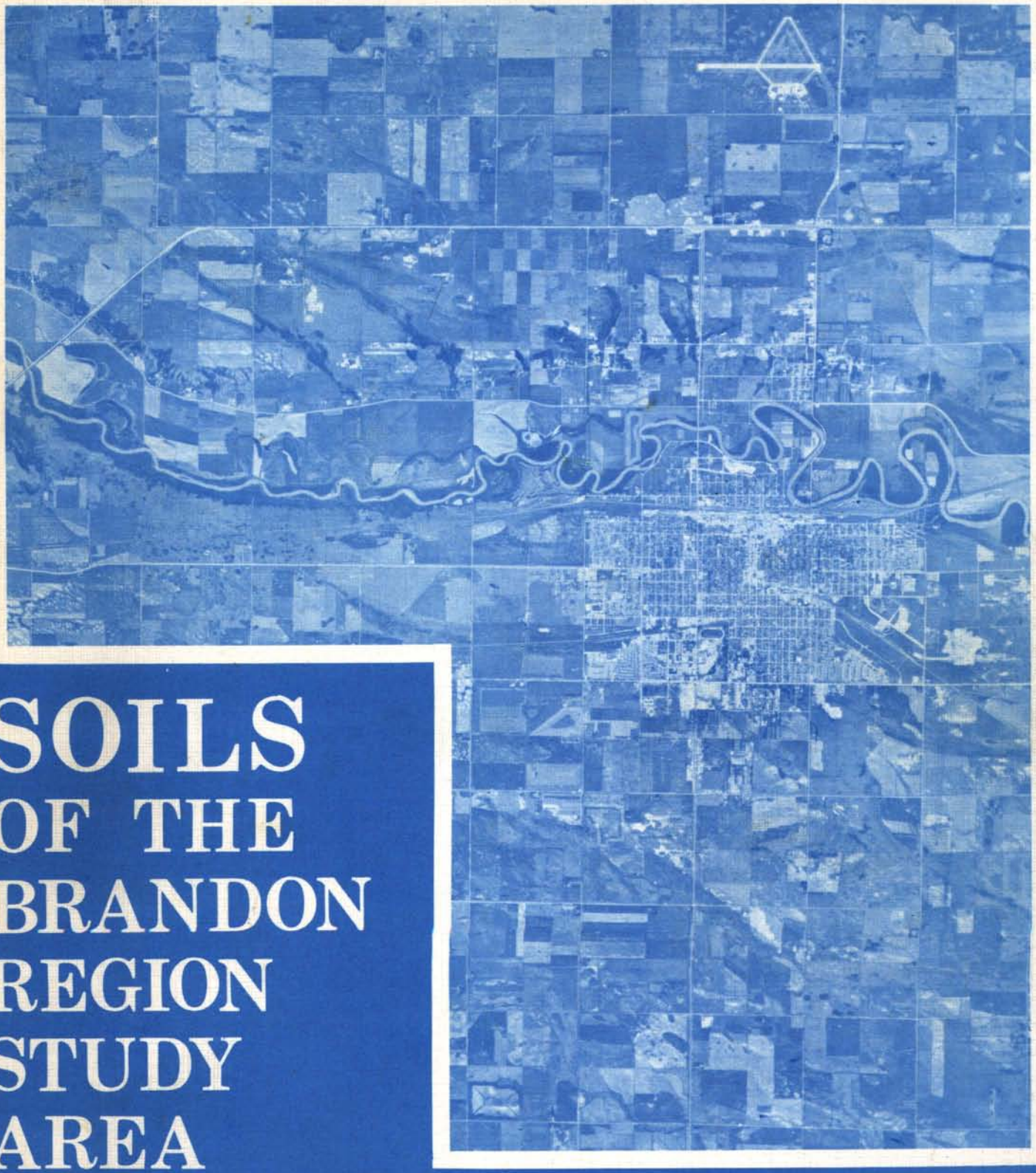
SHIELDS



SOILS OF THE BRANDON REGION STUDY AREA

prepared by:
Canada-Manitoba Soil Survey
prepared for:
Manitoba-Department of Municipal Affairs
Municipal Planning Branch

1976

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of the
BRANDON REGION STUDY AREA

Prepared by:

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PREFACE

A field and laboratory study of soils in selected areas of the Brandon Region was initiated in the spring of 1975. The soils were mapped and classified according to the System of Soil Classification for Canada, but additional soil data were collected so that the information could readily be interpreted for various land use, urban planning, and engineering uses. The results of this study are presented in this report.

This report contains information on the soils that can be applied to land use and land evaluation, farm management, evaluating the engineering properties of soils for building material and construction sites, selecting sites for roads, buildings, urban development, and recreation.

All of the soils are shown on the detailed map following the written report. This map consists of many sheets that are prepared from aerial photographs. On each sheet of the detailed map, soil areas are outlined and identified by symbol. All areas marked with the same symbol represent the same kind of soil with similar properties.

Individual colored maps showing the relative suitability or limitation for many specific purposes can be developed by using the soil map and information in the text.

Interpretations not included in the text can be developed by grouping the soils according to their limitation for a particular use.

ACKNOWLEDGMENTS

The report of the Soils of the Brandon Region Study Area was conducted as a joint project of the Research Branch, Canada Department of Agriculture, Manitoba Department of Agriculture, Manitoba Department of Mines, Resources and Environmental Management, and the Soil Science Department, University of Manitoba in support of a request from the Municipal Planning Branch.

Grateful acknowledgement is made to the following persons and agencies:

Mr. J. Friesen of the Municipal Planning Branch who served as the liaison officer during the course of this project.

Mr. L. Gray, Senior Groundwater Geologist of the Water Resources Branch who provided drill log information from which the static level and stratigraphic maps were compiled.

The soils were mapped by Wm. Gardiner, D. Holmstrom, G. Podolsky, E. St. Jacques and B. Zarn under the direction of Dr. W. Michalyna. Those assisting in the mapping were C. Agluglub, R. Gendzelevich, Gregg Podolsky, V. Shirtliffe and C. Wood.

Laboratory analyses were conducted by E. St. Jacques, R. Mirza, J. Madden, and V. Feld under the supervision of P. Haluschak.

Preparation of map manuscripts and sketches were compiled by R. DePape and J. Griffiths.

Miss B.E. Stupak assisted in the recording of the field and laboratory data and in preparation of the report.

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PART I

GENERAL DESCRIPTION OF THE AREA

LOCATION AND EXTENT

The Brandon Region study area is shown in relation to other published soil information in Figure 1. The study area covers a selected area of 181,000 acres situated within a twenty mile radius of the City of Brandon and a small area around Neepawa and Carberry (Figure 2). The designated area includes those lands where more detailed information on the land resource is required for future planning needs of the Municipal Planning Branch, Province of Manitoba and the Municipalities of Cornwallis, Daly, Elton, Oakland, North Cypress, Whitehead adjacent to the City of Brandon, and Langford, Rosedale adjacent to the town of Neepawa.

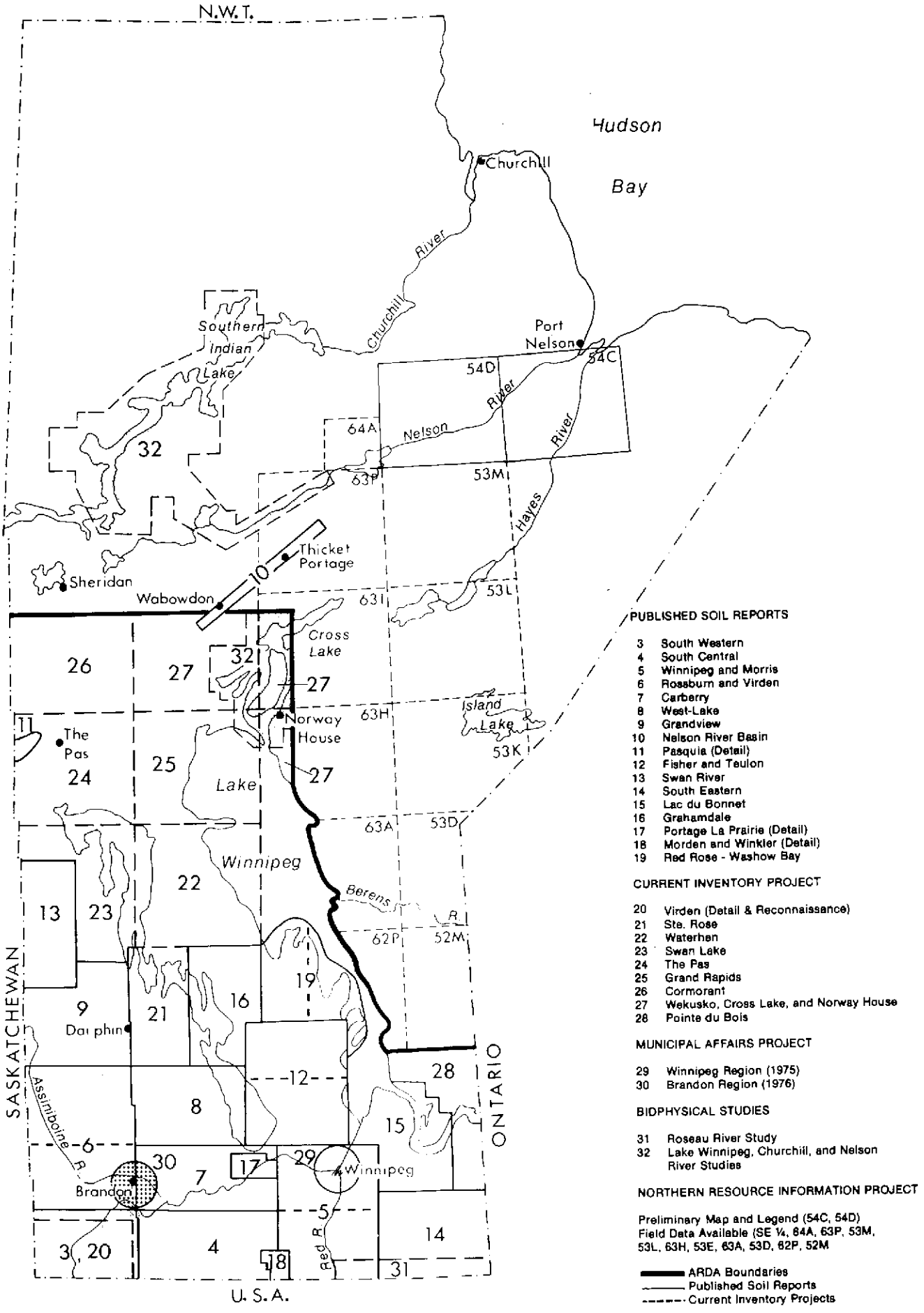


FIGURE 1. Soil Map Area of Manitoba.

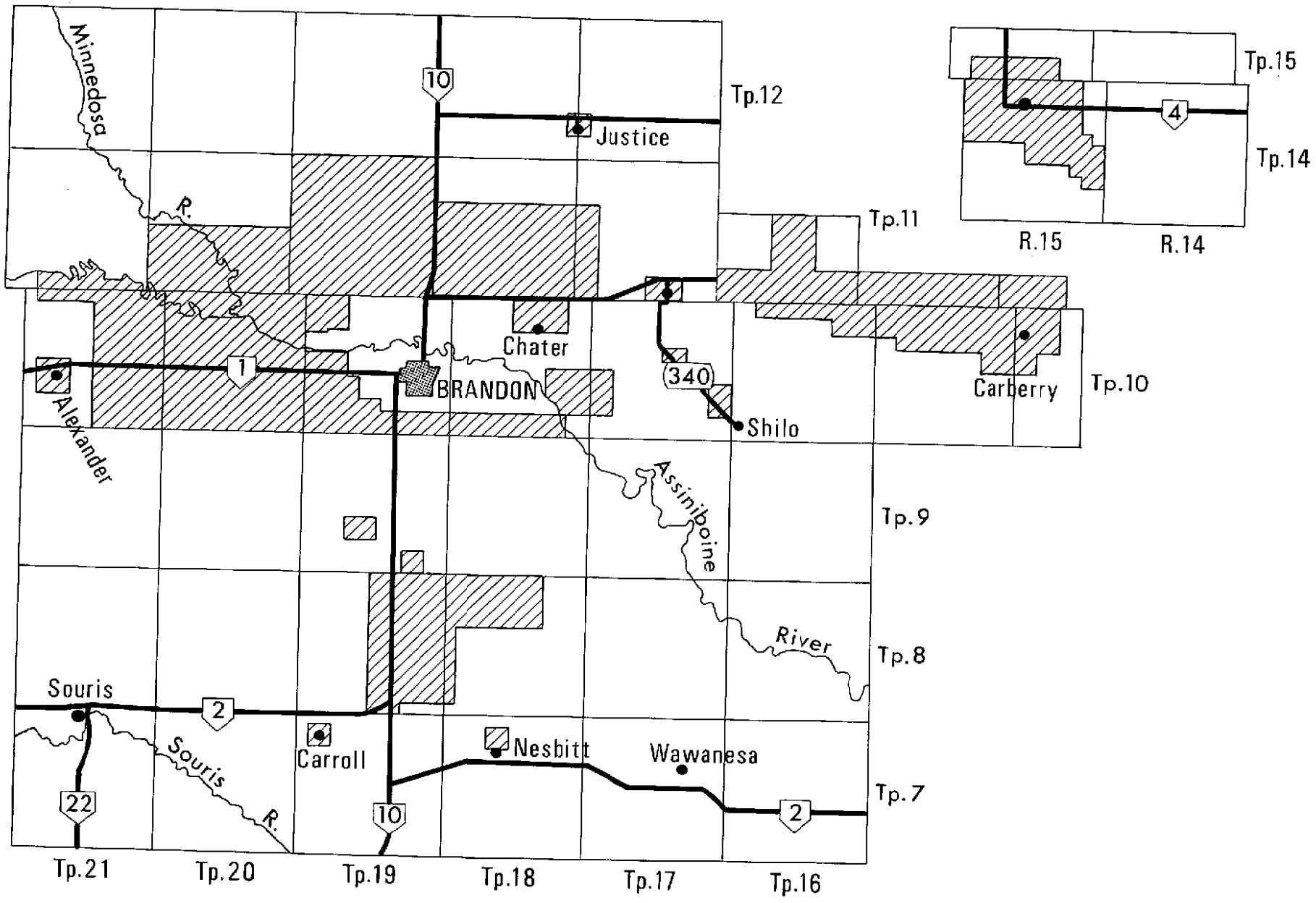


FIGURE 2. Map of the Soil Study Area in the Brandon Region.

PART II

FACTORS AFFECTING SOIL FORMATION

GEOLOGY AND PARENT MATERIALS

A. Geology of Underlying Rocks

The surface deposits of the Brandon Region study area are entirely underlain by bedrock formations of the Mesozoic era. A further subdivision of the rock types will place them in the Cretaceous period of geologic time. The dominant underlying rocks are the shales of the Riding Mountain Formation. These shales exist most extensively in the Brandon study area. The Neepawa portion of the study area is underlain by rocks and sediments of the Vermilion River formation, the Favel formation and the Ashville formation. Shale, limestone, bentonite and minor amounts of sand and silt are present in these three formations.

The eastern portion of the Carberry area is underlain by rocks and sediments of the Vermilion River formation. Shale and bentonite are present in this formation. The western side is underlain by rocks and sediments of the Riding Mountain formation. The approximate location of the contacts; between the formations with the overlying surface deposits, for the Brandon Region study is illustrated in Figure 3.

B. Surficial Geology and Physical Features

The surface deposits of the Brandon Region are quite varied due to the effects of glacier action and subsequent deposition. These unconsolidated materials are composed of rock fragments derived from the bedrock formations through the action of continental ice sheets and glacial melt waters which covered Manitoba during the Pleistocene Epoch. These ice sheets plucked and transported large quantities of material from the bedrock as they passed. As the ice melted, the rock materials were deposited as glacial drift in various forms.

A brief summary of the deglaciation of southwestern Manitoba is provided to explain the variability in the surface deposits in the Study Area. According to Elson (1958)* and Halstead (1957)**, the last ice sheet that covered southern Manitoba flowed southeastward from the center of outflow of ice in northern Saskatchewan and Manitoba. As the glacier thinned and retreated about 12,000 years ago, uplands such as the Duck and Riding Mountains split the ice movement into two lobes — the Northwestern lobe (on the west) and the Red River lobe (to the east). These two lobes coalesced south of the Riding Mountain along the Manitoba Escarpment, north of the Pembina Mountains. The Red River Valley lobe east of the Pembina Mountains flowed south and persisted longer than the lobe to the west. As the Northwestern lobe shrank, the Red River lobe advanced slightly, but did not obstruct the Pembina Valley south of Morden for very long.

The northwestern ice between Turtle and Pembina Mountains withdrew more rapidly and uncovered part of the Pembina Valley west of the Pembina Mountains and deposited an outwash train in it. Stationary periods of the ice front resulted in extensive deposition with prominent end moraines and outwash.

Further retreat of the ice to the Brandon Hills, a bedrock high, resulted in the splitting of the Red River lobe from the Northwestern lobe (Figure 4a). An interlobate moraine comprising the Brandon Hills and a ridge extending to the southeast formed the end moraine of the Red River lobe.

Continued retreat of the Northwestern ice on the west and north of the Turtle Mountain resulted in the northern expansion of Glacial Lake Souris into Manitoba; during this early stage of Glacial Lake Souris, the discharge was south through the Sheyenne River (North Dakota). The Antler, Gainsborough, Graham, Jackson and Stony Creeks were successive ice-marginal streams on the southwest side of the ice lobe; large quantities of outwash were deposited in the basin of Glacial Lake Souris. The continued expansion of Glacial Lake Souris and recession of ice resulted in an ice margin stream which flowed north to become the outlet of Glacial Lake Souris into the Pembina River. While the Northwestern ice lobe continued to retreat, there was a readvance of part of the Red River Valley Lobe — Assiniboine sublobe (containing rock material high in lime carbonate) in a west to southwest direction (Figure 4b) and overrode sediments in

* Elson, J.A. 1958. Pleistocene history of Southwestern Manitoba. North Dakota Geol. Surv. Misc. Set no. 10. Guidebook, Ninth Annual Field Conference; W.M. Laird, Lemke, R.W. and Hansen, M. Eds.

** Halstead, E.C. 1957. Groundwater Resources of the Brandon Map Area, Manitoba. Geol. Surv. of Canada Memoir 300.

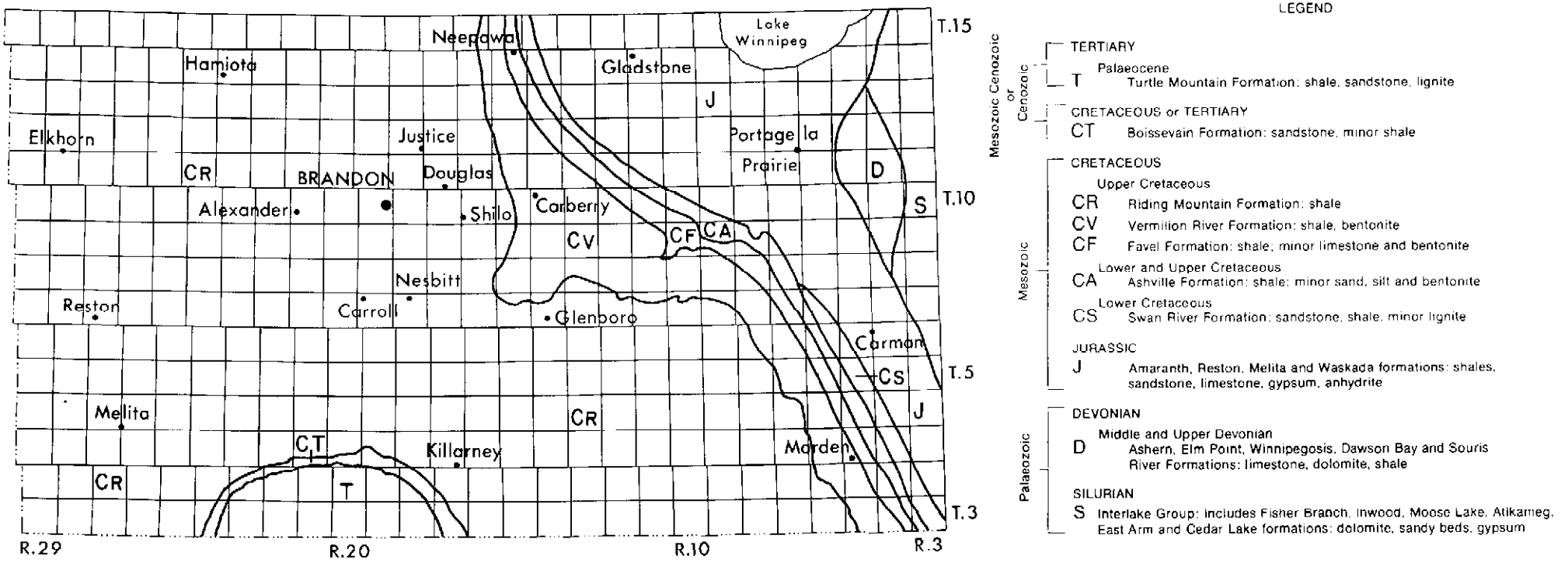


FIGURE 3. Bedrock Geology of the Brandon Region Study Area.

the lake between the two lobes. Rock knobs northeast of Virden caused crevassing of the northwestern ice, and in the crevasses, stratified drift of the Arrow Hills were deposited. Ice margin streams on the west and north of the Assiniboine sublobe deposited considerable outwash, sand and gravel deposits.

As the Assiniboine sublobe retreated northward from the Brandon Hills, a lake formed south of Brandon and merged with a smaller lake to form Lake Brandon to the north and east of Tiger Hills. This lake enlarged with the further retreat of the Assiniboine sublobe (Figure 4c). With expansion of Lake Brandon an outlet channel opened eastward around the north end of the Pembina Mountains and merged with Glacial Lake Agassiz, which at this time was being enlarged northward as the Red River lobe receded. Further retreat of the Assiniboine lobe to the north resulted in the flow of the Assiniboine River into an enlarging Lake Agassiz (Figure 4d) and deposited there in the form of a delta the material eroded from the Assiniboine and Qu'Appelle valleys to the west. This delta extended from Brandon eastward to Portage la Prairie. As Lake Agassiz receded and finally drained, much of the sands on the surface of the Assiniboine delta was blown into dunes.

The soil materials are quite varied ranging from clays, silts and sands to gravel and till. A surface deposit map of the Brandon Region is shown in Appendix II. In general, lacustrine sands, silts and clays occur below the 434 to 442 meter (1425 to 1450 foot) elevation north of the Assiniboine River, while south of the river, the lake deposits occur below the 442 m (1450 foot) contour. Glacial till is the common soil material at the higher elevations. Stratigraphic cross sections of the surface deposits of selected areas are presented in Appendix I. A short explanation of the use and interpretations of the cross sections is also provided.

DRAINAGE AND RELIEF

The prominent relief and drainage features in the Brandon Region study area are outlined in Figure 5 and Appendix III. This area is situated above the Manitoba Escarpment on the Western Uplands of Manitoba and the Brandon portion is within the watershed of the Assiniboine River system; the Neepawa portion is drained by the Whitemud River system. Drainage of the Brandon subregion is facilitated by the network of streams contributory to the Assiniboine, the main ones being the Minnedosa and Little Souris Rivers.

While these numerous water courses facilitate the flow of water through the area and provide for the escape of excess runoff, a considerable amount of the surface drainage on the undulating till plains is local in nature. Runoff water from the knolls and ridges accumulates in the intervening depressions to form sloughs and marshes, or collects in larger basins to form intermittent or permanent lakes. The processes of evaporation and seepage account for the removal of water from these local catchbasins.

The elevation of the Brandon study area ranges from 343 meters (1125 feet) a.s.l. in the Neepawa area, 350 meters (1150 feet) a.s.l. in the Assiniboine River valley to 487 meters (1600 feet) a.s.l. in the Brandon Hills. Most of the landscape consists of lacustrine plains with a nearly level to undulating topography. Greater relief is confined to the till moraines and the deeply incised channel of the Assiniboine River. The till moraines occur in the Brandon Hills above an elevation of 442 meters (1450 feet), on the northern periphery in Township 11 above 434 meters (1425 feet), and in the Neepawa area above 388 meters (1275 feet). These morainal deposits have an undulating to strongly rolling or hilly topographic pattern. The Assiniboine River occupies a broad U-shaped valley having a depth of as much as 61 meters (200 feet) at some localities.

The Neepawa area has a range in elevation from 343 meters (1125 feet) a.s.l. adjacent to the Whitemud River, to 396 meters (1300 feet) a.s.l. in the northwestern portion. The topography varies from a nearly level to gently rolling pattern.

The Carberry area ranges in elevation from 373 meters (a.s.l.) in the eastern side and southwestern corner, to 389 meters (a.s.l.) throughout the centre area. The topography varies from level in the lacustrine areas to hilly in the aeolian areas.

CLIMATE

The climate of the Brandon Region has been designated as dominantly cool to moderately cool, Boreal, subhumid continental*.

A. Temperature

The mean annual air temperatures for the general Brandon Region are given in Table 1. The

* Map of Soil Climates in Canada. 1972. Soil Research Institute, Research Branch, Canada Dept. of Agriculture, Ottawa.

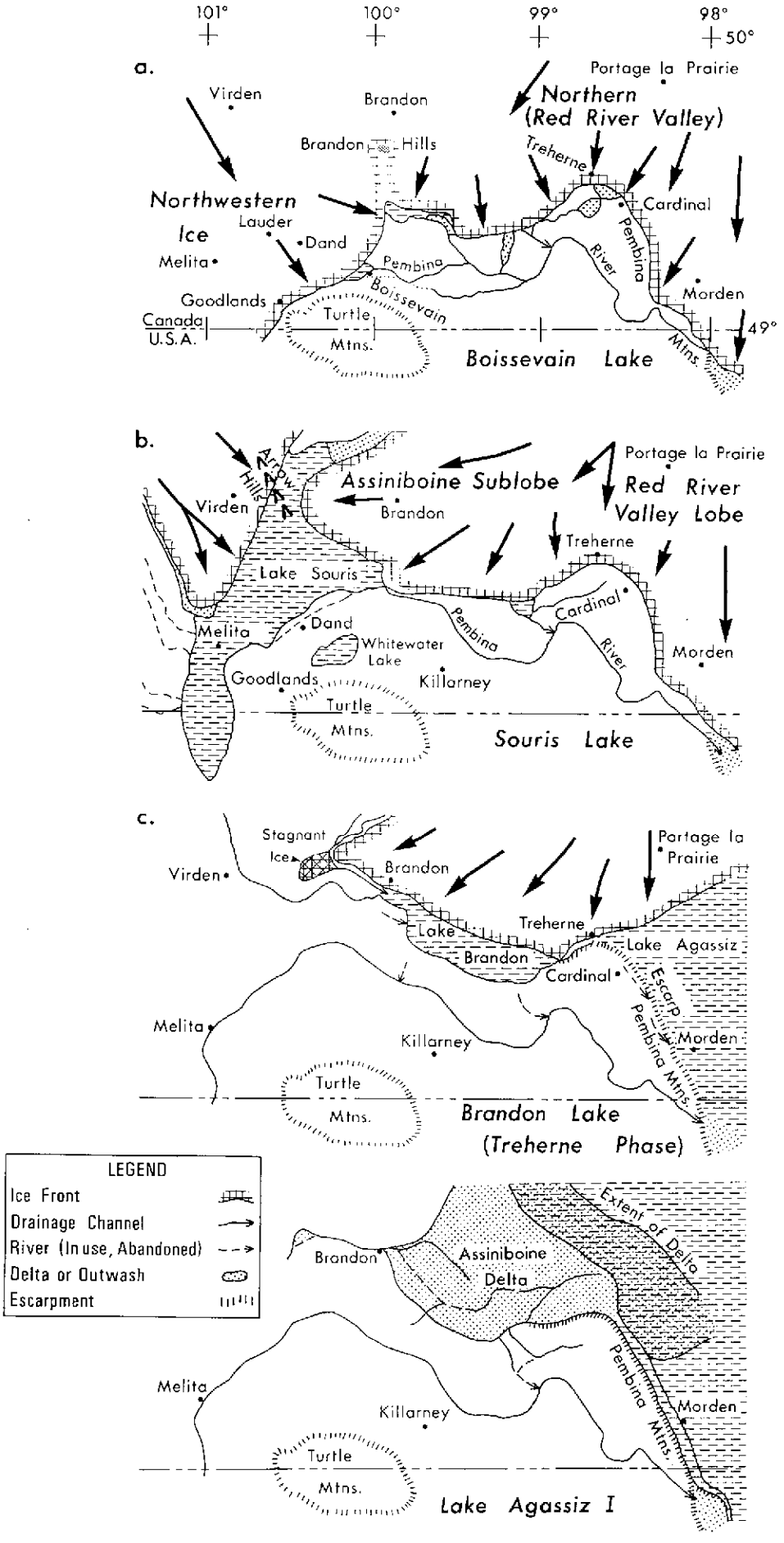


FIGURE 4. Deglaciation of South-West Manitoba — 4 Stages.

mean temperature for Brandon is 1.8°C. Average temperatures for the coldest month (January) and the warmest month (July) are -18.4°C and 19.1°C, respectively.

B. Precipitation

The mean annual precipitation and mean summer precipitation (May 1 to Sept. 30) are also given in Table 1. The mean annual precipitation for Brandon is 467.4 mm., while the mean summer precipitation is 317.5 mm. This indicates that approximately 70 percent of the annual precipitation falls during the period of May 1 to September 30.

C. Soils in Relation to Climate

Climate has two major effects upon soil formation. It is the most important factor influencing the type of natural vegetation under which the soils were formed and it affects the weathering processes whereby rocks, minerals and organic matter are broken down to become soil material. The rate of weathering is high in warm, moist regions and is slow when temperatures are cool and precipitation is low. Soils of southwestern Manitoba are weakly weathered because of the cool temperatures, long winters and low rainfall.

Temperature of the soil and air influence the amount of water removal from the soil through evapotranspiration. When temperatures are cool or when the soil has less exposure to the sun (e.g. eastern and northern slopes of the Brandon Hills) evaporation losses are lower; more of the precipitation moisture is available for downward infiltration and leaching of the soil.

Within any region, the annual precipitation may not vary appreciably, but the effects of relief, air currents and air temperatures may be sufficient to affect the growth response and vigor of vegetation and crops as well as soil properties. These effects may be generally shown on the Soil Climatic Map (Figure 6) of southwestern Manitoba. The area is subdivided into climatic regions (for example, 4, 5, 6) indicating a major difference in climate and soil development. Region 5 has a cooler temperature status and greater precipitation, evapotranspiration efficiency, than in Region 6. The soils in Region 5 are dominantly Dark Gray, Dark Gray Luvisol, Gray Luvisol and Brunisolic soils, while in Region 6, the soils are predominantly Chernozemic.

Subregional divisions (6B, 6C) are made on lesser changes in soil and climate, but sufficient to alter the sequence and thickness of various soil horizons for the separation at Soil Series category. Temperature, precipitation and crop growth parameters also differ between these subregions.

The divisions within the subregions (6C1, 6C2) are made on the basis of subtle changes in the crop growth parameters such as frost-free days, degree days and soil moisture deficit.

The Brandon Region study area lies within the 6B Soil Climatic Subregion, but is separated into two groups, 6B1 and 6B2. The main differences in climatic parameters are in the frost-free days and in degree days above 5.5°C (Table 1). The southern section, 6B1, favors a greater choice of crops due to slightly higher heat units, longer frost-free period, and less moisture deficit. A comparison of the two sections, 6B1 and 6B2, is shown in Table 1.

D. Soil Temperature

Soil temperature relates to areal climate, but the relationship is affected by soil depth, texture, soil water content, surface cover (vegetation, snow), landscape position, and man's manipulation. Soil temperature follows a wave pattern in response to seasonal air temperature changes, the response being greater near the surface with a considerable lag with depth (Figure 7, Table 2). The soil gains heat during the period May to August, then loses heat from September to March. This cross-over of heat loss to heat gain takes place in April and heat gain to heat loss in the latter part of August.

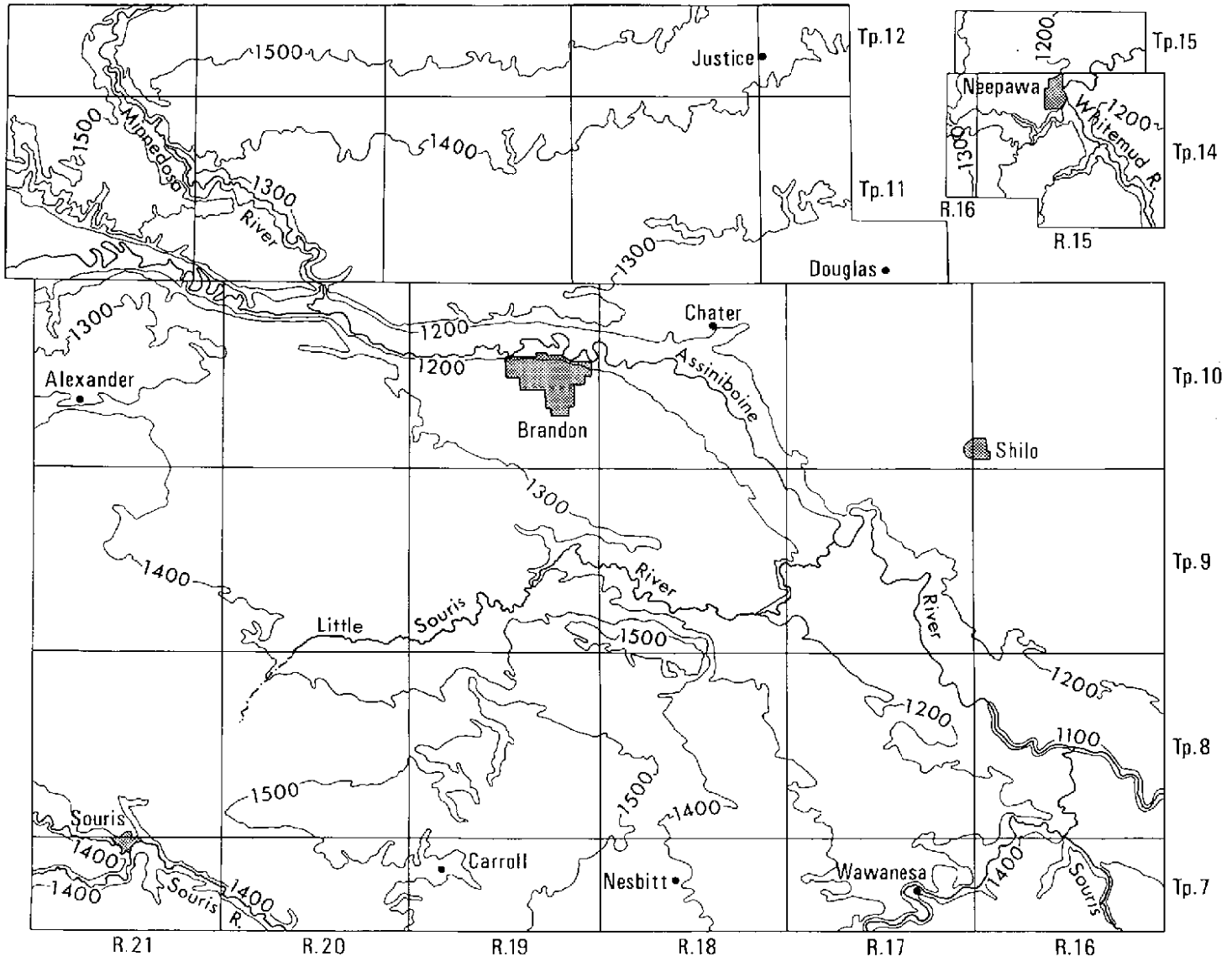
VEGETATION

The Brandon Region study area lies mainly in the Aspen-Oak and Mixed wood sections of the Boreal Forest Region of Canada (Rowe, 1972)*. Oak and trembling aspen is the prevalent species of the Aspen-Oak section and occurs as groves ringing wet depression and locally humid positions in the landscape; bur oak and scrubby aspen generally occur on the locally arid sites such as south or west slopes of the Brandon Hills, or sporadic among aspen vegetation. Well developed stands of aspen and black poplar occur on the locally humid sites on the northern and eastern slopes of the Brandon Hills and along the river channels.

White elm is a common species on the alluvial soils in association with green ash, Manitoba maple, and eastern cottonwood. In the extremely humid positions, where non-saline soils occur, some willow and black poplar are common.

The mixed wood section is characterized by the abundance of coniferous white spruce in addition to the above mentioned varieties; these species are found near and to the east of the Shilo area.

* Rowe, J.S. 1972. Forest Regions of Canada. Publication No. 1300, Department of the Environment, Canada Forestry Service, Ottawa.



METRIC TABLE

FEET	METERS
1100	335
1200	365
1300	396
1400	427
1500	457
1600	488

FIGURE 5. General Relief and Drainage Map of the Brandon Region Study Area — 100 Ft. (30.5 m) contour.

TABLE 1. Climatic Analysis of Meteorological Sites in Manitoba*

Site	Annual [1] Precipitation (mm)	Air Temperature[1]			Frost Free [2] Period (days)	Degree Days[2] Above 5°C May 1-Sept. 30	Precipitation [2] (mm) May 1-Sept. 30	Soil Moisture[2] Decifit (mm) May 1-Sept. 30
		Mean Annual Air Temperature	January (mean)	July (mean)				
6B1								
Rivers	485.1	1.7	-18.6	19.1	119	1489	312.4	-157.5
Neepawa	480.1	2.5	-17.3	19.1	118	1466	304.8	-175.3
Brandon	467.4	1.8	-18.4	19.1	105	1555	317.5	-215.9
Pilot Mound	530.9	2.0	-17.7	18.9	117	1473	330.2	- 58.4
Avg.	490.9	2.0	-18.0	19.1	115	1496	316.2	-151.8
6B2								
Birtle	513.1	1.1	-18.9	17.9	98	1394	312.4	-172.7
Hamiota	431.8	1.5	-18.8	18.9	104	1474	279.4	-231.1
Minnedosa	454.7	1.1	-18.3	17.9	97	1417	294.6	-193.0
Russell	424.2	0.7	-19.9	18.0	95	1383	271.8	-204.7
Avg.	456.0	1.1	-19.0	18.2	99	1417	289.6	-200.4

* Thermal and Moisture characteristics derived from available data as follows:

1 Temperature and Precipitation Normals, 1941-1970. Prairie Provinces Atmospheric Environment Service, Dept. of Environment, Canada.

2 Climatic Analysis of Weather Stations. C.F. Shaykewich, Proc. Man. Soil Sci. Soc., 1970.

GROUNDWATER

Groundwater refers to water that is beneath the surface of the soil in the zone of saturation. Water collects and flows through the pores of the soil during infiltration until it eventually reaches a zone of saturation. The upper surface of the zone of saturation in near surface, unconfined aquifers is called the water table. Since the water table generally conforms to the topography, groundwater in unconfined aquifers tends to flow from topographic highs to topographic lows.

In the Brandon region, the majority of the groundwater is unconfined in near surface aquifers. However, where glacial till is present, at or near ground surface, the groundwater is confined in deeper aquifers and usually under pressure. The till is quite compact, has very fine pores and contains little water. The impermeable nature of the till not only confines the groundwater to some permeable layer of gravel or sand at greater depth, but also restricts the downward movement of surface water.

Static water levels for wells in the deeper confined aquifers represent the piezometric surface while static water levels for wells in the near surface unconfined aquifers represent the water table. For most of the area, the water table is generally higher than the piezometric surface, resulting in recharge conditions. In certain parts of the area, the piezometric surface is near or above the water table, resulting in discharge conditions. A common feature of discharge areas are flowing wells.

A static level map (Appendix IV) was compiled from water well drillers' reports obtained from the Water Resources Division of the Manitoba Department of Mines, Resources and Environmental Management. Major areas where the static levels are at or near the surface are: lower slopes around the Brandon Hills, the central area in Twp. 11, Rge. 19W, and an area in the vicinity and to the east of Alexander.

The quality of the groundwater varies considerably in the Brandon Region, but generally of suitable quality for the required uses. The large sand and gravelly areas have a seasonal water table generally within 4.5 meters (15 feet). The water is generally hard and contains sulfate salts of calcium and magnesium. The quality in the silts and tills is quite variable depending on the type of aquifers encountered and source of inflow. Waters in the upper portion of the Brandon Hills is generally hard but of satisfactory quality, while water at the lower elevations is quite variable both in quality and hardness. Water quantity and quality in the till area to the north of Brandon is quite variable; the quantity is generally low in slowly permeable till unless satisfactory sand or gravel pockets and strata are encountered; the quality in the better sand and gravel strata is hard, but satisfactory, while in strata where the quantity is low, the quality is poorer and often brackish.

Saline soils are associated with the discharge and seepage system in which the groundwater is of poor quality to brackish (contains appreciable soluble salts). The degree of salinity in the soils is dependent on the relative amount of fresh surface water moving downward in relation to the quality of the near surface groundwater and the groundwater at lower depths.

Discharge areas in which non-saline waters move upward toward the surface generally do not accumulate sufficient salts to affect growth of vegetation. Another factor that influences the removal or accumulation of salt in the soil is the texture and permeability of the strata. For example, soils with gravelly or sandy substrata within a meter or two of the surface permit the lateral movement of water, thereby decreasing the probability of any appreciable salt.

The near surface groundwater fluctuates throughout the year with seasonal highs and lows. The groundwater is generally lowest during the winter months from December to March. The level rises in April and May as a result of snowmelt and rainfall. The more permeable soils respond more rapidly to changes such as snowmelt and high rainfall while in the less permeable medium and fine textured soils, there usually is a greater lag or response time. Generally, water levels reach their maximum height in the latter part of May or the beginning of June and recede slowly over the course of the growing season.

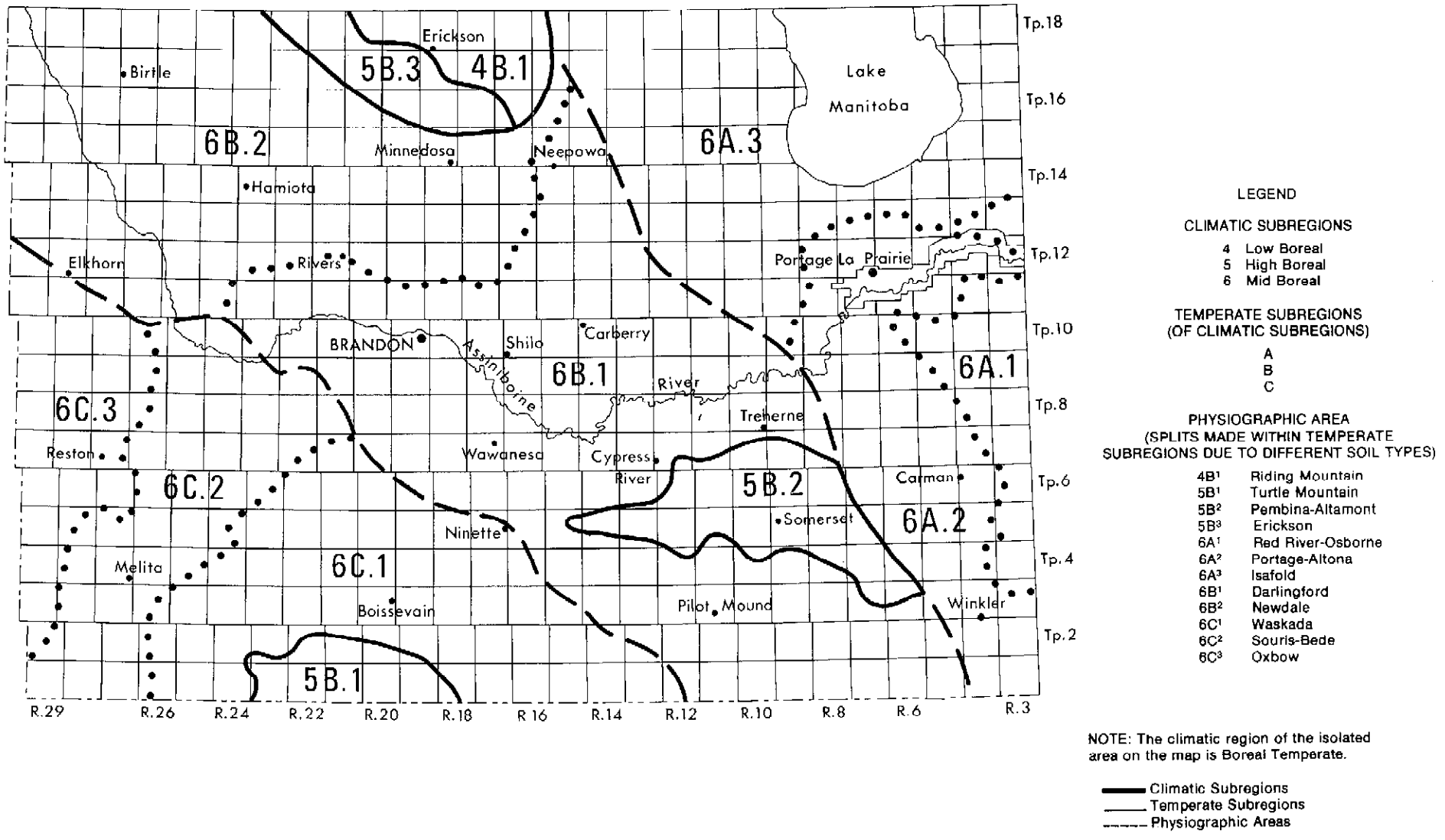


FIGURE 6. Soil Climatic Map of Southwestern Manitoba.

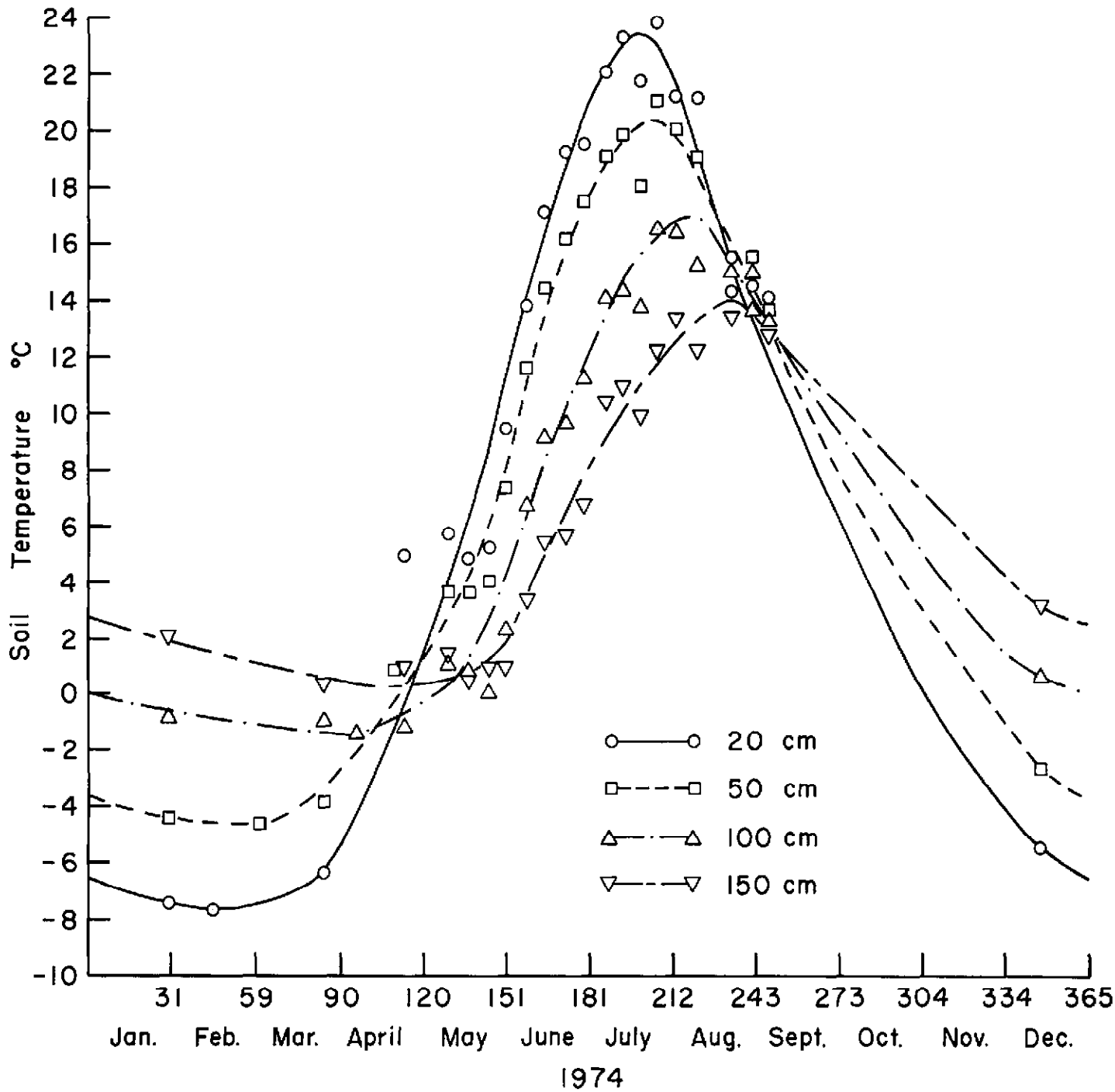


FIGURE 7. Soil Temperature on a Gleyed Black Soil at Brandon Experimental Station.

Site	Depth cm	Soil Temp. °C		Date 0°C		Days Above 0°C	T. Max.	Day	T. Min.	Day	Date 5 °C		Days Above 5 °C	Deg. Days 5°C	Date 15 °C		Days Above 15 °C	Deg. Days 15 °C
		Mean Annual	Mean Summer	Spring	Fall						Spring	Fall			Spring	Fall		
Hamiota	20	5.9	16.3	89	321	232	17.9	205	-3.6	46	115	294	179	1442	167	242	75	142
62K 1	50	5.1	13.6	100	335	234	15.4	217	-3.9	51	130	305	175	1155	201	233	32	9
NW23-13-24W	100	4.3	9.5	124	352	228	12.6	238	-3.0	77	159	317	158	767	-	-	-	-
Ochre River	20	5.3	13.6	100	335	235	15.4	217	-3.2	56	130	304	173	1141	202	233	31	9
62O 1	50	5.4	11.8	99	353	254	13.8	226	-2.0	60	137	314	177	987	-	-	-	-
SC7-24-16W	100	5.6	10.0	90	19	294	12.2	237	-0.4	70	146	328	182	829	-	-	-	-
Virden	20	5.1	18.0	102	309	207	20.1	206	-6.4	52	122	290	167	1589	162	251	89	294
62F 5	50	5.1	15.7	104	319	215	17.7	212	-4.9	57	128	296	168	1348	177	247	70	126
NE16-11-26W	100	4.5	12.1	119	333	214	14.9	226	-4.0	73	147	305	158	989	-	-	-	-
Brandon	20	5.2	17.0	98	315	217	18.8	206	-5.7	46	120	293	173	1504	165	247	82	205
62G 5	50	5.4	14.9	106	328	222	17.1	217	-4.0	61	132	303	171	1296	186	249	63	86
NE28-10-19W	100	5.2	10.9	125	345	220	14.4	235	-2.7	87	156	314	158	938	-	-	-	-
Carberry	20	6.8	15.9	73	339	266	17.1	206	-3.0	28	105	307	201	1526	169	243	74	103
62G 6	50	6.0	14.8	90	343	253	16.4	216	-3.9	38	120	312	192	1381	186	246	60	56
NE11-11-15W	100	4.6	11.9	115	341	227	14.5	228	-4.0	64	145	311	167	1003	-	-	-	-
Glenboro	20	5.0	17.2	96	317	221	18.9	207	-7.5	35	118	296	178	1572	163	250	87	225
62G 7	50	5.4	15.6	100	330	230	17.5	215	-5.3	46	125	305	180	1416	179	251	72	117
SW2-7-14W	100	5.3	11.4	112	357	245	14.2	235	-2.7	69	147	322	175	1025	-	-	-	-

* Mills, G.F., C. Tarnocai and C.F. Shaykewich. 1974. Soil Temperature Studies (1972-1974). Manitoba Soil Sci. Meeting, 1974. Publication Branch, Province of Manitoba.

TABLE 2. Soil Climatic Analysis of Temperature Sites in Manitoba*

PART III

FORMATION, CLASSIFICATION AND MORPHOLOGY OF SOILS

This section describes the important characteristics of the soils and their relationship to the factors of soil development, and provides a description of the classification and morphology of the soils in the Brandon study area.

SOIL DEVELOPMENT

Soil is produced by the action of soil-forming processes on the material deposited or accumulated by geologic forces. The characteristics of the soil at any place are determined by the physical and mineralogical composition of the original geological material, the climate under which the soil material has accumulated and existed, the biota consisting of plant and animal life on and in the soil, the relief (or lay of the land) and drainage that results from it, and the length of time the forces of development have acted on the geologic material.

