, medium textured (VFSL, L, SiL), deposits over moderately calcareous, uniform, deep, moderately coarse (FS, LFS, LS), lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Petrel soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes prairie grasses, shrubs, aspen and oak. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 40 cm thick. The profile is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a brown Bm horizon, 14 to 20 cm thick, a BCgj horizon, 20 to 30 cm thick with faint mottles and a light yellowish brown Ckgj horizon, with yellowish brown to strong brown mottles. A typical profile also contains a weak Cca in the upper part of the sandy substrate.

Petrel soils occur in close association with Glenboro, Grover and Grayson soils. They are similar to Torcan soils by having imperfect drainage and a loamy surface but differ from them in having a sandy substrate. Petrel soils were previously mapped as Black Meadow associates of the Glenboro Association in the Carberry (1957) soil report.

Ramada Series (RAM)

The Ramada series is an Orthic Black Chernozem soil developed on well to moderately well drained, strongly to very strongly calcareous, moderately fine (CL, SiCL), lacustrine sediments. These soils occur in the Upper Assiniboine Delta, and Brandon Lakes Plain on very gently sloping topography or on mid and upper slope positions of undulating topography associated with Barren, Carroll, Charman, Prodan and Tadpole soils. Surface runoff is moderately rapid, and permeability is moderate to moderately slow.

The Ramada soil profile has a very dark gray Ah horizon, 10 to 20 cm thick; a dark grayish brown to brown Bm horizon, 8 to 12 cm thick, and a BC horizon, 6 to 10 cm thick. A Cca horizon is usually present. The Ck horizon is pale brown to light yellowish brown. This soil differs slightly from the Carroll soil in having a prominent Bm horizon. Ramada soils are finer textured and less permeable than the similar coarser textured, loamy Fairland soils, as well as, the Croyon and Zarnet soils which have coarse sandy and gravelly textured subsurface layers and very rapid permeability. Ramada soils were previously mapped as the dominant associate of the Holland Association in the reconnaissance soil survey of South-Central Manitoba (1943).

Rebecca Series (RCC)

The Rebecca series is the poorly drained, saline, carbonated Rego Humic Gleysol member of the Whitewater Association, developed on deep (> 100 cm), strongly calcareous, moderately fine to fine textured (SCL, CL SiCL to SiC, C) saline lacustrine sediments. These soils occur primarily in the vicinity of Whitewater Lake. This soil has level to depressional topography, slow permeability and no surface runoff. The water table is within 1 metre of the surface during most of the growing season. The native vegetation consists of foxtail, sour dock, sow thistle, various species of salt tolerant slough grass and some species of ground moss. The subsoil may contain small stones but it is more common to find large gypsum rosettes at depths up to 5 metres. Some Rebecca soils are used for pasture, but it soon deteriorates with massive infestations of wild foxtail. Some are used for native hay production particularly around the west end of Whitewater Lake.

Rebecca soils are characterized by very dark gray Ahsg horizons, dark gray to gray ACg horizons and gray Cskg horizons. Some of these soils may have thin (5 to 13 cm) layers of light gray calcareous sandy material on the surface which are probably beach sand deposits resulting from water and wave erosion.

Regent Series (RGT)

The Regent series is the imperfectly drained, Gleyed Black Chernozem member of the Ryerson Association, developed on deep (> 100 cm) strongly calcareous, medium to moderately fine (VFSL, L, SiL, to CL, SiCL, SCL) textured glacial till. The till is composed of mixed materials derived from shale, limestone, and granitic rock. A thin overlay (< 25 cm) may occur on some soils. The topography is gently sloping, permeability is moderate, and surface runoff is slow. These soils occur in lower slope and depressional positions and are cultivated. Ryerson and Hazeldean soils are commonly found in close association with Regent soils. The depth to water table in Regent soils is estimated at approximately 2 metres during the growing season. These soils are occasionally weakly saline and sometimes have a few isolated stones on the surface.

A typical profile of the Regent series has a black Ap 10 to 15 cm thick, a very dark grayish brown Bmg 10 to 15 cm thick, a grayish brown to white Cca horizon 18 to 25 cm thick and a light olive brown Ck horizon. Analytical and morphological data are presented below.