Man has also influenced the development of soils or altered the natural soils. Man has removed the natural vegetation, disturbed the surface layers and has used practices that have altered the natural drainage and modified the natural differences between soils.

The most important active factors in soil formation are the temperature and moisture conditions within the soil (i.e. the soil climate). Under native conditions, the soil climate determines the type of biological life which in turn determines the type of, and the manner in which organic matter is added to the soil. The soil climate also determines the micro-organism activity, the rate of production and decomposition of organic matter, the rate and extent of mineral weathering, and the rate at which products of weathering are accumulated in, or removed from the soil.

The soil climate may differ within relatively short distances because of differences in topography and drainage. Knolls or sloping areas are usually "less moist" or "locally arid" as a portion of the precipitation may run off. Depressions are often "locally humid" as they collect water and are wetter and cooler than adjacent soils. Normally the soils developed on the better drained sites have a greater movement of soluble and weathered products and result in the development of A, B, C horizons, while soils in the level to depressional sites vary from the A, C to A, B, C types.

In any geographic area, the degree of development is related to the regional climate and the degree of leaching, translocation and accumulation of the soluble and colloidal fractions of the soil. In the dominantly grassland area, the amount of water available for leaching is low, but sufficient to support grassland vegetation; this results in accumulation of organic matter in the mineral surface and gives the soils the "black color". The translocation of soluble and colloidal fraction is relatively shallow. In the parkland area (transition from grassland to forest), the soil climate is favorable for tree growth as well as grassland species. There is a greater degree of leaching and translocation than in the grassland area proper, and less organic matter accumulation. The result is the formation of soils with a "dark gray" surface and identifiable accumulation of translocated products such as clay and organic matter lower in the soil profile. Under more favorable moisture conditions of the forest regions, there is a greater degree of leaching and translocation of soluble and colloidal soil material resulting in soils with a characteristic leaf mat, a bleached zone and an accumulation zone dominantly of the translocated clay and organic matter.

In a similar climatic zone, soils may differ due to the texture and mineralogical composition of the parent material. Soils developed on moderately coarse to medium texture are more permeable to water and allow for a greater leaching of the soluble and colloidal fraction as compared to finer textured soils. Soils developed on moderately calcareous sediments are noticeably deeper than soils developed on strongly calcareous sediments; soils developed on the extremely calcareous material are very shallow under grassland, parkland or forested conditions because of the difficulty of leaching the large quantity of lime carbonate present; the maximum depth of soil development on these extremely calcareous materials is 20 to 30 cm.

Restrictions on normal soil development are not only imparted by high levels of lime carbonate, but also the length of the saturation period in an area affected by surface ponding, lateral inflow, seepage or a near surface groundwater. Under these conditions, the leaching of soluble and colloidal material is minimal, and in some cases the translocation of soluble soil material is toward the surface; the soil environment is altered from an oxidative state to a depleted oxygen or reductive state. The characteristics associated with various restricted drainage and hydrological conditions are dull soil colors, the development of

mottles of iron and manganese, the presence of lime carbonate near the surface of the soils (not applicable to better drained shallow soils developed on extremely calcareous materials), the presence of, and accumulation of soluble salts within the rooting zone, and the accumulation of peat at the surface.

Time has been an important variable in the development of soils. Soils progress from youth through maturity to old age during which time they come into a period of very slow change or equilibrium with the influencing factors. The soils of the Brandon study area vary from youthful to mature, with the initiation of development dating back to less than 12,000 years ago when the ice receded and waters of Glacial Lakes Souris, Brandon and Agassiz commenced to recede from this portion of the Brandon Region. The soils are considered to be in equilibrium with the environmental factors responsible for their formation; man has altered some of the factors such as vegetation and drainage regime, but the effects of this on the soil profile or properties is not apparent.

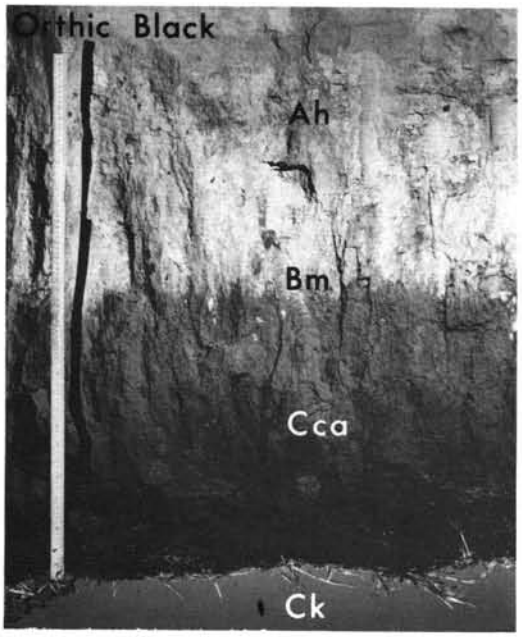
THE SOIL PROFILE

A soil that has come into equilibrium with its environment develops characteristics or morphology unique to itself and is considered a mature soil. Those that have not come into equilibrium with their environment are considered immature. A mature soil when viewed in vertical cross-section, consists of soil layers called soil horizons (Figure 8).

The main or master horizons have been designated by the letters L, F, H, for organic layers and A, B, C for mineral horizons. Lower case suffixes are used to indicate the type of master horizons and arabic numerals are used when further devision into subhorizons are required. If the soil profile is developed from non-conforming parent materials, Roman numeral prefixes are used to indicate lithologic changes. The master horizon symbols and lower case letter suffixes are defined in Table 3.

The A and B horizons are a reflection of the genetic forces operating on the parent material and together they form what soil surveyors call the solum of the soil. No simple definition of master horizons is possible since there are so many different kinds. In general, A horizons or surface layers are subjected to the greatest amount of weathering and leaching or organic matter accumulation. The B horizons, lying immediately below the A horizon contain most of the material leached from A horizons or have had other changes brought about by soil forming forces. The C horizons represent the relatively unweathered underlying geological deposits from which the sola has developed.

FIGURE 8.
Examples of the use of soil horizon nomenclature.



Black soil profile showing subdivision into soil horizons.

Gray Luvisol soil profile showing subdivision into soil horizons.

SOIL CLASSIFICATION

Approximately 97 soil series have been designated and mapped in the Brandon study area, each having a combination of characteristics unique to itself. The properties of these different soils reflect the effect produced by the soil forming forces discussed in the previous section.

The basic unit in the system of soil classification in Canada is the *soil series*. A soil series is defined as a naturally occurring soil body such that any soil profile within the body has a similar number and arrangement of horizons, whose color, texture, structure, consistence, thickness, reaction and composition are within a narrowly defined range. Soil series are very often subdivided into *types* and *phases*. *Soil types* are subdivisions of series based on minor variation in the texture of the surface horizon. *Phases* of soil series are based on variations of such features as degree of erosion of the profile, topographic change, stoniness, or salinity.

Soil series, soil types and soil phases are all three dimensional bodies that occupy a geographic location on the landscape. Since soil is a continuum there are no sharp boundaries between series, types and phases. However, we need to identify, sample and describe these bodies so their properties can be compared and predictions can be made about their use and management. Therefore, limits are placed on the range allowed in the characteristics that differentiate these bodies. These limits are wide enough to permit delineation of them over a practical sized area on a map. Usually, it is impractical to draw exact boundaries between the limits of one soil series and another because of time and mapping scale limitations. Consequently, each delineated area may contain small segments comprising less than 15 percent of other soil series. It can be seen, that the concept of a soil series as a taxonomic unit is related to, but is not strictly speaking, the same as the soil body delineated on a map. Therefore, the soil area delineated on the map is designated as a soil series mapping unit.

Generally mappable differences in any property or group of properties that have significance in soil formation or plant growth are the basis for separating soil series. Differences in soil parent material, drainage, topographic variation, salinity and textural variation have been the key characteristics employed to differentiate soil series mapping units in the Brandon study area (see Tables 4 and 5).

Such mapping units form a very useful basis for evaluating and predicting behavior of soils for such purposes as growing agricultural crops under dryland and irrigation conditions, engineering projects and planning for community services. A discussion of such evaluations and interpretations of the soils in the map area are found in other sections of the report.

SOIL MAPPING

Soil mapping was conducted by soil scientists who examined the soil profile to a depth of four feet along selected traverses in each section of land. In cultivated or accessible areas, the soil was examined at 500 foot intervals along each traverse; two traverses were made per section with some additional sites between traverses as required. In less accessible areas the soils were examined along the roads and trails, supplemented with traverses or inspection sites within the sections. Individual soils and phases were delineated on aerial photographs having a scale of 4 inches equal one mile showing land use, roads, buildings, trails, and other details that readily aided in designation of the inspection site and in drawing boundaries accurately.

In preparing the maps, soil scientists had problems delineating areas where different soils were intricately mixed or so small in size that it was not practical to show them separately on the map. They showed this mixture of soils as one mapping unit, a soil complex which indicated the relative distribution (percentiles) of the various series. The phase of the series was indicated by alphabetic or numeric symbols below the soil series symbol. Four possible phases or combinations of phases were presented as follows: a) first space, numeric, indicated degree of erosion; b) second space, alphabetic, indicated topography; c) third space, numeric, indicated degree of stoniness; and d) fourth space, alphabetic, indicated degree of salinity. An x was used to designate that the phase condition was minimal as described for the soil series.

An example of a complex map unit is given as:

$$\frac{St^4}{1c2x} - \frac{Sy^4}{1d3x} - \frac{Ct^2}{1c2x}$$

and indicates the landscape unit consists of 40 percent Stewart series, slightly eroded, gently undulating slopes, moderately stony, nonsaline; 40% Statley, slightly eroded, gently rolling slopes (5 to 9%), very stony, nonsaline; 20% Clementi, slightly eroded, gently undulating (2 to 5%), moderately stony, nonsaline.

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

TABLE 3

DEFINITION OF SOIL HORIZON SYMBOLS

ORGANIC LAYERS

Organic layers are found in organic soils, and usually at the surface of the mineral soils. They may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon by weight. Two groups of these layers are recognized:

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

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

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

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

Oco — Coprogenous Earth (terre coprogene) — A material in some organic soils that contains at least 50% by volume of fecal pellets less than 0.5 mm in diameter.

L-F-H — These organic horizons develop primarily from leaves, twigs, woody materials and a minor component of mosses.

ORGANIC HORIZONS

Organic horizons may be found at the surface of mineral soils, at any depth beneath the surface in buried soils or overlying geologic deposits. They contain more than 30 percent organic matter. Three horizons are recognized.

L — An organic layer characterized by the accumulation of organic matter in which the original structures are easily discernible.

F — An organic layer characterized by the accumulation of partly decomposed organic matter. The original structures are undiscernible. Fungi mycelia often present.

H — An organic layer characterized by accumulation of decomposed organic matter in which the original structures are undiscernible.

MASTER MINERAL HORIZONS

Mineral horizons are those that contain less organic matter than that specified for organic horizons.

A — A mineral horizon or horizons formed at or near the surface in the zone of maximum removal of materials in solution and suspension, and/or maximum in situ accumulation of organic matter. It includes: (1) horizons in whhch organic matter has accumulated as a result of biological activity (Ah); (2) horizons that have been eluviated of clay, iron, aluminum, and/or organic matter (Ae); (3) horizons dominated by 1 and 2 above but transitional to underlying B or C (AB or A and B); (4) horizons markedly disturbed by cultivation or pasture (Ap).

B — A mineral horizon or horizons characterized by one or more of the following: (1) an enrichment (exclusive of dolomite or salts more soluble in water) in silicate clay, iron, aluminum, and/or illuvial organic matter (Bt, Bf, BH, Bfh); (2) a prismatic or columnar structure which exhibits pronounced coatings or stainings and characterized by the presence of significant amounts of exchangeable sodium (Bn); (3) an alternation by hydrolysis, reduction, or oxidation to give a change in color and/or structure from the horizons above and/or below and does not meet the requirements of (1) and (2) above (Bm, Bg).

C — A mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (1) the process of gleying, and (2) the accumulation of dolomite and salts more soluble in water (Cca, Csa, Cg and C).

R — Underlying consolidated bedrock such as granite limestone, sandstone, etc.

LOWER CASE SUFFIXES

b — A buried soil horizon.

Ca — A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material.

g — A horizon characterized by gray colors and/or prominent mottling indicative of permanent or periodic reduction conditions in soils.

h — A horizon enriched with organic matter. When used with A, it must show at least one Munsell unit of value darker than the layer immediately below.

j — Used as a modifier of suffixes g, n, and t to denote a weak expression of the suffix it modifies.

k — Presence of carbonate as indicated by visible effervescence with dilute hydrochloric acid.

m — A horizon slightly altered by hydrolysis, oxidation and/or solution to give a change in color and/or structure. Suffix to be used with B to denote a B horizon that is greater in chroma by one or more units than the parent material, or that has granular, block or prismatic structure without evidence of strong gleying. It can be used as Bm, Bmgj, Bmk, Bms.

n — A horizon in which the ratio of exchangeable calcium to exchangeable sodium is 10 or less. When used with B it must also have the following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry.

p — A layer disturbed by man's activities, i.e. by cultivation and/or pasturing. It is to be used only with A.

s — A horizon with salts including gypsum which may be detected as crystals or veins, or as surface crusts of salt crystals, or by distressed crop growth, or by the presence of salt tolerant plants.

sa — A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates where the concentration of salts exceeds that present in the unenriched parent material.

t — A horizon enriched with silicate clay. It is used with B along (Bt) and with B and g (Btg).

NOTE: More detailed explanation is provided in "The System of Soil Classification for Canada". Queen's Printer for Canada, Ottawa, 1970.

An example of a single map unit is:

$$\frac{\text{Tdp}}{\text{XXXS}}$$

which represents a landscape consisting entirely of the Tadpole series, peaty phase (p) and slightly saline. The term peaty phase is applied to any mineral soil with a surface covering of 15 to 40 cm peat other than fibric moss peat.

During the course of the soil survey, samples of soils were taken as required for laboratory analyses.

TABLE 4 Classification of Soils in the Brandon Study Area According to the System of Soil Classification for Canada.

Order	Great Group	Subgroup	Series
CHERNOZEMIC SOILS Soils with chernozemic Ah horizons and with B or C horizons of high base saturation with divalent cations, calcium usually being dominant. Well to imperfectly drained soils developed under zero- or mesophytic grasses and forbs or under grassland forest transition.	BLACK SOILS Soils with Ah horizons of value darker than 3.5 moist or dry, and with chroma of 1.5 or less with moist, of sufficient thickness to produce 15 cm of mixed surface or Ap horizon with dry color values less than 4.0 and with chroma of less than 2.0 dry. Usually associated with a mesophytic vegetation of grasses and forbs.	ORTHIC BLACK Profile type: *Ah*, (Ap), *Bm* or *Btj*, C, (Cca), (Ck)	Clementi Croyon Dorset Everton Fairland Glenboro Hilton Janick Kirkness Lockhart Miniota Prosser Ramada Stockton Wellwood Wheatland
		CALCAREOUS BLACK Profile type: *Ah*, *Bmk*, *Cca* or *Ck*	Chater Cordova Dogand Kleysen Marringhurst Rempel Traverse Woodfield
		REGO BLACK Profile type: *Ah*, *C*, (Cca), (Ck)	Ashmore Bankton Bermont Cactus Carroll Chambers Durnan Porple Stewart Rufford Zarnet

Order	Great Group	Subgroup	Series
		GLEYED ORTHIC BLACK Profile type: *Ah*, (Ap), *Btgj*, *Bmgj*, *Cgj*, (Ccag), (Ckg)	Charman Cobfield Crusman Dexter Gateside Harding Justice Lavenham Oberon Petrel Torcan Wytonville
		GLEYED CARBONATED REGO BLACK Profile type: *Ahk*, *Ckgj*, (Ackgj), (Cca)	Barager Barwood Beresford Boswell Capell Crookdale Forrest Gendzel Grover Hummerston Killeen Kilmury Lindstrom Mansfield Melland Pleasant Prodan Sigmund Taggart Varcoe Wesley

Order	Great Group	Subgroup	Series
	DARK GRAY Soils with significant characteristics indicative of degradation in the Ah or Ahe horizons, with dry colour value less than 4.5 and chroma less than 2.0. The A horizon may be platy in structure and the B horizon is moderately developed dark brown coarse granular to blocky structure containing clay accumulations.	ORTHIC DARK GRAY Profile type: (L-H), (Ah), *Ahe*, (Ae), *Bm* or *Bt*, *C*, (Cca), (Ck)	Statley
REGOSOLIC SOILS Well and imperfectly drained mineral soils with good to moderate oxidizing conditions having horizon development too weak to meet the requirements of soils in any other order. Soils with non-chernozemic Ah horizons may be included.	SAME AS THE ORDER.	CUMULIC REGOSOL Profile type: *Ah*, *C*, *Ahb*, *C* or *Ck*; *C*, *Ahb*, *C* or *Ck*	Manson
		GLEYED CUMULIC REGOSOL Profile type: *Ah*, *Cg*, *Ahbg*, *Cg* or *C* or *Ckg*	Assiniboine Levine
		ORTHIC REGOSOL Profile type: (Ah), *Ck* or *C*	Arizona Axford Barren Brownridge Knolls Madill Roddan Shilox
		GLEYED ORTHIC REGOSOL Profile type: (Ah), *Ckg* or *Cg*	Onahan

Order	Great Group	Subgroup	Series
GLEYSOLIC SOILS Soils with organic horizons less than 40 cm of mixed peat or up to 60 cm of fibric moss peat. They may not have an A and B horizon. These soils are saturated with water and under reducing conditions continuously or at some period of the year unless they are artificially drained. They have, within 50 cm of the mineral surface, matrix colors of low chroma as a result of reducing conditions and they have distinct or prominent mottles of high chroma, presumably as a result of localized oxidation of ferrous iron and the deposition of hydrated ferric oxides.	HUMIC GLEYSOL Soils with an Ah horizon more than 8 cm thick under virgin conditions and when mixed to a depth of 15 cm has more than 3% organic matter and a rubbed color darker than 3.5 when moist (5.0 when dry), and is at least 1.5 units of value darker than the next underlying horizon B or C if the value of the underlying horizon is 4 or more, or at least 1 unit lower than that of the next underlying horizon if the value of the underlying horizon is less than 4.	CARBONATED REGO HUMIC GLEYSOL Profile type: (L-H), *Ahk*, *Ckg*, (Ccag)	Basker Bornett Carvey Fenton Fortin Grayson Hickson Kerran Lonery Lowton Mansfield Marsden Mockry Poolex Sewell Sutton Tadpole Vodroff Vordas
ORGANIC SOILS Soils that have developed dominantly from organic deposits that are saturated for most of the year or are artificially drained and contain 30% or more of organic matter to: (a) a depth of at least 60 cm if the surface layer consists dominantly of fibric moss; or (b) a depth of at least 40 cm for other kinds or mixed kinds of organic material; or (c) a lithic contact if it occurs at depths greater than 10 cm but shallower than either (a) or (b).	MESISOL Organic soils composed of dominantly mesic material. This material has an unrubbed fiber content between 1/3 and 2/3 of the organic volume and a rubbed fiber content between 1/10 and 4/10 of the organic volume.	TYPIC MESISOL Profile type - (O+) . Om . (Oh)	Xavier

TABLE 5

Key to the Soils of the Brandon Area

1. Soils developed on moderately to strongly calcareous, stratified, dominantly loams textured recent alluvial deposits of VFSL, FSL, L, SiL, SiCL texture.
   a) Imperfectly drained
      (i) Levine Series (Gleyed Cumulic Regosol) Lv
   (b) Poorly drained
      (i) Basker Series (Carbonated Rego Humic Gleysol) Bk

2. Soils developed on moderately to strongly calcareous, stratified, dominantly clayey recent alluvial deposits of SiC, C with stratum of SiCL, CL textures.
   (a) Well to moderately well drained
      (i) Manson Series (Cumulic Regosol) Mn
   (b) Imperfectly drained
      (i) Assiniboine Series (Gleyed Cumulic Regosol) As
   (c) Poorly drained
      (i) Kerran Series (Carbonated Rego Humic Gleysol) Kr

3. Soils developed on a thin mantle (50-75 cm) of very strongly to extremely calcareous, loamy (L, SiL, SiCL) glacial till of limestone and granitic origin overlying strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.
   (a) Well to moderately well drained
      (i) Hilton Series (Orthic Black) Hn
      (ii) Bermont Series (Rego Black) Bm
   (b) Imperfectly drained
      (i) Barwood Series (Gleyed Carbonated Rego Black) Bw
   (c) Poorly drained
      (i) Hickson (Carbonated Rego Humic Gleysol) Hk

4. Soils developed on a variable mantle of (30-90 cm) moderately to strongly calcareous outwash and glacial fluvial sediments of medium sand to gravel texture overlying very strongly calcareous loamy (L, SiL, SiCL) glacial till. Strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin usually occurs within a two meter depth.
   (a) Well to moderately well drained
      (i) Chater Series (Calcareous Black) Ch
   (b) Imperfectly drained
      (i) Barager Series (Gleyed Carbonated Rego Black) Bg

5. Soils developed on a variable mantle (30-90 cm) of moderately to strongly calcareous outwash and glaciofluvial deposits of medium sand to gravelly texture overlying very strongly calcareous silty (SiL, SiCL) textured lacustrine sediments.
   (a) Well to moderately well drained
      (i) Axford Series (Orthic Regosol) Ax
   (b) Imperfectly drained
      (i) Boswell Series (Gleyed Carbonated Rego Black) Bo

6. Soils developed on moderately to strongly calcareous stratified outwash and glacial fluvial deposits of medium sand to gravelly texture.
   (a) Well to moderately well drained
      (i) Marringhurst Series (Calcareous Black) Ma
   (b) Imperfectly drained
      (i) Mansfield Series (Gleyed Carbonated Rego Black) Mf

7. Soils developed on a thin mantle (25-30 cm) of moderately to strongly calcareous sediments of VFS, LVFS, FSL, SL texture overlying moderately to strongly calcareous medium sand to gravelly textured deposits.
   (a) Well to moderately well drained
      (i) Miniota Series (Orthic Black) Ms
      (ii) Ashmore Series (Rego Black) Am
   (b) Imperfectly drained
      (i) Wytonville Series (Gleyed Orthic Black) Wy
      (ii) Kilmury Series (Gleyed Carbonated Rego Black) Kl
   (c) Poorly drained
      (i) Bornett Series (Carbonated Rego Humic Gleysol) Bt

8. Soils developed on a thin mantle (25-30 cm) of very strongly calcareous loamy (L, SiL, SiCL) glacial till of limestone and granitic origin, overlying strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.
   (a) Well to moderately well drained
      (i) Cordova Series (Calcareous Black) Cv
      (ii) Rufford Series (Rego Black) Rf

(b) Imperfectly drained
  (i) Varcoe Series (Gleyed Carbonated Rego Black) Vr

9. Soils developed on stony, very strongly to extremely calcareous loamy (L, SiL, SiCL) glacial drift of limestone and granitic origin.
(a) Well to moderately well drained
  (i) Statley Series (Orthic Dark Gray) Sy
  (ii) Woodfield Series (Calcareous Black) Wf
  (iii) Stewart Series (Rego Black) St
  (iv) Madill Series (Orthic Regosol) Md
(b) Imperfectly drained
  (i) Wesley Series (Gleyed Carbonated Rego Black) Ws

10. Soils developed on a thin mantle (25-60 cm) of moderately to strongly calcareous sandy sediments (FS, LFS, LS) overlying moderately to strongly calcareous medium sand to gravelly textured deposits.
(a) Well to moderately well drained
  (i) Wheatland Series (Orthic Black) Wh
(b) Imperfectly drained
  (i) Gendzel Series (Gleyed Carbonated Rego Black) Gz

11. Soils developed on a thin mantle (25-60 cm) of moderately to strongly calcareous loamy sediments (L, SiL, SiCL, CL) overlying moderately to strongly calcareous medium sand to gravelly textured deposits.
(a) Well to moderately well drained
  (i) Croyon Series (Orthic Black) Cr
  (ii) Zarnet Series (Rego Black) Zn
(b) Imperfectly drained
  (i) Druxman Series (Gleyed Orthic Black) Dx
  (ii) Capell Series (Gleyed Carbonated Rego Black) Cp
(c) Poorly drained
  (i) Carvey Series (Carbonated Rego Humic Gleysol) Cy

12. Soils developed on a sequence of calcareous sediments consisting of a thin mantle (25-60 cm) of moderately to strongly calcareous loamy sediments (L, SiL, SiCL, CL) over thin (10-40 cm) medium sand to gravelly strata, over very strongly calcareous loamy (L, SiL) glacial till. Strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin usually occurs within a two meter depth.
(a) Well to moderately well drained
  (i) Dogand Series (Calcareous Black) Dg
(b) Imperfectly drained
  (i) Melland Series (Gleyed Carbonated Rego Black) Ml
(c) Poorly drained
  (i) Marsden Series (Carbonated Rego Humic Gleysol) Mr

13. Soils developed on weakly to noncalcareous sandy (FS, LFS) textured, dominantly aeolian deposits.
(a) Well to moderately well drained
  (i) Shilox Seriex (Orthic Regosol) Sh
(b) Imperfectly drained
  (i) Onahan Series (Gleyed Orthic Regosol) Oh
(c) Poorly drained
  (i) Mockry Series (Orthic Gleysol) Mk

14. Soils developed on weakly to moderately calcareous sandy (FS, LFS, LS) textured lacustrine and deltaic deposits.
(a) Well to moderately well drained
  (i) Stockton Series (Orthic Black) Sn
  (ii) Arizona Series (Orthic Regosol) Az
  (iii) Cactus Series (Rego Black) Cc
(b) Imperfectly drained
  (i) Lavenham Series (Gleyed Orthic Black) Lh
  (ii) Hummerston Series (Gleyed Carbonated Rego Black) Hm
(c) Poorly drained
  (i) Sewell Series (Carbonated Rego Humic Gleysol) Sw

15. Soils developed on moderately to strongly calcareous (VFS, LVFS, FSL) lacustrine and deltaic deposits.
(a) Well to moderately well drained
  (i) Prosser Series (Orthic Black) Ps
  (ii) Porple Series (Rego Black) Pp
  (iii) Brownridge Series (Orthic Regosol) Bn
(b) Imperfectly drained
  (i) Gateside Series (Gleyed Orthic Black) Gt
  (ii) Pleasant Series (Gleyed Carbonated Rego Black) Pl
(c) Poorly drained
  (i) Poolex Series (Carbonated Rego Humic leysol) Po

16. Soils developed on strongly to very strongly calcareous loamy (VFSL, L, SiL) lacustrine sediments.
(a) Well to moderately well drained
  (i) Fairland Series (Orthic Black) Fd
  (ii) Traverse Series (Calcareous Black) Tv
  (iii) Durnan Series (Rego Black) Dn
  (iv) Knolls Series (Orthic Regosol) Ko
(b) Imperfectly drained
  (i) Torcan Series (Gleyed Orthic Black) Tc

(ii) Taggart Series (Gleyed Carbonated Rego Black) Tg

(c) Poorly drained
(i) Vordas Series (Carbonated Rego Humic Gleysol) Vs

17. Soils developed on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits.

(a) Well to moderately well drained
(i) Ramada Series (Orthic Black) Ra
(ii) Rempel Series (Calcareous Black) Rp
(iii) Carroll Series (Rego Black) Cl
(iv) Barren Series (Orthic Regosol) Br

(b) Imperfectly drained
(i) Charman Series (Gleyed Orthic Black) Cm
(ii) Prodan Series (Gleyed Carbonated Rego Black) Pr

(c) Poorly drained
(i) Tadpole Series (Carbonated Rego Humic Gleysol) Td

18. Soils developed on moderately to strongly calcareous silty clay to clay lacustrine deposits.

(a) Well to moderately well drained
(i) Bankton Series (Rego Black) Ba
(ii) Janick Series (Orthic Black) Jk

(b) Imperfectly drained
(i) Harding Series (Gleyed Orthic Black) Hg
(ii) Sigmund Series (Gleyed Carbonated Rego Black) Sg

(c) Poorly drained
(i) Lowton Series (Carbonated Rego Humic Gleysol) Lt

19. Soils developed on a thin mantle (25-60 cm) of sandy sediments (FS, LFS, LS) over a thin strata (10-40 cm) of very strongly calcareous loamy (L, SiL, SiCL) glacial till (limestone and granitic origin) over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.

(a) Well to moderately well drained
(i) Kirkness Series (Orthic Black) Kk

(b) Imperfectly drained
(i) Killeen Series (Gleyed Carbonated Rego Black) Kn

20. Soils developed on a thin mantle (25-60 cm) VFS, LVFS, FSL textured sediments over a thin strata (10-50 cm) very strongly calcareous loamy (L, SiL, SiCL) glacial till (limestone and granitic origin) over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.

(a) Well to moderately well drained
(i) Lockhard Series (Orthic Black) Lk

(b) Imperfectly drained
(i) Lindstrom Series (Gleyed Carbonated Rego Black) Ld

(c) Poorly drained
(i) Lonery Series (Carbonated Rego Humic Gleysol) Ln

21. Soils developed on a thin mantle (25-60 cm) of loamy (L, SiL, SiCL, CL) sediments over a thin strata (10-40 cm) of very strongly calcareous loamy (L, SiL, SiCL) glacial till (limestone and granitic origin) over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.

(a) Well to moderately well drained
(i) Clementi Series (Orthic Black) Ct
(ii) Kleysen Series (Calcareous Black) Ky
(iii) Chambers Series (Rego Black) Cb
(iv) Roddan Series (Orthic Regosol) Rd

(b) Imperfectly drained
(i) Cobfield Series (Gleyed Orthic Black) Cf
(ii) Beresford Series (Gleyed Carbonated Rego Black) Bd

(c) Poorly drained
(i) Vodroff Series (Carbonated Rego Humic Gleysol) Vf

22. Soils developed on a thin mantle (25-75 cm) of silty clay to clay sediments over a thin strata (10-40 cm) of very strongly calcareous loamy (L, SiL, SiCL) glacial till (limestone and granitic origin) over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin.

(a) Well to moderately well drained
(i) Everton Series (Orthic Black) Ev

(b) Imperfectly drained
(i) Justice Series (Gleyed Orthic Black) Js
(ii) Forrest Series (Gleyed Carbonated Rego Black) Ft

(c) Poorly drained
(i) Fenton Series (Carbonated Rego Humic Gleysol) Fn

23. Soils developed on a thin mantle (25-75 cm) of moderately to strongly calcareous loamy (VFSL, L, SiL) sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits.

(a) Well to moderately well drained
(i) Glenboro Series (Orthic Black) Gl

(b) Imperfectly drained
(i) Petrel Series (Gleyed Orthic Black) Pt

(ii) Grover Series (Gleyed Carbonated Rego Black) Gr

(c) Poorly drained

(i) Grayson Series (Carbonated Rego Humic Gleysol) Gn

24. Soils developed on a thin mantle (25-75 cm) of strongly calcareous clay loam to sandy clay loam sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits.

(a) Well to moderately well drained

(i) Wellwood Series (Orthic Black) Wd

(b) Imperfectly drained

(i) Oberon Series (Gleyed Orthic Black) Ob

(ii) Crookdale Series (Gleyed Carbonated Rego Black) Ck

(c) Poorly drained

(i) Sutton Series (Carbonated Rego Humic Gleysol) Su

DESCRIPTION OF THE SOIL SERIES

The soil series of the Brandon Study area are described in alphabetical order and include a general description of the genetic profile type, texture, parent material, topography and drainage. Further information on the suitability and management of each soil for agriculture, their engineering properties and their properties in relation to urban and recreational use is given in other sections of the report.

ARIZONA SERIES Az

The Arizona series consists of moderately well to excessively drained Orthic Regosol soils on weakly to moderately calcareous sandy (FS-LFS, LS) textured lacustrine and deltaic deposits. These soils occur in Association with the Cactus (Rego Black) and Stockton (Orthic Black) soils and occupy the upper slope and knoll positions. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. These soils have rapid permeability and moderate to moderately rapid runoff.

The soil is characterized by a 10 to 15 cm gray to light gray plow layer and a light yellowish brown to very pale brown C horizon. These soils occur usually as part of a complex in hummocky, gently undulating to gently rolling topography with the Cactus, Hummerston, Pleasant and Stockton Series.

ASHMORE SERIES Am

The Ashmore series consists of moderately well to well drained Rego Black soils developed on a thin mantle (25 to 50 cm) of moderately to strongly calcareous sediments of VFS, LVFS, FSL and SL texture overlying moderately to strongly calcareous medium sand to gravelly glaciofluvial deposits. These soils occur in irregularly sloping terrain ranging from gently undulating to strongly rolling. They have moderately rapid permeability in the upper sediments and very rapid permeability in the gravelly deposits; runoff is moderate to rapid depending on the degree of slope. The stone content varies from few to very stony land. The native vegetation consists of bur oak and aspen.

The soil is characterized by a very dark gray Ah or Ahk horizon 10 to 17 cm thick and a thin AC horizon. A lime accumulation layer may be present. Cultivated soils on the gently undulating and undulating slopes may be slightly eroded.

ASSINIBOINE SERIES As

The Assiniboine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, stratified, dominantly clayey recent deposits of silty clay and clay with stratum of silty clay loam and clay loam texture. They occur in the flood plain of stream channels. The permeability is moderately slow to slow, and runoff is slow. The topography is level to gently undulating. The native vegetation consists of ash, elm with tall prairie to prairie meadow grasses.

The Assiniboine soil is characterized by a weak dark gray to gray Ah or Ap horizon that is somewhat darker than the C horizon. Under moist conditions the surface looks quite dark, but on drying, lightens up considerably. The C horizon is stratified, and may contain dark stratum representing former surfaces. The soils contain iron stains and mottles in the subsoil.

A description of the Assiniboine soil is given below:

Ap — 0 to 13 cm. gray to dark gray (10YR 4.5/1 d, 10YR 3/1 m) silty clay; weak, very fine to fine granular; very sticky when wet, firm when moist, hard when dry; very plastic; neutral; noncalcareous.

Ah — 13 to 40 cm, gray to dark gray (10YR 4.5/1 d, 10YR 3/1 m) stratified silty clay to clay; weak fine granular; very sticky when wet, firm when moist, hard when dry; very plastic; neutral; noncalcareous; clear, smooth boundary.

Cgj — 40 to 80 cm. grayish brown (2.5YR 5/2 d, 2.5Y 3.5/2 m) stratified silty clay to clay; weak fine granular; very sticky when wet, firm when moist, hard when dry; very plastic; neutral; noncalcareous; few iron mottles.

Ckgj — 80 to 100 cm, grayish brown (2.5Y 5/2 d, 2.5Y 3.5/2 m) stratified, silty clay to clay; weak fine granular; very sticky when wet, firm when moist; very plastic; mildly alkaline; weakly calcareous; few iron mottles.

AXFORD SERIES Ax

The Axford series consists of well to moderately well drained Orthic Regosol soils (that have weak profile development) on a variable depth (50 to 90 cm) of calcareous stratified sand and gravel (glaciofluvial) overlying strongly calcareous silty glaciolacustrine (dominantly SiL to SiCL) sediments. The surface texture is loamy fine sand to fine sand. These soils occur adjacent to the Minnedosa River near the junction to the Assiniboine River. These soils occur in the upper slops positions of undulating topography; the native vegetation consists of trembling aspen, bur oak, chokecherry, rose and grasses.

The soil is characterized by dark gray to gray Ah or Ahk horizons of 6 to 10 cm thick, a thin Cca 4 to 6 cm thick; the depth is usually dependent on the depth of loamy sand to sand over the coarser sand and gravel. The depth of gravel varies from 50 to 90 cm. The underlying sediments consist of stratified pale brown to very pale brown silt loam to silty clay loam textured lacustrine sediments.

They occur as a complex with Boswell and Marringhurst soils in gently to moderately rolling (hummocky) topography. These soils occupy the intermediate slope positions while the Marringhurst soils occupy the upper slope and apex position.

BASKER SERIES Bk

The Basker series consists of poorly to very poorly drained Carbonated Rego Humic Gleysol soils developed on moderately to strongly calcareous, stratified dominantly loamy textured recent alluvial sediments. The textures of the soil vary from fine sandy loam to silty clay loam. They occur as bottom lands adjacent to stream channels and are subject to flooding and are saturated for a considerable period of time in the spring or following heavy rains. The native vegetation consists of dominantly sedges, rushes and willow.

The profile is characterized by a thin layer (3 to 5 cm) of moderately decomposed organic material, and an olive brown to light yellowish brown weak Ahg or Ckg horizon with iron stains. The subsoil is stratified and may have thin organic layers indicating former surfaces. The soil colors are olive to pale yellow and may have some iron mottles in the sandy strata.

BANKTON SERIES Ba

The Bankton series consists of well to moderately well drained Rego Black soils developed on moderately to strongly calcareous silty clay to clay lacustrine deposits. They occur adjacent to the creeks in a level to very gently sloping topography. Permeability is slow; runoff is moderately slow. The natural vegetation consists of tall prairie grasses.

The soil is characterized by a very dark gray to black Ah horizon 16 to 22 cm thick and a calcareous, dark gray AC horizon of irregular thickness (due to past cracking and infilling) grading to the grayish brown C horizon. Some mottles and duller colors occur below the 75 cm depth.

BARAGER SERIES Bg

The Barager series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a variable mantle (30 to 90 cm) of moderately to strongly calcareous outwash and glaciofluvial 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 a 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 ACk horizon which grades to a carbonate accumulation. The solum is relatively shallow and varies with depth from loamy sand to sand layer. Yellowish brown mottles occur above the contact of the coarse materials and the till.

BARREN SERIES Br

The Barren series consists of moderately well to well drained Orthic Regosol soils on strongly to very strongly calcareous clay loam to silty clay loam lacustrine sediments. They occur in the upper slope and knoll position in a gently undulating to moderately rolling topography in association with Carroll (Rego Black) and Prodan (Gleyed Carbonated Rego Black) soils. Originally, these soils had a dark surface, but have been sufficiently eroded that little of the original horizon remains. Permeability is moderate to moderately slow; runoff is rapid.

The soil lacks any recognizeable horizon with the exception of a plow layer that is generally slightly darker than the underlying parent material.

BARWOOD SERIES Bw

The Barwood series consists of imperfectly

drained Gleyed Carbonated Rego Black 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 a level to gently undulating topography; runoff is moderately slow; permeability is moderately slow. The stone content varies from few to moderately stony. The native vegetation consists of dominantly tall prairie grasses.

The soil is characterized by a black to very dark gray Ah horizon 10 to 16 cm, a thin transition ACk, a white carbonate accumulation layer of 15 to 20 cm thick and very pale brown C horizon. The lower carbonated till occurs at 75 to 90 cm depth and is recognized by the presence of shale flakes and light yellowish brown to pale yellow color. A description of the profile is given below:

Ahk — 0 to 11 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) clay loam; weak, fine to medium granular; slightly sticky when wet, friable when moist; slightly plastic; mildly alkaline; weakly calcareous; abrupt, smooth boundary.

Cca — 11 to 31 cm, light gray (10YR 7/2 d, 10YR 6.0/3.5 m) loam; weak, fine to medium granular; slightly sticky when wet, friable when moist; slightly plastic; moderately alkaline; extremely calcareous; gradual, wavy boundary.

Ckgj — 31 to 90 cm, very pale brown (10YR 7/4) loam; weak, medium, angular blocky; slightly sticky when wet, friable when moist; slightly hard when dry; nonplastic; moderately alkaline; extremely calcareous; few, medium, distinct reddish yellow (7.5YR 6/8 m) mottles; clear, smooth boundary.

IICkgj — 90 to 110+ cm, pale yellow (2.5Y 7/4 d, 2.5Y 6/4 m) loam; weak, medium, angular blocky; sticky when wet, friable when moist, slightly plastic; moderately alkaline; strongly calcareous; few, medium, prominent reddish yellow (7.5YR 6/8 m) mottles.

BERMONT SERIES Bm

The Bermont series consists of well drained Rego Black 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 Belmont soil is characterized by a shallow Ah or Ahk horizon 10 to 16 cm thick and an ACk horizon of 4 to 8 cm. This soil profile is similar to the Stewart series (see Stewart series for a description of the profile).

BERESFORD SERIES Bd

The Beresford series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 60 cm) of loamy lacustrine sediments over a thin strata (10 to 40 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 in near level to undulating topographic landscape in association with the Clementi (Orthic Black), Cobfield (Gleyed Orthic Black), or Vodroff (Carbonated Rego Humic Gleysol). They occur in landscapes which are considered to be in a discharge to weak recharge (groundwater) area and may have soluble salts within the rooting zone or subsoil. The runoff is slow, and permeability is moderately slow to slow.

The Beresford soils are characterized by a very dark gray to black Ah horizon 20 to 30 cm, a dark gray ACk horizon of 6 to 12 cm thick. A lime accumulation zone may occur in the loamy lacustrine sediments if the overlay is thick, but in most cases, the solum extends to the loose very strongly calcareous loamy glacial till; the underlying strongly calcareous till of shale limestone and granitic origin is generally more compact and somewhat fissile. A description of a Beresford soil profile is given below:

Ahk — 0 to 28 cm, very dark gray to very dark grayish brown (10YR 3.5/1.5 d, 10YR 2/1 m) clay loam; weak to moderate, fine to medium subangular blocky; friable when moist, slightly hard when dry, plastic; moderately alkaline; moderately calcareous; clear, smooth boundary.

IICca — 28 to 41 cm, light gray to very pale brown (10YR 7.0/2.5 d, 10YR 6/3 m) clay loam (till), weak to moderate, fine to medium, pseudo subangular blocky; friable when moist, hard when dry, plastic; moderately alkaline; extremely calcareous; clear, wavy boundary.

IICkgs — 41 to 54 cm, light brownish gray to light yellowish brown (2.5Y 6/3 d, 2.5Y 4.5/4 m) clay loam (till); weak to moderate, fine to medium pseudo subangular blocky; firm when moist, plastic; moderately alkaline; very strongly calcareous; few, medium, prominent yellowish red (5YR 5/6 m) mottles and gypsum crystals; gradual, wavy boundary.

IIICkgs — 54 to 100 cm, light yellowish brown (2.5Y 6/3 d, 2.5Y 4/4 m) loam; weak to moderate, fine to medium, pseudo subangular blocky; firm when moist, plastic; moderately alkaline, strongly calcareous; few, medium, prominent yellowish red (5YR 5/6 m) mottles and gypsum crystals.

BOSWELL SERIES Bo

The Boswell series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (30 to 90 cm) of moderately to strongly calcareous outwash and glacio-

fluvial sediments of sand to gravel texture overlying very strongly calcareous clay loam to silty clay loam lacustrine sediments. These soils occur in the lower slope positions in an undulating to moderately rolling topographic landscape in association with the Marringhurst, Oxford or Barren soils. Runoff is moderately rapid; permeability is rapid in the surface coarser sediments and moderately slow in the lower fine sediments. These soils are subject to perched water conditions above the more slowly permeable subsoil and to a lateral flow and seepage from the adjacent upland areas.

The soil is characterized by a variable Ah horizon 10 to 20 cm thick, depending on the thickness of sand and occurrence of the coarser gravelly particles. A thin ACk may be present at this contact. Yellowish brown mottles of iron are present in the coarser sediments above the silty clay loam lacustrine sediments.

BROWNRIDGE SERIES Bn

The Brownridge series consists of well to moderately well drained Orthic Regosol soils on weakly to moderately calcareous very fine sandy (VFS, LVFS, FSL) lacustrine and deltaic sediments. These soils occur in association with the Prosser (Orthic Black), Porple (Rego Black), or Pleasant (Gleyed Carbonated Rego Black) soils and occupy the upper slope and knoll positions. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. These soils have moderately rapid permeability; runoff is moderately rapid to rapid depending on the slope gradient. The topography is undulating to moderately rolling.

The soil is characterized by a 10 to 15 cm light gray to light brownish gray calcareous plow layer and a light yellowish brown to very pale brown C horizon. A description of the Brownridge soil is presented below:

Apk — 0 to 10 cm, light gray to light brownish gray (10YR 6.5/1.5 d, 10YR 5/3 m) very fine sandy loam; weak, fine to medium subangular blocky breaking to weak, very fine to fine granular; very friable when moist, soft when dry, nonplastic, moderately alkaline; strongly calcareous, abrupt, smooth boundary.

Ck1 — 10 to 30 cm, pale brown (10YR 6/3 d, 10YR 5.5/5.0 m) stratified loamy very fine sand to very fine sandy loam; structureless; very friable when moist, soft when dry, nonplastic; moderately alkaline; very strongly calcareous.

Ck2 — 30 to 90 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5.5/5.0 m) dominantly loamy very fine sand; structureless; very friable when moist, soft when dry, nonplastic; moderately alkaline; strongly calcareous.

BORNETT SERIES Bt

The Bornett series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 50 cm) of moderately to strongly calcareous very fine sand to sandy loam sediments overlying moderately to strongly calcareous medium sand to gravelly textured deposits. These soils occur in a level to depressional topographic landscape; runoff is slow to negligible; permeability is rapid, but restricted by a high water table throughout the growing season.

The soil is characterized by a thin, moderately decomposed organic layer of 2 to 3 cm thick, a very dark gray to black Ahk horizon of 15 to 24 cm thick, a dark gray ACkg 4 to 6 cm thick, and lime accumulation layer. The subsoil is light olive brown to olive with yellowish brown mottles of iron.

CACTUS SERIES Cc

The Cactus series consists of well drained Rego Black soils developed on moderately calcareous sandy (FS, LFS, LS) textured lacustrine and deltaic deposits. The soil occurs in the upper slope and knoll positions of gently undulating to gently rolling topography. Runoff is moderate to moderately rapid; permeability is moderately rapid. These soils are susceptible to erosion by wind, and must be managed to decrease or minimize the rate of loss.

The soil is characterized by a very dark gray Ah horizon 12 to 16 cm thick and a dark gray ACk 4 to 8 cm thick. A thin lime accumulation is often present.

CAPELL SERIES Cp

The Capell series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments overlying moderately to strongly calcareous medium sand to gravelly textured deposits. These soils occur on level to very gently sloping topography or on the lower slope positions on undulating topography. The soils have moderate permeability in the upper sediments and rapid permeability in the lower coarser sediments, but restricted during periods of subsoil saturation due to a perched condition or high water level. In some areas, where the water contains appreciable soluble salts, a sufficient concentration of salts may occur to inhibit or retard the growth of grasses or cereals.

The soil is characterized by a very dark gray to black Ahk horizon 15 to 24 cm thick, a dark gray to gray ACk horizon 5 to 15 cm thick, and a lime accumulation horizon 8 to 12 cm thick that ex-

tends to or into the coarser materials. Brownish yellow mottles are common in the coarser sediments below. A description of a representative Capell soil is given below:

Ahk — 0 to 28 cm, black (10YR 2/1 d, 10YR 2/1 m) sandy clay loam; weak, fine subangular blocky; friable when moist, soft when dry, slightly plastic; moderately alkaline; weakly calcareous; clear, wavy boundary.

ACk — 28 to 33 cm, dark gray to gray (10YR 4.5/1 d, 10YR 3/1 m) sandy clay loam; weak, fine subangular blocky; friable when moist, soft when dry, slightly plastic; moderately alkaline; strongly calcareous; clear, wavy boundary.

IICca — 33 to 48 cm, light gray (10YR 7/1.5 d, 10YR 6.5/3 m) gravelly sandy loam; weak, fine granular; very friable when moist, slightly hard when dry, nonplastic; moderately alkaline; very strongly calcareous; gradual, wavy boundary.

IICk1 — 48 to 70 cm, light yellowish brown (10YR 6/4 d, m) gravelly sandy loam; stratified, single grained, loose when moist or dry, nonplastic; moderately alkaline; strongly calcareous; gradual, wavy boundary.

IICk2 — 70 to 100 cm, brownish yellow (10YR 5.5/6 d, 10YR 5/4 m) gravelly sand; single grained, stratified; moderately alkaline; strongly calcareous.

CARROLL SERIES Cl

The Carroll series consists of well to moderately well drained Rego Black soils developed on strongly to very strongly calcareous clay loam to silty clay loam, lacustrine deposits. These soils occur on very gently sloping to undulating topography. Runoff is moderate to moderately slow; permeability is moderate. These soils are subject to erosion by wind or water and careful management is required to minimize loss, particularly on the undulating topography.

The Carroll series is characterized by a very dark gray to black Ah or Ahk horizon 15 to 20 cm thick, a dark gray ACk horizon 10 to 15 cm thick and a lime accumulation layer 8 to 14 cm thick.

CARVEY SERIES Cy

The Carvey series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments overlying moderately to strongly calcareous, medium sand to gravelly textured deposits. They occur in level to depressional sites which have a water table at or near the surface for part of the year. Runoff is negligible; permeability of the loamy sediments is moderate to moderately slow above the saturation zone. In areas where the seepage water contains soluble salts, a sufficient concentration of salts may occur in the soil to inhibit the growth of the normal sedge and meadow grasses.

The soil is characterized by a moderately decomposed organic layer 2 to 5 cm thick, a very dark gray Ahk horizon 7 to 15 cm thick, a thin dark gray ACkg horizon and a lime accumulation layer. Yellowish brown mottles are common in the AC and Cca horizon and subsoil.

CHAMBERS SERIES Cb

The Chambers series consists of moderately well to well drained Rego Black soils developed on a thin mantel (25 to 60 cm) of loamy lacustrine sediments over a thin strata (10 to 40 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 in the upper slope positions of gently sloping to hummocky, moderately rolling topography. runoff is moderately rapid to rapid, depending on the slope gradient; permeability is moderate in the lacustrine sediments, and decreases with depth in the tills.

The soil is characterized by a very dark gray to black Ah or Ahk horizon of 10 to 15 cm thick, a thin dark gray to grayish brown ACk horizon of 3 to 8 cm thick and a thin lime accumulation zone. A description of a Chambers soil is given below:

Ahk — 0 to 23 cm, very dark gray (10YR 3.5/1 d, 10YR 2.5/2 m) clay loam; weak to moderate, medium, subangular blocky; friable when moist, slightly hard when dry, plastic; mildly alkaline; noncalcareous; abrupt, smooth boundary.

IICk1 — 23 to 53 cm, light gray to light brownish gray (10YR 6.5/2 d, 10YR 5.5/3 m) silty clay loam (till); very weak, fine to medium pseudo platy; friable when moist, hard when dry, plastic; moderately alkaline; very strongly calcareous.

IICk2 — 53 to 105 cm, very pale brown (10YR 7/3 d, 10YR 4.5/4 m) silt loam; weak, medium to coarse pseudo platy; firm when moist, hard when dry, nonplastic; moderately alkaline; extremely calcareous; few, medium, prominent red (2.5YR 4/7 m) mottles.

IIICk — 105+ cm, light yellowish brown (2.5Y 6/4 d, m) loam; weak to moderate; fine to medium, pseudo subangular blocky; firm when moist, slightly hard when dry, plastic; moderately alkaline; strongly calcareous.

CHARMAN SERIES Cm

The Charman series consists of imperfectly drained Gleyed Carbonated Rego Black soils on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits. They occur on level to very gently sloping topography in areas where the water table occurs within the meter depth for a considerable period. Runoff is slow; permeability is moderate, but may be restricted due to the saturation of the subsoil. In some areas

of seepage or discharge, soluble salts in the subsoil and water may be translocated nearer the surface in appreciable quantities to affect crop growth.

The Charman series consists of a very dark gray to black Ahk horizon 15 to 22 cm thick and a dark gray to dark grayish brown ACk horizon, 5 to 12 cm thick. A light gray lime accumulation Cca is usually present. Some gypsum crystals may be evident below the Cca horizon. Yellowish brown mottles of iron are usually present in the subsoil.

CHATER SERIES Ch

The Chater series consists of moderately well to well drained Calcareous Black soils developed on a variable mantle (30 to 90 cm) of moderately to strongly calcareous outwash and glaciofluvial sediments of medium sand to gravel 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. These soils occur in gently undulating to moderately rolling topography. Surface runoff is moderately rapid; permeability is rapid in the coarser sediments and moderate to moderately slow in the underlying tills. These soils are in favorable topographic positions to allow excess water above the till to flow laterally to downslope positions.

The soil is characterized by a 12 to 18 cm thick, very dark gray Ah horizon and a grayish brown to brown Bmk horizon of 8 to 15 cm thick, and a lime accumulation horizon beginning usually at the contact of a sand stratum with a gravelly stratum.

CLEMENTI SERIES Ct

The Clementi series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 60 cm) of loamy lacustrine sediments over a thin strata (10 to 40 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin over a strongly calcareous loam to clay loam till of shale, limestone and granitic origin. These soils occur in intermediate to upper slopes of a gently sloping, undulating or rolling topography. Runoff is moderate to moderately rapid; permeability is moderate in lacustrine sediments and in the loose, very strongly calcareous till, and moderately slow to slow in the more compact, somewhat fissile, loam to clay loam till.