Ap - 0 to 15 cm, black to very dark gray (10YR 2.5/1 moist), very dark gray to dark gray (10YR 3.5/1 dry), loam; massive; friable when moist; abrupt, smooth boundary; pH 6.3.
Bmgj - 15 to 28 cm, very dark grayish brown to dark brown (10YR 3/2.5 moist), dark yellowish brown to yellowish brown (10YR 4.5/4 dry), loam; moderate coarse to medium columnar breaking to moderate, fine subangular blocky; friable when moist; abrupt, smooth boundary; pH 6.5.

BCgj - 28 to 30 cm, dark brown (10YR 3/3 moist), yellowish brown to light yellowish brown (10YR 5.5/4 dry), loam; moderate, coarse to medium columnar breaking to moderate, fine subangular blocky; friable when moist; clear, irregular boundary; moderately calcareous; pH 6.3.
Ckgj - 30 cm +, yellowish brown (10YR 5/4 moist), very pale brown (10YR 7/3 dry), loam; massive; friable when moist; few, fine, faint iron mottles; strongly calcareous; pH 8.3.

Rempel Series (RMP)

The Rempel series consists of moderately well to well drained Calcareous Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, fine loamy (CL, SiCL), lacustrine deposits. These soils occur in upper positions of undulating landscapes and have moderate permeability, moderately rapid surface runoff, and a low water table during the growing season. Rempel soils are occasionally slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, meadow grasses and aspen-oak groves. The majority of these soils are cultivated for crop production.

In a representative profile, the Rempel soil has a weakly calcareous, very dark gray to very dark grayish brown Ah horizon, 15 to 22 cm thick, a dark grayish brown to brown Bmk horizon, 10 to 15 cm thick, a pale brown BC horizon, 5 to 10 cm thick, moderately calcareous and a light gray to white Cca horizon, 10 to 15 cm thick. Rempel soils occur in close association with Ramada, Prodan and Tadpole soils. They are similar to Ramada soils by having well drained, fine loamy soils but differ from them in having a Bmk rather than Bm horizon. Rempel soils were previously mapped as Blackearth associate of the Holland Association in the Carberry (1957) soil report.

Roseisle Series (RSI)

Roseisle series are well drained, Orthic Black Chernozem soils that have developed on thin medium textured (VFSL, L) lacustrine sediments overlying stony, moderately to strongly calcareous, medium to moderately fine textured water-worked glacial till. Shale bedrock may occur below the till at 1 to 1.5 metres. Depth of the lacustrine mantle over the till is variable ranging from 25 to 100 cm in thickness; a thin (<10 cm) gravelly or cobbly lens usually occurs at this contact. Topography is smooth, gently sloping, dipping very gently eastward in a series of wave-washed terraces formed during the recession of glacial Lake Agassiz. Runoff is moderate; internal drainage is moderately rapid to the contact of the medium textured compacted till where it is moderately slow.

Roseisle soil profiles are characterized by very dark gray to black, granular Ah horizons, friable and neutral in reaction overlying a dark grayish brown, granular Bm horizon that is also friable and neutral to mildly alkaline in reaction. The B horizon often terminates at the gravelly to stony contact of the underlying glacial till. The pale brown granular-like C horizon usually occurs in the till deposit below the sandy mantle, but occasionally occurs within the sandy layer.

Ryerson Series (RYS)

The Ryerson series is the well drained, Orthic Black Chernozem member of the Ryerson Association, developed on deep (> 100 cm), strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to CL, SiCL, SCL) glacial till. Coarse fragments in the till are composed of shale, limestone, and granite rocks. The surface 25 cm may have a variable texture although the most common textures range from loam to clay loam. These soils are found in the upper and mid slope of undulating to gently rolling topography. This soil has moderate permeability and moderate surface runoff. In some areas it is slightly to moderately stony. The depth to water table is estimated at 3 to 4 metres during the growing season.

Ryerson profiles are generally thin with the entire Ah and occasionally the upper part of the Bm horizon incorporated into the Ap horizon. The Ap horizon, therefore, tends to be dark gray in color. The Bm horizon is quite variable in thickness ranging from 10 to 30 cm depending on the topography and amount of mechanical disturbance. The Bm horizons are characterized by moderate, fine prismatic to weak, moderate, medium granular structure and a dark grayish brown color. A light gray Cca horizon,

20 to 30 cm thick, commonly occurs below the Bm horizon. The pale brown to yellowish brown Ckgj horizon may contain weak concentrations of soluble salts, lime carbonates, and prominent iron mottles and concretions.

Scarth Series (SCH)

The Scarth series is the well drained, Rego Black Chernozem member of the Souris Association, developed on deep (> 100 cm), weakly to moderately calcareous, coarse textured (FS, LCoS, LFS) lacustrine sediments. This soil has a fine sand to loamy fine sand surface texture, gently undulating topography, moderate permeability, slow surface runoff and moderately good drainage. The depth to water table is estimated at 2 to 3 metres during the growing season. Most of these soils are cultivated.

Stockton Series (SCK)

The Stockton series is an Orthic Black Chernozem soil developed on moderately well to well drained, weakly to moderately calcareous, coarse textured (FS, LFS, LS), lacustrine sediments. These soils occur in the Upper Assiniboine Delta, the Brandon Lakes Plain and a few areas within the Lower Assiniboine Delta on very gently sloping to irregular undulating topography in association with Cactus, Lavenham, Hummerston and Sewell soils. Surface runoff is low, and permeability is rapid. Wind erosion is common if the soil is not protected with adequate surface residue.

The Stockton soil profile has a very dark gray to very dark grayish brown Ah, 18 to 25 cm thick; a brown to grayish brown Bm horizon, 12 to 22 cm thick; a pale brown to light yellowish brown BC horizon, 8 to 12 cm thick, and a very pale brown Ck horizon with a few yellowish brown mottles at approximately 70 cm depth. A Cca horizon is also frequently present. This soil differs from the very similar Cactus series by having a prominent Bm horizon. The sandy Stockton soils are coarser textured and significantly more rapidly permeable than the finer textured Prosser, Fairland and Ramada soils.

Sewell Series (SEE)

The Sewell series consists of poorly drained Rego Humic Gleysol soils developed on weakly to moderately calcareous, deep, uniform, coarse (FS, LS, LFS) lacustrine deposits. These soils occur in depressional positions of gentle slopes on hummocky landscapes and have moderately rapid permeability, very slow surface runoff, and a high to ponded water table during the growing season. Sewell soils are non-eroded, non-stony, and often slightly saline. They have a low available water holding capacity, high organic matter content, and low natural fertility. 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 approximately 15 cm thick. The profile is characterized by moderately decomposed organic horizon, 2 to 5 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray to gray ACg horizon, 10 to 15 cm thick with carbonates and mottles, and usually a Ccag horizon, 5 to 8 cm thick. A typical profile also contains an olive to pale olive Ckg horizon with yellowish brown mottles and manganese concretions.

Sewell soils occur in close association with Stockton, Lavenham and Hummerston soils. They are similar to Osterwick soils by having poor drainage and a Rego Humic Gleysol profile but differ from them in having sandy rather than coarse loamy deposits. Sewell soils were previously mapped as Meadow associates of the Stockton Association in the Carberry (1957) soil report.

Schaffner Series (SFR)

The Schaffner series is the well drained, Calcareous Black Chernozem member of the Cameron Association, developed on deep, strongly calcareous, medium textured (VFSL, L, SiL) lacustrine deposits. This soil has simple smooth topography, moderately good drainage, a fine sandy loam to loam surface texture, moderately slow permeability and slow surface runoff. The depth to water table is estimated at 2 to 3 metres and the subsoil may occasionally be weakly saline. Under cultivation, the upper part of the B horizon is usually incorporated into a very dark gray brown Ap horizon 10 to 15 cm thick. The weakly calcareous, dark grayish brown Bmk horizon generally has weak granular structure

and is 10 to 15 cm thick; a grayish brown BC horizon, 5 to 13 cm thick and a stratified light yellowish brown to pale olive brown Ck horizon occur below.