The soil is characterized by a very dark gray to black Ah horizon 10 to 14 cm thick, a dark brown to brown Bm horizon 8 to 12 cm thick; the A and B horizons are developed in the lacustrine overlay; the underlying very strongly calcareous till appears as a strongly developed lime carbonate layer. A description of a Clementi profile is given below:

Ap — 0 to 14 cm, black (10YR 2/1 d, 10YR 2/1 m) loam; weak, fine to medium subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; abrupt, smooth boundary.

Bm1 — 14 to 28 cm, dark brown to very dark grayish brown (10YR 3/2.5 d, 7.5 YR 3/2 m) loam; weak, fine to medium subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; clear, wavy boundary.

Bm2 — 28 to 37 cm, dark yellowish brown (10YR 4/4 d, 10YR 3/3 m) loam; weak to moderate, fine to medium, subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; clear, wavy boundary.

IIBCk — 37 to 44 cm, yellowish brown (10YR 4.5/4 d, 7.5YR 4/4 m) loam; weak, fine to medium subangular blocky; friable when moist, soft when dry; slightly plastic; mildly alkaline; strongly calcareous; clear, wavy boundary.

IICca — 44 to 78 cm, light gray to very pale brown (10YR 7/2.5 d, 10YR 7.5/3 m) loam (till); weak to moderate, fine to medium subangular blocky; friable when moist, hard when dry, nonplastic; mildly alkaline; extremely calcareous; few, fine, prominent red (2.5YR 4/6 m) mottles; clear, wavy boundary.

IIICk — 78 to 105 cm, pale brown (10YR 6/3 d, 10YR 4/3.5 m) sand; single grained; loose, nonplastic; mildly alkaline; moderately calcareous; few, fine prominent red (2.5YR 4/6 m) mottles; clear, wavy boundary.

IIICk — 105+ cm, pale brown to very pale brown (10YR 6.5/3 d, 2.5Y 5/4 m) loam (till); weak to moderate, fine to medium, pseudo subangular blocky; moderately alkaline; very strongly calcareous; few, fine, prominent red (2.5YR 4/6 m) mottles.

COBFIELD SERIES Cf

The Cobfield series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 60 cm) of loamy lacustrine sediments over a thin strata (10 to 40 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 in the mid to lower slope position of gently sloping to undulating topography of dominantly weak recharge areas. The runoff is moderately slow; permeability is moderate in the upper lacustrine sediments and moderately slow to slow in the lower till.

The soil is characterized by a very dark gray to black Ah horizon 10 to 18 cm thick, a brown to dark yellowish brown Bm horizon of 8 to 12 cm thick, with few, yellowish brown to strong brown mottles, and a lime accumulation horizon. The underlying till usually has yellowish brown mottles; the lower till of shale, limestone and granitic origin is olive brown to light olive brown, which is indicative of periodic saturation and reducing conditions.

CORDOVA SERIES Cv

The Cordova series consists of moderately well to well drained Calcareous Black soils developed on a thin mantle (25 to 50 cm) of very strongly loamy 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 the mid to upper slope positions on gently sloping to gently rolling topography. Runoff is moderate to moderately rapid depending on the slope; permeability is moderately slow.

The soil is characterized by a very dark gray Ah horizon 15 to 20 cm thick, a dark brown to brown Bmk horizon 10 to 18 cm thick, and a lime accumulation zone of 8 to 15 cm thick. The solum is relatively thin due to high carbonate content of the parent material. In some sites where the higher lime material was thin, a deeper soil was developed. A description of a representative Cordova soil is given below:

Ap — 0 to 15 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) clay loam; moderate, fine granular; friable when moist, slightly hard when dry, plastic; neutral; noncalcareous; abrupt, smooth boundary.

Bmk — 15 to 20 cm, brown to dark brown (10YR 4/3 d, 10YR 3/3 m) clay loam; weak to moderate, fine prismatic breaking to moderate, fine, subangular blocky; friable when moist, slightly hard when dry, plastic; neutral; weakly calcareous; clear, irregular boundary.

BCk — 20 to 30 cm, pale brown (10YR 6/3 d, 10YR 4.5/3 m) clay loam; weak, fine subangular blocky; friable when moist, slightly hard when dry, plastic; mildly alkaline; moderately calcareous; clear, wavy boundary.

Cca — 30 to 46 cm, white (10YR 8/2 d, 10YR 6.5/3 m) silty clay loam; weak, fine granular; friable when moist, hard when dry, plastic; moderately alkaline; very strongly calcareous; clear, smooth boundary.

Ck — 46 to 68 cm, very pale brown (10YR 7/3 d, 10YR 5/4 m) clay loam; massive breaking to very fine to fine, pseudo granular; firm when moist, hard when dry, plastic; moderately alkaline; very strongly calcareous; few, fine distinct, strong brown (7.5YR 5/8 m) mottles; abrupt, smooth boundary.

IICk — 68 to 100 cm, pale brown to very pale brown (10YR 6.5/3 d, 10YR 5.5/3 m) clay loam to loam; weak to moderate, fine subangular pseudo subangular blocky; firm when moist, hard when dry, plastic; moderately alkaline; strongly calcareous; few, fine, distinct, strong brown (7.5YR 5/8 m) mottles.

CROYON SERIES Cr

The Croyon series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy lacustrine sediments overlyiing moderately to strongly calcareous medium sand to gravelly textured deposits. The soil occurs in the mid and upper slope positions of gently undulating to undulating topography. The runoff is moderately rapid; permeability is moderate to moderately rapid in the upper sediments and very rapid in the lower, coarser sediments.

The soil is characterized by a very dark gray to black Ah horizon 20 to 30 cm thick, a brown to dark brown Bm horizon 10 to 18 cm thick and a BCk. A description of the Croyon series is given below:

LH — 2 to 0 cm, very dark brown (10YR 2.5/2 d, 10YR 3/1.5 m) partially decomposed leaf mat; neutral; clear, smooth boundary.

Ah — 0 to 17 cm, very dark gray to very dark grayish brown (10YR 3/1.5 d, 10YR 2/1 m) sandy clay loam; moderate, medium, granular; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; clear, smooth boundary.

Bm — 17 to 36 cm, dark brown to very dark grayish brown (10YR 3/2.5 d, 10YR 2.5/2 m) sandy clay loam; moderate, medium prismatic breaking to moderate, fine to medium subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; gradual, wavy boundary.

BCk — 36 to 46 cm, brown to dark brown (10YR 4/3 d, 10YR 4/4 m) sandy loam; weak to moderate, medium prismatic breaking to moderate, fine to medium subangular blocky; friable when moist, soft when dry, nonplastic; mildly alkaline; very weakly calcareous; clear, smooth boundary.

IICk1 — 46 to 70 cm, brown to grayish brown (10YR 5/2.5 d, 10YR 5/3 m) gravelly sandy loam; stratified; loose, nonplastic; mildly alkaline; strongly calcareous; common, medium, distinct, olive brown (2.5Y 6/6 m) mottles; clear, smooth boundary.

IICk2 — 70 to 110 cm, yellowish brown (10YR 5/4 d, 10YR 4/3 m) very gravelly sand; stratified, loose, nonplastic, moderately alkaline; strongly calcareous; common, medium, distinct olive brown (2.5Y 6/6 m) mottles.

IICk3 — 110+ cm, yellowish brown (10YR 5/4 d) and strong brown (7.5YR 5.5/6 d, 10YR 4/3 m) gravelly sand; stratified, loose, nonplastic; moderately alkaline; strongly calcareous; common, medium, distinct olive brown (2.5Y 6/6 m) mottles.

CROOKDALE SERIES Ck

The Crookdale series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 75 cm) of strongly calcareous clay loam to sandy clay loam sediments grading to moderately calcareous sandy deposits. They occur on level to very 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 and summer.

The soil is characterized by a very dark gray to black Ah horizon 15 to 24 cm thick, and a weakly mottled dark grayish brown to brown Bm horizon 12 to 20 cm thick, and a weakly mottled BCk horizon. A lime carbonate horizon Cca is usually present. The subsoil is olive brown to light olive brown with yellowish brown mottles.

DEXTER SERIES Dt

The Dexter series consists of imperfectly drained Gleyed Orthic Black soils, developed on moderately to strongly calcareous, stratified outwash and glacial fluvial deposits of medium sands to gravelly texture. These soils occur on very gently to gently sloping topography, or occur in the lower slope positions in association with Marringhurst soils on irregular, undulating topography. Runoff is moderate; permeability in the upper solum is rapid, but may be restricted in the subsoil by a saturation zone during the spring and early summer. The soil materials are stratified with strata ranging from fine sands to coarse gravels.

The soil is characterized by a very dark gray Ah horizon, 15 to 20 cm thick, and a grayish brown to brown Bm horizon, 10 to 25 cm thick; a lime accumulation horizon may be present. The depth of solum varies with the depth to a coarser strata.

To differentiate between soils with the sand substrate rather than the stratified sand and gravel substrate, the Dexter, sandy substrate was designated as Dtl. This indicates that the substrate is dominantly coarse sands with minimal gravel.

DOGAND SERIES Dg

The Dogand series consists of well to moderately well drained Calcareous Black soils developed on a sequence of soil materials composed of a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments over thin (10 to 40 cm) medium sand to gravel strata, over a very strongly calcareous loamy textured glacial till. Strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin usually occurs within a two meter depth. The soils occur on gently sloping topography; runoff is moderate; permeability is moderate to rapid in the upper loamy and coarser strata and moderately slow in the underlying till.

The soil is characterized by a very dark gray Ahk horizon 10 to 15 cm thick, a brown to dark grayish brown Bmk horizon of 8 to 12 cm thick and a thin BCk. A lime accumulation layer occurs at the contact of the loamy sediments and the coarser strata.

DRUXMAN SERIES Dx

The Druxman series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments overlying moderately to strongly calcareous medium sand to gravelly textured deposits. These soils occur in gently sloping to level topography. They have a high water table during the spring and early summer. Runoff is moderately slow; permeability is moderate in the upper loamy sediments, and rapid in the coarser sediments below, when not restricted by a high water table.

The soil is characterized by a very dark gray Ah horizon 15 to 24 cm thick, a dark yellowish brown to olive brown Bm horizon with yellowish brown mottles; the depth of solum depends on the depth of the loamy sediments, with the Bm or BCk terminating at the contact of the underlying coarser textured sediments. A lime accumulation horizon is often present at or immediately below this contact. A description of the Druxman soil is given below:

Ah	— 0 to 20 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) clay loam; weak to moderate, fine, granular; friable when moist, soft when dry, plastic; neutral; noncalcareous; clear, wavy boundary.
Bm1	— 20 to 37 cm, dark brown (10YR 3/3 d, m) loam; moderate, medium, prismatic breaking to moderate, coarse granular; friable when moist, soft when dry, slightly plastic; neutral, noncalcareous; clear, wavy boundary.
Bm2	— 37 to 56 cm, brown (10YR 4/3 d, m) loam; weak, medium prismatic breaking to weak coarse granular; friable when moist, soft when dry, slightly plastic; neutral; clear, smooth boundary.
IIBCk	— 56 to 68 cm, grayish brown (10YR 5/2 d, 10YR 5/3 m) gravelly loamy sand; single grained; mildly alkaline; weakly calcareous; abrupt, smooth boundary.
IICk1	— 68 to 82 cm, dark grayish brown (2.5Y 4/2 d, 2.5Y 6/4 m) loamy sand; single grained, stratified; nonplastic; milkly alkaline; moderately calcareous.
IICk2	— 82 to 110 cm, light brownish gray (2.5Y 6/2 d, 2.5Y 4.5/2 m) sand; single grained, stratified; moderately alkaline; moderately calcareous; few, medium, prominent strong brown (7.5YR 5/6 m) mottles.
IICk3	— 110+ cm, light brownish gray (2.5Y 6/2 d, 2.5Y 4.5/2 m) sand; single grained, stratified; moderately alkaline; strongly calcareous; few, medium prominent strong brown (7.5YR 5/6 m) mottles.

DORSET SERIES Dr

The Dorset series consists of moderately well to well drained Orthic Black soils, developed on moderately to strongly calcareous, stratified outwash and glacial fluvial deposits of medium sand

to gravelly texture. These soils occur on gently sloping to irregular, gently rolling topography. On the complex topography, they occur as a complex with other soils. Runoff is moderate to moderately rapid; permeability is very rapid.

The soil is characterized by a very dark gray Ah horizon, 12 to 18 cm thick and a brown to dark brown Bm horizon (BA and Bm), 15 to 22 cm thick. The Cca horizon is 6 to 12 cm thick. These soils differ from the Marringhurst which has carbonates present in the Ah and Bmk horizons. A description of the Dorset soil is given below:

LH — 4 to 0 cm, very dark gray to black (10YR 2.5/1 d, m) decomposed grasses and herbs; neutral, noncalcareous; clear, wavy boundary.

Ah — 0 to 15 cm, very dark gray (10YR 3/1 d, 10YR 2.5/1 m) coarse sand to loamy coarse sand; single grained; loose when moist, loose when dry; nonplastic, neutral, noncalcareous; clear, wavy boundary.

Bml — 15 to 29 cm, dark brown (10YR 3.5/3 d, 7.5YR 3.5/2 m) coarse sand to loamy coarse sand; single grained; loose when moist or dry; nonplastic; neutral; noncalcareous; clear, wavy boundary.

Bm2 — 29 to 35 cm, brown (7.5YR 4.5/4 d, 5YR 3.5/4.0 m) coarse sand; loose when moist or dry; nonplastic; neutral; noncalcareous; few, fine, faint dark reddish brown bottles; gradual, wavy boundary.

Cca — 36 to 45 cm, light yellowish brown (10YR 6.5/4 d, 10YR 5.5/6.0 m) very gravelly coarse sand; single grained; loose; mildly alkaline; moderately calcareous; few, fine, distinct yellowish red mottles; gradual, wavy boundary.

Ck — 45 to 100 cm, pale brown (10YR 6.5/3.0 d, 10YR 5.0/4.0 m) stratified sand to coarse sand; single grained; mildly alkaline; moderately calcareous; common, medium, distinct yellowish red (5YR 4/8 m) mottles.

The Dorset, sandy substrate phase was designated as Drl to indicate that the subsoil was cominantly coarse sands with minimal strata of gravel.

DURNAN SERIES Dn

The Durnan series consists of moderately well to well drained Rego Black soils developed on strongly to very strongly calcareous very fine sandy loam to silt loam lacustrine sediments. The soil occurs in the upper slope and knoll positions of gently undulating to gently rolling topography. Runoff is moderate to rapid depending on the slope gradient; permeability is moderate to moderately rapid. These soils are susceptible to erosion by wind or water and must be carefully managed to minimize soil loss.

The soil is characterized by a very dark gray Ahk horizon 10 to 14 cm thick and a dark gray to gray ACk horizon. A thin lime accumulation of 4 to 7 cm may be present.

EVERTON SERIES Ev

The Everton series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata (10 to 40 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. The soils occur on gently sloping topography or in the upper slope positions of gently undulating to undulating plain. Runoff is moderate; permeability is moderately slow to slow.

The soil is characterized by a granular very dark gray to black Ah horizon 10 to 15 cm thick, a dark grayish brown to brown, fine subangular blocky Bm horizon 8 to 14 cm thick and a pale brown BCk horizon. In areas where the clay overlay is not too deep, the solum extends to the contact of the clay with the very strongly calcareous glacial till which appears a s a prominent Cca horizon.

FAIRLAND SERIES Fd

The Fairland series consists of moderately well to well drained Orthic Black soils developed on strongly to very strongly calcareous loamy (VFSL, L, SiL) lacustrine sediments. The soils occur on gently sloping to gently rolling topography. Runoff is moderately rapid; permeability is moderate. These soils have had some of their surface eroded and often appear as a complex with the Knoll or Durnan series.

The soil is characterized by a very dark gray to very dary grayish brown Ah horizon 10 to 15 cm thick, a brown to dark brown Bm horizon 10 to 14 cm thick and a pale brown BCk horizon. A lime accumulation horizon is usually present. A representative profile of the Fairland soil is given below:

Ah — 0 to 16 cm, very dark grayish brown (10YR 3/2 d, 10YR 3.5/2 m) silt loam; weak, fine to medium, subangular blocky; friable when moist, soft when dry, slightly plastic; mildly alkaline; noncalcareous; clear, wavy boundary.

Bm — 16 to 26 cm, brown (10YR 4/2.5 d, 10YR 3.5/3 m) silt loam; weak, fine to medium granular; friable when moist, soft when dry, slightly plastic; moderately alkaline; weakly calcareous; clear, wavy boundary.

Cca — 26 to 40 cm, light gray to very pale brown (10YR 7.5/2.5 d, 10YR 5.5/4 m) silty clay loam; weak, fine subangular blocky; friable when moist, slightly hard when dry, slightly plastic; strongly alkaline; extremely calcareous; clear, wavy boundary.

Ckl — 40 to 63 cm, pale brown to very pale brown (10YR 6.5/3 d, 2.5Y 5.5/4 m) silt loam; weak,

fine to medium, subangular blocky; friable when moist, soft when dry, slightly plastic; strongly alkaline; extremely calcareous; clear, wavy boundary.

Ck2 — 63 to 100 cm, pale yellow to yellow (2.5Y 7/5 d, 2.5Y 5/4 m) silt; weak to moderate, fine to medium pseudo subangular blocky breaking to fine to medium pseudo platy; moderately alkaline; very strongly calcareous; common, medium, prominent reddish yellow (5YR 6/8 m) and gray (10YR 5/1 m) mottles.

FENTON SERIES Fn

The Fenton series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata (10 to 40 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 in level to depressional topography and are subject to ponding and prolonged wetness. Runoff is very slow; permeability is slow to very slow. Some 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 thin, moderately decomposed organic layer 2 to 5 cm thick, a very dark gray Ah horizon, 8 to 12 cm thick, a thin olive gray ACk horizon, and olive C horizon that may have some yellowish brown mottles. Silt pseudomycelium of magnesium sulfate or gypsum may be present in the surface horizon of saline areas.

FORREST SERIES Ft

The Forrest series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata (10 to 40 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 level to very gently sloping topography. They are subject to some lateral seepage through the less compact very strongly calcareous till. Runoff is moderately slow to slow; permeability is slow to moderately slow in the silty clay to clay strata, and in the underlying lower strongly calcareous till which is more compact and somewhat fissile. Soluble salts are usually found in the subsoil.

The soil is characterized by an irregular very dark gray Ah or Ahk horizon, 10 to 15 cm thick, with tongues to 25 cm, a dark gray to olive gray ACk, 4 to 8 cm thick and a weakly mottled light olive brown C horizon.

FORTIN SERIES Fr

The Fortin series consists of poorly drained Carbonated Rego Humic Gleysol soils, developed on moderately to strongly calcareous, stratified outwash and glacial fluvial deposits of medium sand to gravelly texture. These soils occur on level to depressional topography in association with the Marringhurst, Mansfield and Dexter soils. Runoff is very slow to negligible; permeability is moderately rapid to rapid, but restricted during periods when free water is at or near the surface. Natural vegetation consists of sedges, cattails, and some willow.

The soil is characterized by a thin, moderately decomposed organic layer, 1 to 4 cm, a very dark gray Ah horizon, 10 to 20 cm thick, and olive gray ACkg horizon with yellowish brown mottles. A lime carbonate horizon is usually present at or above a coarser lense or strata.

The Fortin, sand substrate phase was designated as Frl to indicate that the subsoil was dominantly coarse sands with minimal strata of gravel.

GATESIDE SERIES Gt

The Gateside series consists of imperfectly drained Gleyed Orthic Black soils developed on moderately to strongly calcareous very fine sand, loamy very fine sand and fine sandy loam textured sediments. The soils occur in gently sloping to level topography. Runoff is slow to moderately slow; permeability is moderately rapid to moderate. They have a water table within a meter of the surface during the spring and early summer period.

The soil is characterized by a very dark gray to black Ah horizon of 12 to 18 cm thick, a brown, dark yellowish brown to olive brown weakly gleyed Bm horizon with the presence of yellowish brown mottles, and a light olive brown BCk horizon. A lime accumulation horizon may be present. The subsoil varies from light olive brown to light yellowish brown and usually contains yellowish brown to strong brown mottles. A description of a representative Gateside profile is given below:

Ap — 0 to 15 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) fine sandy loam; weak, fine to medium subangular blocky; very friable when moist, soft when dry, nonplastic; neutral; abrupt, smooth boundary.

Ah — 15 to 35 cm, dark grayish brown (10YR 4/2 d, 10YR 3.5/3 m) fine sandy loam; very weak fine granular; very friable when moist, soft when dry, nonplastic; neutral; gradual, irregular boundary.

Bm — 35 to 60 cm, yellowish brown (10YR 5/4 d, 10YR 4.5/4 m) fine sandy loam; very weak, fine

granular; very friable when moist, loose when dry, nonplastic; mildly alkaline; noncalcareous; few, fine faint mottles; abrupt, smooth boundary.

Cca — 60 to 75 cm, light gray (10 YR 7/2 d, 10YR 5/3 m) loam; very weak, fine to medium granular; friable when moist, hard when dry, slightly plastic; moderately alkaline; strongly calcareous; few, fine, faint yellowish brown (10YR 5/6 m) mottles; clear, wavy boundary.

Ckg1 — 75 to 90 cm, light yellowish brown (2.5Y 6/4 d, 10YR 5.5/6 m) fine sandy loam; single grained; loose when moist or dry, nonplastic; moderately alkaline; moderately calcareous; common, coarse, distinct strong brown (7.5YR 5/8 m) mottles; clear, wavy boundary.

Ckg2 — 90+ cm, pale yellow to light yellowish brown (2.5Y 6.5/4 d, 2.5Y 5.5/2 m) loam; weak, fine to medium, granular; friable when moist, soft when dry, slightly plastic; moderately alkaline; moderately calcareous; many, coarse, distinct strong brown (7.5YR 5/8 m) mottles.

GENDZEL SERIES Gz

The Gendzel series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous, sandy sediments overlying moderately to strongly calcareous medium sand to gravelly textured sediments. The soil occurs in a level to gently sloping topography. Runoff is moderately slow; permeability is moderately rapid to rapid, but may be restricted in the subsoil during periods when the water table is high.

The soil is characterized by a very dark gray to black Ahk horizon, 10 to 16 cm thick, a dark gray to light gray ACk horizon 5 to 9 cm thick and a lime accumulation horizon 6 to 12 cm thick. In the soils with a shallow solum, the lime accumulation horizon occurs at the transition of the sandy to gravelly sediments.

GLENBORO SERIES Gl

The Glenboro series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 75 cm) of moderately to strongly calcareous loamy (VFSL, L, SiL) sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits; some stratified sands to loams may occur in the transition to the fine sand subsoil. The soils occur on a gently sloping to gently undulating topography. Runoff is moderately slow; permeability is moderate in the loamy sediments and moderately rapid in the underlying sandy sediments.

The soil is characterized by a granular very dark gray to black Ah horizon 12 to 18 cm thick and a subangular blocky dark brown to brown Bm or Btj horizon, 10 to 16 cm thick; a brown to pale brown BCk, 6 to 14 cm thick grades into a light gray to very pale brown lime accumulation horizon. The underlying sandy sediments are pale brown to light yellowish brown; a few strong brown to reddish yellow mottles may be present between the 75 to 100 cm depth.

A description of the Glenboro series is provided below:

Ah — 0 to 22 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) sandy clay loam; weak to moderate, fine to medium, granular; friable when moist, soft when dry, slightly plastic; slightly acid; clear, irregular boundary.

AB — 22 to 26 cm, very dark grayish brown (10YR 3/2 d, 10YR 3/2.5 m) loam; weak to moderate, medium to coarse angular blocky; friable when moist, soft when dry, slightly plastic; slightly acid; clear, irregular boundary.

Bm — 26 to 42 cm, brown (10YR 4.5/3 d, 10YR 4/3 m) loam; moderate, very coarse columnar breaking to moderate coarse subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; clear, wavy boundary.

Ck1 — 42 to 68 cm, light brownish gray (2.5Y 6/2 d, 2.5Y 5.5/4 m) sandy loam; very weak, fine to medium subangular blocky to weak, coarse granular; friable when moist, slightly plastic; moderately alkaline; moderately calcareous; abrupt, broken boundary.

Ck2 — 68 to 72 cm, light brownish gray (2.5Y 6/2 d, 2.5Y 5.5/4 m) loam; weak, fine to medium pseudo granular; very friable when moist, soft when dry, nonplastic; moderately alkaline; moderately calcareous.

Ck3 — 72 to 120 cm, light olive brown (2.5Y 5.5/4 d, 2.5Y 5/4 m) loam; weak, fine to medium pseudo granular; very friable when moist, slightly plastic; moderately alkaline; moderately calcareous (within this depth occur small pockets of fine sandy loam textured sediments).

GRAYSON SERIES Gn

The Grayson series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 75 cm) of moderately to strongly calcareous loamy (VFSL, L, SiL) sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. The soils occur in level to depressional topography and have a saturation zone at or very near the surface for a considerable time. Runoff is very slow to negligible; permeability of the soil material is moderate, but restricted during periods when the soil is saturated.

The soil is characterized by a thin, moderately decomposed organic layer 2 to 5 cm thick, a very dark gray Ah or Ahk horizon 8 to 12 cm thick and a dark gray ACk. In some soils, thin cumulic layers of organic and mineral matter may be present at the surface. A lime carbonate horizon is often present below the ACk. The subsoil is light olive brown to olive and may have yellowish brown mottles.

GROVER SERIES Gr

The Grover series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 75 cm) of moderately to strongly calcareous loamy (VFSL, L, SiL) sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. The soil occurs in a level to gently sloping topography. Runoff is moderately slow to slow; permeability is moderate with some restrictions in the subsoil during periods of high water table.

The soil is characterized by a very dark gray Ah horizon, 10 to 15 cm thick, a dark gray to dark grayish brown ACk horizon, 4 to 8 cm thick, and a lime accumulation layer.

HARDING SERIES Hg

The Harding series consists of imperfectly drained Gleyed Orthic Black soils developed on moderately to strongly calcareous, silty clay to clay lacustrine deposits. These soils occur on level to very gently sloping topography. Runoff is slow; permeability is moderately slow to slow. Most of these soils occur within a discharge region characterized by an upward pressure of groundwater or a lateral flow of water through the underlying very strongly calcareous till which occurs at depth of one to two meters. Appreciable soluble salts may be present within the rooting zone and gypsum crystals are common.

The soil is characterized by a very dark gray Ah horizon 12 to 22 cm thick, a dark grayish brown, prismatic to subangular blocky Bm horizon, 15 to 20 cm thick with fine yellowish brown mottles; a lime accumulation horizon is common. Salt pseudomycelium and gypsum concretions are common in the olive brown to olive C horizon.

HICKSON SERIES Hk

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 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 AC horizon with mottles. The C horizon is pale olive and may contain yellowish brown mottles.

HILTON SERIES Hn

The Hilton series consists of moderately well to well drained Orthic Black 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 mid to upper slope positions of a gently undulating to moderately rolling topography. Runoff is moderate to rapid depending on the slope gradient; permeability is moderate in the upper loose loamy till and moderately slow in the more compact, somewhat fissile till. These soils are subject to erosion by water and wind, particularly on the undulating and gently rolling landscapes.

The soil is characterized by a very dark gray Ah horizon, 10 to 12 cm thick and a calcareous, grayish brown to brown Bm horizon 4 to 8 cm thick that has appreciable unaltered carbonate minerals. The solum is shallow due to high lime content of the soil. The stone content varies from slight to strongly stony.

HUMMERSTON SERIES Hm

The Hummerston series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on weakly to moderately calcareous, sandy (FS, LFS, LS) textured lacustrine and deltaic deposits. The surface texture is variable from loamy fine sand with local areas of very fine sand or loamy very fine sand. Topography is level to irregular, gently undulating; runoff is moderately slow, and permeability is moderately rapid, but some impediment may occur during the spring and early summer due to a high water table. These soils have had some surface erosion by wind.

The soil is characterized by a very dark gray Ah horizon 15 to 20 cm thick, a dark gray ACk horizon, 10 to 18 cm thick and a light yellowish brown C horizon with prominent mottles.

JANICK SERIES Jk

The Janick series consists of well to moderately well drained Orthic Black soils developed on moderately to strongly calcareous silty clay to clay lacustrine deposits. These soils occur on a nearly level to gently undulating topography in the mid and upper slope positions. Permeability is slow; runoff is moderately slow.

The soil profile is characterized by a very dark gray to black Ah horizon 10 to 18 cm thick, a dark grayish brown to brown, fine subangular blocky Bm horizon 8 to 15 cm thick and a pale brown BCk horizon. The C horizon is light grayish brown to pale brown. Some mottles and duller colors occur below the 75 cm depth.

JUSTICE SERIES Js

The Justice series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata (10 to 40 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. The topography is level to gently sloping; runoff is slow, and permeability is moderately slow to slow. These soils are influenced by a subsoil seepage condition in the very strongly calcareous till and an upward pressure of groundwater. Although these soils are not saline, some of the adjacent soil types have appreciable soluble salts within their solum.

The soil is characterized by a very dark gray Ah horizon, 12 to 22 cm thick, a dark grayish brown, prismatic to subangular blocky Bm horizon 15 to 20 cm thick, with fine yellowish brown mottles; a lime accumulation horizon is common. Where the clay overlay is shallow, the depth of solum extends to the contact of the very strongly calcareous till.

KERRAN SERIES Kr

The Kerran series consists of poorly to very poorly drained Carbonated Rego Humic Gleysol and Carbonated Rego Gleysol soils on moderately to strongly calcareous, stratified, dominantly clayey recent deposits of silty clay and clay with stratum of silty clay loam and clay loam texture. They occur in the level to depressional sites in the flood plain of stream channels and are subject to flooding, or are saturated for a considerable period of time in the spring or following heavy rains. The native vegetation consists of dominantly sedges, rushes and willow.

The Kerran soils are characterized by a thin organic layer of 1 to 2 cm, and either a weakly developed dark gray Ahk horizon of 10 to 15 cm thick or a light gray to pale brown recent depositional (Ck) layer. The C horizon is usually mottled, stratified, and may contain former surface layers.

A description of the Kerran series is given below:

Ckg — 0 to 12.5 cm, gray (10YR 5/1 d, 10YR 4/1 m) silty clay of recent deposition; moderate, fine granular; friable when moist; slightly hard when dry; plastic; neutral to mildly alkaline; moderately calcareous; few shells on surface; iron stains present.

Ahbkg — 12.5 to 25 cm, dark gray (10YR 4/1 d, 10YR 3/1 m) silty clay; moderate, fine granular; friable when moist, slightly hard when dry; plastic; mildly alkaline; moderately calcareous; iron stains.

Ckgl — 25 to 35 cm, grayish brown (10YR 5/2 d, 10YR 4/2 m) silty clay; moderate, fine platy; friable when moist, slightly hard when dry, plastic; mildly alkaline; moderately calcareous; iron stained.

Ckg2 — 35 to 43 cm, light gray to light brownish gray (10YR 6/2 d, 10YR 5/2 m) stratified silty clay loam and silty clay; moderate fine platy to fine subangular blocky; friable when moist, soft when dry; plastic; mildly alkaline; moderately calcareous; iron stained.

Ckg3 — 43 to 68 cm, dark grayish brown to light olive brown (10YR 4/2 to 2.5Y 4.5/4 m) stratified silt loam to silty clay loam; moderate, fine pseudo platy to moderate fine granular; friable when moist, soft when dry; plastic; mildly alkaline; moderately calcareous; iron stains.

Ckg4 — 68 to 93 cm, dark gray to olive gray (5Y 4/1 to 5Y 4.5/3 m) stratified sandy clay loam to silty clay loam; moderate, medium subangular blocky to weak, fine platy; friable to firm when moist; plastic, iron stained.

Ckg5 — 93 to 108 cm, dark gray to gray (5Y 4.5/1 m) silty clay; weak, fine subangular blocky; firm when moist, sticky when wet; plastic; mildly alkaline; moderately calcareous; iron stains.

KILLEEN SERIES Kn

The Killeen series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 60 cm) of sandy sediments (FS, LFS, LS) over a thin strata (10 to 40 cm) of very strongly calcareous, loamy glacial till of limestone and granitic origin over a strongly calcareous loam to clay loam till of shale, limestone and granitic origin. The topography is level to very gently sloping; runoff is moderately slow to slow, and permeability is moderately rapid in the upper sandy strata and decreases to moderately slow to slow in the lower, more compact, weakly to moderately fissile till.

The soil is characterized by a very dark gray Ah horizon, 15 to 20 cm thick, a dark gray to grayish brown, weakly mottled ACk horizon, and a light gray lime accumulation layer. Where the overlay is relatively shallow, the lime accumulation horizon occurs at the contact of very strongly calcareous till.

KILMURY SERIES Kl

The Kilmury series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 50 cm) of moderately to strongly calcareous sediments of VFS, LVFS, SL and FSL texture overlying moderately to strongly calcareous stratified medium sands to gravelly textured deposits. The topography is level to very gently sloping; runoff is moderately slow; permeability is moderately rapid in the very fine sandy sediments and rapid in the subsoil, but restricted by a high water table during spring and early summer.

The soil is characterized by a very dark gray Ah

horizon, 20 to 35 cm thick, a dark gray to grayish brown ACk horizon 10 to 16 cm thick and a lime accumulation horizon 10 to 18 cm thick. Yellowish brown mottles are common in the sandy and coarser subsoil. A description of the Kilmury series is given below:

Ap — 0 to 15 cm, very dark gray (10YR 3/1 d, 10YR 2/1 m) sandy clay loam; weak, coarse subangular blocky breaking to moderate, fine to medium granular; friable when moist, slightly hard when dry, slightly plastic; mildly alkaline; noncalcareous; abrupt, smooth boundary.

Ah — 15 to 36 cm, very dark gray (10YR 3/1 d, 10YR 2.5/1 m) fine sandy loam; weak, coarse subangular blocky breaking to moderate, fine to medium granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; noncalcareous; gradual, wavy boundary.

ACk — 36 to 48 cm, very dark grayish brown (10YR 3/2 d, 10YR 3/2 m) sandy loam; weak, fine to medium, subangular blocky breaking to weak to moderate, fine granular; very friable when moist, soft when dry, nonplastic; moderately alkaline; weakly calcareous; abrupt, irregular boundary.

Cca — 48 to 54 cm, light gray (10YR 6.5/1 d, 10YR 4/2 m) sandy loam; moderate, coarse angular blocky breaking to moderate, fine to medium granular; very friable when moist, slightly hard when dry, nonplastic; moderately alkaline; strongly calcareous; abrupt, wavy boundary.

IICk1 — 54 to 78 cm, pale brown (10YR 6/3 d, 10YR 5/6 m) sand; single grained; stratified; loose, nonplastic; moderately alkaline; moderately calcareous; clear, smooth boundary.

IICk2 — 78 to 100 cm, pale brown (10YR 6/3 d, 10YR 5.5/4 m) fine sandy loam; stratified; loose when moist or dry, nonplastic; moderately alkaline; moderately calcareous; common, medium, distinct, strong brown (7.5YR 5/6 m) mottles.

KIRKNESS SERIES Kk

The Kirkness series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 60 cm) of sandy sediments (FS, LFS, LS) over a thin strata (10 to 40 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. They occur on gently sloping to gently undulating topography. Runoff is moderate; permeability is rapid in the upper strata and moderately slow in the underlying till deposits.

The soil is characterized by a very dark gray Ah horizon 15 to 22 cm thick and a brown Bm horizon 12 to 18 cm thick. The depth of the solum varies with the thickness of the overlay, generally the BCk extends to the contact of the sandy strata and the very strongly calcareous loamy till, which appears as a prominent Cca horizon.

KLEYSEN SERIES Ky

The Kleysen series consists of moderately well to well drained Calcareous Black soils developed on a thin mantle (25 to 60 cm) of loamy lacustrine sediments over a thin strata (10 to 40 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin over a strongly calcareous loam to clay loam till of shale limestone and granitic origin. These soils in the upper slope positions are of gently sloping, undulating or rolling topography. Runoff is moderate to moderately rapid; permeability is moderate in the lacustrine sediments and in the loose, very strongly calcareous till, and moderately slow to slow in the more compact, somewhat fissile loam to clay loam till.

The soil is characterized by a very dark gray to black Ah horizon 10 to 14 cm thick and a brown to dark brown calcareous Bm horizon, 8 to 12 cm thick. The solum usually extends to the contact of the very strongly calcareous till. A description of a representative Kleysen soil is described below:

Ah — 0 to 17 cm, very dark gray (10YR 3/1 d, 10YR 2.5/1 m) silty clay loam; weak, fine subangular blocky; very friable when moist, slightly hard when dry, plastic; mildly alkaline; noncalcareous; clear, smooth boundary.

Bmk — 17 to 30 cm, brown (10YR 4.5/3 d, 10YR 3.5/3 m) silty clay loam; weak to moderate, fine subangular blocky; friable when moist, slightly hard when dry, plastic; moderately alkaline; strongly calcareous; clear, wavy boundary.

IICca — 30 to 45 cm, light gray to very pale brown (10YR 7/2.5 d, 10YR 5.5/3.5 m) silty clay loam (till); very weak, fine, pseudo granular; very friable when moist, hard when dry, plastic; strongly alkaline; extremely calcareous; clear, irregular boundary.

IICk — 45 to 80 cm, very pale brown (10YR 7.5/3 d, 10YR 5.5/4 m) silt loam (till); weak, fine to medium, pseudo subangular blocky; friable when moist, hard when dry, plastic; strongly alkaline; extremely calcareous; abrupt, smooth boundary.

IIICk — 80 to 100 cm, pale brown (10YR 6/3 d, 10YR 4.5/4 m) loam (till); weak to moderate, fine to medium subangular blocky; friable when moist, slightly hard when dry, plastic; moderately alkaline; very strongly calcareous; contains significant amounts of shale fragments.

KNOLLS SERIES Ko

The Knolls series consists of well to excessively drained Orthic Regosol soils developed on strongly to very strongly calcareous loamy (VFSL, L, SiL) lacustrine sediments. They occur in the upper slope and knoll positions in a gently undulating to moderately rolling landscape. The runoff is moderate to rapid depending on gradient; permeability is moderate. Originally, these soils had a dark surface and profile development, but

have been sufficiently eroded that little of the original horizons remain. They continue to be very susceptible to both wind and water erosion.

The soil is characterized by a 10 to 15 cm gray to light gray calcareous plow layer and a light yellowish brown to pale brown C horizon.

LAVENHAM SERIES Lh

The Lavenham series consists of imperfectly drained Gleyed Orthic Black soils developed on weakly to moderately calcareous sandy (FS, LFS, LS) textured lacustrine and deltaic deposits. The topography is level to very gently sloping. Runoff is slow and permeability is moderately rapid, but may be restricted in the subsoil during periods when the water table is high. The water table ranges from 1 to 3 meters below the surface, depending on the season and climatic conditions. These soils are susceptible to erosion.

The soil is characterized by a very dark gray to very dark brown Ah horizon 18 to 25 cm thick, a dark brown to yellowish brown Bm horizon 20 to 40 cm thick, with strong brown mottles in the lower part of the horizon, a lime accumulation (Cca) horizon 12 to 20 cm thick, and a pale brown C horizon with strong brown iron mottles.

LEVINE SERIES Lv

The Levine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, stratified, dominantly loamy textured recent alluvial deposits. They occur as part of the flood plain associated with the Assiniboine River and other rivers and creeks in the region. The topography is level to undulating. Runoff is slow to moderately slow, and permeability is moderate, but restricted during periods of high water in channels. These soils have been subject to inundation during years of above average water flows.

The soil is characterized by dark gray to grayish brown Ap or Ah horizons 10 to 15 cm thick, and a pale brown to light yellowish brown C horizon. The underlying strata may vary in color from light to dark and may have thin former surface and organic strata. Yellowish brown mottles of iron are common throughout the soil. A description of the Levine series is given below:

Ck1 — 0 to 25 cm, pale brown (10YR 5.5/3 d, 10YR 6/3 m) very fine sandy loam; stratified, weak, fine to medium pseudo platy; very friable when moist, soft when dry, nonplastic; mildly alkaline; moderately calcareous; few, fine, distinct, strong brown (7.5YR 5/6 m) mottles; clear, smooth boundary.

Ahkb — 25 to 60 cm, grayish brown to brown (10YR 5/2.5 d, 10YR 3.5/3 m) loam; weak to moderate, medium platy, stratified; friable when moist, slightly hard when dry, slightly plastic; mildly alkaline; moderately calcareous; few, medium, distinct strong brown (7.5YR 5/6 m) mottles; clear, smooth boundary.

Ck2 — 60 to 67 cm, grayish brown to brown (10YR 5/2.5 d, 10YR 5/4 m) loam; stratified; weak to moderate, fine to medium platy; friable when moist, slightly hard when dry, slightly plastic; mildly alkaline; strongly calcareous; few, fine, distinct, strong brown (7.5YR 5/6 m) mottles; clear, smooth boundary.

Ahkb2 — 67 to 92 cm, grayish brown (10YR 5.5/2 d, 10YR 4/2 m) stratified silt loam to silty clay loam; moderate, fine to medium platy; friable when moist, slightly hard when dry, plastic; mildly alkaline; strongly calcareous; few, fine, distinct, strong brown (7.5YR 5/6 m) mottles; clear, smooth boundary.

Ck3 — 92+ cm, pale brown (10YR 5.5/3 d, 10YR 3.5/3 m) stratified silt loam to silty clay loam; moderate, fine to medium, platy; friable when moist, slightly hard when dry, slightly plastic; mildly alkaline; moderately calcareous; common, medium, distinct, strong brown (7.5YR 5/6 m) mottles.

LINDSTROM SERIES Ld

The Lindstrom series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 60 cm) of very fine sandy 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 strongly calcareous glacial till of shale, limestone and granitic origin. Topography is level to very gently sloping; runoff is moderately slow; permeability is moderate in the sandy strata and moderately slow in the underlying till.

The soil is characterized by a very dark gray Ah(k) horizon, 18 to 25 cm thick, a dark gray to grayish brown ACk horizon, 10 to 18 cm thick and a lime accumulation horizon, 6 to 10 cm thick. Where the sandy strata is shallow, the lime accumulation layer grades to the very strongly calcareous glacial till. Few yellowish brown mottles may be present in the Ac and Cca horizons.

LOCKHART SERIES Lk

The Lockhart series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 60 cm) of very fine sandy 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 underly-

ing 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 BCk terminating at the contact of the sandy surface and very strongly calcareous till.

LONERY SERIES Ln

The Lonery series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 60 cm) of very fine sandy 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 level to depressional topography. Runoff is very slow to negligible; permeability is very slow.

The soil is characterized by a thin, moderately decomposed organic layer, 2 to 5 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, and a dark gray to olive gray ACk horizon, 6 to 10 cm thick. A lime accumulation horizon is usually present in the sandy strata and may extend to the very strongly calcareous till. Yellowish brown mottles are usually present below the Ah horizon.

LOWTON SERIES Lt

The Lowton series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on moderately to strongly calcareous silty clay to clay lacustrine deposits. The topography is level to depressional; runoff is negligible to very slow; permeability is slow to very slow. Glacial till underlies these soils at a depth of 1 to 2.5 meters. Most of these soils occur within a discharge region characterized by an upward pressure of groundwater or a lateral flow of water through the underlying, very strongly calcareous glacial till. Appreciable soluble salts may be present within the rooting zone; gypsum crystals are common.

The soil is characterized by a moderately decomposed organic layer of 1 to 5 cm, a very dark gray to black Ahk horizon, 5 to 20 cm thick, and a dark gray to olive gray ACkg horizon with yellowish brown mottles. A lime carbonate horizon may be present. The subsoil is olive gray to olive and has fine yellowish brown mottles and white calcium carbonate pockets.

MADILL SERIES Md

The Madill series consists of well drained Orthic Regosol soils on stony, very strongly to extremely calcareous loamy glacial drift of limestone and granitic origin. The glacial drift may contain strata of variable coarse material. These soils occur on the upper slope and knoll positions of undulating to irregular, moderately rolling topography. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. Runoff is moderately rapid to rapid; permeability is moderate to moderately slow, depending on the strata, compaction and degree of fissility of the drift.

The soil is characterized by a gray plow layer 10 to 18 cm thick and a light gray to white C horizon.

MANSFIELD SERIES Mf

The Mansfield series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on moderately to strongly calcareous, stratified outwash and glaciofluvial deposits of medium sand to gravel. The topography is level to gently sloping; runoff is moderately slow; permeability is rapid, but may be restricted in the subsoil during the spring when the water table is near the surface.

The soil is characterized by a very dark gray Ah horizon 15 to 25 cm thick, a dark gray to grayish brown ACk horizon 8 to 15 cm thick and a lime accumulation horizon. Yellowish brown mottles are present throughout the C horizon.

MANSON SERIES Mn

The Manson series consists of moderately well drained Cumulic Regosol soils on moderately to strongly calcareous, stratified dominantly clayey alluvial deposits of silty clay and clay with stratum of silty clay loam and clay loam. These soils are located in flood plain areas that have been inundated during years of high flood waters. Topography is gently sloping to gently undulating; runoff is moderate; permeability is moderately slow to slow.

The soil is characterized by a dark gray to gray surface horizon (Ah or Ap) 8 to 15 cm thick and generally lighter colored substratum, but some dark stratum consisting of former organic material or Ah horizon may be present.

MARRINGHURST SERIES Ma

The Marringhurst series consists of moderately well to well drained Calcareous Black soils developed on moderately to strongly calcareous stratified outwash and glaciofluvial deposits of medium sand to gravelly texture. These soils occur on very gently sloping to irregular, moderately rolling topography. On the complex topog-

raphic units, they occur as a complex with other soils. Runoff is moderate to moderately rapid; permeability is very rapid. The soil materials are stratifield with strata ranging in texture from fine sand to coarse gravel.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 14 to 18 cm thick and a dark brown to brown Bmk horizon, 10 to 18 cm thick. The solum varies with the depth to a coarser gravelly strata. The lime accumulation layer occurs in the coarser gravelly strata and varies from 20 to 30 cm thick; secondary carbonate accumulation on the lower half of grains and pebbles. A description of the Marringhurst soil is given below:

LH/Ah — 0 to 2 cm, very dark grayish brown (10YR 3/2 d, 10YR 2.5/2 m) partially decomposed grasses and herbs with some inblown mineral material; neutral; weakly calcareous; abrupt. smooth boundary.

Ah — 0 to 13 cm, black (10YR 2/1 d, 10YR 2/1 m) sandy loam; weak, fine to medium granular; very friable when moist, soft when dry, nonplastic; neutral; noncalcareous; clear, wavy boundary.

Ck1 — 18 to 38 cm, grayish brown to brown (10YR 5/2.5 d, 10YR 4.5/4 m) bedded gravelly sand; single grained; loose when moist or dry, nonplastic; neutral; very strongly calcareous; few, medium, prominent dark red (10 R 3/6 m) mottles; clear, wavy boundary.

Ck2 — 38 to 51 cm, light gray to very pale brown (10YR 7/2.5 d, 10YR 5/3 m) bedded gravelly sand; single grained; loose, nonplastic; mildly alkaline; extremely clacareous; few, medium, prominent, dark red (10 R 3/6 m) mottles; clear, wavy boundary.

Ck3 — 51 to 114 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5/4 m) bedded gravelly coarse sand; single grained; loose, nonplastic; mildly alkaline; strongly calcareous; few, medium, prominent dark red (10 R 3/6 m) mottles; clear, wavy boundary.

Ck4 — 114 to 117 cm, very pale brown (10YR 6.5/3 d, 10YR 5/3 m) sandy loam; structureless; single grained; loose, nonplastic; mildly alkaline; very strongly calcareous; common, medium, prominent dark red (10 R 3/6 m) mottles; clear, wavy boundary.

Ck5 — 117+ cm, pale brown (10YR 6/3 d, 10YR 4.5/4 m) gravelly sand; single grained; loose, nonplastic; mildly alkaline; very strongly calcareous; common, medium, prominent dark red (10 R 3/6 m) mottles.

MARSDEN SERIES Mr

The Marsden series consists of poorly drained Carbonated Rego Humic Gleysol 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 very strongly calcareous loamy glacial till of limestone and granitic origin. Strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin usually occurs within a two meter depth. 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 soil is 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 gray ACkg horizon with yellowish brown mottles. A lime carbonate horizon is usually present at or above the contact of the gravel strata.

MELLAND SERIES MI

The Melland series consists of imperfectly drained, Gleyed Carbonated Rego Black soils developed on a sequence of materials consisting of a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy (VFSL to SiCL) sediments over a thin (10 to 40 cm) of medium sand to gravel strata over a very strongly calcareous loamy glacial till of limestone and granitic origin. Strongly calcareous loam to clay loam glacial till of shale, limestone, and granitic origin usually occurs within a two meter depth. Topography is level to gently sloping; runoff is moderately slow; permeability is moderate in the upper strata, but restricted above the till due to perched water conditions. Lateral flow of water occurs through the gravel strata during the spring or following heavy rains.

The soil is characterized by a very dark gray Ah horizon 18 to 25 cm thick, and a dark gray to grayish brown ACk horizon, 10 to 15 cm thick. A lime accumulation horizon is usually present at the transition from loamy to gravel strata. A description of a Melland soil is given below:

Ahk — 0 to 37 cm, very dark gray (10YR 2/1 d, m) sandy loam; weak, fine to medium, granular; very friable when moist, soft when dry, slightly plastic; mildly alkaline; weakly calcareous; abrupt, smooth boundary.

IICk — 37 to 88 cm, light yellowish brown (2.5Y 6.5/4 d, 2.5Y 5/6 m) very gravelly sand; single grained, stratified, loose, nonplastic; moderately alkaline; strongly calcareous, common, medium, prominent red (2.5YR 4/6 m) mottles; abrupt, smooth boundary.

IIICk1 — 88 to 105 cm, white (10YR 8/2 d, 10YR 6/3 m) loam; weak to moderate, fine to medium, angular blocky; friable when moist, firm when moist, hard when dry, plastic; moderately alkaline; extremely calcareous; few, fine, prominent red (2.5YR 4/6 m) mottles; clear, smooth boundary.

IIICk2 — 105+ cm, pale brown (10YR 6/3 d, 2.5Y 4.5/4 m) clay loam; moderate, medium to coarse subangular blocky; firm when moist, hard when dry, plastic; moderately alkaline; extremely calcareous; few, fine, prominent red (2.5Y 4/6 m) mottles.

MINIOTA SERIES Ms

The Miniota series consists of moderately well to well drained Orthic Black soils developed on a thin mantle (25 to 50 cm) 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.

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 BCk horizon. The depth of solum varies with the depth of the sandy strata; the lime accumulation horizon usually occurs at the transition from sandy to coarser sediments.

MOCKRY SERIES Mk

The Mockry series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on weakly to noncalcareous sandy (FS, LFS and some MS) textured dominantly aeolian deposits. The topography is level to depressional; runoff is slow; permeability is restricted by a water table at or near the surface for a considerable period and rapid when the water table is lower.

The soil is characterized by a moderately decomposed organic layer, 2 to 4 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick and an olive gray ACk horizon. A lime accumulation horizon may be present at or above the contact of the gravelly strata.

OBERON SERIES Ob

The Oberon series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 75 cm) 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 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 BCkg horizon, 8 to 16 cm thick. A lime accumulation is usually present within the loamy strata. The sandy substrata is light yellowish brown with yellowish brown to strong brown mottles of iron.

ONAHAN SERIES Oh

The Onahan series consists of imperfectly drained Gleyed Orthic Regosol soils on weakly to noncalcareous sandy (FS, LS to MS) textured dominantly aeolian deposits. The topography is level to gently sloping; runoff is slow; permeability is rapid, but may be restricted in the subsoils during the spring and early summer when the water table is high. These soils have been stabilized for greater than 60 years as indicated by tree growth. Some areas have been seeded to grasses and used for pasture.

The soil is characterized by a partially decomposed LH horizon, 1 to 3 cm thick, a gray to dark gray Ah horizon, 5 to 18 cm thick and a pale brown C horizon with strong brown to yellowish brown mottles.

PETREL SERIES Pt

The Petrel series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 75 cm) of moderately to strongly calcareous loamy (VFSL, L, SiL) sediments grading to moderately calcareous sand (FS, LFS, LS) deposits. The topography is level to very gently sloping; runoff is moderately slow; permeability is moderate in the upper strata, and moderately rapid in the sandy strata if not restricted by a high water table during the spring or early summer.

The soil is characterized by a very dark gray Ah horizon 18 to 25 cm, a brown Bm horizon 14 to 20 cm thick and a weakly mottled BCk horizon that usually extends to the sandy strata. A weak lime accumulation horizon may occur in the upper part of the sandy stratum. The sandy C horizon is light yellowish brown with yellowish brown to strong brown mottles.