Sigmund Series (SGO)

The Sigmund series consists of imperfectly drained, Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform clayey (SiC, C), lacustrine deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have slow permeability, moderately slow surface runoff, and a high water table during the growing season. Sigmund soils are non-eroded, non-stony, and frequently slightly saline. They have a high available water holding capacity, medium organic matter content, and medium natural fertility. The majority of these soils are currently annual crop production.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark gray ACgj horizon, 5 to 18 cm thick with many faint mottles, a light gray Ccagj horizon, 5 to 15 cm thick with many prominent mottles and a light olive brown Ckgj horizon, with many prominent mottles. A typical profile also contains gypsum crystals in the subsoil.

Sigmund soils occur in close association with Janick, Harding and Lowton soils. They are similar to Harding soils by having an imperfectly drained profile in clayey deposits but differ from them by having no B horizon. Sigmund soils were previously mapped as minor inclusions of the Oliver Association in the soil survey of South-Central Manitoba (1943).

Stanton Series (STU)

The Stanton series is the well drained, Orthic Black Chernozem member of the Souris Association, developed on deep (> 1 m), weakly to moderately calcareous, sandy lacustrine sediments. This soil has a fine sand to loamy fine sand surface texture, complex undulating topography, good internal drainage, rapid permeability and low surface runoff. The depth to water table is estimated to be 3 m during the growing season. These soils are susceptible to wind erosion.

Stanton soils usually have deep profiles consisting of black Ap horizons, 10 to 15 cm thick, very dark gray Ah horizons, 20 to 25 cm thick, dark brown to brown Bm horizons 25 to 50 cm thick, and stratified grayish brown Ck horizons. Stanton is equivalent to the Stockton soils in climatic subregion Gt2.

Switzer Series (SWZ)

The Switzer series is the imperfectly drained, carbonated Gleyed Rego Black Chernozem member of the Lyleton Association, developed on deep, moderately calcareous, moderately coarse (LVFS, FSL, VFS) lacustrine deposits. This soil has a very fine sandy loam surface texture, complex gently undulating topography, imperfect drainage, moderate permeability, and no surface runoff. The depth to groundwater during the growing season is estimated at less than 2 m.

The soil profile consists of black Apk horizons, 12 to 15 cm thick, dark gray ACgj horizons, 12 to 15 cm thick, gleyed gray Ccagj horizons, 12 to 15 cm thick, and stratified gleyed Ckgj horizons.

Sutton Series (SXP)

The Sutton series consists of poorly drained Rego Humic Gleysol soils developed on a mantle (25 to 100 cm) of moderately calcareous, moderately fine (CL, SiCL), lacustrine deposits over moderately calcareous, deep, stratified, sandy (FS, LFS, LS), fluvial lacustrine deposits. These soils occur in depressional positions on nearly level landscapes and have restricted permeability, negligible surface runoff, and a near surface water table during the growing season. Sutton soils are non-eroded, non-stony, and frequently weakly saline. They have a moderate available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, hydrophytic grasses and willows. The majority of these soils are currently in native vegetation.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a moderately decomposed organic horizon, 2 to 4 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick,

a dark gray ACg horizon, 4 to 8 cm thick with carbonates and a light gray Ccag horizon, 5 to 8 cm thick with many distinct mottles. The parent material is typically olive brown in colour with many prominent mottles. A typical profile also contains gypsum crystals at depth.

Sutton soils occur in close association with Wellwood soils. They are similar to Tadpole soils by having a poorly drained profile and a fine loamy surface but differ by having a sandy substrate while Tadpole soils are fine loamy throughout. Sutton soils were previously mapped as poorly drained associates of the Wellwood Association in the soil survey of South-Central Manitoba (1943).

Tadpole Series (TDP)

The Tadpole series is a Rego Humic Gleysol, developed on poorly drained, strongly to very strongly calcareous, moderately fine (CL, SiCL), lacustrine sediments. These soils occur in level to depressional positions of gently sloping to undulating topography in association with Carroll, Firdale, Charman and Danlin soils. Surface runoff is very slow and permeability is restricted. Free water occurs at or near the surface for a considerable part of the year. In areas where seepage water contains appreciable soluble salt; a sufficient salt accumulation can occur to inhibit or retard the growth of normal hydrophytic vegetation.