PLEASANT SERIES Pl

The Pleasant series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on moderately to strongly calcareous very fine sandy (VFS, LVFS, FSL) lacustrine and deltaic deposits. They occur on level to very gently sloping topography or on intermediate to lower slope positions of irregular, undulating topography. Runoff is moderately slow; permeability is moderate, but may be restricted in the subsoil during the spring due to the high water table. In some areas, where the water contains appreciable soluble salts, a sufficient concentration of salts may occur in the soil to inhibit or retard the growth of crops or grasses.

The soil is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark gray to grayish brown ACk horizon, 6 to 10 cm thick, and a lime accumulation horizon, 10 to 15 cm thick. The C horizon is light olive brown with yellowish brown

mottles. Gypsum crystals may be present below the lime accumulation horizon, and in saline areas, pseudomycelic mottles of other salts are usually present nearer the surface.

A description of the Pleasant series is given below:

Ahk — 0 to 15 cm, very dark gray to very dark grayish brown (10YR 3/1.5 d, 10YR 2.5/1 m) fine sandy loam; weak, fine to medium granular; very friable when moist, soft when dry, slightly plastic; mildly alkaline; moderately calcareous; gradual, irregular boundary.

ACk — 15 to 35 cm, grayish brown to dark grayish brown (10YR 4.5/2 d, 10YR 3/2 m) fine sandy loam; weak to moderate coarse platy to weak, fine subangular blocky; very friable when moist, soft when dry, slightly plastic; mildly alkaline; moderately calcareous; diffuse, broken boundary.

Cca — 35 to 65 cm, light gray (10YR 7/2 d, 10YR 6.5/3 m) fine sandy loam; weak, coarse subangular blocky breaking to weak medium to coarse granular; moderately alkaline, strongly calcareous; clear, smooth boundary.

Ckg — 65 to 100 cm, light brownish gray to light yellowish brown (2.5Y 6/3 d, 2.5Y 5/2 m) loamy fine sand; laminated, weak fine granular; very friable when moist, soft when dry, nonplastic; moderately alkaline; moderately calcareous; common, fine, distinct, yellowish brown (10YR 5/6 m) mottles; some small local areas of gypsum crystals.

POOLEX SERIES Po

The Poolex series consists of poorly drained Carbonated Rego Humic Gleysols developed on moderately to strongly calcareous very fine sandy (VFS, LVFS, FSL) lacustrine and deltaic deposits. The topography is level to depressional; runoff is slow; permeability is restricted due to water saturation at or near the surface for a considerable period of the year.

The soil is characterized by a moderately decomposed organic layer, 1 to 4 cm, a very dark gray Ah horizon, 15 to 22 cm thick, an olive gray to gray ACk horizon, 6 to 12 cm, and a lime accumulation horizon, 10 to 15 cm. The C horizon is olive to pale olive with yellowish brown mottles.

PORPLE SERIES Pp

The Porple series consists of moderately well to well drained soils developed on moderately to strongly calcareous very fine sandy (VFS, LVFS, FSL) lacustrine and deltaic deposits. They occur in the upper slope positions of gently undulating to undulating topography. Runoff is moderately rapid; permeability is moderate to moderately rapid. These soils have had some erosion, and remain susceptible to both wind or water erosion if not protected. Included with this series are some of the moderately eroded Prosser soils.

The soil is characterized by a very dark gray to very dark grayish brown Ahk horizon, 18 to 25 cm thick, a dark gray to grayish brown ACk horizon, 6 to 12 cm thick and a lime accumulation horizon 10 to 15 cm thick.

PRODAN SERIES Pr

The Prodan series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits. Topography is gently sloping; runoff is moderately slow; permeability is moderate to moderately slow. They have a seasonal water table that occurs within .75 m of the surface.

The soil is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a dark gray to gray ACk horizon, 8 to 15 cm thick and a lime accumulation horizon. The C horizon is light brownish gray with yellowish brown mottles. A description of the Prodan, slightly saline phase, is given below:

Apks — 0 to 15 cm, black (10YR 2.5/1 d, 10YR 2/1 m) clay loam; weak, fine granular; friable when moist, slightly hard when dry, plastic; mildly alkaline; weakly calcareous; abrupt, smooth boundary.

Ahks — 15 to 28 cm, gray (10YR 5/1 d, 10YR 2.5/1.5 m) clay loam; weak, fine granular; friable when moist, slightly hard when dry, plastic; moderately alkaline; moderately calcareous; weakly saline with some gypsum crystals; clear, irregular boundary.

ACks — 28 to 37 cm, light gray (10YR 7.5/1 d, 10YR 4/1.5 m) silty clay loam; weak, fine granular; friable when moist, slightly hard when dry, plastic; moderately alkaline; very strongly calcareous; few, fine, faint yellowish brown (10YR 5/6 m) mottles and white gypsum pseudomycelium, weakly saline; clear, smooth boundary.

Ccas — 35 to 55 cm, white (10YR 8/1 d, 10YR 6/2 m) silty clay loam; weak, fine pseudo granular; friable when moist, plastic; strongly alkaline; very strongly calcareous; few, fine, distinct yellowish brown (10YR 5/6 m) mottles; clear, smooth boundary.

Cks1 — 55 to 74 cm, light gray (10YR 7.5/1 d, 10YR 5/4 m) loam; weak, fine, pseudo granular; friable when moist, slightly plastic; moderately alkaline; very strongly calcareous; weakly saline with small pockets of gypsum crystals; few, fine, faint yellowish brown (10YR 5/6 m) mottles.

Cks2 — 74 to 100 cm, light gray to very pale brown (10YR 7/2.5 d, 10YR 5/5 m) silt loam; very weak, fine pseudo granular; friable when moist, slightly plastic; moderately alkaline; very strongly calcareous; some small pockets of gypsum crystals; few, fine, faint yellowish brown (10YR 5/6 m) mottles.

Cks3 — 100 to 125 cm, very pale brown (10YR 7/4 d, 10YR 5/4 m) silt loam; laminated, weak, fine pseudo platy; friable when moist, slightly plas-

tic; moderately alkaline; very strongly calcareous; few, fine, faint yellowish brown (10YR 5/6 m) mottles.

PROSSER SERIES Ps

The Prosser series consists of moderately well to well drained Orthic Black soils developed on moderately to strongly calcareous very fine sandy (VFS, LVFS, FSL) lacustrine and deltaic deposits. They occur on very gently sloping topography or on mid and upper slopes of undulating to gently rolling topography. Runoff is moderate to rapid; permeability is moderate to moderately rapid.

The soil is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a dark brown to brown Bm horizon, 12 to 20 cm thick, and a pale brown BCk horizon. A lime accumulation horizon, 12 to 18 cm thick is usually present.

RAMADA SERIES Ra

The Ramada series consists of well to moderately well drained Orthic Black soils developed on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits. These soils occur on very gently sloping topography or on mid and upper slope positions of undulating topography; runoff is moderately rapid; permeability is moderate to moderately slow.

The soil is characterized by 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 BCk, 6 to 10 cm thick. A lime accumulation horizon is usually present. The C horizon is pale brown to light yellowish brown. A description of the Ramada series is given below:

Ap — 0 to 10 cm, very dark gray (10YR 3.5/1 d, 10YR 2/1 m) clay loam; weak to moderate, fine granular; friable when moist; slightly hard when dry, plastic; mildly alkaline; weakly calcareous; abrupt, smooth boundary.

Bm — 10 to 20 cm, brown to dark brown (10YR 4/3 d, 10YR 3.5/3 m) loam; moderate, very coarse prismatic breaking to moderate, fine to medium subangular blocky; friable when moist, slightly hard when dry, plastic; mildly alkaline; noncalcareous; clear, wavy boundary.

BCk — 20 to 25 cm, yellowish brown (10YR 5/4 d, 10YR 4.5/4 m) silty clay loam; moderate, very coarse, prismatic breaking to moderate, fine to medium subangular blocky; friable when moist, slightly hard when dry, plastic; mildly alkaline; strongly calcareous; gradual, wavy boundary.

Cca — 25 to 40 cm, light gray (10YR 7/2 d, 10YR 6/3 m) silty clay; weak, fine pseudo subangular blocky; friable when moist, hard when dry, plastic; mildly alkaline; very strongly calcareous; clear, smooth boundary.

Ck1 — 40 to 75 cm, very pale brown (10YR 7/3 d, 2.5Y 5.5/4 m) silty clay loam; weak, fine pseudo subangular blocky; friable when moist, plastic; moderately alkaline; very strongly calcareous; few, fine, distinct, dark red (2.5YR 3/6 m) mottles.

Ck2 — 75 to 100 cm, very pale brown (10YR 7/3 d, 2.5Y 5/4 m) loam; weak, fine, pseudo subangular blocky; friable when moist, plastic; moderately alkaline; strongly calcareous; few, fine, distinct strong brown (7.5YR 5/6 m) mottles.

REMPEL SERIES Re

The Rempel series consists of moderately well to well drained Calcareous Black soils developed on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits. They occur on upper slopes of undulating topography; runoff is moderately rapid; permeability is moderate. These soils are intermediate in development between the Ramada (Orthic Black) and the Carroll series (Rego Black).

The soil is characterized by a very dark gray to very dark grayish brown Ah(k), 15 to 22 cm thick, and a dark grayish brown to brown Bmk horizon, 10 to 15 cm thick, a pale brown BCk horizon of 5 to 10 cm. A light gray to white lime accumulation horizon, 10 to 15 cm thick is present grading to a pale brown C horizon.

The physical characteristics of the soil are similar to the Ramada series.

RODDAN SERIES Rd

The Roddan series consists of well to excessively drained Orthic Regosol soils on a thin mantle (25 to 60 cm) of loamy sediments over a thin strata (10 to 40 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 in the upper slope and knoll positions of irregular undulating to moderately rolling topography. Runoff is moderate to rapid, depending on the gradient; permeability is moderate to moderately slow. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. They continue to be very susceptible to both wind and water erosion.

The soil is characterized by a 10 to 15 cm gray to light gray calcareous plow layer and a very pale brown to white C horizon.

RUFFORD SERIES Rf

The Rufford series consists of moderately well to well drained Rego Black soils developed on a thin mantle (25 to 50 cm) of very strongly 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 on the upper slope and knoll positions in irregular, undulating to moderately rolling topography; runoff is rapid; permeability is moderately slow. These soils have had a variable degree of erosion particularly in the knoll position.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 12 to 18 cm thick and a thin ACk of gray to grayish brown 6 to 10 cm thick, and a lime accumulation of white or light gray of 5 to 10 cm thick. The C horizon is very pale brown and contains pebbles and stones of dominantly limestone origin; the underlying till is less calcareous, is brown to pale brown and contains fragments of shale, limestone and granitic rocks.

SEWELL SERIES Sw

The Sewell series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on weakly to moderately calcareous sandy (FS, LFS, LS) textured lacustrine and deltaic deposits. Topography is level to depressional; runoff is negligible; permeability is restricted during periods when free water is at or near the surface, but is moderately rapid when free water is below 0.7 meters.

The soil is characterized by a moderately decomposed organic layer 2 to 5 cm, a very dark gray Ah horizon 10 to 18 cm, and a dark gray to gray ACk horizon with yellowish brown mottles. A lime accumulation horizon 8 to 12 cm thick is common. The C horizon is olive to pale olive with yellowish brown mottles of iron and fine black mottles of manganese.

SHILOX SERIES Sh

The Shilox series consists of moderately well to excessively drained Orthic Regosol soils on weakly to noncalcareous sandy (FS, LFS, MS) textured dominantly aeolian deposits. These soils have been stabilized with dominantly short prairie grasses, or in some areas, have been cultivated and seeded to grass. A few bur oak, stunted aspen or juniper may be present on undisturbed areas. The topography varies from gently sloping to gently rolling; runoff is negligible due to rapid to very rapid permeability of the soil. Some erosion or translocation of material had occurred on soils that had been formerly cultivated or overgrazed.

The soil is characterized by a partially decomposed LH horizon, 1 to 2 cm thick, grayish brown to pale brown Ah horizon, 6 to 10 cm thick, and a light yellowish brown to pale brown C horizon. Occasionally, a dark strata, 2 to 4 cm thick, of a former surface may occur within the meter depth. A description of the Shilox series is given below:

LH/Ah — 0 to 5 cm, grayish brown to brown (10YR 5/2.5 d, 10YR 4/3 m) misture of partially decomposed plant residue and inblown soil; very weak, fine granular; loose; slightly acid; abrupt, smooth boundary.

Ah — 5 to 20 cm, dark grayish brown to brown (10YR 4/2.5 d, 10YR 3/3 m) medium sand; dominantly single grained with some very weak, fine granular; loose when moist or dry; slightly acid; clear, smooth boundary.

Cl — 20 to 135 cm, yellowish brown 10YR 5/5 d, 10YR 5.5/6 m) medium sand; loose when moist or dry, nonplastic; slightly acid.

Ckl — 135+ cm, yellowish brown to light yellowish brown (10YR 5.5/3.5 d, 10YR 5/3 m) loamy fine sand; loose when moist or dry, nonplastic; mildly alkaline; moderately calcareous.

SIGMUND SERIES Sg

The Sigmund series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on moderately to strongly calcareous silty clay to clay, lacustrine deposits. These soils occur on very gently sloping to gently undulating topography that appears morainal. The clay is underlain by glacial till deposits at depths of 1 to 2.5 meters. Runoff is moderately slow to slow; permeability is slow. Many of these soils are affected by subsoil seepage or upward pressure of groundwater. Where the water contains appreciable soluble salts, a sufficient concentration of salts may occur to inhibit or retard the growth of crops.

The soil is characterized by a very dark gray Ah horizon, 15 to 24 cm thick, a dark gray ACk horizon 5 to 15 cm thick, and a lime accumulation horizon, 8 to 12 cm thick. The C horizon is light olive brown to olive with yellowish brown mottles and may have gypsum crystals below the lime accumulation. In saline areas, the Ah and ACk usually have white pseudomycelia of salt. A description of the Sigmund, moderately saline phase is described below:

Ahs — 0 to 29 cm, very dark gray (10YR 3.5/1 d, 10YR 2/1 m) clay; weak to moderate, fine to medium subangular blocky; firm when moist, slightly hard when dry, very plastic; moderately alkaline; weakly calcareous; saline; abrupt, wavy boundary.

Cks — 29 to 80 cm, gray to light brownish gray (10YR 6/1.5 d, 10YR 3.5/2 m) clay; weak, fine, subangular blocky; firm when moist, hard when dry, very plastic; strongly alkaline; strongly calcareous; saline; abrupt, wavy boundary.

Cksg — 80 to 100 cm, light yellowish brown (2.5Y 6/4 d, 2.5Y 4/4 m) clay; massive breaking to weak, fine pseudo angular blocky; firm when moist, very plastic; moderately alkaline; very strongly calcareous; saline; common, fine, prominent yellowish red (5YR 5/6 m) mottles.

STATLEY SERIES Sy

The Statley series consists of well to moder-

ately well drained Orthic Dark Gray soils developed on stony, very strongly to extremely calcareous loamy glacial drift of limestone and granitic origin. The soil occurs mainly on the mid and upper slopes of irregular undulating to moderately rolling topography, generally near or above the 457 meters (1500 ft.) elevation in the Brandon Hills, and may occur at a lower elevation on the north and east facing slopes. Runoff is moderately rapid; permeability is moderately slow. Under cultivation, these soils are susceptible to both wind and water erosion, particularly on the steeper gradients. Native vegetation consists of bur oak, trembling aspen, shrubs and grasses.

The soil is characterized by a partially decomposed leaf mat (LH), 2 to 4 cm thick, a dark gray to dark grayish brown Ahe horizon 5 to 10 cm thick, a dark brown to brown Btj or Bt horizon, 10 to 15 cm thick, a pale brown BCk horizon, 4 to 6 cm thick, and a white lime accumulation horizon. Stone content is quite variable.

A description of a representative Statley soil is provided below:

LH — 2 to 0 cm, very dark brown (10YR 2.5/2 d, 10YR 2.5/1 m) fine mull; neutral; abrupt, smooth boundary.

Ahe — 0 to 7 cm, grayish brown to brown (10YR 5/2.5 d, 10YR 3/2 m) loamy sand; weak, very fine granular; very friable when moist, soft when dry, nonplastic; neutral; abrupt, smooth boundary.

Acj — 7 to 13 cm, pale brown (10YR 6/3 d, 10YR 4/3 m) loamy sand; weak, very fine granular; very friable when moist, soft when dry, nonplastic; neutral; abrupt, smooth boundary.

Btj — 13 to 36 cm, yellowish brown (10YR 5.5/4 d, 10YR 3.5/4 m) fine sandy loam; moderate, fine subangular blocky; very friable when moist, soft when dry, slightly plastic; neutral; clear, smooth boundary.

BCk — 36 to 50 cm, pale brown (10YR 6/3 d, 10YR 5/3 m) fine sandy loam; weak to moderate, fine, subangular blocky; very friable when moist, soft when dry, nonplastic; mildly alkaline; moderately calcareous; clear, irregular boundary.

Cca — 50 to 62 cm, white to light gray (10YR 7.5/2 d, 10YR 6/3 m) loam; weak to moderate, very fine granular; very friable when moist; slightly hard when dry, slightly plastic; mildly alkaline; extremely calcareous; clear, irregular boundary.

Ck1 — 62 to 135 cm, pale brown to very pale brown (10YR 6.5/3 d, 2.5Y 4/3 m) loam; moderate, fine, pseudo subangular blocky; very friable when moist, nonplastic; mildly alkaline; clear, wavy boundary.

Ck2 — 135 to 155 cm, pale brown to very pale brown (10YR 6.5/3 d, 2.5Y 4/4 m) sandy loam; very weak, fine pseudo granular; very friable when moist, nonplastic; mildly alkaline; strongly calcareous; few, medium, distinct olive yellow (2.5Y 6/6 m) mottles.

Ck3 — 155+ cm, pale brown to very pale brown (10YR 6.5/3 d, 2.5Y 4.5/4 m) loam; moderate, medium, pseudo granular; very friable when moist, nonplastic; mildly alkaline; strongly calcareous; few, coarse, prominent olive yellow (2.5Y 6/8 m) mottles.

STEWART SERIES St

The Stewart series consists of well to excessively drained Rego Black soils developed on stony, very strongly to extremely calcareous loamy glacial drift of limestone and granitic origin, and usually has some coarser strata with depth. They occur on the upper slope and knoll positions of irregular, undulating to moderately rolling topography in the Brandon Hills. Runoff is rapid; permeability is moderate. Under cultivation, these soils have had some soil loss due to wind and water erosion.

The soil is characterized by a partially decomposed leaf mat 2 to 4 cm thick, a very dark gray to very dark grayish brown Ahk horizon, 10 to 15 cm thick and a thin ACk horizon. A white lime accumulation horizon, 8 to 12 cm thick is usually present.

A description of the Stewart series is given below:

LH — 3 to 0 cm, dark reddish brown (5YR 3/2 d, 7.5YR 3/3.5 m) partially decomposed leaves and herbaceous plant material, slightly acid; abrupt, clear boundary.

Ahk — 0 to 12 cm, very dark grayish brown (10YR 3/2 d, 10YR 2/1 m) loam; weak, fine granular; very friable when moist, soft when dry; slightly plastic; neutral; moderately calcareous; clear, smooth boundary.

Ahk2 — 12 to 22 cm, dark grayish brown (10YR 4/2 d, 10YR 3/1.5 m) loam; weak, fine, granular; very friable when moist, soft when dry, slightly plastic; neutral; strongly calcareous; clear, wavy boundary.

ACk — 22 to 28 cm, grayish brown (10YR 5/2 d, 10YR 4/2 m) loam; weak, fine granular; very friable when moist, soft when dry, slightly plastic; neutral; very strongly calcareous; clear, wavy boundary.

Cca — 28 to 40 cm, light brownish gray to pale brown (10YR 6/2.5 m) loam; weak, fine granular; very friable when moist, slightly hard when dry, slightly plastic; neutral; very strongly calcareous; clear, wavy boundary.

Ck1 — 40 to 70 cm, pale brown (10YR 6/3 d, 10YR 5/4 m) loam; very weak, fine pseudo granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; very strongly calcareous; clear, wavy boundary.

Ck2 — 70 to 110 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5/3.5 m) fine sandy loam; weak fine pseudo granular; very friable when moist, soft when dry, nonplastic; moderately alkaline; strongly calcareous; few, coarse, prominent yellowish red (5YR 5/6 m) mottles; clear, wavy boundary.

Ck3 — 110 to 130 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5.5/4.5 m) fine sandy loam; weak, fine, pseudo granular; very friable when moist, soft when dry, nonplastic;

moderately alkaline; few, fine prominent yellowish red (7.5YR 5/6 m) mottles.

Ck4 — 130+ cm, pale brown (10YR 6/3 d, 10YR 5/4 m) sandy loam; weak, fine, pseudo granular; very friable when moist, soft when dry, nonplastic; moderately alkaline; strongly calcareous.

STOCKTON SERIES Sn

The Stockton series consists of moderately well to well drained Orthic Black soils developed on weakly to moderately calcareous sandy (FS, LFS, LS) textured lacustrine and deltaic deposits. Topography is very gently sloping to irregular undulating; runoff is moderate; permeability is moderately rapid to rapid. These soils are subject to wind erosion if not protected or properly managed.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon 18 to 25 cm thick, a brown to grayish brown Bm horizon, 12 to 22 cm thick, and a pale brown to light yellowish brown BCk horizon, 8 to 12 cm thick. A lime accumulation horizon may be present. The C horizon is very pale brown and may have some yellowish brown mottles below .7 m. A description of a Stockton soil is given below:

Ah — 0 to 25 cm, very dark grayish brown (10YR 3.5/2 d, 10YR 3.5/2 m) loamy fine sand; very weak, fine granular; loose when moist or dry, nonplastic; neutral; noncalcareous; clear, smooth boundary.

Bm — 25 to 43 cm, brown (10YR 5/3 d, 10YR 5/4 m) loamy fine sand; very weak, very fine to fine granular; loose when moist or dry, nonplastic; neutral; noncalcareous; abrupt, smooth boundary.

BCk — 43 to 78 cm, pale brown (10YR 6/3 d, 10YR 5.5/4 m) very fine sandy loam; weak, fine granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; moderately calcareous; abrupt, smooth boundary.

Ck1 — 78 to 130 cm, light brownish gray (10YR 6/2 d, 10YR 6.5/3 m) very fine sand; single grained; loose when moist or dry, nonplastic; moderately alkaline; weakly calcareous.

Ck2 — 130+ cm, light brownish gray (10YR 6/2 d, 10YR 6.5/3 m) very fine sand; single grained; loose when moist or dry, nonplastic; moderately alkaline; moderately calcareous.

SUTTON SERIES Su

The Sutton series consists of poorly drained Carbonated Rego Humic Gleysol soils developed ous clay loam to sandy clay loam sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. They have free water at or near the surface for a considerable period of the year. Topography is level to depressional; runoff is negligible; permeability is restricted during periods of free water in the soil.

The soil is characterized by a moderately decomposed organic layer, 2 to 4 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick and a mottled, dark gray ACk horizon, 4 to 8 cm thick; a lime accumulation horizon, 8 to 14 cm thick is usually present.

TADPOLE SERIES Td

The Tadpole series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on strongly to very strongly calcareous clay loam to silty clay loam lacustrine deposits. These soils have free water at or near the surface for a considerable part of the year. Topography is level to depressional; runoff is negligible; permeability is restricted. In areas where the seepage water contains appreciable soluble salt, a sufficient salt accumulation may occur to inhibit or retard the growth of normal hydrophytic vegetation.

The soil is characterized by a moderately decomposed organic layer, 2 to 6 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray ACk horizon, 4 to 6 cm thick, and a lime accumulation horizon, 10 to 15 cm thick. The C horizon is olive to olive gray and has yellowish brown mottles. In areas affected by salts, white pseudomycelia are common in the surface horizons.

TAGGART SERIES Tg

The Taggart series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on strongly to very strongly calcareous, loamy (VFSL, L, SiL) lacustrine sediments. These soils occur on level to very gently sloping topography. Runoff is slow; permeability is moderate, but may be restricted during parts of the year when free water occurs within a meter depth. In some areas, these soils are affected by seepage waters; where the water contains appreciable soluble salts, a sufficient concentration of salts may occur to inhibit or retard the growth of crops.

The soil is characterized by a very dark gray Ah horizon, 15 to 24 cm thick, a dark gray ACk horizon, 5 to 15 cm thick and a lime accumulation horizon, 8 to 12 cm thick. The C horizon is light olive brown, usually has yellowish brown mottles, and may have gypsum crystals below the lime horizon. In saline areas, the Ah and ACk usually have white pseudomycelia of salt. A description of the Taggart series is given below:

Ap — 0 to 15 cm, very dark grayish brown (10YR 3.5/2 d, 10YR 2/1 m) fine sandy loam; moderate, fine, granular; very friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; abrupt, smooth boundary.

Ah — 15 to 34 cm, black (10YR 2.5/1.5 d, 10YR 2/1 m) fine sandy loam; moderate, fine subangular blocky to moderate, fine, granular; very friable when moist, soft when dry, slightly plastic;

neutral; noncalcareous; clear, wavy boundary.

ACk — 34 to 48 cm, gray (10YR 5/1 d, 10YR 3/3 m) fine sandy loam; weak to moderate, fine subangular blocky breaking to weak, fine granular; very friable when moist, soft when dry, slightly plastic; moderately alkaline; moderately calcareous; clear, smooth boundary.

Cca — 48 to 72 cm, light gray (10YR 7/1.5 d, 10YR 6/3 m) sandy clay loam; weak, fine, pseudo granular; friable when moist, slightly hard when dry, slightly plastic; moderately alkaline; strongly calcareous; gradual, wavy boundary.

Ckgj1 — 72 to 88 cm, light gray (10YR 7/1.5 d, 10YR 6.5/3 m) very fine sandy loam; weak, fine, granular; very friable when moist, slightly hard when dry, slightly plastic; moderately alkaline; strongly calcareous; few, fine, distinct, strong brown (7.5YR 5/6 m) mottles.

Ckgj2 — 88 to 100 cm, pale brown (10YR 6/3 d, 10YR 6/5 m) loamy very fine sand; single grained; loose when moist or dry, nonplastic; moderately alkaline; very strongly calcareous; few, fine, distinct, strong brown (7.5YR 5/6 m) mottles.

TORCAN SERIES Tc

The Torcan series consists of imperfectly drained Gleyed Orthic Black soils developed on strongly to very strongly calcareous loamy (VFSL, L, SiL) lacustrine sediments. They occur on very gently sloping topography or on intermediate to lower slope positions of undulating topography. Runoff is moderately slow; permeability is moderate, but may be restricted during the spring or early summer due to free water within a meter.

The soil is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a dark brown or brown Bm horizon, 12 to 18 cm thick and a light olive brown BCk horizon with yellowish brown mottles. A lime accumulation horizon, 8 to 12 cm thick is usually present. The C horizon is light olive brown and may contain yellowish brown mottles.

TRAVERSE SERIES Tv

The Traverse series consists of well to moderately well drained Calcareous Black soils developed on strongly to very strongly calcareous loamy (VFSL, L, SiL) lacustrine sediments. These soils occur on very gently sloping topography or on mid to upper slope positions of irregular, undulating to moderately rolling topography. Runoff is moderate to rapid, depending on the slope gradient; permeability is moderate. In cultivated areas, these soils have been affected by both wind and water erosion.

The soil is characterized by a very dark gray Ah horizon 10 to 18 cm thick, a dark grayish brown to brown calcareous Bm horizon, 8 to 15 cm thick, and a brown to pale brown BCk horizon. A white lime accumulation horizon, 8 to 12 cm thick is usually present. A description of the Traverse series is given below:

Apk — 0 to 15 cm, very dark grayish brown (10YR 3.5/2 d, 10YR 3.5/2 m) loam; weak, fine granular; very friable when moist, soft when dry, slightly plastic; mildly alkaline; moderately calcareous; abrupt, smooth boundary.

Bmk — 15 to 27 cm, brown to dark brown (10YR 4/3 d, 10YR 3/3 m) loam; weak to moderate, medium to coarse prismatic, breaking to weak to moderate fine granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; very strongly calcareous; clear, smooth boundary.

BCk — 27 to 31 cm, brown to pale brown (10YR 5.5/3 d, 10YR 5.5/5 m) silt loam; weak, medium to coarse prismatic breaking to weak to moderate, fine granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; very strongly calcareous; clear, smooth boundary.

Ck1 — 31 to 38 cm, pale brown (10YR 6/3 d, 10YR 5.5 m) silt loam; very weak, fine pseudo granular; very friable when moist, soft when dry, nonplastic; mildly alkaline; very strongly calcareous; gradual, wavy boundary.

Ck2 — 38 to 70 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5.5/4 m) clay loam; weak to moderate, fine pseudo granular; friable when moist, slightly plastic; mildly alkaline; very strongly calcareous.

Ck3 — 70 to 100 cm, pale brown to light yellowish brown (10YR 6/3.5 d, 10YR 5.5/4 m) loam; very weak, fine pseudo granular; friable when moist, slightly plastic; moderately alkaline; very strongly calcareous.

VARCOE SERIES Vr

The Varcoe series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on a thin mantle (25 to 50 cm) of very strongly 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 on lower slopes of irregular, undulating to gently rolling topography. They receive the runoff from the upper slopes and have free water within a meter for part of the year. Permeability is moderately slow and may be restricted during periods of subsoil saturation. In areas where upward groundwater pressure or seepage waters contain appreciable soluble salts, accumulation of salts may occur within the soil.

The soil is characterized by a very dark gray Ah horizon, 12 to 18 cm thick and a dark gray ACk, 4 to 8 cm thick. A lime accumulation horizon may be present, but is often difficult to distinguish within the very strongly calcareous till.

VORDAS SERIES Vs

The Vordas series consists of poorly drained Carbonated Rego Humic Gleysol soils developed

on strongly to very strongly calcareous loamy (VFSL, SiL, L) lacustrine sediments. These soils have free water at or near the surface for a considerable period of the year. Topography is level to depressional; runoff is negligible; permeability is moderate, but restricted during periods when free water is present within a meter of the surface. In areas where the water contains appreciable soluble salts, the salts may accumulate in the soil in sufficient quantities to affect the growth of normal hydrophytic vegetation.

The soil is characterized by a moderately decomposed organic layer, 2 to 5 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray mottled ACk horizon, 4 to 6 cm thick and a lime accumulation horizon, 8 to 14 cm thick. The C horizon is olive to pale olive with yellowish brown mottles of iron. In saline area, the Ah and ACk contain white pseudomycelia of salt.

VODROFF SERIES Vf

The Vodroff series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 60 cm) of loamy sediments over a thin strata (10 to 40 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 have free water at or near the surface for a considerable period of the year. The topography is level to depressional; runoff is negligible; permeability is restricted during periods of free water within a meter. In areas where the inflowing waters contain appreciable soluble salts, the salt may accumulate in the soil in sufficient amount to affect the growth of normal hydrophytic vegetation.

The soil is characterized by a moderately decomposed organic layer, 2 to 5 cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a mottled dark gray ACk horizon, 4 to 8 cm thick and a lime accumulation horizon, 8 to 12 cm thick. The C horizon is olive to pale olive and usually contains yellowish brown mottles. In saline areas, white pseudomycelia salt accumulations are present in the Ah and ACk horizons.

WELLWOOD SERIES Wd

The Wellwood series consists of well to moderately well drained Orthic Black soils developed on a thin mantle (25 to 75 cm) of strongly calcareous loam to sandy clay loam sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. Topography is very gently to gently sloping; runoff is moderate to moderately slow; permeability is moderate in the upper loamy strata and rapid in the sandy strata.

The soil is characterized by a deep black to very dark gray Ah horizon 18 to 30 cm thick, a dark brown to brown, prismatic to subangular blocky Bm horizon, 16 to 24 cm thick, and a yellowish brown to pale brown BCk horizon, 8 to 14 cm thick. A weak lime accumulation may be present. A description of a Wellwood soil is given below:

Ah — 0 to 23 cm, very dark gray (10YR 3/1.5 d, 10YR 2/1 m) fine sandy clay loam; weak, medium subangular blocky; friable when moist, soft when dry, slightly plastic; neutral; noncalcareous; gradual, wavy boundary.

Bm — 23 to 40 cm, dark grayish brown to grayish brown (10YR 4.5/2 d, 10YR 3/2 m) sandy clay loam; weak, medium, subangular blocky; friable when moist, soft when dry, slightly plastic; mildly alkaline; weakly calcareous; gradual, wavy boundary.

Cca — 40 to 48 cm, light gray (10YR 7/1.5 d, 10YR 5.5/3 m) clay loam; very weak, medium subangular blocky; friable when moist, slightly hard when dry, slightly plastic; moderately alkaline; very strongly calcareous; gradual, wavy boundary.

IICk — 48 to 100 cm, pale brown (10YR 6/3 d, 10YR 6/5 m) loamy fine sand; single grained; loose when moist or dry; mildly alkaline; moderately calcareous; few, medium, distinct strong brown (7.5YR 5/8 m) mottles.

WESLEY SERIES Ws

The Wesley series consists of imperfectly drained Gleyed Carbonated Rego Black soils developed on stony, very strongly to extremely calcareous loamy glacial till of limestone and granitic origin; some coarser material may occur at variable depths below the surface. The soils occur on the lower slopes of irregular, undulating to moderately rolling topography; they receive the runoff from the upper slopes as well as seepage waters during the spring. Free water may occur within a meter for a considerable part of the year. Permeability is moderate, but is restricted during periods of free water in the soil.

The soil is characterized by a very dark gray Ah(k) horizon 15 to 20 cm thick, a very dark gray ACk horizon, 6 to 10 cm thick, and a lime accumulation horizon, 8 to 12 cm thick, that is often not adequately discernible from the extremely calcareous pale yellow C horizon.

WHEATLAND SERIES Wh

The Wheatland series consists of well to moderately well drained Orthic Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous sandy sediments (FS, LFS, LS) overlying moderately to strongly calcareous medium sand to gravelly textured deposits. Topography is very gently to gently sloping; runoff is moderately slow; permeability is rapid in the upper sandy strata and very rapid in the underlying coarser strata. These soils, if cultivated, are very susceptible to wind erosion.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 18 to 25 cm thick, a brown to yellowish brown Bm horizon, 12 to 24 cm thick, and a light yellowish brown BCk horizon. The solum extends to the contact of the coarser textured strata. A lime accumulation usually occurs at the top of the coarser strata. A description of a representative Wheatland series is given below:

Ah — 0 to 21 cm, very dark grayish brown (10YR 3/2 d, 10YR 2/1 m) sandy loam; very weak, fine subangular blocky; very friable when moist, soft when dry, nonplastic; mildly alkaline; noncalcareous; abrupt, smooth boundary.

Bm — 21 to 38 cm, brown to dark brown (10YR 3.5/3 d, 10YR 2.5/2 m) loamy medium sand; loose when moist or dry, nonplastic; moderately alkaline; moderately calcareous (due to presence of carbonate sand grains); clear, wavy boundary.

Ck1 — 38 to 62 cm, pale brown (10YR 5.5/3 d, 10YR 5.5/4 m) coarse sand; loose when moist or dry; moderately alkaline; strongly calcareous; clear, wavy boundary.

Ck2 — 62 to 100 cm, pale brown (10YR 5.5/3 d, 10YR 4/4 m) medium sand; loose when moist or dry; moderately alkaline; strongly calcareous.

WOODFIELD SERIES Wf

The Woodfield series consists of moderately well to well drained Calcareous Black soils developed on stony, very strongly to extremely calcareous loamy glacial drift of limestone and granitic origin; some coarser materials may occur at variable depths. These soils occur on the mid and upper slopes of irregular undulating to moderately rolling topography of the Brandon Hills. They are more common on the south and west facing slopes which receive greater amounts of radiation per area resulting in a greater moisture deficiency than Stanley soils on north and east slopes. Runoff is moderately rapid to rapid; permeability is moderate.

The soil is characterized by a very dark gray Ah horizon, 10 to 15 cm thick, a calcareous dark grayish brown to brown Bm horizon, 8 to 12 cm thick. A white lime accumulation horizon is common below the solum but is often difficult to differentiate from the very strongly calcareous till. The cultivated soils are susceptible to wind and water erosion and have had some of the Ah horizon removed.

WYTONVILLE SERIES Wy

The Wytonville series consists of imperfectly drained Gleyed Orthic Black soils developed on a thin mantle (25 to 50 cm) of moderately to strongly calcareous sediments of VFS, LVFS, FSL, SL texture, overlying moderately to strongly calcareous medium sand to gravelly textured deposits. Topography is gently sloping to irregular, undulating; runoff is moderately slow; permeability is moderately rapid on the upper strata, and very rapid in the lower strata unless restricted by a water table within a meter of the surface during the spring or following heavy rains.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 18 to 25 cm thick, a brown to dark brown weakly mottled Bm horizon, 14 to 22 cm thick and a light yellowish brown BCk with strong brown mottles. A lime accumulation horizon occurs at the upper surface of the coarse strata.

XAVIER SERIES Xv

The Xavier series consists of very poorly drained Typic Mesisols developed on deep (>160 cm) deposits of mesic fen peat. They are characterized by a very thin (10 to 30 cm) fibric fen peat surface layer that is dark yellowish brown in color, medium acid to neutral in reaction, a thick very dark brown medium acid to neutral mesic fen peat, which grades into black colored slightly acid to alkaline humic fen peat. Lacustrine deposits ranging in texture from loam to clay generally occur below the 160 cm depth.

The Xavier soils occur in Mesic horizontal fen landforms. Topography is depressional to level. The native vegetation is dominantly sedges and reeds with willow, tamarack and swamp birch in slightly raised positions. In some areas hydric layers can occur within the control section, resulting in "floating fen". A description of the soil is given below:

Om1 — 0 to 100 cm, very dark grayish brown (10YR 3/2 natural, 10YR 3.5/3 pressed, 10YR 2.5/2 rubbed) mesic sedge peat; very fine to fine fibered; felty; slightly sticky when wet; medium acid; abrupt, smooth boundary.

Om2 — 100 to 175 cm, very dark brown (10YR 2/2 natural, 10YR 3.5/3 pressed, 10YR 2/2 rubbed) mesic sedge peat; very fine fibered; felty; slightly sticky when wet; slightly acid; clear, smooth boundary.

Om3 — 175 to 200 cm, very dark brown (10YR 2/2 natural, 10YR 3.5/2 pressed, 10YR 2/2 rubbed) very fine fibered; felty; slightly sticky when wet; slightly acid; clear, smooth boundary.

Oh1 — 200 plus cm, black (10YR 2/1 natural, 10YR 2/2 pressed, 10YR 2/1 rubbed) humic sedge peat; very fine fibered; felty; slightly sticky when wet; slightly acid.

ZARNET SERIES Zn

The Zarnet series consists of well to moderately well drained Rego Black soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments overlying moderately to strongly calcareous medium sand to gravelly textured deposits. The soils occur on gently sloping topography or in the upper slope and knoll positions of irregular, undulating to gently rolling topography. Runoff is moderate to rapid depending on gradient; permeability is moderate in the upper strata and very rapid in the lower coarser strata. These soils have had some removal of the Ah horizon by wind and water erosion.

The soil is characterized by a very dark gray Ah horizon, 12 to 18 cm thick, a dark gray to dark grayish brown ACk horizon, 8 to 14 cm thick, and a lime carbonate accumulation horizon, 10 to 18 cm thick.

PART IV
AGRICULTURE

Agricultural interpretations of soil survey information are made to provide a better understanding of soils and their land use potential under dry land farming systems. These interpretations are based mainly on extensive field observations, soil analyses, and to a limited extend, on experimental data provided by research workers in the soils and crops fields.

The climate in the Brandon Region is suitable for a wide variety of cereal and horticultural crops. For dry land farming, the precipitation is satisfactory; termperatures during the growing season and frost-free season are favorable and pose no limitations. The soil capability for agriculture with dry land farming is described in the following sections.

MINERAL SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE

The soil capability classification for agricultural purposes is one of a number of interpretive groupings that may be made from soil survey data. The capability classification is developed from the soil mapping units. The mineral soils are grouped into seven classes according to their potentialities and limitations for agricultural use. The first three classes are considered capable of sustained production of common cultivated crops, the fourth is marginal for sustained arable culture, the fifth is capable of use only for improved permanent pasture, the sixth class is capable of use only for wild pasture, while the seventh class is for soils and land types considered incapable of use for arable agriculture of permanent pasture. While the soils in classes one to four are capable of use for cultivated field crops, they are also capable for use as permanent pasture. All classes of soil areas may be suitable for forestry, wildlife and recreation.

The capability classification consists of three categories:

1. The capability class, the broadest category is a grouping of subclasses that have the same relative degree of limitation or hazard for agricultural use. The limitation becomes progressively greater from Class 1 to Class 7.

2. The capability subclass is a grouping of soils with similar kinds of limitations and hazards. These limitations are: adverse climate for crop production (c); undesirable soil structure and/or low permeability (d); erosion damage (e); low fertility (f); inundation by streams or lakes (i); moisture limitation, soils affected by droughtiness owing to coarse soil texture (m); salinity (n); stoniness (p); consolidated rock near the surface (r); two or more adverse soil characteristics such as d, f, m and n (s); adverse topography, either steep slopes or frequency and pattern of slopes in different directions (t); excess water, other than that brought about by inundation (w); cumulative adverse characteristics (x).

3. The unit is a subdivision within the subclass category that groups together soils that will respond similarly to management.

ASSUMPTIONS

This soil capability classification is based on certain assumptions which must be understood by those applying this interpretive classification, if the soils are to be assigned consistently into the various classes. These assumptions must be understood also by those using the soil capability maps and statistical data if they are to derive full benefit from such information and avoid making erroneous deductions. These assumptions are:

1. The soil capability classification is an interpretive classification based on the effects of combinations of climate and soil characteristics on limitations in use of the soils for agriculture and their general productive capacity for common field crops. Shrubs, trees or stumps are not considered as limitations to use unless it is entirely unfeasible to remove them.

2. Good soil management practices that are feasible and practical under a largely mechanized system of agriculture are assumed.

3. The soils within a capability class are similar with respect to degree but not to kind of limitations in soil use for agricultural purposes. Each class includes many different kinds of soil and many of the soils within any one class require unlike management and treatment. The subclass provides information on the kind of limitation and the class indicates the intensity of the limitation. Capability Class 1 has no subclasses. Information for specific soils is included in soil survey reports and in other sources of information.

4. Soils considered feasible for improvement by draining, by irrigating, by removing stones, by altering soil structure, or by protecting from overflow, are classified according to their continuing limitations or hazards in use after the improve-

ments have been made. The term "feasible" implies that it is within present day economic possibility for the farmer to make such improvements and it does not require a major reclamation project to do so. Where such major projects have been installed, the soils are grouped according to the soil and climatic limitations that continue to exist. A general guide to what is considered a major reclamation project is that such projects require cooperative action among farmers or between farmers and governments. (Minor dams, small dykes, or field conservation measures are not included).

5. The capability classification of the soils in an area may be changed when major reclamation works are installed that permanently change the limitations in use for agriculture.

6. Distance to market, kind of roads, location, size of farms, characteristics of land-ownership and cultural patterns, and the skill or resources of individual operators are not criteria for capability groupings.

7. Capability groupings are subject to change as new information about the behaviour and responses of the soils becomes available.

8. Research data, recorded observations and experience are used as the basis for placing soils in capability classes and subclasses. In areas where such information is lacking, soils are placed in capability classes and subclasses by interpretation of soil characteristics in accord with experience gained on similar soils elsewhere.

9. The level of generalization of the soil capability classification is indicated by the scale on which the information is published.

SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE IN THE BRANDON REGION

Class 1

Soils in this class have no important limitations in use for crops. Class 1 soils have level or gently sloping topography; they are deep, moderately well drained and have good water-holding capacity. These soils are naturally well supplied with plant nutrients. They are easily maintained in good tilth and fertility, and damage from erosion is slight. They are moderately high to high in productivity for a wide range of field crops.

The soils belonging in this class are:

Bankton Ba
Carroll Cl
Clementi Cm
Chambers Cb
Durnan Dn
Everton Ev
Fairland Fd
Janick Jk
Kleysen Ky
Ramada Ra
Rempel Rp
Traverse Tv
Wellwood Wd

Class 2

Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. Class 2 soils have good water-holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderately high 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. The capability subclasses and units are described below:

2e — The soils in this subclass are well drained and occur on nearly level to gently undulating topography. These loamy materials are permeable and have a medium to moderately high natural fertility status. The productivity of these soils may be lowered due to limited erosion associated with them. A fairly wide range of field crops are suitable to these soils. The soil phases are:

Clementi Ct/1xxx
Chambers Cb/1xxx
Durnan Dn/1xxx
Ererton Ev/1xxx
Fairland Fd/1xxx
Kleysen Ky/1xxx
Ramada Ra/1xxx
Traverse Tv/1xxx

2i — The soils in this subclass are imperfectly drianed, medium to fine textured alluvial deposits. These soils are nearly level to gently undulating and are subject to inundation causing crop damage or restricting agricultural use to a slight extent. The soils are relatively permeable, have a medium to moderately high natural fertility status and with adequate drainage produce good crops. The soils are:

Assiniboine As
Levine Lv

2m — Soils in this subclass are adversely affected by droughtiness. They are soils with a low water-holding capacity, due to their texture. These soils occur on a level to gently undulating topography. The soils are well drained and are medium to moderately coarse textured. Runoff is moderate and permeability is moderately rapid. It is important to maintain organic matter in these soils through the addition of organic residues to increase water retention capacity and to build up fertility. The soils are:

Glenboro Gl, Gl'
Kirkness Kk
Lockhart Lk
Porple Pp
Prosser Ps

2p — The soils in this subclass are medium textured materials and medium textured soils developed on glacial till. These soils occur on slightly stony land where some stones offer only slight hindrance to cultivation. These soils are well drained and exist on a level to gently undulating topography. The phases are:

Clementi Ct/xx1x
Fairland Fd/xx1x
Bermont Bm/xx1x

2t — These soils are well drained soils occurring on an undulating topography. Their chief soil management problem is overcoming the topographic pattern that imposes a slight obstacle to cultivation and water runoff. In most cases this can be overcome economically through land leveling. The soils in this particular subclass range from a moderately fine to a coarse texture. They are variable in moisture retention capacity, organic matter and permeability. The soil phases are:

Carroll Cl/1cxx
Clementi Ct/xcxx
Durnan Dn/ xcxx
Fairland Fd/xcxx
Wellwood Wd/xcxx
Stockton Sn/xcxx
Traverse Tv/1cxx

$2w_1$ — The soils in this subclass are imperfectly drained, occurring on a level to gently undulating topography. They are medium to moderately coarse textured. Glacial till may occur at the 60 cm depth resulting in a temporary high water table and impeded internal drainage. Generally, surface runoff is slow, and in seasons of high rainfall, delayed seeding and reduced yields result because of the wetness. These imperfectly drained soils require artificial drainage and sufficient trash or stubble incorporated into the soil to maintain good tilth, structure and aeration. The soils produce well and respond to phosphate fertilizers. The soils are:

Barwood Bw
Beresford Bd
Cobfield Cf
Gateside Gt
Grover Gr, Gr[1]
Killeen Kl
Lindstrom Ld
Melland Ml
Pleasant Pl
Petrel Pt, Pt[1]
Taggart Tg
Torcan Tc
Varcoe Vr
Wesley Ws

$2w_2$ — Soils in this subclass unit are imperfectly drained, fine to moderately fine textured soils on nearly level to gently undulating topography. Glacial till or coarse materials may occur at the 75 cm depth. These soils have a moderately high content of organic matter and a medium to moderately high natural fertility. Permeability is slow to very slow. Delayed seeding and reduced yields, because of wetness, result in seasons of above average rainfall. Maintenance of tilth and good aeration are the main soil management problems. If cultivated when they are too moist or dry, large massive lumps will result forming a poor seed bed. The soils take longer to warm up in the spring than medium to moderately coarse textures soils and usually take longer to dry out following rains. Incorporation of stubble or green manure crops is a good practice to maintain good surface structure and improve permeability. Shallow surface drains should be planned to remove any standing water. The soils are:

Crookdale Ck
Forrest Ft
Harding Hg
Justice Js
Oberon Ob
Prodan Pr
Sigmund Sg
Charman Cm

2x — These are dominantly well drained soils which occur on a nearly level to undulating topography. Soils in this subclass have minor limitations, none of which by themselves, would be prominent enough to drop the land into Class 2, but together they are severe enough. The cumulative minor adverse limitations could include: low fertility, moisture limitation, soil structure or permeability, erosion, droughtiness, stoniness, topography and excess water. These soils are moderately high in productivity for a wide range of field crops. The soils are:

Bermont Bm
Bermont Bm/xcxx
Cordova Cv
Cordova Cv/xx1x
Cordova Cv/xcxx
Charman Cm/1xxx
Durnan Dn/1cxx
Glenboro Gl/xcxx
Glenboro Gl[1]/xcxx
Glenboro Gl/1xxx
Hilton Hn
Hilton Hn/1xxx
Manson Mn
Melland Ml/xx1x
Pleasant Pl/xcxx
Rufford Rf
Ramada Ra/1xcc
Ramada Ra/xcxx
Statley Sy
Stewart St
Woodfield Wf
Beresford Bd/xx1x

Class 3

Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. The limitations include one or more of the following: moderate climatic limitation, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water-holding capacity or slowness in release of water to plants, stoniness and depth of soil to consolidated bed-

rock. Under good management these soils are fair to moderately high in productivity for a fairly wide range of field crops.

3e — These soils occur on nearly level to gently undulating topography and are medium textured lacustrine to glacial till deposits. The soils have been subjected to severe erosion where 50 to 100% of the original A horizon has been removed, thus limiting their use for crop production. These soils are well drained and not affected by adverse topography or stoniness. In order to prevent erosion, build up fertility, and improve or maintain the organic matter status, organic residues such as manure, stubble, straw or green manure crops should be incorporated into the soil regularly. Proper management of these soils will result in good production. The soils are:

Durnan Dn/2xxx
Fairland Fd/2xxx
Roddan Rd
Stewart St/2xxx

3em — These are well drained soils developed on nearly level to gently undulating, moderately fine to moderately coarse textured deposits. They have a moderate permeability, low to fair water retention capacity and moderate organic matter content. Soils in this subclass have a combination of limitations. The adverse affects are erosion and droughtiness, erosion being the more serious limitation. The soils are subject to droughtiness if a dry period results, but once a crop is established, moist subsoils contain sufficient water to maintain a crop. These soils will produce good to excellent crops of cereals, forage and hay, under good management. The soils are:

Brownridge Bn
Barren Br
Knolls Ko
Kirkness Kk/1xxx
Prosser Ps/1xxx
Porple Pp/1xxx

3it — These soils are developed on moderately to strongly calcareous, stratified, dominantly loamy textured recent alluvial deposits. They are subject to inundation due to occasional damaging stream overflow during the spring and periodically during the summer. These soils occur on a sloping topography with 2 to 5 % slopes. The soils are fair to moderately high in productivity for a fairly wide range of crops. Drainage is imperfect.