The Tadpole soil profile has a moderately decomposed organic layer, 2 to 6 cm thick; a very dark gray Ah horizon, 10 to 18 cm thick; a dark gray AC horizon, 4 to 6 cm thick; a Ccag horizon, 10 to 15 cm thick, and an olive to olive gray Ckg horizon with distinct yellowish brown mottles. In areas affected by salts, white pseudomycelia are common in the surface horizons. Tadpole soils are finer textured and less permeable than the very similar and coarser textured Vordas, Poolex and sandy Mockry and Sewell soils. The similar Carvey soils have coarser textured sandy to gravelly subsurface layers that are much more rapidly permeable than the Tadpole soils.

Taggart Series (TGR)

The Taggart series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in middle positions of undulating landscapes and have moderate permeability, slow surface runoff, and a high water table during the growing season. Taggart soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes aspen, oak, willow and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 24 cm thick, a dark gray AC horizon, 5 to 15 cm thick, moderately calcareous, a Ccagj horizon, 8 to 12 cm thick with a carbonate accumulation and an olive brown Ckgj horizon, with yellowish brown mottles. A typical profile also contains gypsum crystals below the Cca horizon.

Taggart soils occur in close association with Fairland, Durnan and Vordas soils. They are similar to Torcan soils by having imperfect drainage and loamy deposits but differ from them by having no prominent Bm horizon. Taggart soils were previously mapped as associates of the Holland Association in the Carberry (1957) soil report.

Torcan Series (TOC)

The Torcan series consists of imperfectly drained Gleyed Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in middle to lower positions of undulating to rolling landscapes and have moderate permeability, moderately slow surface runoff, and a medium water table during the growing season. Torcan soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes aspen, willow, shrubs and meadow grasses. The majority of these soils are cultivated for crop production.

In a representative profile the solum is approximately 45 cm thick. The profile is characterized by a very dark gray Ah horizon 18 to 25 cm thick, a light brown Bmgj horizon, 10 to 18 cm thick with yellowish brown mottles, a Ccagj horizon, 8 to 12 cm thick, and a light olive brown Ckgj horizon, with yellowish brown mottles. Torcan soils occur in close association with Fairland, Taggart and Vordas soils. They are similar to Taggart soils by having imperfect drainage and loamy deposits but differ from them by having a prominent Bm horizon. Torcan soils were previously mapped as associates of the Holland Association in the Carberry (1957) soil report.

Turtlehead Series (TUA)

The Turtlehead series is the Gleyed Black Chernozem member of the Bernice Association, developed on thin (25 to 100 cm), moderately to strongly calcareous, very coarse textured (VCoS, CoS, S) gravelly deltaic beach and outwash deposits overlying strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to SCL, CL, SiCL) glacial till. This soil is imperfectly drained and occurs in areas adjacent to outwash deposits and stream channels mainly. The surface material has rapid permeability but the less permeable till restricts downward drainage. Surface runoff is slow; most of the water infiltrates the profile where the flow of water is horizontal lateral across the top of the underlying till. These soils are used mainly for pasture.

The Turtlehead series resembles the Cartwright series of the Bede Association. The only difference is the Turtlehead series is underlain by glacial till.

Two Creeks (TWC)

The Two Creeks series is the imperfectly drained, Gleyed Black Chernozem member of the Waskada Association. It is developed on thin (25 to 100 cm), strongly calcareous, medium textured discontinuous eolian and lacustrine sediments overlying strongly calcareous, medium to moderately fine textured glacial till. A very thin (less than 5 cm), gravelly pebble line may occur at the contact. This soil has complex, very gently sloping topography, a very fine sandy loam to loam surface texture, moderately slow permeability and slow surface runoff. The estimated depth to water table is 2 to 3 metres during the growing season. These soils are usually cultivated.

A typical profile has a very dark gray Ap horizon, 8 to 15 cm thick, a dark grayish brown Bmgj horizon, 13 to 18 cm thick, a gleyed light gray Cca horizon, 8 to 15 cm thick and light olive brown II Ckgj horizon.