Levine Lv/xcxx

3m — These are moderately well to well drained soils developed on nearly level to gently undulating, moderately fine to moderately coarse textured soils developed on coarse outwash deposits. Coarse textured deposits may exist alone. They have rapid permeability, low water retention capacity and low to moderate organic matter content. They become droughty readily during dry periods. These soils would be susceptible to erosion if the land remained bare. They are relatively low in natural fertility, but respond well to additions of fertilizer. Organic residues should be incorporated into the soil to improve or maintain the organic matter status, increase water retention capacity, prevent erosion and build up the fertility. Careful management of these soils will produce good crops. The soils in this subclass are:

Ashmore Am
Croyon Cr
Cactus Cc
Cactus Cc/1xxx
Druxman Dx
Dogand Dg
Miniota Ms
Stockton Sn
Zarnet Zn

3mt — Soils in this subclass are in the well drained category. A combination of droughtiness and topography account for the class rating in order of severity. Droughtiness is a direct result of the drainage and soil characteristics, of which texture is most relevant. The topography of these soils is undulating to gently rolling. The obstacle of topographic pattern may be overcome through land leveling. Proper management would involve the incorporation of organic residues into the soil to prevent erosion, increase water retention and build up fertility. The soil phases are:

Ashmore Am/xcxx
Croyon Cr/xcxx
Kirkness Kk/xcxx
Miniota Ms/xcxx
Porple Pp/1cxx
Porple Pp/xcxx
Prosser Ps/xdxx
Stockton Sn/xcxx
Zarnet Zn/xcxx

3mw — These soils occur on nearly level to gently undulating topography and are the coarser textured deposits. They have rapid permeability, low water retention capacity and low to moderate organic matter content. These soils have imperfect drainage. In the spring and after heavy summer rains they have adequate moisture. They may become dry in the summer but most are affected by a high level of groundwater. Good management of these soils will produce good to excellent crops. The soils included in this subclass are:

Barager Bg
Boswell Bo
Capell Cp
Capell Cp/1xxx
Capell Cp/xx1x
Gendzel Gz
Hummerston Hm
Kilmury Kl
Lavenham Lh
Wytonville Wy

3nw — Soils in this subclass are imperfectly drained, medium to fine textured and occur on nearly level to gently undulating topography. Glacial till may be present at the 60 cm depth for some of the soils. Surface runoff is slow and internal drainage is very slow, often impeded by a high water table in early spring, resulting in delayed seeding and reduced yields due to wetness. The degree of salinity is quite variable throughout areas of these soils and the affect on crops is also variable depending on type of crop grown and moisture conditions throughout the growing season. However, the soils in this subclass would sustain crops at a moderately affected level. The growth of sensitive crops would be more serious. Salts may be

translocated either during the year or over a period of years, by capillary rise of saline water and subsequent evaporation, resulting in a concentration of salts. Salinity may be decreased by improving drainage, avoiding the practice of summerfallow and the growth of crops that will help maintain soil permeability. These soils will produce good crops of cereals, forage and hay under good management and fertilizer practice. The soil phases are:

Beresford Bd/xxxs
Charman Cm/xxxs
Harding Hg/xxxs
Taggart Tg/xxxs
Prodan Pr/xxxs

3pe — These are well drained, nearly level to gently undulating soils. They are medium textured soils developed on strongly to extremely calcareous glacial till. Agricultural utilization of these soils is hampered by stoniness and erosion. This is slightly stony land where the stones offer only slight to no hindrance to cultivation. Little to no removal is required. Erosion is slight to moderate on these soils. Good crops of wheat, oats, barley, flax, alfalfa, hay and grass seed can be produced with proper fertilization and management. The phases are:

Bermont Bm/1x1x
Cordova Cv/1x1x
Clementi Ct/1x1x

3pt — The soils in this subclass are well drained, medium textured soils developed on strongly calcareous glacial till. Their chief soil management problems are due to the stony soil condition and an undulating topographic pattern. Both impose obstacles to cultivation and/or limit the choice of crops to some extent. These soils are usually low in available phosphorus. Good crops of cereal and forage can be grown with the addition of nitrogen and phosphate fertilizers. The phases included are:

Cordova Cv/xc2x
Clementi Ct/1c1x
Clementi Ct/xc1x
Cordova CV/1c1x

3pw At the subclass level, where there is more than one limitation, the symbol representing the most severe problem is listed first. In this particular section two subclasses are being described, with the only difference being the order of severity. Agricultural utilization of these soils is hampered by the limitation of stoniness and excess water. The severity of the stoniness may be such that the stones are of sufficient size and quantity to restrict the types of crop grown and affect cultivation slightly, thus some removal is required. The problem of excess water may result from inadequate soil drainage, a high water table, and seepage or runoff from surrounding areas. These soils occur on a nearly level to gently undulating topography and are imperfectly drained. In order to improve the problem of wetness, trash and stubble should be incorporated into the soils to maintain good tilth and structure and to improve aeration. The soils are:

3pw
Barwood Bw/xx2x
Beresford Bd/xx2x
Cobfield Cf/xx1x
Cobfield Cf/xx2x
3wp
Barwood Bw/xx1x
Prodan Pr/xx1x
Varcoe Vr/xx1x

3pw
&
3wp

3px — The soils in this subclass are well drained, medium textured soils developed on calcareous glacial till. Agricultural utilization of these soils is hampered by stoniness and a number of small problems which are not severe enough to be listed individually. The stones are of sufficient size and quantity to restrict the types of crops grown and affect cultivation, thus some removal is required. The soils are:

Bermont Bm/1c1x
Bermont Bm/xx2x
Hilton Hn/1x2x
Clementi Ct/xx2x

3t — The topography on which these soils occur is undulating to gently rolling. Generally, these are loamy soils developed on calcareous glacial till. The major management problem is to overcome the complex topographic pattern which imposes an obstacle to cultivation and runoff. Since these soils have poor profile development, it is necessary to incorporate as much crop residue, manure or green manure crops as possible to maintain good tilth. The soil phases are:

Bermont Bm/xdxx
Brownridge Bn/xcxx
Clementi Ct/xdxx
Durnan Dn/xdxx
Fairland Fd/xdxx
Fairland Fd:xdxx
Rufford Rf/xdxx

3te — These are well drained soils occurring on an undulating to gently rolling topography. Erosion is slight to moderate, thus limiting use for crop production. The complex topographic pattern may be overcome through land leveling. Continuous cropping and returning the stubble is recommended to minimize erosion losses by wind and water. The extent of erosion is proportional to an increasingly complex topography. These soils are able to produce good crops of cereals, forage and hay under careful management. The soils in this category are:

Bankton Ba/1cxx
Cordova Cv/1cxx
Dordova Cv/1Dxx
Clementi Ct/1cxx
Chambers Cb/1dxx
Durnan Dn/1dxx
Fairland Fd/1cxx
Wellwood Wd/1cxx

3wt — These are imperfectly drained soils that occur on an undulating landscape. These soils are limited by the adverse effects of excess moisture and topography. Wetness may be a result of inadequate soil drainage, a high water table, seepage or runoff from surrounding areas. Management practices on these soils include

artificial drainage and land leveling. Grain and forage crops can be grown. The phases are:

Beresford Bd/xc1x
Beresford Bd/1cxx
Charman Cm/xcxx
Cobfield Cf/xcxx
Oberon Ob/xcxx
Prodan Pr/xcxx
Taggart Tg/xcxx
Torcan Tc/xcxx
Varcoe Vr/xcxx

These soils have a combination of wetness and erosion problems which affect their productivity. They are imperfectly drained with a nearly level to gently undulating topography. Erosion is slight to moderate and water is removed slowly enough to keep such soils wet for significant periods. Grain and forage crops can be grown if adequate drainage and good management is provided. The soils are:

Beresford Bd/1xxx
Beresford Bd/1x1x
Cobfield Cf/1xxx
Grover Gr/1xxx
Prodan Pr/1xxx
Torcan Tc/1xxx

3we
&
3ew

3x — These are imperfectly to well drained soils of variable texture. They occur on nearly level to undulating topography. The soils have 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. Management practices will vary due to the complexity of the limitations. The phases are:

Bermont Bm/xc1x
Chambers Cb/1c1x
Chambers Cb/1cxx
Cobfield Cf/xc1x
Cobfield Cf/1x1x
Durnan Dn/1c1x
Glenboro Gl/1cxx
Glenboro Gl'/1cxx
Hummerston Hm/xcxx
Hummerston Hm/1xxx
Kilmury Kl/xx1x
Knolls Ko/xcxx
Kirkness Kk/1cxx
Lavenham Lh/1xxx
Lindstrom Ld/1c1x
Lockhart Lk/1cxx
Pleasant Pl/1cxx
Pleasant Pl/1xxx
Prosser Ps/1cxx
Prosser Ps/xcxx
Prodan Pr/1cxx
Rufford Rf/1c1x
Rufford Rf/1x1x
Statley Sy/1c1x
Statley Sy/xc2x
Statley Sy/xc1x
Stewart St/1x1x
Stewart St/1c1x
Stockton Sn/1xxx
Woodfield Wf/xc2x
Woodfield Wf/1x2x
Woodfield Wf/xc1x
Woodfield Wf/1cxx
Wesley Ws/xc1x
Wesley Ws/xx1x

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, deficiencies in the 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. The subclasses and units in this class are:

4e — These are imperfectly to well drained soils occurring on a nearly level to undulating topography. Severe erosion, where 50 to 100% of the original A horizon is removed, is a limitation to agricultural use. Soil productivity is lowered with the loss of topsoil and fields cut by gullies are more expensive to farm. Wind erosion remains a problem if the land is bare. Continuous cropping and the incorporation of organic residues into the soil will increase water retention capacity, prevent erosion and build up fertility. The soils are:

Hummerston Hm/2xxx
Rufford Rf/2c1x
Stewart St/2cxx

— These soils have a combination of adverse affects, which are listed in order of severity. They are well drained, medium textured soils developed on strongly calcareous glacial till. The topography ranges from undulating to gently rolling. Agricultural use of these soils is limited by moderate to severe erosion and slight to moderate stoniness. The stones may restrict the types of crops grown and affect cultivation. Management difficulties arise due to the combination of adverse affects. The soils included are:

Bermont Bm/2c1x
Clementi Ct/2c1x
Clementi Ct/1c2x
Hilton Hn/2d1x

4etp
4pte
&
4tep

4m — These are sandy to gravelly coarse textured.

imperfectly to well drained soils that are droughty. They may be underlain by glacial till. They are low in natural fertility and low in organic matter. Wind erosion is a hazard in cultivated areaa. Organic residues such as barnyard manure, stubble and green manure crops should be returned to the soil to prevent erosion, build up nutrient levels and increase water retention capacity. These soils are suitable for production of forage and cereal crops under good management. The soils are:

Chater Ch
Dexter Dt, Dt[1]
Mansfield Mf, Mf[1]
Wheatland Wh

4me — These are well drained soils that have been adversely affected by droughtiness and erosion. They occur on a nearly level to undulating topography and are not affected by stoniness. Erosion is moderate to severe. Management practices involve the incorporation of organic residues into the soil. Included are:

Arizona Az
Ashmore Am/2xxx
Chater Ch/1xxx
Carroll Cc/2xxx
Carroll Cc/2cxx

— Soils in this category have agricultural use limited by droughtiness, erosion and topography, their order depending upon severity. The topography is undulating to gently rolling, while erosion may be slight to severe. Texturally, these soils range from coarse to moderately fine materials. The droughtiness is basically a result of the texture and good drainage. These soils are only suited for a few crops, otherwise yields may be low. Careful management is required. The soil phases are:

Arizona Az/xcxx
Ashmore Am/2cxx
Brownridge Bn/xdxx
Barren Br/xdxx
Barren Br/xcxx
Croyon Cr/1cxx
Knolls Ko/xdxx
Miniota Ms/2cxx
Porple Pp/2dxx
Zarnet Zn/2cxx

4mt — These are well drained, medium to very coarse textured soils. They occur on undulating to gently rolling topography and are low in water holding capacity. As a result of rapid runoff and permeability, these soils are moderately affected by droughtiness. They are low in natural fertility and low in organic matter. Wind erosion is a hazard in cultivated areas. Organic residues should be incorporated into the soil as a management practice. These soils are suitable for production of forage and cereal crops. The soils in this subclass are:

Chater Ch/xcxx
Chater Ch/1cxx
Cactus Cc/1cxx
Cactus Cc/1dxx
Cactus Cc/1Dxx
Miniota Ms/xc1x
Miniota Ms/xd1x
Stockton Sn/1dxx
Wheatland Wh/xcxx
Zarnet Zn/1dxx

4met
&
4tem

4mtp — This is a well drained, moderately coarse soil underlain by sand and gravel at 25 to 50 cm. The soil has a low water holding capacity. Agricultural limitations include droughtiness, undulating to gently rolling topography and stoniness. The stones may offer slight to a serious handicap to cultivation and some clearing is required. These factors increase management difficulties and costs of cultivation. Uniformity of crop growth and maturity is affected. Phases included are:

Ashmore Am/xd2x
Ashmore Am/1c3x
Ashmore Am/xd1x
Ashmore Am/1c1x

4mp — These are well drained soils, hampered by droughtiness and stoniness. They are moderately coarse to very coarse soils, which may be underlain by till at 30 to 90 cm. The underlying till is slowly permeabile and restricts the movement of water in the lower portion of the profile. Some stone removal may be required; however, the problem of droughtiness is a more serious limiting factor. Management practices should include the incorporation of organic residues into the soil.

Chater Ch/xx1x
Miniota Ms/xx2x

These are imperfectly drained, moderately to seriously saline soils. They occur in depressional to level positions in the landscape. They are subject to ponding for long periods during spring runoff and after heavy rains. These soils may have a low water holding capacity if the texture is medium to coarse, but high water tables during most of the growing season cause them to be moist. The soluble salts adversely affect crop growth or restrict the range of crops that may be grown. If adequate drainage is provided, cereal grain and forage crop production is possible. The soils are:

Barwood Bw/xxxs
Beresford Bd/xxxt
Beresford Bd/1xxs
Beresford Bd/xx1s
Capell Cp/xxxs
Capell Cp/xxxt
Forrest Ft/xxxs
Gateside Gt/xxxs
Hummerston Hm/xxxs
Justice Js/xxxs
Lindstrom Ld/xxxs
Oberon Ob/xxxs
Prodan Pr/xxxt
Prodan Pr/1x1s
Prodan Pr/1xxs
Pleasant Pl/xxxs
Sigmund Sg/xxxs
Tordan Tc/xxxs
Taggart Tg/xcxs

4nw
&
4wn

— These are imperfectly to well drained soils of

medium texture developed on strongly calcareous glacial till. The limitations associated with these soils are stoniness and topography, with their order of listing at the subclass level depending on their severity. Topography is undulating to gently rolling and the surface is moderately to very stony. Surface stone removal is required for continuous cultivation. These limitations hinder tillage, planting, harvesting operations, and decrease the growth and maturity of crops. The soils are:

Bermont Bm/xc3x
Clementi Ct/xc2x
Cobfield Cf/xc3x
Stewart St/xd3x
Stewart St/1d2x
Stewart St/xd2x
Statley Sy/xd2x
Woodfield Wf/xd3x
Wesley Ws/xd2x

4pt
&
4tp

— These are imperfectly to well drained soils of medium texture developed on highly calcareous glacial till. Topography is nearly level to undulating. The major limitation associated with these soils is stoniness; however, there may be a cumulative effect of other minor adverse characteristics. Utilization of these soil areas is hampered by very stony land, which constitutes a handicap to cultivation and requires removal. Fields from which the stones have been removed produce good crops of wheat, oats, barley, flax, alfalfa, hay and seed on additions of nitrogen and phosphate fertilizers. Other minor limitations which may occur on these soils are adverse topography and some erosion. The soil phases are:

Barwood Bw/1x2x
Clementi Ct/xx3x
Melland Ml/xx3x
Stewart St/1c3x
Stewart St/1c2x
Stewart St/xc3x
Statley Sy/xc3x
Woodfield Wf/1c2x
Wesley Ws/1c3x

4p
&
4px

4te
&
4et

— These soils are well drained, medium textured and medium textured underlain by glacial till, occurring on an undulating to moderately rolling topography. Management difficulties include adverse topography and erosion. Moderate to severe erosion results in a loss of productivity. Soil conservation practices such as returning trash to the soil is strongly recommended if these soils are continuously cultivated. The soils included are:

Cordova Cv/2d1x
Carroll Cl/2cxx
Carroll Cl/2dxx
Clementi Ct/1exx
Clementi Ct/1dxx
Chambers Cb/2dxx
Chambers Cb/2cxx
Chambers Cb/1cxx
Durnan Dn/2cxx
Durnan Dn/2dxx
Durnan Dn/1cxx
Madill Md
Madill Md/xcxx
Madill Md/xdxx
Rufford Rf/2cxx
Roddan Rd/1d1x
Roddan Rd/2d1x
Roddan Rd/1dxx
Traverse Tv/2cxx
Woodfield Wf/2cxx
Wellwood Wd/2dxx

4tw
&
4wt

— These imperfectly drained soils are limited for agricultural use by wetness and topography. The landscape is undulating to gently rolling. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas. With adequate artificial drainage and land leveling, cereal grain and forage crop production is possible. The soils are:

Beresford Bd/xDxx
Boswell Bo/xcxx
Onahan Oh/xcxx
Onahan Oh/xdxx
Taggart Tg/xdxx

4tx — The soils in this subclass are imperfectly to well drained and have multiple limitations of which adverse topography is the most serious. Erosion, wetness, stoniness and droughtiness constitute a moderate limitation on the soils. The undulating to moderately rolling topography results in soil management problems of overcoming the complex pattern that imposes an obstacle to cultivation and water runoff. The soil phases are:

Pleasant Pl/1dxx
Porple Pp/1dxx
Porple Pp/1cxx
Prosser Ps/1dxx
Rufford Rf/1e1x
Statley Sy/1d1x
Statley Sy/1d1x
Statley Sy/xd1x
Varcoe Vr/1Dxx
Varcoe Vr/1dxx
Woodfield Wf/2c2x
Woodfield Wf/1d1x

4w — These are imperfect to poorly drained soils occurring in level to depressional positions in the landscape. They are moderately coarse to coarse in texture and have a high water table for a substantial part of the year. Droughtiness may occur on the imperfectly drained sites during dry seasons. These soils are suited for hay and pasture and crop production if ade-

quate drainage and good management is provided. Included are:

Onahan Oh
Poolex Po
Sewell Sw
Sewell Sw/1xxx

4x — Soils in this subclass have a number of limitations which affect their productivity. Each of the adverse effects may be relatively serious. These soils have a nearly level to gently rolling topography, slightly to moderately stony surface and slight to moderate erosion. Other limitations are wetness and droughtiness. The soils in this category are well to imperfectly drained. Proper management of these soils requires multiple practices and suitability for production is limited. The soils are:

Beresford Bd/1c1x
Cobfield Cb/1x2x
Chambers Cb/1d1x
Capell Cp/1cxx
Capell Cp/xx2x
Gendzel Gz/1cxx
Hummerston Hm/1cxx
Hummerston Hm/1dxx
Kilmury Kl/1cxx
Lavenham Lh/1cxx
Lockhart Lk/1c1x
Stockton Sn/1cxx
Wheatland Wh/1c1x

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 such serious soil, climatic or other limitations that they are not capable of use for sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control.

Some soils in Class 5 can be used for cultivated field crops provided unusually intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions unlike those needed by the common crops. Cultivated field crops may be grown in Class 5 areas where adverse climate is the main limitation but crop failures occur under average conditions.

5em — The soil in this subclass has a nearly level to gently undulating topography and is well drained. It is developed on a thin mantle of moderately coarse to coarse deposits over moderately fine materials. This soil has been subjected to very severe erosion and use of the land for ordinary agriculture is not feasible without extensive reclamation. Droughtiness has also adversely affected the soil. These soils have poor capability for use in the production of annual field crops. The soil series is:

Axford Ax

5m — These coarse to very coarse textured soils are well drained and occur on gently undulating to nearly level topography. They are low in natural fertility and have a low water holding capacity. As a result of rapid permeability, these soils are severely affected by droughtiness. These soils are well suited for grazing land. They are:

Dorset Dr, Dr[1]
Marringhurst Ma
Shilox Sh

5mt & 5tm — The soils in this subclass are coarse to very coarse textured materials that are well drained. Strongly calcareous glacial till may occur at the 30 to 90 cm depth for some of these soils. They have a low moisture holding capacity, low organic matter content and are generally low in available plant nutrients. The droughtiness condition along with the complex topographic pattern make the management of these soils very difficult. Deep rooted forage crops that are able to reach the finer textured substrate till for moisture are best suited for these soils. These soils will respond to additions of nitrogen and phosphorus and also potassium, if the till is out of the rooting depth. The soils are:

Chater Ch/1dxx
Chater Ch/xdxx
Dorset Dr[1]/xcxx
Marringhurst Ma/xcxx
Marringhurst Ma/xdxx
Shilox Sh/xdxx
Shilox Sh/xcxx

5mte & 5met — These well drained soils occur on a undulating to strongly rolling landscape. Management of these soils is hampered by erosion, adverse topography and droughtiness. Actual erosion may be slight to severe and damage is assessed on the loss in productivity. The soils are also adversely affected by droughtiness owing to inherent soil characteristics such as texture. The soils are:

Axford Ax/xdxx
Arizona Az/xdxx
Arizona Az/odxx
Barren Br/xexx
Chater Ch/2dxx
Dorset Dr[1]/2dxx
Marringhurst Ma/2dxx
Shilox Sh/xfxx
Stockton Sn/odxx
Wheatland Wh/2cxx

5mx — The soil in the subclass is developed on stratified outwash and glaciofluvial deposits of medium sand to gravelly texture. Till may occur at a depth of 30 to 90 cm. This imperfect to well drained soil occurs on a nearly level to undulating landscape. The major limitation associated with this soil is droughtiness; however, it has a number of other problems which are of lesser significance. Moderately to slightly stony land will cause some interference to cultivation. Erosion damage may be severe enough to limit crop production. These limitations greatly restrict the capability of the land and make management practices difficult for sustained production. The soil phases are:

Chater Ch/xx2x
Marringhurst Ma/xc2x

Marringhurst Ma/xc1x
Marringhurst Ma/2cxx
Marringhurst Ma/1xxx
Mansfield Mf/xc2x
Marringhurst Ma/1cxx
Marringhurst Ma/xx2x
Marringhurst Ma/xx1x

5pw & 5wp — These soils occur in level to depressional areas and are normally saturated with water for a considerable portion of the growing season. These soils are imperfectly to poorly drained. They are moderately to exceedingly stony which requires considerable clearing to improve the capability. Adequate drainage would improve the wetness problem and some perennial forage crops are feasible. The soils are:

Bornett Bt/xx3x
Melland Ml/xx4x
Tadpole Td/xx2x
Vodroff Vf/xx2x

5px — These imperfect to well drained soils are developed on a thin mantle of loamy sediments over glacial till or directly on glacial till. Very stony to exceedingly stony land imposes a severe limitation to these soils. Other limiting factors include undulating to gently rolling topography, moderate to severe erosion and wetness. Agricultural utilization of these soils is hampered by these affects and thus sustained production is not possible without intensive management practices. The soils are:

Clementi Ct/1c4x
Cobfield Cf/1x3x
Kilmury Kl/xx3x
Stewart St/1d3x
Woodfield Wf/2d3x

5te — Soils in this class are well drained and developed on glacial till. Agricultural use of these soils is limited by a gently rolling to a strongly rolling topography and severe erosion. Some stones may be present but they are not of sufficient size or quantity to affect cultivation or to limit the crops grown. They are low in natural fertility and low in organic matter. Under cultivation these soils are susceptible to water as well as wind erosion. These soils are best suited to hay and pasture with limited forage cropping. Included soils are:

Cordova Cv/2f1x
Cordova Cv/2c1x
Rufford Rf/2e1x
Varcoe Vr/2d1x

5tep & 5pte — These are well drained soils developed on glacial till. They are adversely affected by topography, erosion and stoniness. These limitations are listed in order of severity at the subclass level. The topography is gently rolling to strongly rolling. Erosion is slight to moderate and stoniness is of slight to no hindrance to cultivation. Pasture and production of tame species of forage plants is feasible. Sustained production of annual field crops is not possible. The soils are:

Hilton Hn/2d3x
Madill Md/xc3x
Rufford Rf/2e2x
Woodfield Wf/2e2x

5tp & 5pt — These are imperfectly to well drained soils developed on a thin mantle of loamy sediments over glacial till or they may be developed directly on glacial till. The limitations include the adverse effects of a gently rolling to strongly rolling landscape and a slightly to very stony land surface. In addition, slight to moderate erosion may exist. The stony glacial till and stony surface are not feasibly improved by stone removal. The agricultural utilization is limited to perennial forage plants and pasture. The soil phases are:

Clementi Ct/xc4x
Chambers Cb/xf1x
Statley Sy/xd3x
Woodfield Wf/1e3x
Woodfield Wf/2c3x
Wesley Ws/xe2x
Statley Sy/1d3x

5tx — These are well to imperfectly drained soils that are most seriously limited for agricultural use by the adverse effects of a gently to strongly rolling topographic pattern. Other limitations are stoniness, excess moisture, erosion and droughtiness. A wide range of management practices are necessary to render this land agriculturally productive. The soils are:

Chambers Cb/1e1x
Gendzel Gz/1d1x
Lavenham Lh/1fxx
Rufford Rf/2f1x
Rufford Rf/1f1x
Rufford Rf/1f2x

5w¹ — These are poorly drained soils developed on moderately fine to fine textured, strongly calcareous material, having a depressional to nearly level terrain. These soils are essentially nonarable due to their topographic position and high water table. Where adequate drainage is supplied, these soils will still be subject to a moderate limitation of wetness. They remain saturated for most of the year, despite drainage, due to the continuous high water table and very slow surface runoff. Internal drainage is moderately slow to slow. Adequate perennial forage crops, under good management, can be grown with additions of phosphate and nitrogen fertilizers. The soils are:

Fenton Fn
Lowton Lt
Sutton Su, Sup
Tadpole Td
Tadpole Td/1cxx
Vodroff Vf

5w² — These are poorly drained soils developed on medium to coarse materials, occurring on level to depressional areas. Glacial till may be present within the 60 cm depth. They are subject to waterlogging throughout most of the year. Where adequate drainage is supplied, these soils will still be subject to a moderate limitation of wetness, but under good management, perennial forage crops can be grown. These soils are low in natural fertility; crops respond to additions of nitrogen, phosphorus and potassium. The soil series are:

Bornett Bt, Btp
Carvey Cy, Cyp
Drokan Dk

Fortin Fr, Fr[1]
Grayson Gn, Gn[1]
Hickson Hk
Lonery Ln
Marsden Mr
Mockry Mk, Mkp
Vordas Vs

5wn & 5nw — These are poorly drained soils occurring on a nearly level to gently undulating topography. Surface runoff is slow and internal drainage is impeded by very low permeability and a high water table in the spring. In addition to wetness, these soils also have a salinity problem. Crops are moderately to seriously affected by salinity, permitting only salt tolerant forage crops to be grown. Management practices for these soils must involve the improvement of drainage. The soils are:

Fenton Fn/xxxs
Harding Hg/xxxu
Hickson Hk/xxxs
Lowton Lt/xxxs
Lonery Ln/xxxs
Marsden Mr/xxxs
Poolex Po/xxxs
Sewell Sw/xxxt
Sutton Sn/xxxs
Tadpole Td/xxxs
Vodroff Vf/xxxs
Vordas Vs/xxxs

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 responsible to improvement practices, or because stock-watering facilities are inadequate. Such improvement practices as may be effected by seeding and fertilizing by hand or by aerial methods shall not change the classification of these soils. Where costly clearing is required to change Class 7 areas to Class 6 areas, those areas shall remain classified as Class 7. The subclasses in this class are:

6iw — These soils are poorly drained, highly carbonated, stratified alluvial soils. The topography is depressional to undulating. They are subject to inundation due to stream overflow and ponding during the spring and quite frequently during the summer, thus having an additional wetness limitation as well throughout the growing season. They are best suited to pasture and native hay. The soils are:

Basker Bk
Basker Bk/xxxs
Basker Bk/xcxx

6m6 & 6tm — These are well drained soils developed on coarse to very coarse materials, occurring on a moderately rolling to hilly terrain. Besides having the adverse effect of topography, these coarse textured soils have a very low moisture holding capacity (droughtiness), low organic matter content, and low natural fertility. They are limited in use to grazing land of low carrying capacity. The soils are:

Chambers Cb/xgxx
Marringhurst Ma/xexx
Shilox Sh/xexx
Shilox Sh/xgxx
Marringhurst Ma/2exx

6mtp &6tpm & 6mpt — These soils are limited by the combined adverse effect sof droughtiness, topography and stoniness. The order of these limitations at the subclass level depends upon their severity, with the most severe appearing first. These are coarse to very coarse materials with the possibility of glacial till at 30 to 90 cm. Erosion may vary from slight to severe and the topography may range from undulating to hilly. In most cases, the land is very stony to exceedingly stony. Neither land levelling nor stone removal are feasible management practices on these soils, thus use is limited to natural pasture of low carrying capacity. The soil phases are:

Chater Ch/1d2x
Chater Ch/xx4x
Marringhurst Ma/2f4x
Marringhurst Ma/2g3x
Marringhurst Ma/2f3x
Marringhurst Ma/xd3x
Marringhurst Ma/xd4x
Marringhurst Ma/1d3x
Marringhurst Ma/xc4x

6mtx & 6tmx — The soils in this subclass are well drained, coarse to very coarse deposits. Glacial till may be present at 30 to 90 cm. The main problems associated with these soils are droughtiness and adverse topographic pattern. Other limitations include the cummulative effects of stoniness and erosion. The terrain is moderately stony, moderately to strongly rolling and is affected by slight to moderate erosion. The soils are:

Chater Ch/2e2x
Marringhurst Ma/2f2x
Marringhurst Ma/2c2x
Wheatland Wh/2e2x

6tp & 6pt — These soils are well drained and developed on glacial till. They occur on a moderately rolling to hilly landscape and are very stony to exceedingly stony. Slight erosion may have affected the surface A horizon. Besides the limitations imposed on these soils by stoniness and topography they are also low in natural fertility. These soils are limited to grazing land of low quality and improvement practices are not feasible. The soils are:

Cordova Cv/1f3x
Rufford Rf/1f3x
Statley Sy/1f3x
Woodfield Wf/2g3x
Woodfield Wf/1e4x

6tpe & 6tep & 6pte — These are well drained soils that are adversely affected by a gently rolling to hilly topographic pattern, slightly to exceedingly stony land and slight to severe erosion. These limitations are listed in their order of severity at the subclass level. These soils have natural sustained graz-

ing capacity; however, improvement practices are impractical. Cultivation is hampered by stoniness; the topography is too steep for working with machinery and erosion decreases the quality of the soil by removing the fertile surface horizons. The soils are:

Axford Ax/x3xx
Ashmore Am/2f1x
Croyon Cr/2f2x
Chambers Cb/1c4x
Miniota Ms/2g3x
Madill Md/xc4x
Rufford Rf/2g1x
Stewart St/2f3x
Woodfield Wf/1f3x
Chambers Cb/1c4x

6wn & 6nw — These are poorly drained, medium to fine textured soils occurring on a nearly level to gently undulating terrain. Glacial till or coarser materials may be present at the 60 cm depth for some of these soils. Surface runoff is slow and a high, seasonal water table results in natural saturation for most of the growing season. In addition, moderate to severe salinity conditions permit only salt tolerant species to grow. Utilization of these soils is limited to hay or grazing. A peaty phase may be associated with the soils. The phases are:

Carvey Cy/xxxt
Lowton Ltp/xxxt
Lowton Lt/xxxt
Tadpole Td/xxxt
Tadpole Tdp/ xxxs
Vordas Vsp/xxxs
Vordas Vs/xxxt
Vodroff Vf/xxxt
Vodroff Vfp/xxxt

Class 7

Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. All classified areas not included in Classes 1 to 6 shall be placed in this class. 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. The Brandon area has a minor amount of land in this class. The existing subclasses are:

7tp — These are well drained soils developed on loamy materials overlying sand and gravel or directly on sand and gravel deposits. This class of land has single slopes ranging from 30 to 60%, which are a severe limitation to agriculture. The extremely stony condition of these soils is a very serious handicap. Other limitations are the adverse effects of erosion and droughtiness. These soils have only a limited capability for pasture. The soils are:

Croyon Cr/2G4x
Marringhurst Ma/2G4x

ORGANIC SOIL CAPABILITY FOR AGRICULTURE

The organic soils in the Brandon Study Area have been rated for: (a) "potential" agricultural capability, and (b) degree of development difficulty involved in achieving this potential, after the method of Leeson, 1969[1] and modifications for Manitoba by Mills et al., 1974[2]. This twofold approach to classifying organic soils recognizes that the agricultural suitability of most of these soils requires reclamation or development from their native state and that most organic soils in their native state have little or no value for agriculture. Rating degree of development difficulty takes into consideration intrinsic characteristics of the soils affecting development and also associated costs required for development.

The capability classes of organic soils established not only reflect potential for agricultural use but also identify the continuing limitation of these soils for agriculture after reclamation has been implemented or is assumed to have been implemented.

Water table control is the major reclamation requirement for the agricultural development of organic soils. Optimum water table control is necessary both for successful crop production as well as the long term maintenance of the soil itself. Improper manipulation of the water regime of an organic soil area can result in loss of the organic soil base through increased rates of subsidence, potential irreversible physical damage to the soil and increased hazards of wind erosion and fire damage. With water control at optimum levels (usually 45 to 90 cm below the surface) for both crop production and minimal subsidence rates, soil loss through subsidence can continue at rates of 2 to 5 cm annually. In consideration of eventual loss of the organic soil base, the capability ratings, therefore, reflect the continuing use-capability of such areas based on the character of underlying mineral substrates. Shallow organic soil areas underlain by unsuitable mineral substrates would preclude their long term utilization as a productive land base and should not be reclaimed for agricultural use.

The evaluation of organic soils for agriculture was carried out according to the methods outlined by Mills et al., 1974.

The organic class is a grouping of subclasses that have the same relative degree of agricultural potential under adequate controlled drainage and management. The subclass is a grouping of soils

[1] Leeson, Bruce, et al., 1969. An Organic Soil Capability Classification for Agriculture and a study of the soils of Simcoe County. Soil Sci. Dept., Ont. Agric. College, Guelph, Ont.

[2] Mills, G.F., et al., 1974. Inventory and Assessment for Agriculture of the Organic Soil of the Roseau River Watershed in Manitoba. Canada-Manitoba Soil Survey, Soils Department, University of Manitoba.

with similar kinds of limitations and hazards and indicates major limitation within the classes. These are adverse climate (C), excess water (groundwater level and flooding) (W), coarse wood fragments (L), degree of decomposition (H), nature of the surface materials (F), salinity (N), and depth of organic material and nature of underlying material (D).

THE AGRICULTURE CAPABILITY AND DEGREE OF DIFFICULTY RATINGS FOR THE ORGANIC SOILS IN THE BRANDON STUDY AREA

Class 03

Organic soils in this class have moderately severe limitations that restrict the range of crops that can be grown or that require special development and management practices.

03W — These are poorly to very poorly drained soils that are derived from moderately decomposed fen peat. These smooth, level organic deposits range in depth from 60 cm to more than 3 meters in places. They are normally very uniform with respect to degree of decomposition and nature of plant residues from which the peat has been derived. They usually range from medium acid to neutral in reaction and have a high water holding capacity. Movement of water in these organic soils is moderately slow and is similar to that in a uniform, medium textured mineral soil. They are usually underlain by calcareous, sandy to clay textured lacustrine sediments.

The deeper Xavier soils have a major degree of development difficulty rating. Most of these soils normally occur in the central section of large peatland areas and usually serve as catchment to adjacent shallow soils and upland mineral soils. Because of this, major reclamation is required to remove large volumes of water. The soil in this subclass is:

Xavier Xv

PART V
ENGINEERING AND LAND USE PLANNING*

This section is intended to supplement the engineering information given on the Soils Map with additional data, to present interpretations of this data, and to form a guide to the use of both the Soils Map and the Soils Report.

A. HOW TO USE THE SOILS REPORT*

Both the report and the map contain information which can be of great value to engineers, land use planners and others interested in these aspects. However, because there are likely to be many different types of people (both professional and non-professional) included under this general heading it is difficult to write a report of a general nature to suit everyone. For convenience, potential users were grouped into the following three categories:

1. Conservation and Transportation Engineers
2. Land Use Planners
3. Geotechnical Engineers and Geologists

1. CONSERVATION AND TRANSPORTATION ENGINEERS

Engineers involved with Soil Conservation and with the pavement design aspects of transportation engineering can probably make most direct use of the Soils Map. For instance, transportation routes (whether they be highways, airstrips or even railroads) may for long stretches be constructed directly on "the soil", as defined in pedology, and the soil profile often represents the foundations for these pavement structures. The pedological classification system considers the soil "in situ" and takes into account not only the parent materials but also the effects of soil climate, topography, drainage, capillarity, etc. Specialists in such fields as pavement design may find the pedological classification system preferable to other engineering systems for their particular needs.

Generally, it may be found that the performance of highway (or airstrip) pavements can be correlated with the Soil Series. This is normally done by plotting the existing highway (or airstrip) locations on the Soils Map (or alternatively transferring the map data to the general layout plans). The performance data, if available, is then added and analyses made to determine to what degree performance can be related to the mapping units shown. The information obtained on the soil within a mapped unit can be used to predict performance elsewhere on the map with the same map symbol or Soil Series. Likewise, the performance of pavements in similar areas marked by the same map symbol should be the same.

Similar types of "performance correlations" are often applied to soil stabilization (e.g. by soil cement application), runoff and infiltration characteristics (In the U.S.A. those are termed Hydrological Soil Factors). Further relations have yet to be established.

For those interested in establishing this type of performance correlation the following procedure could be followed:

(i) Become familiar with the section on "The Engineering Significants of Pedology" in this report.

(ii) Identify the Soil Series in the particular area of interest by their names.

(iii) Consult the section on "Soils" in this report; identify the type of terrain and soil profile from the photographs and descriptions of these particular Soil Series; select those parts of the detailed descriptions of the mapping units which are of engineering significance.

(iv) Tabulate all of this data and add the relevant engineering test data included in Tables 8 and 9 in this chapter.

(v) Visit the site to identify the terrain characteristics and dig test holes to identify the soil profiles as given in the report.

(vi) Verify that these are definitely characteristic of that particular mapping unit as described.

(vii) Apply the performance data available and extrapolate this known performance to the project sites.

The pedological Soil Map can then become an excellent base on which to store performance data; the pedological report becomes a handy reference document.

2. LAND USE PLANNERS

For specialists in this field, the interpretive type of information may be most relevant. It is as-

* Format follows the chapter dealing with "Engineering and Land Use" by G. Wilson, Soil Mechanics Engineer, Soil Research Institute, Ottawa, contained in the "Soils of the Morden-Winkler Area" by R.E. Smith and W. Michalyna. Soil Report No. 18, 1973.

sumed that the information is preferred in the form of recommendations rather than as data for design. The sections on engineering interpretation (Tables 8, 9, & 10) should be consulted for this type of information. This information can be used either as described or it can be reinterpreted. Thus, for use of soils for community development with septic tanks, for example, special coloured plans can be drawn up showing areas which have "severe limitations" and "slight limitations", for disposal fields according to the recommendations given.

Alternatively after studying the interpretations in detail the planner can reinterpret this data and (in conjunction with other factors) adapt it to convey a particular planning philosophy as desired.

3. GEOTECHNICAL ENGINEERS AND GEOLOGISTS

For specialists in foundation engineering, site investigations and supply of construction materials, the pedological classification system itself may not be directly applicable for the majority of everyday problems. This is mainly because the system was conceived to describe the near surface layers of surficial deposits.

Nevertheless, people interested or engaged in the above fields of specialization may find soil surveys of the pedological type of great value for two main reasons:

(i) There are special engineering problems which are definitely concerned with the altered and unaltered soil material within 1 to 2 meters of the surface.

(ii) While making the soil survey, the pedologist is himself also very much interested in the underlying materials, including the bedrock.

For those engineering problems which definitely do concern the upper layers of the soil, the reader is referred to the previous section (written for Conservation and Transportation Engineers). Typical examples of such problems include:

Urban Engineering — shallow foundations, septic tanks

Hydraulic Engineering — watershed control of runoff and drainage

Corrosion Engineering — pipelines, concrete foundations

Construction Engineering — search for sand and gravel, topsoil

For those engineering problems which concern more than just the upper layers of soil, valuable information can be obtained from the soil map in conjunction with the stratigraphic surface deposit maps or cross sections (Appendix I and II).

4. DIFFERENCES BETWEEN "PEDOLOGICAL" AND "ENGINEERING" SOILS

There are a number of terms and concepts used by pedologists which are similar in name but rather different in meaning to those used by Soil Engineers. This is a "pedological" report and the terms used should generally be interpreted in the pedological sense. The glossary should be consulted for precise meaning.

5. LIMITATIONS OF DATA

The reader is reminded that the data given in this report were never intended and never could be used in place of a site investigation. This point is more fully discussed in the section dealing with the soil map.

However, for certain types of problems, for example in "pavement design", the time and money spent on site exploration can be much more effectively used by using the Soil Series as a base. It would thus be preferable to soil test within the boundaries of the Soil Series than to drill holes at specified intervals regardless of this information.

B. THE SOIL MAP

1. PURPOSE AND SCALE

The soils information for the Brandon study area was presented on a photo mosaic base at the scale of 1:20,000. It departs from the previous method of showing soils information on a line map, at a scale of 1:125,000 or 1 inch per two miles. The latter are too small in scale to show many important local soils; they are also out of date with respect to the present state of the knowledge of soils and systems of soil classification. Little, if any, information of significance to engineering problems was previously given.

2. CURRENT STATUS OF SOIL MAPPING IN MANITOBA

The published soil reports in Manitoba and the areas covered by the new soil series is indicated in Figure 1. It also shows the user where some soil mapping has been carried out and for which (unpublished) data is available.

3. HOW TO USE THE SOILS MAP

The Soils Map of Brandon Study Area is presented on a photo mosaic base at a scale of

1:20,000 (approx. 3 inch/mile). Specialized concepts are involved in this type of mapping and some additional explanations are necessary to indicate clearly what is being portrayed.

All areas outlined on the map and marked with the same symbol are characterized by soils of the same Soil Series, the same Soil Type or the same Phase. This does not mean that the only soil profile existing in that area belongs to the Soil Series or type which typifies that name.

At this point the philosophy of pedological mapping comes into the picture. Soil Series as a "mapping unit" is not synonymous with Soil Series as a soil profile, landform or taxonomic unit. The difference is that in the mapping unit there may be (in fact, there generally are) inclusions of other soil "individuals" or even of "non-soil" (i.e. bedrock, etc.).

It is thus, first of all necessary to read carefully the definitions of what constitutes the "mapping unit". This may refer to the degree to which the area outlined contains inclusions of other soils. i.e. the unit may actually be a "complex" of more than one Soil Series; or it may be relatively uniform or it may be entirely transitional between one Soil Series and another.

Even if it is relatively uniform, it is only implied that, in the estimation of the pedologist, at least 85% of the area outlined should be truly representative of the Soil Series named. Thus, small localized pockets of unlike soil may be known to occur inside the boundaries of a certain Soil Series and yet if it is too small to be shown on that map scale, it will not be indicated but becomes part of the "untypical" 15% for the mapping unit in which it occurs. Thus, the map was never intended to show site specific data and it never could be used in lieu of site investigations.

The reader is referred to the section on soil mapping and classification for further details concerning the mapping procedures used and, in particular, to the "Descriptions of the Soil Series and Mapping Units". Each Soil Series is described in alphabetical order.

When using the Soil Map in the field it should thus be borne in mind that if inclusions of other soils or "non-soils" are found within Soil Series boundaries, this does not necessarily indicate lack of accuracy. The definitions used for that particular "mapping unit" should be studied and the remarks given above noted carefully.

C. ENGINEERING DESCRIPTION OF THE SOILS

This section defines and describes some of the properties of the soils that will be considered for various engineering and land use planning.

The soils in the Brandon study area, mapped as series and phases, are based on soil profile type reflecting the influence of climate, native vegetation, drainage, topography or slope of land on the parent material. Within a particular climatic area or soil zone, texture and composition of the parent material, drainage, slope and time are the dominant factors in soil profile development. Characteristics of soils such as permeability, density, structure, consistence and color are dependent on these dominant factors.

The basic properties used for defining soils in a natural classification system can also be used for the evaluation of soils for other uses. The effects of a given soil characteristic or quality often vary with different uses. The following are some of the qualities that singly or in combination with others, commonly affect use of soils.

1. SOIL TEXTURE AND ITS EFFECT ON PROPERTIES AND BEHAVIOR

Texture refers to the proportion or distribution of various sized particles such as sands (gravels), silt and clay. All soils and soil-like material usually consist of a mixture of these three main size categories. The relative size of the three constituents vary slightly depending on the classification system used (see Appendix). U.S. Dept. of Agriculture (U.S.D.A.) is the one used by pedologist.

Some indication of the effect of soil texture on soil properties is given in Table 6. Knowledge of soil texture is essential for landscape architects and gardeners because it affects the soil's natural fertility, its ability to drain properly and its capacity to hold water. Engineers and building contractors are interested in texture of the subsoils because of its effect on drainage, water-holding capacity, stability, and ease of excavation and erodibility.

TABLE 6. EFFECT OF TEXTURE ON SOIL CHARACTERISTICS.

Soil Characteristics	Soil Texture	
	Sandy	Clayey
Water holding capacity	low	high
Permeability or drainability	high	low
Total pore space	low	high
Size of pores (dominant)	large	small
Tendency to shrink-swell	low	high
Bearing strength (dry)	high	high
Bearing strength (wet)	high	low
Stability from sliding on slopes	high	low
Plasticity	low	high
Soil Fertility	low	high
Erodibility by water	low	high
Ion exchange capacity	low	high

Some properties of the major textural groups of soils are provided.

GRAVELLY SOILS

In general gravelly soils normally are preferred construction and foundation materials from the standpoint of their low compressibility and high strength characteristics. Well graded gravels (GW) and poorly graded gravels (GP) are pervious because they contain little or no fines. Good drainage normally can be assured. Their properties are not affected appreciably by saturation. Freezing and thawing conditions are not a problem. As sand, silt and clay fractions are increased and this matrix begins to predominate over the gravel skeleton structure, the total material assumes more of the properties of the matrix.

SANDY SOILS

The structural characteristics of sands approach gravelly soils when they are coarse and approach silty soils when they are fine. Like gravelly soils, the density, amount and nature of the matrix (silt and clay) control structural properties. Permeability of poorly graded and well graded sands (SP and SW) is high while sands with greater amount of silt and/or clay are semi-pervious to impervious depending upon the amount and character of the fines. The latter soils are good for impervious earth dam and other embankment materials because of their relative low permeability, relatively good shear strength and low compressibility when adequately compacted and drained. The engineering problems encountered with sandy soils are those of stability under saturated conditions. The strength of saturated sands containing appreciable amounts of silt and clay fines will be controlled by the water content. As water content becomes higher, relative density becomes lower and bearing strength decreases.

SILTY SOILS

Soils containing a high content of silt are non-plastic fine soils. They are inherently unstable when saturated and like fine sands may become fluid. Silty soils are semi-pervious to impervious, often difficult to compact, are highly susceptible to frost heaving and have low cohesive strength. Small amounts of these fines, as little as 5 to 10% in sand and gravel soils may significantly reduce permeability or cause these soils to be susceptible to frost action.

PLASTIC CLAY SOILS

As the clay component of soils becomes predominant, the mineral composition of the clays assumes great importance. Soil properties such as cohesion, consistency and ability to hold water are directly influenced by the mineral constituents of clay. When soils are moist, clay particles are surrounded by water films. As dehydration takes place, these films become thinner and thinner until adjacent particles are held together by strong cohesive forces.

Clay minerals are complex crystalline hydrous alumino-silicates often containing small amounts of potassium, sodium, magnesium and iron. Briefly, two groups of clay minerals have been recognized, the kaolin group and the montmorillonite group. The kaolin minerals have fixed crystal lattices or layered structure and exhibit only a small degree of hydration and adsorptive properties. In contrast montmorillonite minerals have expanding lattices and exhibit a high order of hydration and cation exchange. The degree of lattice expansion is dependent upon the nature of the cations adsorbed. Illite, another clay mineral, is sometimes described as a third type, but many investigators prefer to class it under the expanding lattice group. In illite there is a strong bonding of the silica sheets by means of potassium ions which reduces the expansion to very small amounts.

Montmorillonitic clay soils, such as those in the Brandon area, with expanding lattice structure and resulting capacity for a wide range in water content can be particularly troublesome. Settlement from shrinkage, heave from swelling, and loss of stability caused by shrinkage or swelling can cause major structural problems, particularly in the case of earth dam structures and highway construction.

The amount of volume change that occurs in an expansive soil is related to its initial density and water content, loading, soil structure (natural or remoulded), amount of clay particles and nature of the clay minerals. The higher the colloidal content, the greater the degree of expansion. High initial water content and corresponding low relative density means low bearing strength capacity, and unconforming textures or strata.

The uniformity of materials with depth affects many properties. The occurrence of unconforming textural layers in the subsoil affects water movement in soil. When fine textured soils overlie coarse textured soils, water, because it is held more tightly by fine material such as clay, will not flow freely into the coarse textured layer until the fine layer becomes saturated. When coarse textured soils overlie fine textured soils, water will flow rapidly downward until it contacts the fine layer where it is impeded because of the very slow permeability (drainability) of the fine layer. These unconforming layers in the subsoil therefore complicate the problem of assessing soil suitability for residential development where on-site

sewage disposal is being considered. They may also affect the bearing capacity of the soil; silt layers throughout the soil drastically reduce the bearing capacity and could result in the shifting and movement of basements and foundations. The texture expressed in the U.S.D.A., Unified and AASHO Systems is given in Table 8.

2. PERMEABILITY

Permeability or internal soil drainage is a qualitative term used to indicate rate of water movement in the soil. Coarse textured soils usually have relatively high rates of water movement while fine textured massive structured, cohesive soils do not.

Percolation tests are used to determine the rate of water movement through soils and are therefore important in determining the possibility of on-site sewage disposal facilities. The absorbing ability of soils is extremely variable and several percolation tests should be made at each particular building site. Percolation rates obtained from these tests are usually expressed as the minutes required for the water level in the test holes to drop 1 inch. Table 7 shows some typical percolation rates for well drained soils of various texture. However, these values could vary with the structure and density of the various soil horizons and parent materials.

The permeability of the soils in the Brandon area have been estimated and recorded in Table 8.

TABLE 7. PERCOLATION RATES OF SOILS IN DRAINED CONDITION*

Soil Type	Percolation rates minutes/inch
Sand and gravelly soils	less than 10
Loamy sand soils	11-30
Loam to sandy loam soils	31-60
Clay loam to silty clay loam soils	61-90
Silty clay to clay soils	more than 90

The rate of water movement through soil is the primary factor dictating the design of on-site sewage disposal, as it indicates the over-all ability of a soil to allow passage of septic tank effluent. Research at Cornell University** indicates that seepage fields in natural soil is possible in soils having a percolation rate of 30 minutes per inch or less. On some of the soils with sand and gravel, the probability is so high that effluent passing through these soils will be inadequately filtered and could contaminate well water supplies located at greater depths or in downslope positions.

3. DRAINAGE

Drainage may be divided into two types — surface and subsurface. Surface drainage refers to the ease with which water moves through or off the soil and is dependent on permeability and slope. Permeability is influenced by the silt and clay content; the greater the clay and silt, the slower the permeability. Slope influences the rate that water will run off the soil; little or no slope in association with slow permeability results in saturation and ponding on the soil.

Subsurface drainage refers to that quality of a soil that allows the downward flow of excess water through it. It is reflected in the frequency and duration of the period of saturation with water and may be affected by change in texture, structure, frost layers, high water table and seepage water.

Drainage in reports is described on the basis of actual moisture content in excess of field capacity (that moisture retained after soil is allowed to drain) and length of the saturation period within the plant root zone. The terms are as follows:

(i) Well Drained — moisture content does not normally exceed field capacity except immediately after water additions. Soils are usually free of mottles within a meter of the surface, but may be mottled below this depth. Soil horizons are usually bright colored.

(ii) Moderately Well — soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled in the .6 to 1.0 meter depth. Colors are dull brown in the subsoil with stains and mottles.

(iii) Imperfectly or Somewhat Poor — soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. They generally have mottling below the surface layers and generally have duller colors with depth, generally brownish gray with mottles of yellow and gray.

(iv) Poorly — water moves so slowly that the soil remains wet for a large part of the time. They have a dark colored surface layer and usually mottled with gray to bluish gray colors in the subsoil.

A general statement concerning the need for agricultural drainage is given in Table 9; it is based on the properties of the soils using the above criteria.

*Source: L.J. Bartelli, "Use of Soils Information in Urban Fringe Areas". Journal of Soil and Water Conservation in 17:3, May-June, 1962, pp. 99-103.

** J.H. Huddleston and G.W. Olson, "Soil Survey Interpretation for Subsurface Sewage Disposal", Soil Sci. Vol. 104, No. 6, pp. 401-409.

4. GROUNDWATER

Groundwater refers to water that is beneath the surface of the soil in the zone of saturation. Water collects and flows through the pores of the soil during infiltration until it eventually reaches a zone of saturation. The upper surface of the zone of saturation in near-surface unconfined aquifers is called the water table. The position of the water table can affect the design of roads, buildings with basements, and the operation of a septic field. Since the water table generally conforms to the topography, groundwater in unconfined aquifers tends to flow from topographically high areas to topographically low areas. Recognition of this situation would have to be taken into consideration when planning for on-site sewage disposal because water flow could spread improperly filtered effluent and result in contamination or pollution downslope. Bearing strength of silty and clayey soils is substantially reduced below the water table (under saturated conditions).

In the Brandon Study Area, the piezometric surface of the deeper confined aquifers is relatively close to ground surface. Most of the area may be considered a weak recharge area, a situation where the piezometric surface (static level) of the confined aquifers is at a lower elevation than the water table (static level) in near-surface unconfined aquifers. There are also areas considered discharge areas; a condition where the piezometric surface of the deeper aquifers is near or above the water table of shallower unconfined aquifers.

A map showing the static water levels* of the confined and unconfined aquifers is provided in Appendix IV. Seasonal fluctuations in static water levels for the more extensive deeper aquifers are generally smaller than those for the less extensive near-surface aquifers.

Saline soils are often found within and adjacent to areas where the static levels are near or above the ground surface, and the groundwater contains appreciable soluble salts. Where the quality of the discharge water is good, the soil problem is mainly one of saturation, while salt contents in the soil are generally low.

The static water level map could be useful to engineers to indicate the approximate depth to the saturation zone or seepage area that could affect the bearing capacity and stability of the subsoil.