Underhill Series (UHL)

The Underhill series is the imperfectly drained, Gleyed Black Chernozem member of the Cameron Association, developed on deep, strongly calcareous, medium textured stratified lacustrine sediments. This soil has smooth, very gently sloping topography, a loam to fine sandy loam surface texture, moderate permeability and moderately slow surface runoff. The estimated depth to water table during the growing season is 1.5 metres. The surface soil is cultivated and non-stony although small pebbles may be present.

A typical profile has a black Ap horizon, 5 to 13 cm thick, a black Ah horizon, 10 to 18 cm thick, sometimes a very thin, very dark brown AB horizon, 2 to 5 cm thick, a very dark grayish brown Bmgj horizon, 10 to 18 cm thick which may have weak lime carbonates present in the lower portion. The parent material is usually stratified light yellowish brown to light brownish gray in color. Analytical and morphological data are presented below.

Ap - 0 to 13 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry), loam; weak, fine granular; friable when moist; soft when dry; abrupt, smooth boundary; pH 6.1.
Ah - 13 to 30 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry), loam; moderate, fine to medium granular; friable when moist; soft when dry; clear, smooth boundary; pH 6.5.
AB - 30 to 36 cm, very dark brown (10YR 2/2 moist), very dark grayish brown (10YR 3/2 dry), loam; moderate, fine to medium granular; friable when moist; soft when dry; clear, smooth boundary.

Bmkgj - 36 to 51 cm, very dark grayish brown (10YR 3/2 moist), brown (10YR 4/3 dry), loam; few, fine, faint dark reddish brown (5YR 3/4) iron mottles; weak, medium prismatic to moderate, medium subangular blocky; friable when moist; slightly hard when dry; clear, smooth boundary; pH 7.3.
BCgj - 51 to 56 cm, very dark grayish brown (10YR 3/2 moist), brown (10YR 4/3 dry) few, fine, faint dark yellowish brown to yellowish brown (10YR 4/4 to 5/6) iron mottles; loam; weak, fine granular; friable when moist; soft when dry; clear, smooth boundary; moderately calcareous; pH 7.5.
Ckgj1- 56 to 69 cm, dark grayish brown to grayish brown (10YR 4/2 to 5/2 moist), light brownish gray (10YR 6/2 dry), loam; few, fine, faint yellowish brown (10YR 5/6) iron mottles; weak, fine granular; friable when moist; slightly hard when dry; smooth, clear boundary; moderately calcareous; pH 7.6.
Ckgj2 - 69 to 100 cm, yellowish brown (10YR 5/4 to 5/6 moist), light yellowish brown (10YR 6/4 dry), loam; common, fine, faint yellowish brown (10YR 5/6) iron mottles; weak, fine granular; friable when moist; soft when dry; clear, smooth boundary; moderately calcareous; pH 7.5.

Ullrich Series (ULH)

The Ullrich series consists of imperfectly drained Gleyed Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to a strongly calcareous, uniform, fine loamy (L, CL, SiCL), lacustrine deposits over moderately to strongly calcareous, deep, uniform, fine loamy (L, CL, SiCL), mixed till deposits. These soils occur in middle to lower slope positions of undulating landscapes and have moderate permeability, moderately slow surface runoff and a medium water table during the growing season. Ullrich soils have medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie grasses interspersed by aspen-oak groves. The majority of these soils are currently used for crop production.

In a representative profile the solum is approximately 35 cm thick. The profile is characterized by black to very dark gray Ap or Ah horizon, 10 to 20 cm thick, a very dark brown Bmgj horizon, 10 to 20 cm thick with fine, faint iron mottles, a transitional dark brown II BCgj horizon, 5 to 10 cm thick and a grayish brown II Ckgj horizon with distinct, iron mottles.

Ullrich soils occur in close association with Knudson, Joyale and Guerra soils. They are similar to Nikkel soils by having an imperfectly drained Gleyed Black Chernozem profile and a fine loamy till substrate. However, they differ from Nikkel soils by having a loamy textured lacustrine mantle overlying glacial till. Ullrich soils were previously mapped as imperfectly drained associates of the Altamont association in the reconnaissance soil survey of South-Central Manitoba (1943).

Vordas Series (VDS)

The Vordas series consists of poorly drained Rego Humic Gleysol soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, SiL, L), lacustrine deposits. These soils occur in level to depressional positions of undulating landscapes and have moderate permeability, very slow surface runoff, and a high to ponded water table during the growing season. Vordas soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, high organic matter content, and low natural fertility. 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 approximately 15 cm thick. The profile is characterized by a moderately decomposed organic horizon, 2 to 5 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray ACg horizon, 4 to 6 cm thick with carbonates and mottles, and an olive to pale olive Ckg horizon, with yellowish brown iron mottles. A typical profile also contains white pseudomycelia of salt in the Ah and AC horizons in saline areas.

Vordas soils occur in close association with Fairland, Taggart and Torcan soils. They are similar to Tadpole soils by having poor drainage and loamy deposits but differ from them by having slightly coarser textures. Vordas soils were previously mapped as Meadow associates of the Holland Association in the Carberry (1957) soil report.

Villette Series (VLT)

The Villette series, a poorly drained, Orthic Humic Gleysol member of the Waskada Association, is developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL), discontinuous eolian and lacustrine sediments overlying strongly calcareous, medium to moderately fine (VFSL, L, SiL to SCL, CL, SiCL) textured glacial till. A very thin (less than 5 cm) gravelly stratum or pebble line may occur at the contact. This soil has a very fine sandy loam to loam surface texture, nearly level to depressional topography, slow permeability and no surface runoff. These poorly drained soils occur in enclosed depressions. They are very susceptible to flooding and ponding in the early spring and after heavy summer rains. The native vegetation usually consists of hydrophytic vegetation such as slough grasses. These soils are not cultivated.

William Series (WIL)

The William series is the poorly drained, carbonated Rego Humic Gleysol member of the Dromore Association, developed on thin (25 to 100 cm), strongly calcareous, medium textured (VFSL, L, SiL) lacustrine sediments overlying coarse textured (FS, LCoS, LS, LFS) gravelly deltaic beach and outwash deposits. This soil has nearly level to depressional topography, a fine sandy loam surface texture and commonly occurs in depressions and stream channels. Permeability is moderate and surface runoff is moderate. The ground water level usually occurs within 1 metre of the surface. These soils are used mainly for pasture.

Whitewater Series (WIW)

The Whitewater series is the imperfectly drained, saline, Gleyed Rego Black Chernozem member of the Whitewater Association. It is developed on deep (> 100 cm), strongly calcareous, moderately fine to fine textured, stratified, moderately saline lacustrine sediments. Whitewater soils have a clay loam to clay surface texture, nearly level topography, slow permeability and slow surface runoff. The depth to water table ranges from 1 to 2 metres. These soils are moderately saline as is evident by the abundance of white salt crystals in the form of pseudo-mycelia in the profile. Some of these soils are cultivated but crop growth and yield are severely reduced. Analytical and morphological data for a representative profile are presented below.

Apkgj - 0 to 15 cm, black (10YR 2/1 moist), silty clay; massive, firm when moist; abrupt, smooth boundary; weakly calcareous; pH 8.1.
Ahksgj - 15 to 35 cm, black (10YR 2/1 moist), silty clay; amorphous; slightly sticky when wet; gradual, irregular boundary; weakly calcareous; pH 8.0.
II AC - 35 to 64 cm, very dark gray (10YR 3/1 moist), silty loam; amorphous; slightly sticky when wet; gradual, irregular boundary; moderately calcareous; weakly saline; pH 8.2.
II Cskg - 64 +, light brownish gray to light gray (2.5Y 6.5/2 moist), silty clay loam; amorphous; slightly sticky when wet; moderately calcareous; moderately saline; pH 8.7.

Waskada Series (WKD)

The Waskada series is the well drained, Orthic Black Chernozem member of the Waskada Association and is developed on thin (<1 m), strongly calcareous, medium textured (VFSL, L, SiL) lacustrine sediments overlying strongly calcareous, loamy glacial till. A very thin (< 5 cm), gravelly pebble line may occur at the contact. These soils have complex, gently sloping topography, moderately good drainage, loam surface texture, moderate permeability and moderate surface runoff. The depth to water table is approximately 3 m during the growing season. Most of these soils are cultivated for crop production. Waskada soils usually occur in intermediate and upper slope positions. The knolls are sometimes slightly to moderately eroded. The Waskada series resembles the Cameron series of the Cameron Association. The only difference is the Waskada series is underlain by glacial till. The presence of few stones in the till makes it difficult to determine the depth of overlay.