5. TOPOGRAPHY

Topography refers to the rise or fall of land or gradient and is expressed in terms of slope and frequency of slope. Topography could affect the suitability of an area for urban planning, sewer and water line installation or affect the cost of construction of roads and services. Topography has a great influence on water intake, runoff and water table. In steeply sloping complex terrain the water table is usually at considerable depth, with waterlogged soils often occurring in minor depressions. Slow surface drainage associated with level topography may result in ponding or a high water table. Steeply sloping surfaces have lower rates of water intake, greater runoff, and more erosion than level soils. In the Brandon area, the landscape varies considerably from level to moderately rolling topography.

6. CHEMICAL PROPERTIES — pH AND ELECTROLYTE

Chemical properties such as reaction and electrical conductivity are important for predicting the corrosive properties of soils. The reaction or pH of soils refers to the degree of acidity or alkalinity; soils with pH values below 6.6 are acid, 6.6 to 7.4 are neutral, and above 7.4 are alkaline (see Glossary). The normal pH range of soils in the Brandon area is from 6.5 to 7.8 in the surface layers and 7.4 to 8.4 in the subsoil.

The presence of sulfate salt in the soil affects the stability of normal concrete. If gypsum crystals are present in the soil (electrical conductivity greater than 1.6 mmhos), the relative sulfate hazard is considerable.

Underground cables, pipelines and other metallic installations are affected by poor drainage and aeration, electrolyte (salt) and pH. Slightly acid to neutral, coarse to medium soils of low conductance (less than 0.5 mmhos/cm^3) and good drainage have low corrosion potential; alkaline, medium to fine textured soils with soluble salts (greater than 1.6 mmhos), peat and organic soils are most corrosive.

The reaction and sulfate hazard for the soils of the Brandon area are given in Table 8.

7. DISPERSION

Dispersion refers to the tendency of the soil to deflocculate or become dispersed in water or under saturated conditions. Soils in the Brandon area have dominantly calcium and magnesium ions on the colloids, therefore a low dispersion (Table 8). Soils with considerable sodium to calcium and magnesium ratio on the colloid or in solution will have a greater tendency to disperse.

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* Static level map was compiled from water well drillers' reports obtained from the Water Resources Division of the Manitoba Department of Mines, Resources and Environmental Management and from water table records from drill sites of the Manitoba Soil Survey.

8. SHRINK-SWELL POTENTIAL

Volume changes associated with swelling and shrinkage cause considerable damage to structure, especially to walls and foundations of houses, and to roads in areas where large moisture variations occur in soils. The more important factors influencing the swell potential of soils are moisture variation, density, structure, mineralogic composition and amount of clay. The volume of coarse grained soils are usually not affected by changes in moisture content. Silty, medium textured soils may be moderately susceptible. Fine grained soils with a high percentage of montmorillonitic clays are most susceptible; swelling pressures could be quite large with values for some clays of 10 tons per sq. ft.*.

A rating of the shrink-swell potential for the Brandon area are given in Table 8.

9. POTENTIAL FROST ACTION

Frost action includes the heave or stresses caused by ice lenses forming in a soil and the subsequent loss of strength as a result of excess moisture during thawing periods. Some soils are more susceptible than others. In general, coarse grained materials with little or no fines are only slightly affected; silty and very fine sandy soils are the most susceptible. Clays or fine grained soils are subject to frost action, but the loss of strength may not be as great as for silty soils.

The hazards of frost action are increased if water becomes more available during the freezing period and a suitable temperature gradient exists long enough for freezing temperatures to penetrate the ground. Water necessary for the formation of ice lenses may become available from a high groundwater table, capillary supply, water held within the voids of the soils or through infiltration.

If conditions are such that frost action is possible, the most desirable procedure is to remove any susceptible soil and replace it with coarse grained soil to the depth of frost penetration, about 1 to 1.5 meters below ground surface. If this is uneconomical, the design of a building or other structure should be based on reduced strengths and on heave that must be expected. Residential buildings with foundations that are below the frost line should not heave in any soil except under unusual conditions.

D. ENGINEERING INTERPRETATIONS FOR VARIOUS USES

Soil interpretations for engineering uses involve relating relevant soil and landscape qualities and characteristics to specific uses. Estimated suitability or limitations of soils in the Brandon study area for various engineering uses are given in Table 9.

1. SUITABILITY AS SOURCE OF TOPSOIL

The term "topsoil" includes soil materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens, flower beds, etc. The factors considered include not only characteristics of the soil itself, but also the ease or difficulty of excavation and where removal of topsoil is involved, accessibility to the site. The soil and landscape properties important to this use are texture or engineering class, organic matter content, thickness of surface layer and reaction, degree of salinity, degree of stoniness, slope, degree of wetness, and risk of flooding.

2. SUITABILITY AS A SOURCE OF SAND AND GRAVEL

The purpose of this interpretation is to provide guidance on the probable supply as well as quality of the sand or gravel for use as road base material and concrete. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 1.5 to 2 meters, augmented by observations in deep cuts as well as geological knowledge. The important soil and landscape criteria for this interpretation are texture or engineering class, thickness of layers, depth to water table, and ease of excavation.

3. SUITABILITY AS A SOURCE OF FILL MATERIAL

Fill material for buildings or roads are included in this use. Performance of material when removed from its original location and placed under load at the building site or road bed are considered. Since surface materials are generally removed during road or building construction their properties are usually ignored. The whole soil to a depth of 1.5 to 2 meters is evaluated. Parameters of importance include texture or engineering class, soil drainage class, depth to water table, depth to bedrock, slope, plasticity index, susceptibility to flooding, and ease of excavation.

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* Federal Housing Administration Architectural Standards Division Staff, "Engineering Soil Classification for Residential Developments", Revised Ed., 1961, pp. 19, U.S. Govt. Printing Office, Washington 25, D.C.

TABLE 8. Engineering Description of the Soils and Their Estimated Properties Significant to Engineering

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	%Passing No. 10 (2.0 mm)	%Passing No. 40 (0.42 mm)	%Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Am	Ashmore	0-40	LVFS-FSL	ML to SM	A-4 to A-2-6	100	100	40-90	0.8-2.50	7.4-7.8	low	low	low	below 2 m
		40-100	S & Gr	Gp to Gw	A-1	40-70	15-30	2-5	>10	7.8-8.0	low	low	low	
Az	Arizona	0-25	FS-LFS	SM	A-3, A-2-4	100	90-100	5-25	6-10	7.2 7.6	none	low	low	below 2 m
		25-100	FS	SM to SP	A-3	100	90-100	3-15	2-6	7.4-7.8	none	low	low	
As	Assiniboine	0-40	C-SiC	CH	A-7-6	100	100	90-100	.2-.8	7.0-7.4	low	low	high	subject to flood
		40-100	strat. C-SiC	CH	A-7-6	100	100	90-100	<.2	7.6-7.8	low to mod.	low	high	
Ax	Axford	0-20	LMS-MSL	SM	A-2	75-95	50-90	10-20	>6	7.6-8.0	low	low	low	below 2 m
		20-80	S & Gr	Gw to Gp	A-1	-	-	2-5	>10	7.8-8.2	low	low	low	
		80+	SiL-SiCL	ML to CL	A-4 to A-7-6	100	100	75-100	0.2-0.6	7.8-8.2	low	low	mod.	
Ba	Bankton	0-25	SiC-C	OH	A-7-6	100	100	95-100	.05-2.0	7.3-7.6	low	low	high	seasonal
		25-100	SiC-C	CH	A-7-6	100	100	90-95	<.05	7.8-8.2	mod.	mod.	high	>1.5 m
Bd	Beresford	0-30	CL	CL	A-6	100	100	75-85	0.6-1.0	7.4-7.8	low	low	high	seasonal
		30-60	SiCL-CL	ML to CL	A-4, A-6	85-95	75-85	60-75	<.1	7.8-8.2	mod.	mod.	mod.	0.6 m
		60-100+	L-CL	CL	A-4, A-6	85-90	55-75	40-60	<.05	7.8-8.2	high	mod.	mod.	
Bd/ xxxs	Beresford saline	Similar to above - contains appreciable soluble salts									severe	high	high	subject to upward flow of ground-water
Bg	Barager	0-15	LMS-MSL	SM	A-2	75-90	50-75	15-25	6-12	7.0-7.4	none	low	low	seasonal
		15-75	S & Gr	Gw to Gp	A-1	-	-	2-5	>20	7.4-7.8	none	low	low	0.7 m
		75-100	SiCL	ML to CL	A-4 to A-7	85-95	75-85	60-75	<.1	7.8-8.2	mod.	low	mod.	
		100+	L-CL	CL	A-4 to A-6	85-90	55-75	40-60	<.05	7.8-8.4	high	mod.	mod.	
Bk	Basker	0-20	SiL-SiCL	ML to CL	A-6, A-7	100	100	95-100	0.2-0.8	7.6-8.0	low	low	mod.	at or near surface - subject to flood
		20-60	strat. FSL-SiL CL	ML to CL	A-4 to A-7-6	100	100	65-100	-	7.8-8.2	low	low	mod.	
		60-100	strat. SiL-SiCL	ML to CL	A-4 to A-7-6	100	100	75-100	-	7.8-8.2	low	low	mod.	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	%Passing No. 10 (2.0 mm)	%Passing No. 40 (0.42 mm)	%Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Bm	Belmont	0-20	CL	CL	A-6	85-95	75-90	70-85	.6-1.0	7.4-7.8	low	low	mod.	seasonal
		20-65	SiCL	ML to CL	A-4 to A-7	85-95	75-85	60-75	.2	7.8-8.2	low	low	mod.	>2 m
		65-100	L-CL	CL	A-4 to A 7	85-90	55-75	40-60	<.05	7.8-8.2	low	low	mod.	
Bn	Brownridge	0-15	VFSL	ML	A-4 to A-7-5	100	100	75-95	.8-2.5	7.3-7.6	none	low	low	>2 m
		15-50	VFS-LVFS	ML	A-4 to A-7-5	100	100	50-90	.8-2.5	7.8-8.2	none	low	low	
		50-100	VFS-LVFS	ML	A-4 to A-7-5	100	100	50-90	.8-2.5	7.8-8.2	none	low	low	
Bo	Boswell	0-20	LMS-SL	SM	A-2	75-90	50-80	10-20	>6	7.4-7.8	low	low	low	seasonal
		20-70	S & Gr	Gw to Gp	A-1	-	-	2-5	>10	7.8-8.2	low	low	low	0.7 m
		70-100+	SiCL-CL	ML to CL	A-4 to A-7-6	100	100	75-100	0.2-0.6	7.8-8.2	low	low	mod.	
Br	Barren	0-25	SiCL-CL	CL	A-4 to A-7-6	100	100	95-100	0.6-2.0	7.4-7.8	low	low	mod.	>2 m
		25-100	SiL-SiCL	ML to CL	A-4 to A-7-6	100	100	85-95	0.2-0.6	7.8-8.2	low	low	mod.	
Bt	Burnett	0-15	FSL-VFSL	OL to ML	A-4 to A-6	100	100	45-70	0.6-2.0	7.6-8.0	low	low	low	at or near
		15-35	VFS-FSL	ML to SM	A-4 to A-7-5	100	100	45-80	-	7.8-8.2	low	low	low	surface
		35-100+	MS-Gr	SW to Gp	A-1	-	5-15	2-5	-	7.8-8.2	low	low	low	
Bw	Barwood	0-20	L-CL	CL	A-6, A-7-5	85-95	80-95	60-75	.6-2.0	7.6-8.0	low	low	mod.	seasonal
		20-60	L-SiCL	CL to ML	A-4	85-95	80-90	60-75	.2-.6	8.0-8.4	mod.	low	mod.	0.7 m
		60-100	L-CL	SC to CL	A-6, A-4	85-95	75-90	40-65	<.1	8.0-8.4	mod.	low	mod.	
Cb	Chambers	0-15	L-CL	OL	A 6 to A-7-5	100	100	65-85	0.6-2.0	7.0-7.4	low	low	mod.	seasonal
		15-40	L-CL	CL	A-6	100	100	65-85	0.6-2.0	7.4-7.8	low	low	mod.	0.8 m
		40-70	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	.2-.6	7.8-8.4	low	low	mod.	
		70-100+	L-CL	CL	A-4 to A-7	85-90	55-80	40-70	<.1	7.8-8.4	mod.	low	mod.	
Cc	Cactus	0-20	LFS	SM to SP	A-2-4	100	85-95	5-35	>10	6.5-7.2	none	low	low	>2 m
		20-100	FS-LS	SM to SP	A-3, A-2-4	100	85-95	3-15	5-10	7.3-7.8	none	low	low	
Cf	Cobfield	0-15	L-CL	CL	A-6	100	100	65-85	0.6-2.0	7.3-7.8	low	low	mod.	>1.5 m
		15-50	L-CL	CL	A-6	100	100	65-85	0.6-2.0	7.6-8.0	low	low	mod.	
		50-80	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	.2-.6	7.8-8.4	low	low	mod.	
		80-100+	L-CL	CL	A-6, A-4	85-90	55-80	40-70	<.1	7.8-8.4	mod.	low	mod.	
Ch	Chater	0-15	LMS-SL	SM	A-2	75-95	50-90	10-20	>10	7.6-8.0	low	low	low	>1.5 m
		15-70	S & Gr	Gw to Gp	A-1	-	-	2-5	>10	7.8-8.2	low	low	low	
		70-90	SiCL-L	CL to ML	A-4	85-95	80-90	60-75	.2-.6	7.8-8.4	low	low	mod.	
		90+	L-CL	CL	A-6, A-4	85-90	55-75	40-60	<.1	7.8-8.4	mod.	low	mod.	
Ck	Crookdale	0-25	SCL-CL	CL	A-6	100	100	60-80	0.6-2.0	7.0-7.4	low	low	mod.	seasonal
		25-75	SCL-CL	CL	A-6	100	100	60-80	.6-2.0	7.4-7.8	low	low	mod.	0.8 m
		75-100+	LFS-FS	SM, SP, ML	A-2 to A-4	100	100	5-50	2.5-5.0	7.6-8.0	low	low	low	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Cl	Carroll	0-20	CL	CL	A-7-6	100	100	90-100	0.6-2.0	7.3-7.8	low	low	mod.	>2.0 m
		20-80	SiCL	CL	A-7-6	100	100	90-100	0.2-0.8	7.8-8.2	low	low	mod.	
		80-100	SiL-SiCL	CL	A-6, A-7-6	100	100	90-100	0.2-0.8	7.8-8.4	low	low	mod.	
Cm	Charmau	0-20	CL	CL	A-7-6	100	100	90-100	0.6-2.0	7.4-7.8	low	low	mod.	seasonal
		20-80	strat. SiCL	CL	A-7-6	100	100	90-100	<0.6	7.8-8.2	low	low	mod.	0.8 m
		80-100	SiL-SiCL	CL	A-6, A-7-6	100	100	90-100	0.05-2.0	7.8-8.4	mod.	low	mod.	
Cp	Capell	0-20	SCL-L	CL	A-6, A-7-5	95-100	85-95	40-55	0.6-2.0	7.6-8.0	low	low	mod.	seasonal
		20-40	SCL-L	SC to CL	A-6, A-4	95-100	85-95	30-50	0.6-2.0	7.8-8.2	low	low	mod.	0.8 m
		40-70	Gr SL	SM	A-1, A-2	-	<50	15-30	10-20	7.8-8.2	low	low	low	
		70+	Gr S	Sp to Gp	A-1	-	<45	<5	>20	7.8-8.2	low	low	low	
Cr	Croyon	0-25	SCL-L	CL	A-6	100	100	75-85	0.6-2.0	7.2-7.6	low	low	mod.	
		40-70	SiCL	ML to CL	A-4, A-6	85-90	75-85	60-75	0.2-.8	7.8½8.4	low	low	mod.	
		70-100+	L-CL	CL	A-4, A-6	85-90	55-75	40-60	<.1	7.8-8.2	low to	low	mod.	
Cr	Croyon	0-25	SCL-L	CL	A-6	100	85-95	60-80	0.6-2.0	7.2-7.6	low	low	mod.	>2 m
		25-50	SL-L	CL	A-4, A 6	90-100	85-95	50-75	0.6-2.0	7.8-8.2	low	low	mod.	
		50-100+	CS-GrS	Sp	A-1	-	<20	<5	>10	7.8-8.2	low	low	low	
Ct	Clementi	0-40	L-CL	CL	A-6	100	100	75-85	0.6-1.0	7.2-7.6	low	low	mod.	>1.5 m
		40-70	SiCL	ML to CL	A-4, A-6	85-90	75-85	60-75	0.2-.8	7.8-8.4	low	low	mod.	
		70-100+	L-CL	CL	A-4, A-6	85-90	55-75	40-60	<.1	7.8-8.2	low to mod.	low	mod.	
Cv	Cordova	0-25	L-CL	CL	A-6	85-90	75-85	60-75	0.6-2.0	7.2-7.6	low	low	mod.	>1.5 m
		25-70	L-SiCL	ML to CL	A-4, A-6	85-90	75-85	60-75	0.2-0.8	7.8-8.2	low	low	mod.	
		70-100+	L-CL	CL	A-4, A-6	85-90	55-75	40-60	<.1	7.8-8.2	mod.	low	mod.	
Cy	Carvey	0-25	SCL-L	CL	A-6	100	85-95	60-80	-	7.8-8.2	low to mod.	low	mod.	at or near surface (seasonal)
		25-50	SL-L	CL	A-4, A-6	95-100	85-95	50-75	-	7.8-8.4	low to mod.	low	mod.	
		50-100	CS-GrS	Sp	A-1	-	-	<5	-	7.8-8.4	low to mod	low	low	
Cy/xxxs	Carvey saline phase	Similar to above - contains appreciable soluble salts									severe	mod.		
Dg	Dogand	0-40	SL-L	ML to CL	A-6	85-95	75-90	35-70	0.6-2.0	7.3-7.8	low	low	mod.	>2 m
		40-85	GrS	Gp to Sp	A-1	var	<10	<5	>10	7.8-8.2	low	low	low	
		85-100+	L-CL	CL	A-6 (A-4)	80-90	60-80	50-70	.05-.20	7.8-8.4	low	low	mod.	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	%Passing No. 10 (2.0 mm)	%Passing No. 40 (0.42 mm)	%Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Dn	Durnan	0-25	SiL-VFSL	ML	A-4, A-6	100	100	90-100	0.6-2.0	7.4-7.8	low	low	mod.	>2 m
		25-60	SiL-L	ML	A-4	100	100	90-100	0.6-2.0	7.8-8.4	low	low	mod.	
		60-100	SiL	ML	A-4	100	100	95-100	0.6-2.0	7.8-8.4	low	low	mod.	
Dr	Dorset	0-20	LFS-LS	Sp	A-2-4	100	90-100	10-35	6-10	7.0-7.4	low	low	low	>2 m
		20-50	GrLS-GrS	GP-Sp	A-1	35-60	-	<5	>10	7.4-7.8	low	low	low	
		50-100	S+Gr	GP-Sp	A-1	35-60	-	<5	>10	7.8-8.2	low	low	low	
Dr_1	Dorset	50-100	M-CS	Sp	A-1-b, A-3	90-100	40-75	<5	>10	7.6-8.2	low	low	low	>2 m
Dt	Dexter	0-20	LFS-FSL	Sm-Sp	A-2-4	100	90-100	10-35	6-10	6.8-7.4	low	low	low	seasonal
		20-70	S-GrLS	Gp-Sp	A-1	35-60	-	<5	>10	7.2-7.8	low	low	low	0.7 m
		70-100	S+Gr	Gp-Sp	A-1	35-60	-	<5	>10	7.4-7.8	low	low	low	
Dt_1	Dexter	20-70	M-CS	Sp	A-1-b, A-3	90-100	40-75	<5	>10	7.2-7.8	low	low	low	seasonal
		70-100	M-CS	Sp	A-1-b, A-3	90-100	40-75	<5	>10	7.2-7.8	low	low	low	0.7 m
Dx	Druxman	0-20	L-CL	CL	A-6	100	90-100	70-90	0.6-2.0	7.0-7.4	low	low	mod.	>2 m
		20-55	L-SiL	ML	A-4, A-6	100	90-100	70-90	0.6-2.0	7.6-8.0	low	low	mod.	
		55-80	LS	SM	A-2-4	var	<60	15-25	5-10	7.6-8.2	low	low	low	
		80-100+	S & Gr	Sp	A-1, A-2	var	<60	<5	>10	7.8-8.2	low	low	low	
Ev	Everton	0-40	C	CH	A-7-6	100	100	100	0.2-0.8	7.2-7.6	low	low	high	>1.5 m
		40-70	SiCL-L	ML to CL	A-4 to A-7	85-95	75-85	60-75	<.1	7.8-8.4	low	low	mod.	
		70-100	L-CL	CL	A-6	85-90	55-75	40-60	<.05	7.8-8.4	mod.	low	mod.	
Fd	Fairland	0-25	VFSL-SiL	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.0-7.4	low	low	mod.	>2 m
		25-60	SiL-L	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.8-8.4	low	low	mod.	
		60-100	SiL	ML	A-4	100	100	95-100	0.6-2.0	7.8-8.4	low	low	mod.	
Fn	Fenton	0-15	SiC-C	OH	A-7-6	100	100	95-100	<.05	7.6-8.0	mod.	mod	high	at or near surface
		15-60	SiC-C	CH	A-7-6	100	100	95-100	-	7.8-8.4	mod.	mod.	high	
		60-90	SiCL-L	ML to CL	A-4 to A-7	85-95	75-85	60-75	-	7.8-8.4	severe	mod.	mod.	
		90-100+	L-CL	CL	A-6	85-90	55-75	40-60	-	7.8-8.4	severe	mod.	mod.	
$Fn/_{xxxs}$	Fenton saline phase	Similar to above - contains appreciable soluble salts									severe	high		subject to upward flow of ground-water
Fr.	Fortin	0-20	LFs-Ls	Sp	A-2-4	100	90-100	10-35	0.2-.6	7.4-7.8	low	low	low	at or near surface
		20-100	S+Gr	Gp-Sp	A-1	35-60	-	<5	-	7.6-8.2	low	low	low	
Fr_1	Fortin	20-100	M-Cs	Sp	A-1-b, A-3	90-100	40-75	<5	-	7.6-8.2	low	low	low	at or near surface

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Ft	Forrest	0-20	C-SiC	OH	A-7-6	100	100	95-100	0.6-2.0	7.2-7.6	low	mod.	high	seasonal
		20-50	C-SiC	CH	A-7-6	100	100	95-100	.05-.20	7.6-8.0	low	mod.	high	0.8 m
		50-75	SiCL-L	ML to CL	A-4 to A-7	85-95	75-85	60-75	<.05	7.8-8.4	mod.	mod.	mod.	
		75-100+	L-CL	CL	A-6	85-90	55-75	40-60	<.05	7.8-8.4	mod.	mod.	mod.	
Ft/xxxs	Forrest saline phase	Similar to above - contains appreciable soluble salts									severe	high		subject to upward flow of ground-water
Gl	Glenboro	0-40	L-VFSL	ML to CL	A-4, A-6	100	100	80-90	0.6-2.0	7.0-7.4	low	low	mod.	>1.5 m
		40-90	Strat. LFS-L	SM to ML	A-2 to A-4	100	90-100	30-90	0.2-1.0	7.4-7.8	low	low	mod.	
		90+	FS-LFS	SM to SP	A-2 to A-4	100	85-95	5-40	5-10	7.8-8.2	low	low	low	
Gn	Grayson	0-50	L-SiL	ML to CL	A-4, A-6	100	100	80-90	.2-.6	7.8-8.2	low	low	mod.	at or near the surface
		50-90	Strat. LFS-L	SM to ML	A-2 to A-4	100	90-100	30-90	.2-.6	7.8-8.4	low to mod.	low	mod.	
		90+	FS-LFS	SM to Sp	A-2 to A-4	100	85-95	5-40	.6-2.0	7.8-8.4	low	low	low	
Gr	Grover	0-40	L-SCL	ML to CL	A-4, A-6	100	100	80-90	0.6-2.0	7.4-7.8	low	low	mod.	seasonal
		40-90	strat. LFS-L	SM to ML	A-2 to A-4	100	90-100	30-90	0.6-2.0	7.8-8.4	low	low	mod.	0.7 m
		90+	FS-LFS	SM to Sp	A-2 to A-4	100	85-95	5-40	0.6-2.0	7.8-8.4	low	low	low	
Gt	Gateside	0-60	FSL-VFSL	SM to ML	A-2-4 to A-4	100	100	30-75	0.6-2.0	7.4-7.8	low	low	mod.	seasonal
		60-90	VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	0.6-2.0	7.8-8.4	low	low	low to mod.	0.8 m
		90+	strat. VFS-L	SM to ML	A-2-4 to A-4	100	100	30-75	0.2-0.8	7.8-8.4	low	low	low to mod.	
Gz	Gendzel	0-20	LFS-LS	SM	A-2-4	100	80-95	5-35	>10	7.4-7.8	low	low	low	seasonal
		20-50	FS-LFS	SW to Sp	A-2-4	100	80-95	5-35	5-10	7.8-8.4	low	low	low	0.6 m
		50-100	S & Gr	SW, Sp, Gp	A-1, A-2	-	<20	<5	>10	7.8-8.2	low	low	low	
Hg	Harding	0-20	C-SiC	OH	A-7-6	100	100	95-100	.6-2.0	7.0-7.4	low	low	high	seasonal
		20-80	C-SiC	CH	A-7-6	100	100	95-100	.2-.8	7.4-7.8	low	low	high	0.8 m
		80+	C-SiC	CH	A-7-6	100	100	95-100	<.05	7.8-8.2	mod.	mod.	high	
Hk	Hickson	0-20	L-CL	CL	A-6, A-7-5	85-95	80-95	60-75	.05-.2	7.4-7.8	low to mod.	low	mod.	at or near surface
		20-60	L-SiCL	CL to ML	A-4	85-95	80-90	60-75	<.05	7.8-8.4	mod.	low to mod.	mod.	
		60-100	L-CL	SC to CL	A-6, A-4	85-95	75-90	40-65	<.05	7.8-8.4	mod.	low to mod.	mod.	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	%Passing No. 10 (2.0 mm)	%Passing No. 40 (0.42 mm)	%Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Hm	Hummerston	0-20	LFS-FSL	SM to Sp	A-2 to A-4	95-100	85-95	5-40	2.5-5.0	7.3-7.6	low	low	low	seasonal
		20-100	FS-LFS	SM to Sp	A-2-4	95-100	80-95	5-35	2.5-5.0	7.6-8.0	low	low	low	0.6 m
Hn	Hilton	0-20	L-CL	CL	A-6, A-7-5	85-95	80-95	60-75	0.6-2.0	7.6-8.0	low	low	mod.	>2 m
		20-60	L-SiCL	CL to ML	A-4	85-95	80-90	60-75	0.2-0.8	7.8-8.4	low	low	mod.	
		60-100	L-CL	SC to CL	A-6, A-4	85-95	75-90	40-65	<0.2	7.8-8.4	mod.	low	mod.	
Ju	Justice	0-20	SiC-C	OH	A-7-6	100	95-100	80-90	.2-.8	7.3-7.6	low	low	high	seasonal
		20-50	SiC-C	CH	A-7-6	100	95-100	80-90	<.1	7.8-8.4	low	low	high	0.8 m
		50-80	SiCL-L	CL to ML	A-4	85-95	80-90	60-75	<.05	7.8-8.4	mod.	low	mod.	
		80+	L-CL	SC to CL	A-6, A-4	85-95	75-90	40-65	<.05	7.8-8.4	mod. (severe)	low	mod.	
Kk	Kirkness	0-40	LFS-FS	SM to Sp	A-2-4	100	85-95	5-35	5-10	7.0-7.3	low	low	low	>2 mm
		40-70	L-SiCL	CL to ML	A-4	85-95	80-90	60-75	0.2-0.8	7.8-8.1	low	low	mod.	
		70-100	L-CL	CL	A-6, A-4	85-95	75-90	40-65	.05-.2	7.8-8.4	low	low	mod.	
Kl	Kilmury	0-20	FSL	ML to SM	A-4 to A-2-4	100	90-100	25-60	2-6	7.3-7.6	low	low	low	seasonal
		20-40	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	35-80	0.6-2.0	7.8-8.2	low	low	low	0.7 m
		40-100	S & Gr	Gp to Sp	A-1	40-70	15-30	2-5	>10	7.8-8.4	low	low	low	
Kn	Killeen	0-40	LFS-FS	SM to Sp	A-2-4	100	85-95	5-35	5-10	7.6-8.0	low	low	low	seasonal
		40-70	L-SiCL	CL-ML	A-4	85-95	80-90	60-75	.05-.2	7.8-8.2	low	low	mod.	<.8 m
		70-100	L-CL	CL	A-6, A-4	85-95	75-90	40-65	<.05	7.8-8.4	mod.	low	mod.	
Ko	Knolls	0-25	SiL-VFSL	ML	A-4, A-6	100	100	90-100	0.6-2.0	7.4-7.8	low	low	mod.	>2 m
		25-60	SiL-L	ML	A-4	100	100	90-100	0.6-2.0	7.8-8.4	low	low	mod.	
		60-100	SiL	ML	A-4	100	100	95-100	0.6-2.0	7.8-8.4	low	low	mod.	
Kr	Kerran	0-40	C-SiC	CH	A-7-6	100	100	90-100	-	7.4-7.8	low	low	high	at or near surface - subject to flood
		40-100	strat. C-SiC	CH	A-7-6	100	100	90-100	-	7.8-8.4	mod.	mod.	high	
Ky	Kleysen	0-15	L-CL	OL	A-6 to A-7-5	100	100	65-85	0.6-2.0	7.2-7.6	low	low	mod.	>2 M
		15-40	L-CL	CL	A-6	100	100	65-85	0.6-2.0	7.4-7.8	low	low	mod.	
		40-70	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.6	7.8-8.4	low	low	mod.	
		70-100	L-CL	CL	A-6, A-4	85-95	55-80	40-70	<.1	7.8-8.4	mod.	low	mod.	
Ld	Lindstrom	0-40	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	35-80	.5-2.0	7.4-7.8	low	low	low	seasonal
		40-70	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.6	7.8-8.4	low	low	mod.	0.7 m
		70-100	L-CL	CL	A-6, A-4	85-95	55-80	40-70	<.1	7.8-8.4	mod.	low	mod.	
Lh	Lavenham	0-25	LFS	SM	A-2-4	100	90-100	10-25	6-10	7.0-7.4	low	low	low	seasonal
		25-50	FS-LFS	SM	A-3, A-2-4	100	90-100	5-25	6-10	7.6-8.0	low	low	low	0.8 m
		50-100	FS	SM	A-3, A-2-4	100	90-100	3-15	2-6	7.6-8.0	low	low	low	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Mr	Marsden	0-40	SL-L	ML to CL	A-6	85-95	75-90	35-70	<.6	7.4-7.8	low	low	mod.	at or near surface
		40-85	GrS	Gp to Sp	A-1	-	10-20	<5	-	7.8-8.4	low	low	low	
		85-100	L-CL	CL	A-6, A-4	80-90	60-80	50-75	-	7.8-8.4	mod.	low	mod.	
Ms	Miniota	0-20	FSL	ML to SM	A-4 to A-6	100	100	45-80	2.5-5.0	6.5-7.0	low	low	low	>1.5 m
		20-40	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	-	0.8-2.5	6.5-7.0	low	low	low	
		40-100	S & Gr	GP to Sp	A-1	40-70	-	2-5	>10	7.4-7.8	low	low	low	
Ob	Oberon	0-25	SCL-CL	CL	2-6	100	100	60-80	0.6-2.0	7.2-7.6	low	low	mod.	Seasonal
		25-75	SCL-CL	CL	A-6	100	100	60-80	0.6-2.0	7.6-8.0	low	low	mod.	0.8 m
		75-100	LFS-FS	SM, Sp, ML	A-2 to A-4	100	100	5-50	2.5-5.0	7.8-8.4	low	low	low	
Oh	Onahan	0-20	LFS-FS	SM to Sp	A-2-4	100	80-100	10-35	5-10	6.8-7.2	low	low	low	seasonal
		20-100	LFS-FS	SW to Sp	A-3, A-2-4	100	80-100	7-35	5-10	7.8-8.2	low	low	low	0.8 m
Pl	Pleasant	0-60	FSL-VFSL	SM to ML	A-2-4 to A-4	100	100	30-75	0.6-2.0	7.4-7.8	low	low	mod.	seasonal
		60-90	VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	0.6-2.0	7.8-8.2	low	low	mod.	0.7 m
		90+	strat. VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	.2-.8	7.8-8.2	mod.	mod.	mod.	
Pl/xxxs	Pleasant saline phase	Same as above - contains appreciable soluble salts									severe	mod. to high	mod.	subject to upward seepage of saline water
Po	Poolex	0-20	FSL-L	ML to CL	A-4 to A-6	100	100	60-85	<.2	7.6-8.0	low	low	mod.	at or near surface
		20-60	VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	-	7.8-8.4	low	low	mod.	
		60-100	strat. VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	-	7.8-8.4	mod.	mod.	mod.	
Po/xxxs	Poolex saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	subject to upward pressure of groundwater
Pp	Porple	0-40	VFS-FSL	ML to CL	A-2-4 to A-4	100	100	30-75	0.6-2.0	7.6-8.0	low	low	mod.	seasonal
		40-100	strat. VFS-FSL	SM to ML	A-2-4 to A-4	100	100	30-75	0.2-0.8	7.8-8.4	mod.	low	mod.	0.7 m
PP/xxxs	Porple saline phase	Similar to above - contains appreciable soluble salts									severe	mod. to severe	mod.	subject to upward flow of groundwater
Pr	Prodan	0-30	CL	CL	A-7-6	100	100	90-100	0.6-2.0	7.6-8.0	low	low	mod.	seasonal
		30-60	CL-SiCL	CL	A-6, A-7-6	100	100	95-100	0.6-2.0	7.8-8.4	low	low	mod.	0.7 m
		60-100	VFSL-SiL	ML to CL	A-6	100	100	95-100	0.2-0.8	7.8-8.4	mod.	low	mod.	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	%Passing No. 10 (2.0 mm)	%Passing No. 40 (0.42 mm)	%Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Lk	Lockhart	0-40	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	35-80	0.6-2.0	7.2-7.6	low	low	low	>2 m
		40-70	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.6	7.8-8.4	low	low	mod.	
		70-100	L-CL	CL	A-6, A-4	85-95	55-80	40-70	<.1	7.8-8.4	low	low	mod.	
Ln	Lonery	0-20	VFS-FSL-L	OL	A-4 to A-7-5	100	100	35-90	-	7.4-7.8	low	low	low	at or near the surface
		20-45	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	35-80	-	7.8-8.4	low	low	low	
		45-75	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	-	7.8-8.4	mod.	low	mod.	
		75-100	L-CL	CL	A-6, A-4	85-95	55-80	40-70	-	7.8-8.4	mod.	mod.	mod.	
Lt	Lowton	0-20	SiC-C	CH	A-7-6	100	100	100	<.05	7.4-7.8	low	low	high	at or near the surface
		20-70	SiC-C	CH	A-7-6	100	100	95-100	<.05	7.8-8.4	low	mod.	high	
		70-100	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	<.05	7.8-8.4	mod.	mod.	mod	
		100+	L-CL	CL	A-6, A-4	85-95	55-80	40-70	<.05	7.8-8.4	mod. to severe	mod.	mod.	
Lt/xxxs	Lowton saline phase	Similar to above - contains appreciable soluble salts									severe	mod. to high		subject to upward movement of groundwater
Lv	Levine	0-20	VFSL-L	ML to CL	A-4 to A-7-6	100	100	65-100	.6-2.0	7.4-7.8	low	low	mod.	Seasonal 0.8 m, subject to occasional flooding
		20-100	strat. SiL-CL	ML to CL	A-4 to A-7-6	100	100	65-100	.2-.6	7.8-8.4	low	low	mod.	
Ma	Marringhurst	0-20	LFS-FSL	SM to Sp	A-2-4	100	90-100	10-35	6-10	7.4-7.8	low	low	low	>2 m
		20-50	GrLS-GrS	Gp to Sp	A-1	35-60	-	<5	>10	7.8-8.4	low	low	low	
		50-100	S & Gr	Gp to Sp	A-1	35-60	-	<5	>10	7.8-8.4	low	low	low	
Md	Madill	0-25	L-SiCL	CL	A-6	85-95	75-85	60-75	0.2-0.6	7.6-8.0	low	low	mod.	>2 m
		25-50	L-SiCL	CL to ML	A-6	85-95	75-85	60-75	0.2-0.6	7.8-8.4	low	low	mod.	
		50-100+	SL-L	ML to SM	A-4, A-2	75-85	65-80	30-70	0.2-0.6	7.8-8.4	low	low	low to mod.	
Mf	Mansfield	0-20	LFS-FSL	SM to Sp	A-2-4	100	90-100	10-35	6-10	7.6-8.0	low	low	low	seasonal 0.7 m
		20-50	GrLS-GrS	Gp to Sp	A-1	35-60	-	<5	>10	7.8-8.4	low	low	low	
		50-100	S & Gr	Gp to Sp	A-1	35-60	-	<5	>10	7.8-8.4	low	low	low	
Mk	Mockry	0-20	LFS-FS	SM to Sp	A-2-4	100	80-100	10-35	-	7.6-8.0	low	low	low	at or near surface
		20-100	FS-LFS	SW to SM	A-3, A-2-4	100	80-100	8-35	-	7.8-8.4	low	low	low	
Ml	Melland	0-40	SL-L	ML to CL	A-6	85-95	75-90	35-70	0.6-2.0	7.4-7.8	low	low	mod.	seasonal 0.8 m
		40-85	GrS	Gp to Sp	A-1	-	10-20	<5	>10	7.8-8.4	low	low	low	
		85-100+	L-CL	CL	A-6, A-4	80-90	60-80	50-75	.05-.20	7.8-8.4	low	low	mod.	
Mn	Manson	0-20	SiC-C	CH	A-7-6	100	95-100	85-95	0.6-2.0	7.2-7.6	low	low	high	1.5 m (subject to low frequency flooding)
		20-100	strat. SiC-C	CH	A-7-6	100	95-100	85-95	0.2-0.6	7.8-8.4	low w	low	high	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Pr/xxxs	Prodan saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	subject to upward pressure of groundwater
Ps	Prosser	0-50	FSL-VFSL	SM to ML	A-2-4, A-4	100	100	30-75	0.6-2.0	7.0-7.4	low	low	mod.	>2 m
		50-80	VFS-FSL	SM to ML	A-2-4, A-4	100	100	30-75	0.6-2.0	7.4-7.8	low	low	mod.	
		80-100+	strat. VFS-L	SM to ML	A-2-4, A-4	100	100	30-75	0.6-2.0	7.8-8.4	low	low	mod.	
Pt	Petrol	0-40	L-SCL	ML to CL	A-4, A-6	100	100	80-90	0.6-2.0	7.0-7.4	low	low	mod.	seasonal 0.8-1 m
		40-90	strat. LFS-L	SM to ML	A-2 to A-4	100	90-100	30-90	0.6-2.0	7.4-7.8	low	low	mod.	
		90-100+	FS-LFS	SM to Sp	A-2-4	100	85-95	5-35	0.6-2.0	7.8-8.4	low	low	low	
Ra	Ramada	0-20	L-CL	CL	A-7-6	100	100	85-95	0.6-2.0	7.0-7.4	low	low	mod. to high	>2 m
		20-75	SiCL	CL	A-7-6	100	100	85-95	0.6-2.0	7.4-7.8	low	low	mod. to high	
		75-100	L-SiCL	CL	A-6, A-7-6	100	100	80-90	0.2-0.8	7.8-8.4	low	low	mod.	
Rd	Roddan	0-30	L-CL	CL	A-6 to A-7-5	100	100	65-85	0.6-2.0	7.6-8.0	low	low	mod.	>2 m
		30-60	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.6	7.8-8.4	low	low	mod.	
		60-100+	L-CL	CL	A-4 to A-7	85-90	55-80	40-70	<.1	7.8-8.4	low	low	mod.	
Rf	Rufford	0-40	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.8	7.6-8.0	low	low	mod.	>2 m
		40-100	L-CL	CL	A-4 to A-7	85-90	55-80	40-70	<.1	7.8-8.4	low	low	mod.	
Rp	Rempel	0-20	CL	CL	A-7-6	100	100	90-100	0.6-2.0	7.3-7.8	low	low	mod.	>2 m
		20-80	SiCL	CL	A-7-6	100	100	90-100	0.2-0.8	7.8-8.2	low	low	mod.	
		80-100+	SiL-SiCL	CL	A-6, A-7-6	100	100	90-100	0.2-0.8	7.8-8.4	low	low	mod.	
Sg	Sigmund	0-30	C	CH	A-7-6	100	100	90-95	0.2-0.8	7.4-7.8	low	low	high	seasonal 0.7 m
		30-70	C-SiC	CH	A-7-6	100	100	90-95	<.05	7.8-8.2	mod.	mod.	high	
		70-100	C-SiC	CH	A-7-6	100	100	90-95	<.05	7.8-8.2	severe	mod. to high	high	
Sg/xxxs-t	Sigmund saline phase	Similar to above - contains appreciable soluble salts									severe	mod. to high	high	subject to upward flow of groundwater
Sh	Shilox	0-20	LFS-FS	SM to Sp	A-2-4	100	80-100	10-35	>10	6.6-7.2	low	low	low	>2 m
		20-100	FS-LFS-MS	SW to Sp	A-3, A-2-4	100	60-90	7-35	5-10+	7.6-8.0	low	low	low	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Sn	Stockton	0-30	LFS	SM to Sp	A-2-4	100	85-95	5-35	>10	6.8-7.2	low	low	low	>2 m
		30-100	FS-LS	SM to Sp	A-3, A-2-4	100	85-95	3-15	5-10+	7.4-7.8	low	low	low	
St	Stewart	0-25	CL	CL	A-6	85-95	75-85	60-75	0.6-2.0	6.8-7.2	low	low	mod.	>2 m
		25-70	L-SiCL	CL to ML	A-6	85-95	75-85	60-75	0.2-0.6	7.8-8.4	low	low	mod.	
		70-100	SL-L	ML to SM	A-4, A-2	70-85	60-80	30-70	0.2-0.6	7.8-8.4	low	low	low to mod.	
Su	Sutton	0-25	CL-SiCL	CL	A-7-6	100	100	60-90	<.2	7.6-8.0	low	low	mod.	at or near surface
		25-90	SCL-CL	CL	A-6	100	100	60-80	-	7.8-8.4	low	low	mod.	
		90+	LFS-FS	SM, SP, ML	A-2-4, A-4	100	100	5-50	-	7.8-8.4	low	low	low	
Su/xxxs	Sutton saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	subject to upward flow of ground-water
Sw	Sewell fine sandy loam	0-20	LFS-FSL	SM, SP	A-2-4, A-4	100	100	5-50	<0.2	7.6-8.0	low	low	low	at or near surface
		20-100	LFS-FS	SM, SP	A-2-4, A-4	100	100	5-50	-	7.8-8.4	low	low	low	
Sw/xxxs	Sewell saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	low	subject to upward flow or seepage of groundwater
Sy	Statley	0-25	CL	CL	A-6	85-95	75-85	60-75	0.6-2.0	7.2-7.6	low	low	mod.	>2 m
		25-70	L-SiCL	CL to ML	A-6	85-95	75-85	60-75	0.2-0.6	7.8-8.4	low	low	mod.	
		70-100	SL-L	ML to SM	A-4, A-2	70-85	60-80	30-70	0.2-0.6	7.8-8.4	low	low	mod. to low	
Tc	Torcan	0-25	VFSL-SiL	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.0-7.4	low	low	mod.	seasonal 0.8-1.0 m
		25-60	SiL-L	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.4-7.8	low	low	mod.	
		60-100	SiL	ML	A-4	100	100	95-100	0.2-0.6	7.8-8.4	low	low	mod.	
Td	Tadpole	0-30	CL	CL	A-7-6	100	100	90-100	<0.2	7.6-8.0	low	low	mod. to high	at or near surface
		30-60	CL-SiCL	CL	A-6, A-7-6	100	100	95-100	-	7.8-8.4	low	low	mod.	
		60-100	strat. VFSL-SiL-SiCL	ML to CL	A-6	100	100	95-100	-	7.8-8.4	mod.	mod.	mod.	
Td/xxxs-t	Tadpole saline phase	Similar to above - contains appreciable soluble salts									severe	mod. to severe	mod.	subject to upward flow of ground-water

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permeability ins/hr	Reaction	Sulfate Hazard	Dispersion	Shrink-Swell	Depth to water table
Tg	Taggart	0-25	VFSL-SiL	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.6-8.0	low	low	mod.	seasonal
		25-60	SiL-L	ML	A-4 (A-6)	100	100	90-100	0.2-0.6	7.8-8.4	low	low	mod.	0.7 m
		60-100	SiL	ML	A-4	100	100	95-100	0.2-0.6	7.8-8.4	low to mod.	low	mod.	
Tg/xxxs	Taggart saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	area subject to upward flow of groundwater
Tv	Traverse	0-20	VFSL-SiL	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.4-7.8	low	low	mod.	>1.5 m
		20-60	SiL-L	ML	A-4 (A-6)	100	100	90-100	0.6-2.0	7.8-8.4	low	low	mod.	
		60-100	SiL	ML	A-4	100	100	95-100	0.2-0.6	7.8-8.4	low	low	mod.	
Vf	Vodroff	0-40	CL	CL	A-6	100	100	75-85	<.1	7.8-8.2	low	low	mod.	at or near surface
		40-70	SiCL-CL	ML to CL	A-4, A-6	85-95	75-85	60-75	-	7.8-8.4	low	low	mod.	
		70-100	L-CL	CL	A-4, A-6	85-90	55-75	40-60	-	7.8-8.4	mod.	low	mod.	
Vf/xxxs	Vodroff saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	subject to upward flow of ground-water
Vr	Varcoe	0-40	L-SiCL	CL to ML	A-4	90-100	80-95	60-90	0.2-0.8	7.6-8.0	low	low	mod.	seasonal
		40-100	L-CL	CL	A-4 to A-7	85-90	55-80	40-70	<.1	7.8-8.4	mod.	low to mod.	mod.	0.7 m
Vs	Vordas	0-20	SiL-CL	CL	A-6 to A-7-6	100	100	95-100	<.1	7.6-8.0	low	low	mod. to high	at or near surface
		25-60	SiL-L	ML	A-4 (A-6)	100	100	90-100	-	7.8-8.4	low	low	mod.	
		60+	SiL-L	ML	A-4 (A-6)	100	100	95-100	-	7.8-8.4	mod.	low to mod.	mod.	
Vs/xxxs	Vordas saline phase	Similar to above - contains appreciable soluble salts									severe	mod.	mod.	subject to upward flow of ground-water
Wd	Wellwood	0-40	SCL-CL	CL	A-6	100	100	60-80	0.6-2.0	7.0-7.4	low	low	mod.	>2 m
		40-85	SCL-CL	CL	A-6	100	100	60-80	0.6-2.0	7.8-8.4	low	low	mod.	
		85-100	LFS-FS	SM, SP, ML	A-2 to A-4	100	100	5-50	2.5-5.0	7.8-8.4	low	low	low	
Wf	Woodfield	0-25	CL	CL	A-6	85-95	75-85	60-75	0.6-2.0	7.4-7.8	low	low	mod.	<2 m
		25-80	L-SiCL	CL to ML	A-6	85-95	75-85	60-75	0.2-0.8	7.8-8.4	low	low	mod.	
		80-100	SL-L	ML to SM	A-4, A-2	70-85	60-80	30-70	0.2-0.8	7.8-8.4	low	low	mod. to low	
Wh	Wheatland	0-20	SL	SM	A-2-4	100	50-75	10-35	5-10	7.0-7.4	low	low	low	2 m
		20-40	LFS-LS	SP, SM SW	A-2-4	100	50-75	10-35	5-10	7.4-7.8	low	low	low	

Map Symbol	Soil Series	Depth cm	USDA	Classification Unified	Classification AASHO	% Passing No. 10 (2.0 mm)	% Passing No. 40 (0.42 mm)	% Passing No. 200 (.074 mm)	Permea-bility ins/hr	Reaction	Sulfate Hazard	Disper-sion	Shrink-Swell	Depth to water table
Wh	Wheatland	0-20	SL	SM	A-2-4	100	50-75	10-35	5-10	7.0-7.4	low	low	low	2 m
		20-40	LFS-LS	SP, SM, SW	A-2-4	100	50-75	10-35	5-10	7.4-7.8	low	low	low	
		40-100	MS, CS, FGr	GP, Sp	A-1, A-2	50-100	20-60	2	10	7.8-8.2	low	low	low	
Ws	Wesley	0-25	CL	CL	A-6	85-95	75-85	60-75	0.6-2.0	7.4-7.8	low	low	mod.	seasonal 0.7 m
		25-70	L-SiCL	CL to ML	A-6	85-95	75-85	60-75	0.2-0.6	7.8-8.4	low	low	mod.	
		70-100	SL-L	ML to SM	A-4, A-2	70-85	60-80	30-70	0.2-0.6	7.8-8.4	low	low	low to mod.	
Wy	Wytonville	0-20	FSL-L	SM, ML, CL	A-4, A-6, A-2-4	100	90-100	25-60	2-6	7.2-7.4	low	low	mod.	seasonal 0.8-1.0 m
		20-50	VFS-FSL	SM to ML	A-4 to A-7-5	100	100	35-80	0.6-2.0	7.4-7.8	low	low	low	
		50-100	S & Gr	Gp to Sp	A-1, A-2	40-70	15-30	2-5	5	7.8-8.4	low	low	low	
Xv	Xavier	0-160+	Mesic peat	Pt	-	-	-	-	-	6.5-7.6	low	-	-	at surface
Zn	Zarnet	0-25	SCL-L	CL	A-6	100	85-95	60-80		7.4-7.8	low	low	mod.	2m
		25-50	SL-L	CL	A-4, A-6	90-100	85-95	50-75	0.6-2.0	7.8-8.4	low	low	mod.	
		50-100	CS-GrS	Sp, Gp	A-1	-	20	5	10	7.8-8.4	low	low	low	

4. SOIL FEATURES AFFECTING LOCATION OF ROADS

Soil and landscape properties that affect design, construction and performance of highways and all weather roads are considered here. It is not the intention to suggest that soil maps possess adequate information to conduct engineering design; however, the soil map and interpretations are an invaluable aid in planning and conducting an engineering soil survey for design purposes.

Aside from the organic enriched surface horizon which is generally removed in construction, the entire soil profile in its undisturbed state was evaluated for this use. Those properties of importance are texture or engineering class, thickness of significantly different layers, soil drainage class, depth to water table, permeability, depth to bedrock, type of bedrock, slope, stoniness, mineralogy, atterberg limits, and susceptibility to flooding.

5. SOIL FEATURES AFFECTING FOUNDATION CONSTRUCTION

These interpretations apply to those features of soil and landscape influencing the support and construction of foundations suitable for low buildings, generally less than three stories high. As foundations are placed in the substratum below the average depth of penetration of frost, properties of the subsoil to a depth of at least 1.5 to 2 meters are considered. Properties influencing foundation support are those affecting bearing strength and settlement under load. Important parameters include density, wetness, flooding, plasticity, texture, shrink-swell potential, and susceptibility to frost heaving. Properties affecting ease of excavation and cost of foundation construction are wetness, risk of flooding, slope, depth to bedrock, stoniness and rockiness.

6. SOIL FEATURES AFFECTING AGRICULTURAL DRAINAGE

Factors which affect the suitability of the soils for agricultural drainage are the texture of the soil, the rate of water movement into and through the soil, depth to bedrock, depth to water table, and position of the soil in the landscape.

7. SOIL FEATURES AFFECTING RESERVOIR AREAS

Factors affecting the ability of undistrubed soils to impound water and prevent seepage are considered for evaluating soil suitability for reservoir areas. As impounded liquid 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. Soil features affecting their use for reservoirs are given in Table 9.

8. SOIL FEATURES AFFECTING EMBANKMENTS

Evaluation of soil suitability for embankment materials including dikes and levees is based on the resistant ability of the soil materials to seepage and piping, and the ability of the disturbed soil to restrain water flow when compacted. The soils must be favorable in terms of stability, shrink-swell potential, shear strength, and compactability. Presence of stones or organic matter are unfavorable features. Soil features affecting embankments are given in Table 9.

9. SOIL LIMITATIONS FOR SEPTIC TANK FILTER FIELDS

Criteria employed for rating soils for this use are based on their ability to absorb effluent. Effluent should move through soil at a moderate rate. Severe limitations may exist where (1) rapid permeability might permit contamination of water supplies and (2) restricted effluent movement, as a consequence of impermeable materials or high water table, result in surface overflow. Soils with slope gradients that contribute to side hill seepage of effluent are also considered to have severe limitations even though other characteristics are favorable. When evaluating the significance of fluctuating water table levels for septic fields, the seasonal high level is considered in order to express soil suitability in the most limiting situation. Important soil and landscape features for effluent absorption fields include soil permeability, depth to water table, risk of flooding, slope, depth to bedrock, nature of bedrock, stoniness and rockiness.

The soils of the Brandon study area were rated on their limitations for septic filter field based on evaluation of the soils in their natural condition, and not for disturbed areas that may be altered by cut and fill operations. Three degrees of limitations are used:

1. None to slight — relatively free of limitations or the limitations are easily overcome.
2. Moderate — limitations need to be recognized but can be overcome with good management or careful design.
3. Severe — limitations are severe enough to make use of the soil questionable: or extreme measures are needed to overcome the limitation. Useage generally is not practical.

The interpretation presented will not eliminate the need for onsite sampling, testing and study of specific sites for design and construction of residential development. The interpretation should

be used primarily to plan more detailed field investigations to determine the conditions of the soil at the proposed site for the intended use. By using the soil map and interpretations, it is possible to select sites that have the least limitation. Where the soils are rated as severe limitation for septic field (probability of failure is high), the user should consider the problem and thoroughly investigate the immediate or future improvement costs before proceeding with installation.

TABLE 9. Engineering Interpretations of Soils

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Am	Ashmore loamy very fine sand	Fair	Fair to good	Good	High bearing strength, high shear strength, low compressibility	High bearing strength, low compressibility	Not required	Very rapid permeability, will not hold water	Very rapid permeability	Slight, very rapid permeability, possible contamination hazard
Am/2xxx	Ashmore moderately eroded	Poor	Fair to good	Good	As above	As above	As above	As above	As above	Slight, may have to bring in topsoil to establish good vegetation cover on field
Am/xcxx	Ashmore undulating phase	Fair	Fair to good	Good	As above	As above	As above	Will not hold water	Undulating topography, very rapid permeability	Slight
Am/1c1x	Ashmore weakly eroded, undulating, slightly stony	Poor	Fair to good	Good	As above, has some stones present	As above	As above	Will not hold water	Similar to above, contains some stones	Slight
Am/2cxx	Ashmore moderately eroded, undulating	Poor	Fair to good	Good	High bearing strength, high shear strength, low compressibility	As above	Not required	Will not hold water	Undulating topography, rapid permeability	Slight, will require topsoil to establish good vegetation
Am/1c3x	Ashmore weakly eroded, undulating, very stony phase	Poor	Fair	Fair	Similar to above, contains appreciable stones	Contains appreciable stones	Not required	Will not hold water	Undulating topography, appreciable stone content	Severe, due to stone content, rapid permeability

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Am/xd1x	Ashmore moderately sloping slightly stony	Fair	Fair to good	Good	High bearing strength, high shear strength, low compressibility	High bearing strength low compressibility, few stones	Not required	Will not hold water	Moderately sloping, few stones	Moderate, slopes to 15%, rapid permeability, groundwater pollution hazard
Am/xd2x	Ashmore moderately sloping moderately stony	Poor	Fair to good	Good	Moderate limitation due to moderately sloping topography, high shear strength	Moderate to severe limitation because of stones & topography, good bearing capacity	Not required	Will not hold water	Moderately sloping, moderately stony, high shear strength, pervious when compacted	Severe, moderately sloping, moderately stony
Am/2f1x	Ashmore moderately eroded, steeply sloping	Poor	Fair to good	Fair	Severe limitation, steeply sloping, moderately eroded	Severe limitation, steeply sloping topography	Not required	Will not hold water	Steeply sloping	Severe, steeply sloping topography
Az	Arizona loamy fine sand	Poor	Fair to good for fine sand	Good	Slight, fair to good bearing strength, low compressibility	Slight limitation, good bearing strength, low shrink-swell	Not required	Rapid permeability, will not hold water	Permeable when compacted, high shear strength	Slight, rapid permeability, possible contamination hazard to groundwater
Az/xcxx	Arizona gently sloping	Poor	Fair to good	Good	As above	As above	Not required	Gently sloping, will not hold water	Gently sloping, permeable when compacted, high shear strength	Slight, possible contamination hazard to groundwater
Az/xdxx	Arizona moderately sloping	Poor	Fair to good	Good	Moderately sloping, cut bank subject to erosion if exposed	Slight to moderate, due to topography	Not required	Moderately sloping, will not hold water	Moderately sloping	Moderate limitation, moderately sloping possible lateral seepage, possible contamination hazard

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
As	Assiniboine silty clay	Poor	Not suitable	Poor	Subject to flooding, low bearing strength when wet, very plastic	Severe limitation, subject to flooding high shrink-swell	Not applicable	Associated with stream channels, low vertical permeability, moderate horizontal permeability	Poor workability, high silt & clay, high compressibility, high shrink-swell, low shear strength	Severe, subject to flooding & seasonal high water table
Ax	Axford loamy medium sand	Poor	Fair to depth of 80 cm, not suitable below	Good to depth of 80 cm, poor below	Slight limitation	Fair, subsoil has low bearing strength when wet	Not required	Rapid permeability in upper 80 cm, moderate below	Rapid permeability of surface 80 cm, low compressibility medium to high shear strength	Slight, rapid permeability in upper strata, moderate below
Ax/xdxx	Axford moderately sloping phase	As above	As above	As above	Moderate limitation, moderately sloping topography, cut banks will erode easily	Moderate limitation, moderately sloping topography, low bearing strength in subsoil when wet	Not required	Severe limitation due to topography & permeability	As above	Moderate moderately sloping topography
Ax/xexx	Axford strongly sloping	As above	As above	As above	Similar to above	Moderate limitation, strongly sloping	Not required	As above	As above	Moderate strongly sloping topography, subject to lateral seepage
Ba	Bankton clay	Poor	Not suitable	Poor	Severe limitation, high plastic clay, high compressibility	Severe limitation, high shrink-swell	Some surface drinage beneficial on the high plastic clay	Slight limitation, very slow permeability, will hold water	Medium to low shear strength high compressibility, low permeability, high shrink-swell	Severe, very low permeability
Ba/1cxx	Bankton slightly eroded, gently sloping	As above	As above	As above	As above	As above	Not required	As above	As above	Severe

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Bd Bd/xx1x Bd/1xxx Bd/1x1x	Beresford clay loam, also slightly stony phase; weakly eroded phase	Fair	Not suitable	Fair to poor	Temporarily perched water condition, high risk of frost heave, low shear strength, some stones present	Moderate sulfate hazard in subsoil, seasonal water table, fair to low bearing strength some stones present	Required in area	Slight limitation, slow permeability with depth, suitable for lagoon or dugout, some stones may be present	Fair to poor compaction properties, some stones may be present	Severe, slow permeability, seasonal water table within 7 m
Bd/xxxs,t Bd/xx1s Bd/1xxs	Beresford saline phase	Poor	Not suitable	Poor	Severe limitation, area subject to upward flow of groundwater, some stones present	High sulfate hazard, fair bearing strength	Subsurface drainage required to alleviate salt problem	Slight limitation, slow permeability with depth	Salt and gypsum present, poor compaction properties	Severe, slow permeability soluble salt
Bd/xx2x	Beresford moderately stony phase	Poor	Not suitable	Poor	Temporarily perched water condition, high risk of frost heave, moderately stony, low shear strength	Moderately stony, moderate sulfate hazard, fair bearing strength	Required in area	Slight limitation, will hold water	Moderately stony, difficult to compact	Severe
Bd/1cxx Bd/1c1x Bd/xc1x	Beresford slightly eroded, gently sloping, slightly stony phase	Poor	Not suitable	Fair to poor	Low shear strength, subject to lateral seepage & perched conditions, as above	Slightly stony, moderate sulfate hazard in subsoil, seasonal water table, fair to low bearing strength	Required in associated soils	Gently sloping, slow permeability with depth, slightly stony, will hold water	Fair to poor compaction properties, slightly stony	Severe, slow permeability, seasonal water table
Bd/xDxx	Beresford moderately sloping	Poor	Not suitable	Poor	Soil subject to seepage, moderately sloping topography, unstable when moist or wet	Severe limitation, soil subject to lateral seepage, low bearing capacity, unstable	Not practical	Severe limitation, area subject to lateral seepage, moderately sloping	Moderately sloping, low shear strength when compacted, poor compaction properties	Severe, area subject to seepage, moderately sloping
Bg	Barager loamy sand	Poor	Fair in upper 60-75 cm	Good in upper 60-75 cm, fair below	Seasonal perched water condition in upper 75 cm, subject to frost heave, moderately high shear strength in upper 75 cm	Seasonal perched water conditions, fair to good bearing strength	Some required to remove perched water conditions	Rapid permeability in upper 75 cm, slow permeability with depth	Poor, upper 75 cm permeable when compacted, high shear strength	Severe, seasonal perched water conditions

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Bk	Basker silty clay loam	Poor	Not suitable	Poor	Unsuitable, flood area, low bearing capacity when wet	Unsuitable, flood area, low bearing capacity when wet	Not applicable, seasonal flooding	Severe, flood area, stratified sediments of moderate to moderately slow permeability	Lower position in stream channels, subject to inundation	Severe, water table at or near surface
Bk/xxxs	Basker saline phase	Similar to above - contains appreciable soluble salts, high sulfate hazard								
Bm Bm/xx1x Bm/1x1x	Bermont clay loam, slightly stony phase, slightly eroded, slightly stony phase	Poor	Not suitable	Fair - difficult to compact at high moisture content, some stones present	Moderate limitation, fair to poor compaction characteristics, medium to low shear strength, some stones may be present	Slight to moderate limitation, low bearing strength, moderate compressibility, some stones may be present	Not required	Slight limitation, moderately slow permeability, decreases with depth	Moderate limitation, difficult to compact when wet	Moderate to severe, moderately slow permeability decreases with depth, severe if subsoil is fissile
Bm/1c1x BM/2c1x BM/xcxx BM/xc1x	Bermont weakly eroded, slightly stony & gently sloping phases	Poor	Not suitable	Fair slightly stony	Moderate limitations, gently sloping, slightly stony	Similar to above	Not required	Moderate limitations, gently sloping, some stones present	Similar to above, slightly stony	As above, some lateral seepage & surfacing expected
BM/xx2x	Bermont moderately stony	Poor	Not suitable	Poor, moderately stony	Moderate limitations, as for Bm	Moderate limitations, moderately stony, low bearing strength when wet	Not required	Slight limitation, will hold water	Moderate limitation, difficult to compact	Moderate to severe, moderately slow permeability severe if subsoil is compact and fissile, moderately stony

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Bm/xc3x	Bermont gently sloping, very stony phase	Poor	Not suitable	Poor, very stony	Moderate limitation if used as road bed, severe limitation if area is to be cut	Severe limitation, very stony land, low to medium bearing strength	Not required	Moderate limitation, very stony and gently sloping topography, will hold water	Severe limitation, very stony difficult to compact	Severe, very stony land moderately slow permeability
Bm/xdxx	Bermont moderately sloping	Poor	Not suitable	Fair	Moderate limitation	Slight to moderate limitation	Not required	Severe limitation, moderately sloping land	Difficult to compact when wet	Moderate to severe (same as Bm)
Bn	Brownridge very fine sandy loam	Poor	Poor	Fair, erodes easily	Moderate limitation, good drainage, low compressibility, low shear strength when wet	Moderate limitation, moderate to low bearing capacity	Not required	Moderately rapid permeability	Permeable, moderate compaction characteristics	None to slight, moderately rapid permeability
Bn/xcxx	Brownridge undulating	Poor	Poor	Fair	As above	As above	Not required	Moderate limitation, gently sloping land	As above	None to slight
Bn/xdxx	Brownridge gently rolling	Poor	Poor	Fair	Gently rolling, good drainage, low compressibility, low shear strength when wet	As above	Not required	Severe limitation, moderately sloping	As above	Slight to moderate, moderately sloping
Bo	Boswell fine sandy loam	Poor	Poor in upper 70 cm, not suitbelow	Good to depth of 70 cm, fair	Seasonal perched water condition, fair bearing capacity in low bearing capacity in soil below	Severe, seasonal perched water condition, low bearing strength when wet	Required to remove seasonal perched water	Very rapid permeability in upper 70 cm, moderately	Upper 70 cm permeable when compacted, high	Severe, seasonal perched water conditions with
Bo/xcxx	Boswell gently sloping	As above	As above	As above	As above	As above	Required to remove seepage water from upper slopes	Gently sloping, downslope seepage, will not hold water	As above	Severe

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Bo	Boswell fine sandy loam	Poor	Poor in upper 70 cm, not suitable below	Good to depth of 70 cm, fair below	Seasonal perched water condition, fair bearing capacity in upper 70 cm, low bearing capacity in soil below	Severe, seasonal perched water condition, low bearing strength of subsoil when wet	Required to remove seasonal perched water condition	Very rapid permeability in upper 70 cm, moderately slow below	Upper 70 cm permeable when compacted, high shear strength	Severe, seasonal perched water conditions with 1 m
Bo/xcxx	Boswell gently sloping	As above	As above	As above	As above	As above	Required to remove seepage water from upper slopes	Gently sloping, downslope seepage, will not hold water	As above	Severe
Br	Barren silty clay lo loam	Poor	Not suitable	Poor	Moderate limitation, moderate shrink-swell, moderate compressibility	Good drainage, fair bearing capacity, moderate shrink-swell	Not required	Moderately slow permeability in subsoil, will hold water	Low permeability when compacted, moderate shrink-swell, fair workability, moderate compressibility	Moderate, moderate to moderately slow permeability
Br/xcxx	Barren undulating	Similar to above			As above	As above	Not required	Moderate limitation, gently sloping, will hold water	As above	Moderate
Br/xdxx	Barren gently rolling	Similar to above			Moderate limitation, cut bank subject to erosion	Slight limitation	Not required	Severe, moderate slopes	As above	Moderate to severe, moderate slopes
Br/xexx	Barren moderately rolling	Similar to above			Moderate to severe, strongly sloping, cut banks erode easily	Moderate limitation, strongly sloping	Not required	Severe, strongly sloping	As above	Severe, strongly sloping
Bt	Bornett fine sandy loam	Poor	Poor (due to wetness)	Poor (due to wetness)	Severe, water table at or near surface, fair bearing strength	Severe limitation, water table at or near surface, fair bearing strength	Required	Wet, subsoil is permeable	Wet (permeable when compacted)	Severe, water table at or near surface

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Bt/xx3x	Bornett very stony phase	Similar to above, contains appreciable stones								
Btp	Bornett peaty	Poor	Poor	Poor	Severe, peaty surface, water table at or near surface	Severe limitation, water table at or near surface	Required	Wet, subsoil is permeable	Wet (permeable when compacted)	Severe, water table at or near surface
Bw Bw/xx1x	Barwood clay loam & Barwood slightly stony phase	Poor (shallow soil)	Not suitable	Fair (seasonal water table within 1 m)	Moderate limitation, seasonal water table within 1 m, risk of frost heave	Seasonal high water table within 1 m, low bearing capacity when wet, may contain some stones	Some surface drainage beneficial	Slight limitation, moderately slow permeability	Moderate limitation, difficult to compact when wet, moderate to high compressibility	Severe, seasonal water table, slow permeability with depth
Bw/xx2x Bw/1x2x	Barwood moderately stony phase & weakly eroded phase	Poor	Not suitable	Fair	As above	As above, moderately stony	As above	Moderate limitation, moderately stony	Stones offer some difficulty in compacting	Severe
Bw/xxxs	Barwood slightly saline	Poor	Not suitable	Poor	As above, area subject to seepage	Seasonal high water, and seepage, high sulfate hazard	Required	Moderate limitation, moderate dispersion of sediment	Moderate limitation, difficult to compact, moderate to high compressibility	Severe
Cb Cb/1xxx	Chambers clay loam & Chambers slightly eroded	Poor (shallow soil)	Not suitable	Fair, difficult to compact at high moisture content	Moderate limitation, good drainage, cut banks are highly erosive	Slight limitation, moderate to low bearing strength when wet, some stones	Not required	Slight limitation, permeability usually decreases with depth	Slight limitation, low permeability when compacted, moderate compressibility	Moderate to severe permeability decreases with depth; severe where till is compact & fissile
Cb/1cxx	Chambers slightly eroded, undulating Chambers		As above		As above, gently sloping	As above	As above	Moderate limitation, gently sloping land	As above	Severe

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Cb/2cxx	moderately eroded, undulating									
Cb/1c1x	Chambers slightly eroded, undulating, slightly stony									
Cb/1c4x	Chambers slightly eroded, undulating, exceedingly stony	Poor	Not suitable	Poor, exceedingly stony	Exceedingly stony	Severe limitation, exceedingly stony	Not required	Severe limitation, exceedingly stony, gently sloping	Severe limitation, exceedingly stony	Severe
Cb/1dxx	Chambers slightly eroded, gently rolling	Poor	Not suitable	Fair	Moderate limitation	Slight limitation, may have some stones	Not required	Moderate limitation, gently sloping land	Slight limitation, some stones present, moderate compressibility	Severe
Cb/1d1x	Chambers, slightly eroded, gently rolling, slightly stony									
Cb/2dxx	Chambers, moderately eroded, gently rolling									
Cb/1exx	Chambers, slightly eroded, moderately rolling	Poor	Not suitable	Fair	Moderate to severe; strongly sloping, cut banks erode easily	Moderate limitation	Not required	Severe limitation, strongly sloping	Slight limitation, material has moderate compressibility, moderate workability, low permeability when compacted	Severe, low permeability strongly sloping land
Cb/1e1x	Chambers slightly eroded, moderately rolling, slightly stony									
Cb/xfxx	Chambers steeply sloping	Poor	Not suitable	Poor	Severe, steeply to very strongly sloping	Severe, steeply to very strongly sloping	Not required	Severe, steeply to very strongly sloping	Material as above, area of soil removal would be subject to erosion	Severe, steeply to very strongly sloping
Cb/xgxx	Chambers very strongly sloping									

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Cc	Cactus loamy fine sand	Poor	Fair (to good) for sand	Fair to good	Slight limitation, cut banks are subject to erosion	Slight limitation (area may be subject to wind erosion if disturbed)	Not required	Severe limitation, rapid permeability	Permeable when compacted, high shear strength, subject to wind erosion	Slight, rapid permeability possible pollution hazard to shallow groundwater supply
Cc/$_{1xxx}$ Cc/$_{2xxx}$	Cactus slightly eroded Cactus moderately eroded	Poor	Fair	Fair to good	As above	As above, area subject to wind erosion	Not required	Severe	As above	Slight, may have some problems to establish grass on field
Cc/$_{1cxx}$ Cc/$_{2cxx}$	Cactus slightly eroded, undulating Cactus moderately eroded, undulating	Poor	Fair to good for fine sand	Fair to good	Slight limitation, cut banks erode easily, high shear strength	Slight limitation, high bearing strength (area subject to wind erosion)	Not required	Severe, permeable, will not hold water	Permeable when compacted, high shear strength, erosive	Slight, may have some problem to establish grass on field
Cc/$_{1Dxx}$ Cc/$_{1dxx}$	Cactus, slightly eroded, moderately sloping Cactus, slightly eroded, gently rolling	Poor	Fair to good for fine sand	Fair to good	Slight to moderate, moderately sloping, cut banks subject to erosion	Slight to moderate, moderately sloping	Not required	Severe	As above	Slight to moderate, moderately sloping, may have some problem to establish grass
Cf Cf/$_{xx1x}$ Cf/$_{1xxx}$ Cf/$_{1x1x}$	Cobfield clay loam Cobfield, slightly stony phase Cobfield, slightly eroded Cobfield, slightly eroded, slightly stony	Fair	Not suitable	Fair	Moderate limitation, seasonal water table within 1 m, subject to some frost heave	Severe limitation, seasonal water table within 1 m, may have some stones	Some surface drainage beneficial, soil has moderately slow permeability	Slight limitation, permeability decreases with depth	Slight limitation, moderate shrink-swell	Severe, moderately slow permeability, seasonal high water table

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Cf/xx2x	Cobfield moderately stony	Poor	Not suitable	Fair	Moderate limitation, seasonal water table within 1 m	Severe limitation, seasonal water table within 1 m, moderately stony	Some surface drainage beneficial, cost could be a factor	Moderate limitation, moderately stony, will hold water	Moderate limitation, moderately stony	Severe
Cf/1x2x	Cobfield, slightly eroded, moderately stony									
Cf/1x3x	Cobfield slightly eroded, very stony	Poor	Not suitable	Poor	Severe, very stony, seasonal water table within 1 m	Severe limitation, very stony, seasonal water table within 1 m	Very stony, affects cost of drainage	Severe limitation, very stony	Severe, very stony, difficult to compact, poor workability	Severe
Cf/xcxx	Cobfield, gently sloping phase	Poor	Not suitable	Fair	Moderate limitation, seepage from upper slopes, frost heave hazard	Severe limitation, subsoil seepage from upper slope low bearing capacity when wet	Required to intercept seepage	Moderate limitation	Slight limitation, moderate compressibility, impervious when compacted	Severe
Cf/xc1x	Cobfield, gently sloping, slightly stony									
Cf/xc3x	Cobfield, gently sloping, very stony	Poor	Not suitable	Poor	Severe limitation, very stony, subject to frost heave	Severe limitation, very stony, subsoil seepage from upper slopes	Very stony, affects cost of drainage	Severe limitation, very stony	Severe limitation, very stony, difficult to compact, poor workability	Severe
Ch	Chater loamy sand	Poor	Fair in upper 70 cm, not suitable below	Good in surface 70 cm, fair in subsoil	Slight limitation, good drainage, high shear strength	Slight limitation, good drainage, good bearing capacity, may have some stones	Not required	upper material very permeable, will not hold water	Permeable when compacted, high shear strength	Moderate, rapid permeability in upper 70 cm, subject to lateral seepage at till contact
Ch/1xxx	Chater, slightly eroded phase									
Ch/xx1x	Chater slightly stony phase									
Ch/xx2x	Chater moderately stony	Poor	Fair in upper 70 cm	Fair, moderately stony in upper 70 cm	Moderate limitation, moderately stony	Moderate limitation, moderately stony	Not required	Upper material moderately stony & very permeable, will not hold water	Moderately stony, permeable when compacted	Moderate to severe, moderately stony subject to later seepage at till contact

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Ch/$_{xcxx}$	Chater, undulating	Poor	Fair in upper 70 cm	Good in upper 70 cm, fair in subsoil	Slight limitation, high shear strength	Slight limitation, good bearing capacity	Not required	Severe, gently sloping, upper material very permeable	Upper 70 cm permeable when compacted	Moderate, rapid permeability in upper 70 cm, subject to lateral seepage at till contact
Ch/$_{1cxx}$	Chater slightly eroded, undulating									
Ch/$_{xdxx}$	Chater, gently rolling phase	Poor	Fair in upper 70 cm	Good in upper 70 cm, fair below	Slight to moderate, moderately sloping	Slight to moderate, moderately sloping, good bearing capacity	Not required	Severe, moderately sloping, very permeable in upper 70 cm	High shear strength, upper 70 cm permeable when compacted	Severe, moderately sloping, rapid permeability
Ch/$_{1dxx}$	Chater, slightly eroded, gently rolling									
Ch/$_{2dxx}$	Chater, moderately eroded, gently rolling									
Ch/$_{1d2x}$	Chater slightly eroded, gently rolling, moderately stony	Poor	Fair in upper 70 cm	Fair, moderately stony in upper 70 cm	Moderate limitation, moderately sloping, moderately stony	Moderate limitation, moderately sloping, moderately stony, good bearing capacity	Not required	Severe limitation, moderately sloping, permeable	Moderately stony, permeable when compacted, poor workability	Severe, moderately sloping, moderately stony
Ch/$_{2e2x}$	Chater, moderately eroded, moderately rolling, moderately stony	Poor	Fair in upper 70 cm	Fair, moderately stony in upper 70 cm	Severe limitation, strongly sloping, moderately stony	Severe limitation, strongly sloping, moderately stony, good bearing capacity	Not required	Severe limitation	Moderately stony, poor workability, permeable when compacted	Severe, strongly sloping moderately stony
Ck	Crookdale sandy clay loam	Good	Not suitable	Fair	Moderate limitation, subject to frost heave	Seasonal water table within 1 m	Some local drainage beneficial	Slight to moderate, moderate to moderately slow permeability	Impermeable when compacted, medium to low shear strength	Moderate to severe, seasonal water table within 1 m

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Cl	Carroll clay loam	Poor (shallow soil)	Not suitable	Poor	Moderate to severe limitation, cut bank subject to erosion, poor stability at high moisture content	Moderate, good drainage, medium to low bearing capacity at high moisture content, high shrink-swell	Not required	Moderate limitation, moderately slow permeability	Moderately high shrink-swell medium compressibility, silts difficult to compact when wet	Moderate to severe, moderate to moderately slow permeability
Cl/$_{1cxx}$	Carroll, slightly eroded, undulating	Poor	Not suitable	Poor	Severe limitation, cut bank erodes easily, poor stability at high moisture content	As above	Not required	Severe limitation, gently sloping land	As above	Moderate to severe, gently sloping land, moderate to moderately slow permeability
Cl/$_{2cxx}$	Carroll moderately eroded, undulating									
Cl/$_{2dxx}$	Carroll moderately eroded, gently rolling	Poor	Not suitable	Poor	Severe, moderately sloping, poor stability at high moisture content, moderate to high plasticity	Moderate to severe, moderately sloping, good drainage, medium to low bearing capacity at high moisture content	Not required	Severe, moderately sloping land	As above	Severe, moderately sloping, subject to lateral flow
Cm	Charman clay loam	Fair	Not suitable	Poor	Moderate to severe limitation, poor stability at high moisture content, risk of frost heave, silty layers may be subject to liquifaction	Severe limitation, seasonal water table within 1 m, low bearing capacity at high moisture content, moderate sulfate hazard	Some surface drainage required, moderately slow permeability	Moderate limitation, moderately slow permeability	Moderately high shrink-swell, medium compressibility, high silt, difficult to compact	Severe, moderately slow permeability, seasonal water table within 1 m
Cm/$_{1xxx}$	Charman slightly eroded									
Cm/$_{xxxs}$	Charman, slightly saline	Poor	Not suitable	Poor	Severe, subject to upward movement or seepage of groundwater, low bearing capacity	Severe limitation, high sulfate hazard, as above	Required	Moderate, will hold water	As above	Severe

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Cm/xcxx	Charman gently sloping	Fair	Not suitable	Poor	Moderate to severe limitation, subject to seepage from associated better drained soils, poor stability	Severe limitation, seepage, low bearing capacity when wet	Required	Moderate, will hold water	As above	Severe
Cp Cp/1xxx	Capell clay loam Capell slightly eroded	Fair	Fair to good at depths below 70 cm	Fair	Moderate to severe limitation, seasonal water table within 1 m, low bearing strength in upper 70 cm	Moderate limitation, good bearing strength below 70 cm, seasonal water table within 1 m	Generally not required	Subsoil below 70 cm very permeable, moderate permeability in upper 70 cm	Upper 70 cm has medium compressibility, moderate shrink-swell, medium to low bearing strength	Severe, seasonal water table within 1 m, subsoil very permeable, possible pollution hazard
Cp/xx1x Cp/xx2x	Capell slightly stony Capell moderately stony	Poor	Fair to good below 70 cm	Fair	Similar to above, slightly to moderately stony	Similar to above, slightly to moderately stony	As above	As above	As above, poor workability	Severe
Cp/1cxx	Capell slightly eroded, gently sloping	Poor	Fair to good below 70 cm	Fair	Similar to above, some seepage from better drained soil	Similar to above	Some required to decrease seepage problem	As above	As above	Severe
Cp/xxxs Cp/xxxt	Capell slightly saline Capell moderately saline	Poor	Fair below 70 cm	Poor, contains gypsum & salts	Severe, as above, contains appreciable soluble salts	Severe, high sulfate hazard	Required	Not suitable	As above	Severe
Cr	Croyon loam	Fair	Fair to good at depths below 70 cm	Good	Good drainage, high bearing strength, good stability	Slight limitation, good bearing strength, good drainage	Not required	Very permeable, will not hold water	Very permeable when compacted	Slight, high contamination hazard

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Cr/xcxx Gr/1cxx	Croyon undulating phase Croyon slightly eroded, undulating	Poor	Fair to good below 70 cm	Good	Slight limitation, good drainage, high bearing strength, good stability	As above	Not required	As above, gently sloping	Very permeable when compacted	Slight, high contamination hazard
Cr/xc2x	Croyon undulating, moderately stony	Poor	Fair to good below 70 cm	Good	As above	Moderate limitation, moderately stony	Not required	As above	As above	Moderate, moderately stony, rapid permeability high contamination hazard
Cr/2f2x	Croyon moderately eroded, steeply sloping, moderately stony	Poor	Fair to good below 70 cm	Fair	Moderate, steeply sloping, eroded	Severe, moderately stony, steeply sloping, eroded	Not required	As above, steeply sloping	As above	Severe, steeply sloping (as above)
Cr/2G4x	Croyon moderately eroded, very steeply sloping, exceedingly stony	Poor	Poor to fair	Poor	Severe, very steeply sloping, exceedingly stony	Severe, exceedingly stony, very steeply sloping	Not required	As above, very steeply sloping	Very permeable, very steeply sloping	Severe
Ct Ct/1xxx Ct/1x1x Ct/xx1x	Clementi clay loam Clementi slightly eroded Clementi slightly eroded, slightly stony Clementi, slightly stony phase	Fair	Not suitable	Fair to poor	Moderate limitation, good drainage, low to moderate bearing strength, moderate shrink-swell	Low to moderate bearing strength good drainage, moderate shrink-swell, may have some stones	Not required	Slight limitation, moderately slow permeability, will hold water	Medium to low shear strength, medium compressibility, low permea-	Moderate to severe, moderate to moderately slow permeability in upper 60 cm, decreases in lower till, severe if till is compact and fissile

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Ct/xcxx	Clementi-undulating	Fair	Not suitable	As above	As above	As above	Not required	Moderate limitation, gently sloping, will hold water	As above	As above
Ct/1clx	Clementi slightly eroded, undulating, slightly stony									
Ct/xclx	Clementi, undulating slightly stony									
Ct/1cxx	Clementi, slightly eroded, undulating									
Ct/2clx	Clementi, moderately eroded, undulating, slightly stony									
Ct/xx2x	Clementi moderately stony	Poor	Not suitable	Fair to poor	Moderate limitation, as above, contains appreciable stones	Moderate limitation, moderately stony	Not required	Severe limitation, gently sloping, moderately stony, will hold water	As above, more difficult to work due to stones	Severe, moderately stony, gently sloping
Ct/cx2x	Clementi, undulating, moderately stony									
Ct/1c2x	Clementi, slightly eroded, undulating, moderately stony									
Ct/xx3x	Clementi exceedingly stony	Poor	Not suitable	Poor	Moderate limitation, very stony	Severe limitation, very stony	Not required	Severe limitation, very stony	Exceedingly stony, difficult to work & compact due to stones	Severe, very stony
Ct/xdxx	Clementi gently rolling	Fair	Not suitable	Fair to poor	Moderate limitation, good drainage	Moderate limitation, good drainage, low to moderate bearing strength	Not required	Severe, moderately sloping land within the gently rolling landscape	Use of the material for dikes, levees, etc. similar to Ct	Severe, moderate to moderately slow permeability, moderately sloping
Ct/1dxx	Clementi slightly eroded gently rolling									
Ct/xx4x	Clementi exceedingly stony	Poor	Not suitable	Poor	Severe limitation, exceedingly stony	Severe limitation, exceedingly stony	Not required	Severe, moderately sloping, exceedingly stony	Severe, exceedingly stony	Severe, exceedingly stony

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Ct/1c4x	Clementi, slightly eroded, undulating, exceedingly stony									
Ct/xc4x	Clementi, undulating, exceedingly stony									
Ct/1exx	Clementi, slightly eroded, moderately rolling	Poor	Not suitable	Poor	Severe, strongly sloping, subject to erosion	Moderate limitation, strongly sloping, good drainage, low to moderate bearing capacity	Not required	Severe limitation, strongly sloping	Material properties as for Ct, area subject to erosion after soil is removed	Severe, strongly sloping
Cv	Cordova clay loam	Fair	Not suitable	Fair to poor	Moderate limitation, good drainage, low to moderate bearing strength, moderate shrink-swell	Low to moderate bearing strength, good drainage, moderate shrink-swell	Not required	Slight limitation, moderately slow permeability, will hold water	Medium to low shear strength, medium compressibility, low permeability	Moderate to severe, moderate to moderately slow permeability in upper 60 cm, decreases with depth, severe if till is compact or fissile
Cv/xx1x	Cordova slightly stony									
Cv/1x1x	Cordova slightly eroded, slightly stony									
Cv/xcxx	Cordova undulating phase	Fair	Not suitable	Fair to poor	As above for Cv	As above for Cv	Not required	Moderate limitation, undulating	As above for Cv	As above for Cv
Cv/1cxx	Cordova slightly eroded, undulating									
Cv/1c1x	Cordova, slightly eroded, undulating, slightly stony									
Cv/xc2x	Cordova, undulating moderately stony	Poor	Not suitable	Poor	As above for Cv	Moderate, moderately stony, low to moderate bearing strength	Not required	Moderate limitation, undulating, moderately stony	Workability affected by stone content as for Cv	Severe, moderately stony, undulating, moderate to moderately slow permeability
Cv/1Dxx	Cordova slightly eroded, moderately sloping	Poor	Not suitable	Poor	Slight to moderate, moderately sloping, as for Cv	As for Cv	Not required	Moderate limitation, moderately sloping, some stones	Material as for Cv	Severe, moderately sloping moderate to moderately slow permeability

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Cv/$_{2d1x}$	Cordova moderately eroded, gently rolling, slightly stony									
Cv/$_{2e1x}$	Cordova, moderately eroded, moderately rolling, slightly stony	Poor	Not suitable	Poor	Moderate, strongly sloping, some stones	Moderate, strongly sloping, some stones	Not required	Severe, strongly sloping, some stones	Material as for Cv some stones	Severe, strongly sloping
Cv/$_{2f1x}$	Cordova moderately eroded, steeply sloping, slightly stony	Poor	Not suitable	Poor	Severe, steeply sloping, some stones	Severe, steeply sloping, some stones	Not required	Severe limitation, steeply sloping	Material as for Cv, if soil is removed area is subject to gully & water erosion	Severe, steeply sloping
Cv/$_{1f3x}$	Cordova slightly eroded, steeply sloping, very stony phase	Poor	Not suitable	Poor	Severe, steeply sloping, very stony	Severe, steeply sloping, very stony	Not required	Severe limitation, steeply sloping, very stony	As above, very stony	Severe steeply sloping, very stony
Cy	Carvey sandy clay loam	Poor	Poor (due to wetness)	Poor (due to wetness)	Severe limitation, seasonal water at or near surface, very low bearing strength in upper 50 cm, subject to frost heave	Severe limitation, poor drinage, very low bearing strength in upper strata, good bearing strength below	Required, subsoil very permeable	Severe, subsoil very permeable, will not hold water	Severe, poor drainage, material is permeable	Severe, water table at or near surface
Cyp	Carvey peaty	Poor	Poor (due to wetness)	Poor (due to wetness)	Severe; water table at or near surface, very low bearing strength in upper 50 cm	Severe; poor drainage, very low bearing strength in upper 50 cm	Required	Severe, subsoil very permeable	Severe, poor drainage, material is permeable	Severe; water table at or near surface
Cy$_{xxxt}$	Carvey moderately saline	Poor	Poor	Poor	As above	As above, high sulfate hazard	Required	Severe, as above	Severe, as above, high salt content	Severe, water table at or near surface, high salt content

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Dg	Dogand sandy loam	Fair	Poor (variable sand & gravel strata at 40-85 cm	Fair	Slight limitation, good bearing strength, good drainage, low shrink-swell	Slight limitation, good drainage, good bearing strength in upper 80 cm, fair below	Not required	Upper 80 cm has rapid permeability, subsoil has moderately slow permeability	Not suitable unless core can cut through gravel	Slight to moderate, rapid permeability in upper 80 cm, moderately slow below, subject to lateral seepage above till
Dn $Dn/_{1xxx}$ $Dn/_{2xxx}$	Durnan silt loam Durnan slightly eroded Durnan, moderately eroded	Poor (shallow depth)	Not suitable	Poor to fair, low stability & shear strength, susceptible to liquifaction	Good drainage poor to fair stability, close control required during compaction, cut banks erode easily	Good drainage, low bearing capacity when wet	Not required	Moderate limitation, moderate permeability if bottom is compacted	Poor to fair stability, poor compaction chacteristics, semipervious when compacted	Moderate, moderate permeability
$Dn/_{xcxx}$ $Dn/_{1cxx}$ $Dn/_{1c1x}$ $Dn/_{2cxx}$	Durnan undulating Durnan, slightly eroded, undulating Durnan slightly eroded, undulating, slightly stony Durnan, moderately eroded, undulating	Poor	Not suitable	Poor to fair, as above	As above	As above	Not required	Moderate limitation, gently sloping, moderate permeability	As above	Moderate (as above)
$Dn/_{xdxx}$ $Dn/_{1dxx}$ $Dn/_{2dxx}$	Durnan, gently rolling Durnan, slightly eroded, gently rolling Durnan, moderately eroded, gently rolling		Not suitable	Poor to fair	Moderate limitation, moderately sloping, easily eroded by wind & water	Moderate, moderately sloping, low bearing strength when wet	Not required	Severe limitation, moderately sloping	As above	Moderate (as above)
$Dn/_{1exx}$	Durnan slightly eroded, moderately rolling	Poor	Not suitable	Poor	Severe, strongly sloping, easily eroded, poor to fair stability	Severe, strongly sloping	Not required	Severe limitation, strongly sloping	As for Dn	Severe, strongly sloping

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Drl	Dorset, loamy sand, sandy subsoil	Poor	Good (sand is dominant fraction)	Good to fair	Slight limitation, good drainage, high shear strength, high bearing strength highly stable under wheel load	High bearing strength, good drainage, low compressibility	Not required	Severe limitation, rapid permeability, will not hold water	Permeable when compacted, high shear strength	Slight, very rapid permeability, high contamination hazard.
Drl/xcxx	Dorset, undulating, sandy subsoil	As above								
Drl/2dxx	Dorset, moderately eroded, gently rolling, sandy subsoil	Poor	Good (sand dominant fraction)	Good to fair	Slight to moderate, moderately sloping, high shear strength	Slight to moderate limitation as for Drl	Not required	Severe, rapid permeability	As above	Slight limitation as for Drl
Dtl	Dexter, loamy sand, sandy subsoil	Poor	Fair to good (sand fraction dominant)	Good to fair	Moderate limitation, seasonal water table within 1 m, high bearing strength, high shear strength	Severe limitation, seasonal water table within 1 m, high bearing strength, high shear strength low compressibility	Generally not required; moist subsoil conditions an asset	Permeable, will not hold water	Pervious when compacted high shear strength	Severe; seasonal water table within 1 m, rapidly permeable, pollution hazard high
Dx	Druxman loam	Good	Fair to good below 80 cm	Upper 80 cm is fair, subsoil is good	Seasonal water table within 1 m, good bearing capacity in subsoil, possible frost heave	Seasonal water table within 1 m, good bearing capacity in subsoil (severe limitation for basements)	Generally not required-beneficial in some areas	Subsoil has rapidly permeable sand & gravel, will not sustain a bead of water unless lined	Not suitable unless core can cut through gravel, mixing with clay required if used for embankment	Moderate to severe, seasonal water table within 1 m, rapidly permeable subsoil subject to pollution hazard
Ev	Everton clay	Poor	Not suitable	Poor	High critical volume change, high compressibility	High compressibility & high critical volume change, low bearing capacity when wet	Generally required to avoid surface ponding	Slight limitation, slow permeability	High shrink-swell, high compressibility, subject to cracking	Severe, slow permeability
Ev/1xxx	Everton slightly eroded									

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Fd	Fairland silt loam	Good	Not suitable	Poor to (air stability & shear strength, poor compaction characteristics	Good drainage, poor to fair stability, close control required during compaction, cut banks erode easily	Good drainage, low bearing capacity when wet	Not required	Moderate limitation, moderate permeability if bottom is compacted	Poor to fair stability, poor compaction characteristics, semipervious when compacted	Moderate, moderate permeability
Fd/1xxx	Fairland slightly eroded phase									
Fd/xx1x	Fairland slightly stony									
Fd/2xxx	Fairland moderately eroded	Fair								
Fd/xcxx	Fairland undulating	Good	Not suitable	Poor to fair	As above	As above	Not required	Moderate, gently sloping, moderate permeability	Poor to fair, as above	Moderate, as above
Fd/1cxx	Fairland, slightly eroded, undulating									
Fd/xDxx	Fairland moderately sloping	Fair	Not suitable	Poor to fair	Moderate, poor to fair stability, moderately sloping, cut bank subject to erosion	As above	Not required	Severe, moderately sloping	Poor to fair, as above, soil removal area must be stabilized	Moderate to severe, moderately sloping moderate per-
Fd/xdxx	Fairland gently rolling									
Fn	Fenton silty clay	Poor	Not suitable	Poor in upper 60 cm, fair below	High critical volume change, water table at or near surface	Water table at or near surface, high shrink-swell	Required	Very low permeability, will hold water	High shrink-swell, high compressibility, subject to cracking	Severe
Fn/xxxs	Fenton saline phase	Similar to above - has appreciable soluble salts and sulfate hazard								
Fr1	Fortin, loamy sand, sandy subsoil	Poor	Poor (due to wetness)	Poor (due to wetness)	Severe; water table at or near surface, fair bearing strength	Severe limitation, water table at or near surface, fair bearing strength	Required	Wet, subsoil is permeable	Wet, permeable when compacted	Severe, water table at or near surface

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Ft	Forrest silty clay	Poor	Not suitable	Poor in upper 50 cm, fair below	High critical volume, seasonal water table within 1 m, susceptible to frost heave	Upper clay has low bearing capacity when wet, high shrink-swell, subsoil has low to fair bearing capacity	Generally required to overcome temporary ponding	Slight limitation, slow permeability in the clay and in the till	High shrink-swell, high compressibility, subject to cracking	Severe, slow permeability both in the upper clay and lower till
Ft/xxxs	Forrest saline phase	Poor	Not suitable	Poor	Area of upward groundwater seepage, low bearing strength, frost heave	High sulfate hazard, low bearing strength	Subsoil drainage required, slow permeability	Similar to above		Severe
Gl	Glenboro loam	Good	Not suitable	Fair to good in subsoil	Good drainage, moderate bearing capacity, good stability, cut bank subsceptible to erosion	Slight limitation, good to fair bearing strength in subsoil	Not required	Subsoil has moderately rapid permeability, some lining of bottom required	Semipervious to impervious when compacted	Slight, moderate to moderately rapid permeability
Gl/1xxx	Glenboro slightly eroded									
Gl/xcxx	Glenboro undulating	Good	Not suitable	Fair to good in subsoil	As above	As above	Not required	Severe limitation, gently sloping, subsoil has moderately rapid permeability	As above	Slight (as above)
Gl/1cxx	Glenboro slightly eroded undulating									
Gl 1	Glenboro, loamy fine sand clayey strata	Good	Not suitable	Fair on surface; Fair to good in subsoil	Slight to moderate limitation, good drainage, good to fair bearing capacity in top 50 cm grading to low in clayey strata, good stability in top 50 cm grading to moderate in clayey strata.	Slight to moderate limitation, good to fair bearing strength in subsoil (below 85 cm)	Not required	Moderate permeability in upper .8 to 1 m. Moderately rapid permeability below. Some lining of bottom required	Semi-pervious to impervious when compacted	Slight limitation, moderate permeability in upper .8 to 1 m, moderately rapid below
Gl 1/xcxx	Glenboro, undulating, clayey strata	As above	As above	As above	As above	As above	As above	As above	As above	As above

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Gl 1/ 1cxx	Glen-boro, slightly eroded, undulating clayey strata	As above	As above	As above	As above	As above	As above	As above	As above	As above
Gnl	Grayson, loamy fine sand, clayey strata	Poor	Not suitable	Poor, difficult to obtain due to wetness	Poorly drained, susceptible to frost heave, low bearing strength when wet	Water table at or near surface, low bearing strength when wet	Required	Semipermeable, some lining of bottom required.	Semipervious to impervious when compacted subject to piping	Severe
Gn	Grayson silt loam	Poor	Not suitable	Poor, difficult to obtain due to wetness	Poorly drained, susceptible to frost heave, low bearing strength when wet	Water table at or near surface, low bearing strength when wet	Required	Semipermeable, some lining of bottom required	Semipervious to impervious when compacted, subject to piping	Severe
Gr	Grover loam	Fair to good	Not suitable	Fair to poor in upper 90 cm, fair below	Seasonal water table within 1 m, subject to frost heave, fair stability	Seasonal water table within 1 m, moderate bearing capacity in subsoil	Some required	Semipermeable in upper 90 cm, permeable below	Fair stability in sandy sub-stratum, sandy subsoil per-vious when compacted	Severe, seasonal water table within 1 m
Gr/ 1xxx	Grover slightly eroded									
Grl	Grover, loamy fine sand, clayey strata	Fair	Fair to poor for fine sand	Fair in upper 50 cm & below 90 cm	Seasonal water table within 1 m, moderate bearing strength, some risk of frost heave	Seasonal water table within 1 m, moderate bearing cap-acity in subsoil	Some required	Semipermeable in upper 90 cm, permeable below	Semipervious to impervious when compacted	Severe seasonal water table within 1 m
Gt	Gateside loamy very fine sand	Good	Not suitable	Poor, high, very fine sand content	Seasonal water table within 1 m, subject to frost heave, low stability, cut bank very erosive	Seasonal water table within 1 m, low bearing capacity when wet	Some required	Moderate limit-ation, high seasonal water table, sufficient fines to seal, sides unstable	Low stability, poor com-paction character-istics, possible piping	Severe, seasonal water table within 1 m
Gt/ xxxs	Gateside slightly saline	Fair	Not suitable	Poor	As above	As above, high sulfate hazard	Required	As above	As above	Severe

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Gz	Gendzel loamy fine sand	Poor	Fair to good below 50 cm	Good	Seasonal water table within 1 m, good bearing capacity, high shear strength	Seasonal water table within 1 m, good bearing capacity in subsoil	Some required	Rapidly permeable, will not hold water under load	Pervious when compacted	Severe, seasonal water table within 1 m, possible pollution hazard
Gz/$_{1cxx}$	Gendzel slightly eroded, undulating	Poor	Fair to good below 50 cm	Good	Seasonal water table & seepage from soil at higher elevation	Severe, seepage problem from soils at higher positions	Required	As above, subject to lateral seepage, will not hold a bead of water	Material if used is pervious when compacted	Severe, subject to some seepage from lands at higher positions
Gz/$_{1dxx}$	Gendzel, slightly eroded, moderately sloping									
Hg	Harding clay	Poor	Not suitable	Poor	High shrink-swell, high compressibility, subject to frost heave	Low bearing capacity when wet, high shrink-swell	Required to alleviate surface ponding	Slow permeability, will hold water	High compressibility, subject to cracking	Severe, slow permeability
Hg/$_{xxxs}$	Harding slightly saline	Poor	Not suitable	Poor	As above, high sulfate hazard, area subject to upward ground-water flow	As above, high sulfate hazard, area subject to upward ground-water flow	Required to remove excess water and salt	Will hold water	High sulfate, high dispersion	Severe
Hg/$_{xxxu}$	Harding strongly saline									
Hk	Hickson clay loam	Poor	Not suitable	Poor (due to wetness)	Water table at or near surface, moderate shrink-swell, subject to frost heave	Water table at or near surface, low bearing capacity when wet	Required, usually difficult to drain	Slight limitation, will hold water	Fair stability, high water content, moderate compressibility	Severe
Hk/$_{xxxs}$	Hickson slightly saline	Poor	Not suitable	Poor	As above, high sulfate hazard, area subject to upward ground-water flow or seepage	As above, high sulfate hazard, area subject to upward ground-water flow	Required, as above	As above	As above moderate dispersion	Severe
Hm	Hummerston loamy fine sand	Poor	Fair to poor as fine sand	Good	Seasonal water table within 1 m, moderate bearing strength	Seasonal water table within 1 m, moderate bearing strength	Generally some required	Severe limitation, moderately rapid permeability	Pervious when compacted, medium to high susceptibility	Severe seasonal water table within 1 m

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Hm/1xxx	Hummerston slightly eroded				when wet, some risk of frost heave				to piping, fair to good compaction	
Hm/2xxx	Hummerston moderately eroded									
Hm/xxxs	Hummerston slightly saline	Poor	Fair to poor as fine sand	Fair	As above, sulfate hazard	Severe, high sulfate hazard, seasonal water table	Required to intercept seepage water	Severe limitation, pervious when compacted, area subject to possible upward groundwater flow	As above	Severe
Hm/xcxx	Hummerston undulating	Poor	Fair to poor as fine sand	Fair	Intermediate slope of undulating topography, some lateral flow of groundwater from upslope area	Seasonal water table, seepage from soils in upslope position	Generally required	Severe limitation, moderately rapid permeability, will not hold a bead of water unless lined	As above	Severe
Hm/1cxx	Hummerston slightly eroded, undulating									
Hm/1dxx	Hummerston slightly eroded, gently rolling	Poor	As above	As above	Lower slope of gently rolling topography, as above	Severe, lower slope of gently rolling topography	Generally required	Severe, as above	As above	Severe
Hn	Hilton loam	Poor	Not suitable	Fair to poor, difficult to compact at high moisture content	Severe to moderate limitation, good drainage, medium to low shear strength, fair to poor compaction properties	Moderate limitation, moderate bearing strength & shrink-swell, till is more compact with depth	Not required	Slight limitation, moderately slow permeability, decreases with depth	Moderate limitation, fair to poor compaction properties, unstable at high moisture content	Moderate to severe, moderately slow permeability decreases with depth severe if subsoil is compact & fissile
Hn/1xxx	Hilton slightly eroded									
Hn/1x2x	Hilton slightly eroded, moderately stony	Poor	Not suitable	Poor, as above, moderately stony	Severe to moderate, moderately stony, as above	Moderate limitation, moderately stony, as above	Not required	Moderate limitation, moderately stony, as above	As above	Severe, as above, moderately stony
Hn/2d1x	Hilton, moderately eroded, gently rolling, slightly stony	Poor	Not suitable	Poor	Severe limitation, moderately sloping, stony	Moderate to severe, moderately sloping, stony	Not required	Severe, moderately sloping, stony	Material used as above	Severe

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Hn/$_{2d3x}$	Hilton, moderately eroded, gently rolling, very stony									
Jk	Janick clay	Poor	Not suitable	Poor	High shrink-swell, high compressibility	High shrink-swell, low bearing capacity when wet	Not required	Slight limitation, slow permeability	Fair stability, high shrink-swell, subject to cracking	Severe, slow permeability
Js	Justice clay	Poor	Not suitable	Poor	High shrink-swell, high compressibility, subject to frost heave	High shrink-swell, low bearing capacity when wet	Generally some required	Slight limitation, slow permeability, will hold water	Fair stability, high shrink-swell, subject to cracking	Severe, slow permeability
Js/$_{xxxs}$	Justice slightly saline	Poor	Not suitable	Poor	As above, sulfate hazard	As above, high sulfate hazard	As above	As above	As above	Severe
Kk	Kirkness loamy fine sand	Poor	Not suitable	Fair	Good drainage, sandy surface mantle has low shrink-swell, high shear strength, subsoil has moderate bearing strength, moderate shrink-swell	Slight to moderate limitation, good drainage, moderate bearing strength in subsoil	Not required	Moderately slow permeability in subsoil, will hold water	Sandy surface mantle is permeable, core should cut sandy layer, sandy strata is pervious when compacted	Moderate to severe, moderately slow permeability at depths below 40 cm, severe if till is compact & fissile
Kk/$_{1xxx}$	Kirkness slightly eroded									
Kk/$_{1cxx}$	Kirkness, slightly eroded, undulating									
Kk/$_{xcxx}$	Kirkness, undulating									
Kl	Kilmury fine sandy loam	Fair	Fair to good in subsoil below 60 cm	Good	Seasonal water table within 1 m, good bearing strength, high shear strength, some stones	Seasonal water table within 1 m, good bearing strength, some stones	Generally not required	Permeable, will not hold water	Pervious in natural state & when compacted	Moderate to severe, seasonal water table within 1 m, rapid permeability, contamination hazard
Kl/$_{xx1x}$	Kilmury, slightly stony									
Kl/$_{xx3x}$	Kilmury, very stony	Poor	Fair to good in subsoil	Fair, contains appreciable stones	Moderate to severe limitation, very stony, seasonal, as above	Severe limitation, very stony, as above	Generally not required	As above	As above, very stony, difficult to compact	Severe, very stony, seasonal water table within 1 m
Kl/$_{1cxx}$	Kilmury, slightly eroded, undulating	Fair	Fair to good in subsoil	Good	As for Kl	As for Kl	Not required	As above, undulating topography	As above	Severe