A typical profile has very dark gray Ap horizons 10 to 15 cm thick, dark brown Bm horizons, 12 to 15 cm thick; sometimes a brown BC horizon occurs above the pale brown II Ck horizon. Analytical and morphological data are presented below.

Ap - 0 to 18 cm, very dark grayish brown (10YR 2.5/2 moist), very dark gray (10YR 3/1 dry) loam; weak, fine to medium granular; friable when moist; slightly hard when dry; abrupt, smooth boundary; pH 7.1.
Bm - 18 to 33 cm, dark brown (7.5YR 3.5/2 moist), brown (7.5YR 4.5/2 dry) loam; weak, coarse prismatic breaking to moderate, medium sub-angular blocky; friable when moist; slightly hard when dry; clear, smooth boundary; pH 7.1.
BC - 33 to 43 cm, brown (10YR 4.5/3 moist), brown (10YR 5/3 dry), silt loam; moderate, medium subangular blocky; friable when moist; hard when dry; clear, smooth boundary; moderately calcareous; pH 7.5.
II Cca - 43 to 66 cm, pale brown (10YR 6/3 moist), light gray (10YR 7/2 dry), loam till; moderate, medium granular breaking to weak, fine granular; friable when moist; hard when dry; clear, smooth boundary; strongly calcareous; pH 8.1.
II Ck - 66 cm +, grayish brown to light brownish gray (10YR 5/2 to 6/2 moist), light brownish gray to light gray (10YR 6/2 to 7/2 dry), loam till; pseudo, weak fine granular; firm when moist; hard when dry; strongly calcareous; pH 8.0.

Wassewa Series (WSW)

The Wassewa series is the poorly drained, carbonated Rego Humic Gleysol member of the Croll Association, developed on thin (25 to 100 cm), strongly calcareous, moderately fine textured (SCL, CL, SiCL), discontinuous lacustrine sediments overlying strongly calcareous, medium to moderately fine textured (VFSL, L, SiL to SCL, CL, SiCL) glacial till. A very thin (less than 5 cm), gravelly stratum may occur at the till contact. This soil has depressional topography, silty clay loam to clay loam surface texture; no surface runoff and very slow permeability. The depth to water table is estimated at less than 1 metre during the growing season. Under dry conditions these soils may be cultivated, but due to frequent flooding and surface ponding, they rarely produce a crop. In some instances, these soils may be weakly saline.

This soil has a black Ahk horizon, 10 to 25 cm thick, and a dark olive gray Ck horizon. A thin black Ap horizon may be present in some soils. A typical profile description is given below.

Apk - 0 to 15 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry) clay loam; weak, fine sub-angular blocky; slightly stick when wet; slightly hard when dry; abrupt smooth boundary; weakly calcareous.
Ahkg - 15 to 25 cm, black (10YR 2/1 moist), very dark gray (10YR 3/1 dry) clay loam; amorphous; slightly sticky when wet; slightly hard when dry; clear, irregular boundary; moderately calcareous.
Ckg -25 cm +, dark olive gray (5Y 3/2 moist), olive gray (5Y4/2 dry), clay loam; amorphous; slightly sticky when wet; very hard when dry; strongly calcareous.

Wawanesa Series (WWS)

The Wawanesa series is the imperfectly drained, carbonated, Gleyed Rego Black Chernozem member of the Wawanesa Association and is developed on thin (25 to 100 cm), moderately to strongly calcareous, medium textured (VFSL, L, SiL) lacustrine sediments overlying strongly calcareous, coarse textured (FS, LCoS, LFS) lacustrine deposits. This soil has a silt loam to loam surface texture, gently undulating topography, moderate permeability and slow surface runoff. The depth to water table is estimated at between 1 and 2 metres during the growing season. The proximity of the sandy subsoil causes the surface soil to remain saturated for longer periods, after rains than would normally be expected from this type of soil. The majority of these soils are cultivated.

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