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Kn	Killeen loamy fine sand	Poor	Not suitable	Fair to poor	Temporarily perched water condition, high risk of frost heave	Moderate sulfate hazard in subsoil, seasonal water table, fair bearing strength	Required	Upper 40 cm is permeable, subsoil is slowly permeable, will hold water	Upper 40 cm is pervious, subsoil slowly permeable, core should cut through sandy surface	Severe, seasonal water table within 1 m
Ko	Knolls silt loam	Poor	Not suitable	Poor to fair	Moderate, good drainage, low to moderate stability, close control required during compaction, cut banks erode easily	Good drainage, low bearing capacity when wet	Not required	Moderate limitation, moderate permeability when compacted	Low to moderate stability, poor compaction characteristics	Moderate
Ko/xcxx	Knolls undulating	Poor	Not suitable	Poor to fair	Moderate limitation, as above	Moderate limitation, as above	Not required	Moderate limitation, gently sloping, as above	As above	Moderate, requires some topsoil for sod establishment
Ko/xdxx	Knolls gently rolling	Poor	Not suitable	Poor to fair	Moderate to severe	Moderate limitation, as above	Not required	Severe, moderately sloping	As above	Moderate to severe, moderately sloping,
Kr	Kerran silty clay	Poor	Not suitable	Poor	Poor drainage, subject to flooding, unstable, alluvial	Severe limitation, subject to flood, low bearing strength	Not applicable	Severe limitation, flood plain, high water table	Subject to inundation, low bearing strength, high compressibility, subject to cracking	Severe
Ky Ky/1xxx	Kleysen clay loam Kleysen slightly eroded	Poor (shallow soil)	Not suitable	Fair, difficult to compact at high moisture content	Moderate limitation, good drainage, cut banks erode easily	Slight limitation	Not required	Slight limitation, permeability decreases with depth	Slight limitation, low permeability when compacted, moderate compressibility	Moderate to severe permeability decreases with depth, severe where till is compact & fissile
Ld	Lindstrom loamy very fine sand	Fair	Not suitable	Fair	Seasonal water table within 1 m, difficult to compact, frost heave hazard	Seasonal water table within 1 m, fair	Some required	Upper 40 cm permeable, till below has slow permeability, will hold water	Surface 40 cm difficult to compact, low shear strength, core should extend into the sandy mantle	Severe, seasonal water table within 1 m, slow permeability with depth

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Ld/xxxs	Lindstrom slightly saline	Poor	Not suitable	Fair	High sulfate hazard, area subject to seepage, as above	High sulfate hazard, as above	Required	As above	As above	Severe
Ld/1c1x	Lindstrom slightly eroded, undulating, slightly stony	Poor	Not suitable	Fair	Moderate limitation, as for Ld	Severe, seasonal water table & seepage within 1 m	Required	Moderate limitation, gently sloping, as above	As above	Severe
Lh	Lavenham loamy fine sand	Poor	Fair to poor for fine sand	Good	Seasonal water table within 1 m, moderate bearing strength, some risk of frost heave	Severe limitation, seasonal water table within 1 m, moderate bearing strength	Generally some required	Moderately rapid permeability	Pervious when compacted, medium to high susceptibility to piping	Severe, seasonal water table within 1 m, moderately rapid permeability above water table
Lh/1xxx	Lavenham slightly eroded									
Lh/1cxx	Lavenham slightly eroded, undulating	Poor	Fair to poor for fine sand	Good	As above, possible seepage from upslope	As above	Generally required	Severe, will not hold bead of water	Pervious when compacted, as above	Severe
Lh/1fxx	Lavenham slightly eroded, strongly rolling	Poor	Fair to poor for fine sand	Good, area should be stabilized after soil removal	Soils on lower slopes of strongly rolling topography subject to seepage from upslope, as for Lh	Severe, soils on lower slopes of rolling topography	Required	As above, steeply sloping	As above	Severe
Lk	Lockhart loamy very fine sand	Fair	Not suitable	Fair	Good drainage upper 40 cm difficult to compact, low bearing strength when wet	Good drainage, subsoil has moderate bearing strength, moderate shrink-swell	Not required	Upper 40 cm permeable, till below has slow permeability, will hold water	Upper 40 cm difficult to compact, low shear strength, core should extend into the till	Moderate to severe, moderate permeability in upper 50-70 cm, decreases with depth, severe if till below is compact & fissile
Lk/1c1x	Lockhart slightly eroded, undulating, slightly stony	Fair	Not suitable	Fair	Moderate limitation, as above	Moderate limitation, as above	Not required	Moderate limitation, as above	As above	Moderate to severe

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Lk/$_{1cxx}$	Lockhart, slightly eroded, undulating									
Ln	Lonery loamy very fine sand	Poor (wetness)	Not suitable	Poor (wetness)	Water table at or near surface, high susceptibility to frost heave, low bearing capacity when wet	Water table at or near surface, low bearing capacity	Required	Will hold water	High water table, soil difficult to compact, subject to piping	Severe
Ln/$_{xxxs}$	Lonery slightly saline	Similar to above, contains appreciable soluble salts								
Lt	Lowton clay	Poor	Not suitable	Poor	Soil saturated to surface for part of year, high shrink-swell, low shear strength	Water table at or near surface, low bearing capacity when wet, high shrink-swell, moderate sulfate hazard	Required, slow permeability	Slight limitation, will hold water	High water table, high compressibility, high shrink-swell, subject to cracking	Severe
Lt/$_{xxxs}$	Lowton slightly saline phase	Similar to above, contains appreciable soluble salts, sulfate hazard high								
Lt/$_{xxxt}$	Lowton moderately saline									
Ltp/$_{xxxt}$	Lowton peaty, moderately saline	Poor	Not suitable	Peaty layer unsuitable	Soil has peaty layer of low bearing capacity that must be removed	25 to 40 cm of peaty surface of very low bearing capacity, subsoil similar to above	Required	Peaty layers should be scraped off before use	Peaty layer not suitable	Severe
Lv	Levine loam	Fair to poor	Not suitable	Poor	Area subject to occasional flooding, low shear strength, stratified sediments, some stratum subject to liquifaction	Subject to flooding, low shear strength	Surface drainage beneficial to remove excess water after flooding	Variable permeability with depth, subject to lateral seepage, side walls unstable	Difficult to compact, stratified layers with high silt subject to piping	Severe, subject to flooding, moderate permeability

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Ma	Marringhurst loamy sand	Poor	Good	Good	Slight limitation, good drainage, high shear strength, high bearing strength, highly stable under wheel load, some stones	High bearing strength, good drainage, low compressibility, some stones	Not required	Severe limitation, rapid permeability, will not hold water	Permeable when compacted, high shear strength	Slight, very rapid permeability, high contamination hazard
Ma/1xxx	Marringhurst slightly eroded									
Ma/xx1x	Marringhurst slightly stony									
Ma/xc1x	Marringhurst, undulating, slightly stony									
Ma/xcxx	Marringhurst, undulating									
Ma/1cxx	Marringhurst, slightly eroded, undulating									
Ma/2cxx	Marringhurst, moderately eroded, undulating									
Ma/xx2x	Marringhurst moderately stony	Poor	Good	Good	Slight limitation, as above	Moderate limitation, moderately stony, as above	Not required	As above	As above	Moderate, moderately stony, high contamination hazard
Ma/xc2x	Marringhurst undulating, moderately stony									
Ma/xdxx	Marringhurst gently rolling	Poor	Good	Good	Slight to moderate, moderately sloping, high shear strength, as for Ma, may be moderately stony	Slight to moderate limitation, as for Ma, may be moderately stony	Not required	Severe, rapid permeability	As above	Slight limitation, as for Ma
Ma/xDxx	Marringhurst moderately sloping									
Ma/2dxx	Marringhurst moderately eroded, gently rolling									
Ma/1d2x	Marringhurst, slightly eroded, gently rolling, moderately stony									
Ma/xd3x	Marringhurst gently rolling, very stony	Poor	Fair (due to stones)	Fair (due to stones)	Moderate to severe limitation, very to exceedingly stony, moderately sloping	Severe limitation, very to exceedingly stony, moderately sloping	Not required	As above very stony	Very to exceedingly stony, permeable when compacted	Severe, very to exceedingly stony, permeable, as above
Ma/1d3x	Marringhurst, slightly eroded, gently rolling, very stony									

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Ma/xd4x	Marringhurst, gently rolling, exceedingly stony									
Ma/xc4x	Marringhurst, undulating, exceedingly stony									
Ma/xexx	Marring-hurst moderately rolling	Poor	Good	Good	Moderate limit-ation, strongly sloping, as for Ma	Moderate limit-ation, strongly sloping, as for Ma	Not required	Severe limit-ation, rapid permeability	Material properties as for Ma	Severe, strongly sloping, rapid permeability
Ma/2exx	Marringhurst moderately eroded, moder-ately rolling									
Ma/2e2x	Marringhurst, moderately eroded, moderately rolling, moderately stony									
Ma/2f2x	Marring-hurst moderately eroded, strongly rolling, moder-ately stony	Poor	Fair	Fair to poor (variable stoniness)	Severe, steeply sloping, moder-ately to exceedingly stony	Severe, steeply sloping, moder-ately to exceedingly stony	Not required	Severe limit-ation, steeply sloping	Permeable when com-pacted, contains appreciable stones	Severe, steeply sloping, moderately to exceedingly stony
Ma/2f3x	Marringhurst, moderately eroded, strongly rolling, very stony									
Ma/2f4x	Marringhurst, moderately eroded, strongly rolling, exceedingly stony									
Ma/2g3x	Marring-hurst moderately eroded, hilly very stony	Poor	Fair	Poor (variable stoniness)	Severe, very steeply sloping, very to exceedingly stony	Severe, very steeply sloping, very to exceedingly stony	Not required	Severe limit-ation, very steeply sloping	Material is permeable when compacted, very to exceedingly stony	Severe, very steeply sloping, very to exceedingly stony
Ma/2G4x	Marringhurst moderately eroded, very steeply sloping, exceedingly stony									

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Md	Madill loam	Poor	Not suitable	Fair, difficult to compact, some stones	Moderate limitation, good drainage, low to moderate bearing strength, cut banks easily eroded, unstable road bed at high moisture content	Good drainage, Low to moderate bearing strength, some stones present	Not required	Slight to moderate limitation, moderate to moderately slow permeability	Difficult to compact, unstable at high moisture levels	Moderate to severe, moderate to moderately slow permeability severe if compact and fissile
Md/xcxx	Madill undulating	Poor	Not suitable	Fair	As above	As above	Not required	Moderate, gently sloping, as above	As above	Moderate to severe, as above
Md/xc3x	Madill undulating very stony	Poor	Not suitable	Fair	As above, very stony	Severe limitation, very stony	Not required	Severe, gently sloping, very stony		Severe, as above, very stony, gently sloping
Md/xd1x	Madill gently rolling, slightly stony	Poor	Not suitable	Fair	As for Md	As for Md	Not required	Severe, moderately sloping	As above	Severe, moderately sloping, as for Md
Md/xe4x	Madill moderately rolling, exceedingly stony	Poor	Not suitable	Poor	Severe, strongly sloping, exceedingly stony	Severe, strongly sloping, exceedingly stony	Not required	Severe, strongly sloping, exceedingly stony	Exceedingly stony, as for Md	Severe
Mf	Mansfield loamy fine sand	Poor	Fair to good	Good	Moderate limitation, seasonal water table within 1 m, high bearing strength, high shear strength	Severe limitation, seasonal water table within 1 m, high bearing strength, high shear strength, low compressibility	Generally not required, moist subsoil conditions an asset	Permeable, will not hold water	Pervious when compacted, high shear strength	Severe, seasonal water table within 1 m, rapidly permeable, pollution hazard high
Mf1	Mansfield, loamy sand, sandy subsoil	Poor	Fair to good (sand fraction dominant)	Good to fair	Moderate limitation, seasonal water table within 1m, high bearing strength, high shear strength	Severe limitation, seasonal water table within 1 m, high bearing strength, high shear strength, low compressibility	Generally not required, moist subsoil conditions an asset	Permeable, will not hold water	Pervious when compacted, high shear strength	Severe, seasonal water table within 1 m, rapidly permeable, pollution hazard high

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Mf/xc2x	Mansfield undulating moderately stony	Poor	Fair	Fair	As above, lower slope of undulasting topography, seepage from upslope	As above, moderately stony	As above	As above	As above, moderately stony	Severe, as above, moderately stony
Mk	Mockry loamy fine sand	Poor	Not suitable (due to wetness)	Poor (due to wetness)	Water table at or near surface, low to moderate bearing strength, risk of frost heave	Water table at or near surface, low to moderate bearing strength when wet	Required, soil is permeable to water	Soil is permeable, high water table, banks unstable at high moisture content	High water table, moderate shear strength, subject to piping	Severe, water table at or near surface
Mkp	Mockry peaty	Poor	Not suitable (due to wetness)	Poor (due to wetness)	Water table at or near surface, low to moderate bearing strength, risk of frost heave	Water table at or near surface, low to moderate bearing strength when wet	Required, soil is permeable to water	Soil is permeable, high water table, banks unstable at high moisture content	High water table, moderate shear strength, subject to piping	Severe, water table at or near surface
Ml Ml/xx1x	Melland loam Melland slightly stony	Fair	Poor (due to thickness, 30 to 50 cm strata)	Fair if upper 85 cm is mixed	Perched seasonal water table within 1 m, moderate to high shear strength in upper 85 cm, possibly frost heave, some stones	Perched water within 1 m, moderate bearing capacity, low compressibility, some stones	Required to remove perched water	Rapid permeability in upper 85 cm, moderately slow permeability at lower depth	Upper 85 cm pervious when compacted, core should extend through the coarse material if used as embankment	Severe, perched water conditions, subject to lateral seepage
Ml/xx3x Ml/xx4x	Melland very stony Melland exceedingly stony	Poor	Poor	Fair to poor	Severe, very to exceedingly stony, seasonal water table within 1 m	Severe, very to exceedingly stony, seasonal water table within 1 m	Required	As above, very to exceedingly stony	As above, very to exceedingly stony	Severe, very to exceedingly stony, as above
Mn	Manson silty clay	Poor	Not suitable	Poor	Moderately well drained, possible flood hazard,	Possible flood hazard, high shrink-swell,	Generally not required	Slow permeability, will hold water	Poor workability, difficult to	Severe, slow permeability, possible flood
Mn	Manson silty clay	Poor	Not suitable	Poor	Moderately well drained, possible flood hazard, high shrink-swell, high compressibility	Possible flood hazard, high shrink-swell, low bearing strength when wet	Generally not required	Slow permeability, will hold water	Poor workability, difficult to compact due to high silt & clay content, subject to cracking	Severe, slow permeability possible flood hazard

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Mr	Marsden loam	Poor (shallow soil, & wetness)	Not suitable due to wetness & thin strata of sand & gravel	Poor (wetness)	Water table at or near surface, subject to frost heave, moderate shear strength in upper 85 cm	Severe limitation, water table at or near surface, subsoil has medium bearing strength	Required	Severe limitation, water table at or near surface, rapid permeability in upper 85 cm	Water table at or near surface, rapid permeability in upper 85 cm, core should extend into till if used for embankment	Severe, water table at or near surface
Mr/xxxs	Marsden slightly saline	Poor	Poor	Poor	Severe limitation, as above, moderate dispersion due to salt	Severe limitation, as above, high sulfate hazard	Required	Severe, as above, slightly saline	As above	Severe, as above
Ms	Miniota fine sandy loam	Good	Fair to good below 40 cm depth dominantly sands	Good	Good drainage, high shear strength, low compressibility	Good drainage, high bearing strength, low compressibility	Not required	Rapid permeability, will not hold water	Pervious when compacted, high shear strength	Slight, rapid permeability possible pollution hazard
Ms/xx2x	Miniota moderately stony	Fair	Fair to good	Fair	Slight limitation, as above	Moderate limitation, moderately stony, as above	Not required	As above, moderately stony	As above, moderately stony	Moderate, moderately stony, as above
Ms/2cxx	Miniota, moderately eroded, undulating	Poor	Fair to good, dominantly sands	Good	High bearing strength, high shear strength, low compressibility	High bearing strength, low compressibility	Not required	Very rapid permeability, will not hold water	Very rapid permeability, undulating topography	Slight, will required topsoil for good vegetation
Ms/xcxx	Miniota undulating	Poor	Fair	Fair to good	Slight limitation, as for Ms	Slight limitation, as for Ms	Not required	As for Ms	As for Ms	Slight, as for Ms
Ms/xc1x	Miniota undulating, slightly stony									
Ms/xd1x	Miniota, gently rolling, slightly stony									
Ms/2g3x	Miniota, moderately eroded, hilly, very stony	Poor	Fair	Poor	Severe, very steeply sloping, very stony	Severe, very steeply sloping, very stony	Not required	Severe, steeply sloping, very stony	Material very stony, pervious when compacted	Severe, very steeply sloping, very stony

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Ob	Oberon sandy clay loam	Fair	Not suitable	Fair to poor	Seasonal water table within 1 m, low shear strength, moderate compressibility, high frost heave	Seasonal water table within 1 m, low bearing capacity when wet, moderate shrink-swell,	Generally required	Moderate permeability, seasonal water table, subsoil has moderately rapid permeability	Low shear strength, impervious when compacted, subject to piping	Severe, moderate permeability, seasonal water table within 1 m
Ob/xcxx	Oberon gently sloping				ate compressibility, high frost heave hazard	when wet, moderate shrink-swell, moderate bearing strength below 85 cm		ately rapid permeability	subject to piping	table within 1 m
Ob/xxxs	Oberon slightly saline	Poor	Not suitable	Poor	Severe limitation, low shear strength when wet, slight to moderate dispersion, high frost heave hazard	Severe, high sulfate hazard seasonal water table within 1 m	Required	Severe limitation, seasonal water table, subsoil permeable, will not hold bead of water	As above	Severe, as above
Oh	Onahan loamy fine sand	Poor	Fair to good for fine sand	Good	Seasonal water table, high shear strength, low compressibility	Seasonal water table within 1 m, high bearing capacity, low shrink-swell	Generally not required	Permeable, will not hold water, walls would be unstable	Pervious when compacted	Moderate to severe, rapid permeability, seasonal water table within 1 m, subject to pollution hazard
Oh/xcxx	Onahan gently sloping	Poor	Fair	Good	Moderate limitation, seasonal lateral water flow from upper slopes, as above	Moderate to severe limitation, seasonal lateral water flow from upper slopes	As above	As above, will not hold bead of water	As above	Moderate to severe, possible pollution hazard (as above)
Oh/xdxx	Onahan moderately sloping (lower slopes of gently rolling)									
Pl	Pleasant very fine sandy loam	Fair	Not suitable	Poor, difficult to compact, unstable when wet	Seasonal water table within 1 m, low shear strength, high susceptibility to frost heave	Seasonal water table within 1 m, low bearing capacity, moderate sulfate hazard	Some drainage beneficial, moderate permeability of soil	Moderate permeability, seasonal water table within 1 m	Low shear strength, semipermeable when compacted, possible piping hazard	Severe, seasonal water table within 1 m, moderate permeability
Pl/1xxx	Pleasant slightly eroded									

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Pl/xxxs	Pleasant saline phase	Poor (saline)	Similar to above, contains appreciable soluble salts							
Pl/xcxx	Pleasant gently sloping	Poor	Not suitable	Poor	Moderate limitation, lower slopes of undulating to gently rolling topography, lateral water flow from upslope, as above	Moderate to severe limitation, lateral water flow from upslope, as for Pl	Some beneficial	Severe limitation, gently sloping, will not hold bead of water	As for Pl	Severe
Pl/1cxx	Pleasant, slightly eroded, gently sloping									
Pl/1dxx	Pleasant slightly eroded moderately sloping									
Po	Poolex fine sandy loam	Poor (wetness)	Not suitable	Poor	Water table at or near surface, low shear strength, high susceptibility to frost	Water table at or near surface, low bearing capacity when wet, moderate sulfate hazard	Required	Water table at or near surface, moderate permeability	Water table at or near surface, low shear strength subject to piping	Severe, water table at or near surface
Po/xxxs	Poolex saline phase	Similar to above, contains appreciable soluble salts								
Pp	Porple fine sandy loam	Fair	Not suitable	Fair erodes easily	Moderate limitation, good drainage, low compressibility	Slight to moderate limitation, low to moderate bearing strength when wet	Not required	Moderate to moderately rapid permeability, will not hold water	Semipermeable when compacted, low shear strength	None to slight, moderate to moderately rapid permeability
Pp/1xxx	Porple slightly eroded									
Pp/xcxx	Porple undulating									
Pp/1cxx	Porple, slightly eroded, undulating									
Pp/1dxx	Porple slightly eroded, gently rolling	Fair	Not suitable	Fair	Moderate limitation, moderately to strongly sloping	As above	Not required	Severe limitation, moderately to strongly sloping, as above	As above	Moderate, moderately to strongly sloping, as above
Pp/1exx	Porple, slightly eroded, moderately rolling									

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Pr	Prodan clay loam	Fair	Not suitable	Poor	Moderate to severe limitation, poor stability at high moisture content, risk of frost heave, silt layers may be subject to liquifaction	Severe limitation, seasonal water table within 1 m, low bearing capacity at high moisture content, moderate sulfate hazard	Some surface drainage required, moderately slow permeability	Moderate, will hold water	Moderately high shrink-swell, medium compressibility, high silt, difficult to compact	Severe, moderately slow permeability seasonal water table within 1 m
Pr/1xxx	Prodan slightly eroded									
Pr/xx1x	Prodan slightly stony									
Pr/1xxs	Prodan slightly eroded, slightly saline	Poor	Not suitable	Poor	Severe limitation, poor stability at high moisture content, area influenced by upward flow of groundwater & seepage as above	Severe limitation, low bearing strength, high sulfate hazard	Subsoil drainage required for salt removal, moderately slow permeability	Will hold water, subject to salinization around reservoir	As above, moderate to high dispersion	Severe
Pr/xxxs	Prodan slightly saline									
Pr/xxxt	Prodan moderately saline									
Pr/1x1s	Prodan slightly eroded, slightly stony, slightly saline									
Pr/xcxx	Prodan lower slopes of undulating	Poor	Not suitable	Poor	Lower slopes of undulating topography, as for Pr	Severe limitation, as for Pr	Some seepage in lower slope, as for Pr	Moderate, as for Pr	as for Pr	Severe
Pr/1cxx	Prodan slightly eroded, undulating									
Pr/2cxx	Prodan moderately eroded, undulating									
Ps	Prosser fine sandy loam to very fine sandy loam	Good	Not suitable	Fair erodes easily	Moderate limitation, good drainage, low compressibility	Moderate limitation, low to moderate bearing capacity when wet	Not required	Moderate to moderately rapid permeability, will not hold water	Semipermeable when compacted low shear strength	None to slight, moderate to moderately rapid permeability
Ps/1xxx	Prosser slightly eroded									
Ps/xcxx	Prosser, undulating									
Ps/1cxx	Prosser, slightly eroded, undulating									

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Ps/xdxx Ps/1dxx	Prosser gently rolling Prosser slightly eroded, gently rolling	Fair	Not suitable	Fair	As above, moderately sloping	As above, moderately sloping	Not required	Moderately sloping, as above	As above	Slight to moderate moderately sloping
Pt	Petrel loam	Good	Not suitable	Fair	Seasonal water table within 1 m, low shear strength in upper 90 cm, subject to frost heave	Seasonal water table within 1 m, moderate bearing capacity in subsoil	Generally not required, beneficial in some areas	Moderate to moderately rapid permeability in subsoil	Low shear strength in upper 90 cm, fair compaction characteristics, impervious when compacted, subject to piping	Severe, seasonal water table within 1 m, moderately rapid permeability in subsoil
Ptl	Petrel, loamy fine sand, clayey strata	Fair	Fair to poor for fine sand	Fair in upper 50 cm & below 90 cm	Seasonal water table within 1 m, moderate bearing strength, some risk of frost heave	Seasonal water table within 1 m, moderate bearing capacity in subsoil	Some required	Semipermeable in upper 90 cm, permeable below	Semipervious to impervious when compacted	Severe, seasonal water table within 1 m
Ra Ra/1xxx	Ramada clay loam Ramada slightly eroded	Fair	Not suitable	Poor	Moderate to severe, poor stability at high moisture content, high compressibility, risk of frost heave	Moderate limitation, low bearing strength at high moisture content, moderate to high shrink-swell	Not required	Slight limitation, moderately slow seepage rate, will hold water	Poor to fair compaction properties, low shear strength, high compressibility	Moderate to severe, moderate to moderately slow permeability
Ra/xcxx Ra/1cxx	Ramada undulating Ramada slightly eroded, undulating	Fair	Not suitable	Poor	As above	As above	Not required	Moderate limitation, gently sloping	As above	Moderate to severe, moderate to moderately slow permeability

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Rd	Roddan loam	Poor	Not suitable	Poor	Moderate limitation, good drainage, low to moderate shear strength, moderate shrink-swell	Moderate limitation, good drainage, low to moderate bearing capacity moderate shrink-swell	Not required	Slight limitation, will hold water	Medium to low shear strength, medium compressibility, impervious when compacted	Moderate to severe, moderately slow permeability in upper 60 cm, decreases with depth, severe if lower till is compact & fissile
Rd/xcxx	Roddan undulating	Poor	Not suitable	Poor	As above	As above	Not required	Moderate limitation, gently sloping, will hold water	As above	Moderate to severe
Rd/xdxx	Roddan gently rolling	Poor	Not suitable	Poor	As above	As above	Not required	Severe limitation, moderately sloping	As above	Severe, moderately sloping, moderately slow permeability
Rd/xdlx	Roddan gently rolling, slightly stony									
Rf	Rufford clay loam	Poor (shallow soil	Not suitable	Poor high plasticity	Moderate limitation, moderate to high plasticity, low to moderate shear strength, variable topography, some stones	Moderate, good drainage, low to moderate bearing strength, moderate to high shrink-swell, some stones	Not required	Slight limitation, moderately slow permeability in subsoil, will hold water moderate limitation if gently sloping	Low to medium shear strength, moderate compressibility, impervious when compacted	Moderate to severe moderate to moderately slow permeability in upper 60 cm, decreases with depth, severe if till is compact & fissile
Rf/lxlx	Rufford slightly eroded, slightly stony									
Rf/lclx	Rufford, slightly eroded, undulating, slightly stony									
Rf/2cxx	Rufford, moderately eroded, undulating									
Rf/2clx	Rufford, moderately eroded, undulating, slightly stony									
Rf/xdxx	Rufford gently rolling	Poor	Not suitable	Poor	Moderate limitation, moderate to high plasticity, moderately sloping	Moderate, moderate to high plasticity, moderately sloping	Not required	Severe, moderately sloping	As above	Moderate to severe, as above
Rf/lelx	Rufford, slightly eroded, moderately rolling, slightly stony	Poor	Not suitable	Poor	Moderate to severe, strongly sloping, slightly to moderately stony, moderate to high plasticity	Moderate to severe limitation, strongly sloping, slightly to moderately to stony, moderate to high plasticity	Not required	Severe limitation, strongly sloping	As above, slightly to moderately stony	Severe limitation strongly sloping, slightly to moderately stony
Rf/2elx	Rufford, moderately eroded, moderately rolling, slightly stony									

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Rf/$_{2e2x}$	Rufford, moderately eroded, moderately rolling, moderately stony									
Rf/$_{1f1x}$	Rufford, slightly eroded, strongly rolling, slightly stony	Poor	Not suitable	Poor	Severe limitation, steeply sloping, variable stoniness, medium to high plasticity	Severe limitation, steeply sloping, variable stoniness	Not required	Severe limitation	Material properties as for Rf, slightly stony	Severe limitation, steeply sloping
Rf/$_{2f1x}$	Rufford, moderately eroded, strongly rolling, slightly stony									
Rf/$_{1f2x}$	Rufford, slightly eroded, strongly rolling, moderately stony									
Rf/$_{1f3x}$	Rufford, slightly eroded, strongly rolling, very stony									
Rf/$_{2g1x}$	Rufford, moderately eroded, hilly, slightly stony									
Rp	Rempel clay	Poor to	Not	Poor	Moderate to	Good drainage,	Not required	Moderate limit-	Moderately	Moderate to
Rp	Rempel clay loam	Poor to fair	Not suitable	Poor	Moderate to severe limitation, good drainage, poor stability at high moisture content, high shrink-swell	Good drainage, medium to low bearing capacity at high moisture content, high shrink-swell	Not required	Moderate limitation, moderately slow permeability, will hold water	Moderately high shrink-swell, medium compressibility, silts difficult to compact	Moderate to severe, moderate to moderately slow permeability stratified layers could be restrictive
Sg	Sigmund clay	Poor	Not suitable	Poor	Seasonal water table within 1 m, low shear strength, high compressibility, high plasticity, subject to frost heave	Seasonal water table within 1 m, low bearing capacity when wet, high shrink-swell, sulfate hazard	Required, slow permeability of soil, subject to ponding	Slight limitation, will hold water	High compressibility, subject to cracking	Severe, slow permeability, seasonal water table within 1 m
Sg/$_{xxxs}$	Sigmund saline phase	Similar to above, contains appreciable soluble salts								

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Sh	Shilox loamy fine sand	Poor	Fair to good for fine sand	Good	Slight limitation, good drainage, high shear strength, subject to wind erosion, low compressibility	Slight limitation, good drainage, high bearing strength	Not required	Severe limitation, will not hold water (requires a lining if used)	Pervious when compacted, high shear strength	Slight, very rapid permeability, possible pollution hazard to groundwater
Sh/xcxx	Shilox undulating									
Sh/xdxx	Shilox gently rolling									
Sh/xexx	Shilox moderately rolling	Poor	Fair to good for fine sand	Good	Moderate limitation, strongly sloping, as above	Moderate limitation, strongly sloping, as above	Not required	Severe, as above	As above	Moderate, strongly sloping, as above
Sh/xfxx	Shilo strongly rolling	Poor	Fair to good for fine sand	Good	Moderate to severe limitation, steeply sloping, subject to wind erosion, as above	Moderate to severe limitation, steeply sloping, as above	Not required	Severe, as above	As above	Moderate to severe, steeply sloping, as above
Sh/xgxx	Shilo, hilly	Poor	Fair to good for fine sand	Good	Severe, very steeply sloping, as above	Severe, very steeply sloping, as above	Not required	Severe, as above	As above	Severe, very steeply sloping, as above
Sn	Stockton loamy fine sand	Poor	Fair to good for fine sand	Good, poor for surface	Slight, good drainage, high shear strength, low compressibility subject to wind & water erosion	Slight, good drainage, high bearing capacity	Not required	Severe limitation, will not hold water	Pervious when compacted, high shear strength	Slight, rapid permeability, possible pollution hazard to groundwater
Sn/lxxx	Stockton slightly eroded									
Sn/xcxx	Stockton undulating									
Sn/lcxx	Stockton slightly eroded, undulating	Poor	Fair to good for fine sand	Good, poor for surface	Slight, good drainage, high shear strength, low compressibility subject to wind & water erosion	Slight, good drainage, high bearing capacity	Not required	Severe limitation, will not hold water	Pervious when compacted, high shear strength	Slight, rapid permeability, possible pollution hazard to groundwater
Sn/ldxx	Stockton slightly eroded, gently rolling									

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Sn/$_{ocxx}$ Sn/$_{odxx}$	Stockton overblown undulating Stockton overblown gently rolling	Poor	Fair to good for fine sand	Good, poor for surface	Slight, good drainage, high shear strength, low compressibility subject to wind & water erosion	Slight, good drainage, high bearing capacity	Not required	Severe limitation, will not hold water	Pervious when compacted, high shear strength	Slight, rapid permeability, possible pollution hazard to groundwater
St St/$_{2xxx}$ St/$_{1x1x}$	Stewart clay loam Stewart moderately eroded Stewart, slightly eroded, slightly stony	Poor (shallow soil)	Not suitable	Poor	Moderate limitation, good drainage, low shear strength, moderate to high compressibility	Moderate limitation, good drainage, low bearing capacity when wet in upper 70 cm, medium bearing capacity below subsoil has variable composition with less fines	Not required	Slight to moderate limitation, moderate to moderately slow permeability, will hold water	Medium to low shear strength, medium compressibility, low permeability, till variable below 70 cm, may have medium shear strength, more stones	Moderate to severe, moderate to moderately slow permeability in upper 60 to 80 cm, variable material below with moderate permeability, severe if till is compact & fissile
St/$_{xcxx}$ St/$_{1c1x}$ St/$_{2cxx}$	Stewart, undulating Stewart, slightly eroded, undulating, slightly stony Stewart, moderately eroded, undulating	Poor	Not suitable	Poor	As above	As above	Not required	Moderate limitation, gently sloping, as above	As above	Moderate to severe, as above
St/$_{xc3x}$ St/$_{1c2x}$ St/$_{1c3x}$	Stewart undulating, very stony Stewart, slightly eroded, undulating, moderately stony Stewart, slightly eroded, undulating, very stony	Poor	Not suitable	Poor	Moderate to severe limitation, moderately to very stony, undulating, low shear strength	Severe limitation, moderate to very stony, as above	Not required	Moderate to severe limitation, moderately to very stony, gently sloping	As above, moderately to very stony	Severe limitation, moderately to very stony, as for St
St/$_{1d2x}$	Stewart slightly eroded, gently rolling, moderately stony	Poor	Not suitable	Poor	Severe limitation, moderately sloping, moderately to very stony, low shear strength	Severe limitation, moderately sloping, moderately to very stony	Not required	Severe limitation, moderately sloping, moderately to very stony	Material is moderately to very stony, as for St	Severe

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St/xd2x	Stewart, gently rolling, moderately stony									
St/xd3x	Stewart, gently rolling, very stony									
St/1d3x	Stewart, slightly eroded, gently rolling, very stony									
St/2f3x	Stewart moderately eroded, strongly rolling, very stony	Poor	Not suitable	Poor	Severe limitation, steeply sloping, very stony	Severe limitation, steeply sloping, very stony	Not required	As above	As above	Severe
Su	Sutton clay loam	Poor	Not suitable	Poor	Water table at or near surface, low shear strength, subject to frost heave	Poor drainage, depressional, low bearing capacity, moderate sulfate hazard	Required, depressional	Poorly drained, will hold water	Seasonal water at or near surface, low shear strength, poor workability	Severe water table at or near surface, slow permeability
Sup	Sutton peaty									
Su/xxxs	Sutton saline phase	Contains appreciable soluble salts			Similar to above, high risk of frost heave	Poor drainage, high sulfate hazard	Subsurface drainage required to remove salts	Will hold water	Moderate dispersion, poor workability	Severe
Sw	Sewell fine sandy loam	Poor	Not suitable	Poor	Severe limitation, water table at or near surface, possible frost heave, low to medium shear strength when wet	Severe limitation, water table at or near surface, low to medium bearing capacity when wet	Required	Severe limitation, high water table will not maintain water head, permeable	Low to medium shear strength, semipervious to pervious when compacted, subject to piping	Severe, water table at or near surface
Sw/1xxx	Sewell overblown phase									
Sw/xxxt	Sewell moderately saline	Similar to above, contains appreciable soluble salts, sulfate hazard high								

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Sy	Statley clay loam	Poor	Not suitable	Poor	Moderate limitation, good drainage, low shear strength when moist or wet, moderate to high compressibility	Moderate limitation, good drainage, low bearing capacity when wet in upper 70 cm, low to medium bearing capacity below	Not required	Slight to moderate in upper 70 cm, variable below, may contain some coarser strata with less fines than above	Low shear strength in upper 70 cm, impervious when compacted	Moderate to severe, moderate to moderately slow permeability in upper 70 cm, variable below, severe if the glacial drift is compact & fissile
Sy/xc1x	Statley undulating, slightly stony									
Sy/1c1x	Statley, slightly eroded, undulating, slightly stony									
Sy/xc2x	Statley undulating, ,pderately	Poor	Not suitable	Poor	Moderate limitation, as above	Moderate to severe limit-	Not required	Moderate limitation, gently	As above, moderately	Severe, moderately to very
Sy/xc2x	Statley undulating, moderately stony	Poor	Not suitable	Poor	Moderate limitation, as above	Moderate to severe limitation	Not required	Moderate limitation, gently sloping, moderately to very stony	As above, moderately to very stony	Severe, moderately to very stony, undulating, as for Sy
Sy/xc3x	Statley, undulating very stony									
Sy/xd1x	Statley gently rolling slightly stony	Poor	Not suitable	Poor	Moderate limitation, as for Sy	Moderate limitation, moderately sloping, as for Sy	Not required	Severe limitation, moderately sloping, slightly to moderately stony	As for Sy	Severe, moderately sloping, slightly to moderately stony, as for Sy
Sy/1d1x	Statley, slightly eroded, gently rolling, slightly stony									
Sy/xd2x	Statley, gently rolling, moderately stony									
Sy/xd3x	Statley gently rolling very stony	Poor	Not suitable	Poor	Severe limitation, very stony, moderately to steeply sloping	Severe limitation, very stony, moderately to steeply sloping	Not required	Severe limitation, very stony, moderately to steeply sloping	Material is very stony as for Sy	Severe
Sy/1d3x	Statley, slightly eroded, gently rolling, very stony									
Sy/1f3x	Statley, slightly eroded, strongly rolling, very stony									

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Tc Tc/1xxx Tc/xcxx	Torcan silt loam Torcan slightly eroded Torcan gently sloping	Fair	Not suitable	Fair to poor	Moderate limitation, seasonal water table within 1 m, frost heave hazard, low shear strength when moist or wet, cut banks erode easily	Severe limitation, seasonal water table within 1 m, low bearing capacity when moist or wet, moderate compressibility, sulfate hazard	Some drainage beneficial	Moderate permeability, moderate limitation	Low shear strength, poor workability, impervious when compacted	Severe, seasonal water table within 1 m, moderate permeability
Tc/xxxs	Torcan slightly saline	Poor	Not suitable	Poor	Severe limitation, high salt and sulfate hazard, subsoil seepage area, moderate dispersion	Severe limitation, high sulfate hazard, as above	Required	Moderate to severe limitation, appreciable salts	As above, appreciable soluble salt and gypsum	Severe
Td Tdp	Tadpole clay loam Tadpole peaty phase	Poor	Not suitable	Poor	Severe limitation, water table at or near surface, low shear strength when wet, subject to frost heave, moderate to high compressibility, may have some peat on surface	Severe limitation, water table at or near surface low bearing capacity, high shrink-swell moderate sulfate hazard, some peat on surface	Required	Slow permeability, will hold water	Water table at or near surface, low shear strength, moderate to high compressibility, poor workability	Severe, water table at or near surface
Td/xxxs	Tadpole slightly saline phase	Similar to above, contains appreciable soluble salts - high gypsum hazard								
Td/xxxt	Tadpole, moderately saline									
Tdp/xxxs	Tadpole peaty, slightly saline									
Tg Tg/xcxx	Taggart silt loam Taggart gently sloping (lower slopes)	Fair	Not suitable	Fair to poor	Moderate limitation, seasonal water table to .8 m, frost heave hazard, low shear strength when moist or wet, cut banks erode easily, subject to seepage from upper slopes	Severe limitation, seasonal water table to .8 m, low bearing capacity when moist to wet, moderate shrink-swell, moderate sulfate hazard	Some drainage required	Moderate permeability, moderate limitation, will hold water	Low shear strength, poor workability, impervious when compacted	Severe, seasonal water table within 1 m, moderate permeability

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Tg/xxxs	Taggart saline phase	Similar to above - contains appreciable soluble salts								
Tg/xcxs	Taggart gently sloping, saline									
Tv	Traverse silt loam	Fair	Not suitable	Fair to poor	Moderate limitation, good drainage, poor to fair stability, close control required during compaction, cut banks erode easily	Moderate limitation, good drainage, low bearing capacity when wet	Not required	Moderate limitation, moderate permeability if bottom is compacted	Poor to fair stability, poor compaction characteristics, semipervious when compacted	Moderate limitation, moderate permeability
Tv/1xxx	Traverse slightly eroded	Poor								
Tv/1cxx	Traverse slightly eroded, undulating	Poor								
Tv/2cxx	Traverse, moderately eroded, undulating									
Vf	Vodroff clay loam	Poor	Not suitable	Poor	Severe limitation, water table at or near surface, depressional, low shear strength when moist or wet, high risk of frost heave (moderately stony)	Severe limitation, water table at or near surface, low bearing capacity when moist or wet, moderate shrink-swell, moderate sulfate hazard	Required	Water table at or near surface, slow permeability, will hold water	Water table at or near surface, poor workability, moderate to high compressibility, low shear strength, impervious when compacted	Severe, water table at or near surface, slow permeability
Vf/xx2x	Vodroff moderately stony									
Vf/xxxs	Vodroff slightly saline	Similar to above, contains appreciable soluble salts (severe sulfate hazard)								
Vfp/xxxt	Vodroff peaty, moderately saline									
Vf/xxxt	Vodroff, moderately saline									

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Vs	Vordas silt loam	Poor	Not suitable	Poor	Severe limitation, water table at or near surface, high frost heave hazard, low shear strength when wet or moist	Severe limitation, water table at or near surface, low bearing capacity when moist or wet, moderate compressibility, low to moderate sulfate hazard	Required	Water table at or near surface, moderate permeability (may not hold a bead of water)	Water table at or near surface, poor workability, low shear strength, impervious when compacted, subject to piping	Severe, water table at or near surface
Vs/xxxs	Vordas slightly saline	Similar to above, contains appreciable soluble salts (severe sulfate hazard)								
Vs/xxxt	Vordas moderately saline									
Vsp/xxxs	Vordas peaty, saline phase									
Wd	Wellwood clay loam	Fair	Not suitable	Fair to poor	Moderate limitation, good drainage, low shear strength, moderate compressibility	Moderate limitation, good drainage, moderate to high bearing strength below 85 cm	Not required	Moderate permeability in upper .8 to 1 m, moderately rapid permeability below	Low shear strength, impervious when compacted	Slight limitation, moderate permeability in upper .8 to 1 m, moderately rapid below
Wd/xcxx	Wellwood undulating									
Wd/1cxx	Wellwood, slightly eroded, undulating									
Wd/2dxx	Wellwood moderately eroded, gently rolling	Poor	Not suitable	Fair to poor	Moderate limitation, as above	Moderate limitation, as above	Not required	Severe limitation, moderately sloping, as above	As above	Moderate limitation, moderately sloping, as above
Wf	Woodfield clay loam	Poor	Not suitable	Poor	Moderate limitation, good drainage, low shear strength when moist or wet, moderate to high compressibility	Moderate limitation, good drainage, low bearing capacity when wet in upper 70 cm, low to medium bearing capacity below	Not required	Moderate in upper 70 cm, variable below, subsoil may contain coarser strata with less fines	Low shear strength in upper 70 cm, impervious when compacted	Moderate to severe, moderate to moderately slow permeability in upper 70 cm, variable below severe if the glacial drift is compact & fissile
Wf/1x2x	Woodfield slightly eroded, moderately stony									
Wf/1cxx	Woodfield, slightly eroded, undulating									

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Wf/xc1x	Woodfield, undulating, slightly stony									
Wf/2cxx	Woodfield, moderately eroded, undulating									
Wf/1c2x	Woodfield, slightly,eroded, undulating, moderately stony									
Wf/xc2x	Woodfield undulating, moderately stony									
Wf/2c2x	Woodfield moderately eroded, undulating, moderately stony									
Wf/2c2x	Woodfield moderately eroded, undulating, moderately stony									
Wf/1d1x	Woodfield slightly eroded, gently rolling, slightly stony	Poor	Not suitable	Poor	As above	As above	Not required	Severe limitation, moderately sloping, as above	As above	Moderate to severe, as above
Wf/xd3x	Woodfield gently rolling, very stony	Poor	Not suitable	Poor	Severe limitation, very to exceedingly stony, moderately to very steeply sloping	Severe limitation, very to exceedingly stony, moderately to very steeply sloping	Not required	Severe limitation	Very to exceedingly stony, as for Wf	Severe limitation, very to exceedingly stony, moderately to very steeply sloping
Wf/2d3x	Woodfield moderately eroded, gently rolling, very stony									
Wf/1e3x	Woodfield slightly eroded, moderately rolling, very stony									
Wf/2e2x	Woodfield moderately eroded, moderately rolling, moderately stony									
Wf/2e3x	Woodfield moderately eroded, moderately rolling, very stony									
Wf/1e4x	Woodfield slightly eroded, moderately rolling, exceedingly stony									
Wf/1f3x	Woodfield slightly eroded, strongly rolling, very stony									
Wf/2g3x	Woodfield moderately eroded, hilly, very stony									

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Wh	Wheatland loamy fine sand	Poor	Fair to good	Good	Slight limitation, good drainage, high shear strength, low compressibility	Slight limitation, good drainage, high bearing capacity, low shrink-swell, low compressibility	Not required	Rapid permeability, will not hold water	Pervious when compacted, high shear strength	Slight limitation, rapid permeability in subsoil risk of pollution to groundwater
Wh/xcxx	Wheatland undulating									
Wh/1c1x	Wheatland slightly eroded, undulating, slightly stony									
Wh/2cxx	Wheatland moderately eroded, undulating									
Wh/xx2x	Wheatland moderately stony	Poor	Fair to good	Good	Slight limitation, as above	Moderate limitation, moderately stony	Not required	Severe limitation, as above	As above	Moderate limitation, moderately stony, as above
Wh/2e2x	Wheatland moderately eroded, moderately rolling, moderately stony	Poor	Fair to good	Good	Severe limitation, strongly sloping, moderately stony	Severe limitation, strongly sloping, moderately stony	Not required	Severe limitation	Material as above	Severe, strongly sloping, moderately stony
Ws	Wesley clay loam	Poor	Not suitable	Poor	Moderate limitation, seasonal water table within 1 m, low shear strength when moist or wet, moderate to high compressibility, moderate frost heave hazard	Severe limitation, seasonal water table within 1 m, low bearing capacity when moist or wet, moderate to high shrink-swell in upper meter, low to moderate bearing capacity below	Some surface drainage beneficial	Moderate limitation, moderately slow permeability in upper meter, variable below, generally will hold water	Low shear strength in upper meter of soil, impervious when compacted	Severe, seasonal water table within 1 m, moderately slow permeability
Ws/xx1x	Wesley slightly stony									
Ws/xc1x	Wesley gently sloping slightly stony									
Ws/1c3x	Wesley slightly eroded, gently sloping, very stony	Poor	Not suitable	Poor	Severe limitation, very stony	Severe limitation, very stony, as above	As above	Severe limitation, very stony, as above	Very stony, as above	Severe

Map Symbol	Soil Name, Texture, Phase	Suitability as source of — Topsoil	Sand and Gravel	Roadfill	Soil features affecting — Road Location	Foundation Construction	Agricultural Drainage	Water retention structures Reservoir area	Embankment, Dikes, Levees	Soil limitation for use as septic field
Ws/xd2x	Wesley moderately sloping, moderately stony (lower slopes)	Poor	Not suitable	Poor	Moderate limitation, as for Ws, moderately sloping, moderately stony, some seepage problem	Severe limitation, some seepage problem, as for Ws	As above	Severe limitation	As for Ws	Severe
Ws/xe2x	Wesley strongly sloping, moderately stony (lower slopes)	Poor	Not suitable	Poor	Severe limitation, lower slope of moderately rolling land, some seepage, as for Ws	Severe limitation, lower slope of moderately rolling land, some seepage problem, as for Ws	Some required	Severe limitation	Material as for Ws	Severe
Wy	Wytonville fine sandy loam	Fair	Fair to good in subsoil below 60 cm, seasonal water table	Good	Moderate limitation, seasonal water table within 1 m, good bearing capacity, high shear strength	Moderate to severe, seasonal water table within 1 m, good bearing strength	Generally not required	Severe limitation, permeable, will not hold head of water above groundwater level	Pervious when compacted, high shear strength	Moderate to severe, seasonal water table within 1 m, rapid permeability, possible contamination hazard
Xv	Xavier, mesic peat	Poor	Not suitable	Poor	Severe limitation, water table at or near surface. Peat unsuitable due to low shear strength,	Severe limitation, water table at or near surface. Peat unsuitable due to low shear strength,	Required	Severe, will not hold water	Severe, low shear strength, high compressibility, water table at or near surface	Severe, water table at or near surface
Zn	Zarnet loam	Fair	Fair to good below 60 cm	Good	Slight limitation, good drainage, high shear strength, good stability	Slight limitation, good drainage, high bearing strength	Not required	Severe limitation, very permeable, will not hold water	Permeable when compacted, high shear strength	Slight, rapid permeability, high contamination hazard
Zn/xcxx	Zarnet undulating									
Zn/2cxx	Zarnet moderately eroded, undulating	Poor								
Zn/1dxx	Zarnet slightly eroded, gently rolling	Poor								

E. SOILS AND COMMUNITY DEVELOPMENT

The purpose of this section is to present soil and landscape information in a form that can be more readily understood by urban planners. Important agricultural service centers such as Brandon, Neepawa and other smaller towns attract population and thus the demand for land suitable for housing, schools, shopping centers, parks, golf courses and other development is increasing. In selecting sites for such needs, suitability of soils must be considered to avoid costly errors and to prevent waste, abuse and loss for all time, of the very valuable agricultural soils that are the heritage of this area. In selecting a site for a home, a highway, or for industrial purposes, the suitability of the soil in each site must be considered. Soils that are nearly level to gently sloping, deep, well drained and are free of boulders and stones generally provide the best sites.

Suburban development beyond existing sewage lines makes the use of septic tanks necessary. Of prime importance, therefore, is the suitability of soils for septic tank filter fields. Each site must be examined closely to determine the ability of the soil to absorb and filter the effluent that flows from the septic tank. Soil must have a percolation rate of 60 minutes per inch or less; the equivalent of a permeability rate of one inch per hour for a sewage disposal system to function properly. Filter fields with a slow rate of absorption must be larger than those in soils which have a rapid rate. Therefore, the size of the lot needed for a particular building depends on the kind of soil. Studies have shown that septic tanks may fail because they are installed in poorly drained soils that are dense, compact and fine textured. The percolation of effluent through such soils in wet weather and for considerable periods after, is hampered because the soil is saturated and lacks space for absorption. Septic tanks may also fail due to a seasonal high water table, flooding by overflow from streams and rivers or shallowness to bedrock or an impervious substratum.

The soil map is a reliable guide for predicting the general suitability of an area, but often does not contain sufficient detail to predict the suitability for a specific site. Soil variation may occur within a short distance and most maps are not detailed enough to supply the precise information as to where on a building site a filter field should be located. Therefore, onsite determination of the rate of water movement may be needed. The rate of movement is measured by a percolation test. The percolation test, previously mentioned, will not only indicate whether the soil is suitable but will also provide the necessary information to calculate the size of the filter field.

SOIL GROUPS FOR BUILDING SITES

The suitability of soils as building sites for residential or light commercial construction is based on characteristics such as "texture", particularly of the substratum, a property affecting sewage absorption, rate of internal drainage, stability and bearing strength for foundations, and risk of frost heaving; "natural soil drainage", a feature of soil and landscape affecting location of residences, roads, services and sewage disposal fields; "topography" or percentage slope, a feature of landscape that determines drainage and site location; "flooding hazard", soils on flood plains of rivers and streams are subject to flooding and should not be used as sites for residences; "depth of soil", a feature which has a direct affect on amount of effluent that can be disposed of, therefore affecting lot size; and "stoniness", a feature which affects site location. The soils in any one group are similar in those characteristics affecting their suitability for residential and community development. These groupings are intended as a general guide to investigators, and are not a substitute for the detailed investigations needed at proposed building sites. Further, most of these groupings take into account only the characteristics of the soils to a depth of 4-5 feet, though certain predictions can be made for the soil beyond this depth.

In the discussion of each site group, the soils in that group are given an approximate rating of desirability based on limitations of the soils. Very good to good means that there are no to slight limitations to use and any limitation can readily be overcome; a rating of fair means limitations are moderate but the soils can be used under good management and careful design; a poor rating means that limitations are severe and that suitability for use is questionable or not wise.

GROUP 1

This group consists of deep, well drained, coarse textured soils with very gently undulating to rolling topography. The surface materials range from very coarse to moderately fine texture and are underlain by deep deposits of stratified sand and gravel.

The soils in this group are fairly droughty and are only fairly good for a narrow range of agricultural crops. These soils are susceptible to wind and water erosion as outlined at the phase level.

All of the soils in this group provide good building sites. They have moderate runoff and a low water table. The suitability of these soils for foundations for low buildings is good. The soils have good internal drainage, high bearing capacity and shear strength and low shrink-swell potential. Susceptibility to frost action is low.

These soils are also suitable as fields for septic tanks because they have good permeability, are not affected by a high water table and absorb sewage effluent fairly rapidly. Caution: Subject to pollution hazard to groundwater. As these gravelly soils may permit inadequately filtered sewage effluent to travel long distances, care must be used to keep the effluent from contaminating nearby water supplies. Adverse topography may affect drainage and site location to an extent.

In landscaping these soils, a top dressing of loamy material may be required before seeding grass or sodding. Some irrigation may be necessary to overcome seasonal droughtiness. Stone removal may be necessitated by a stony surface. The soils included in this group are:

(1A) VERY COARSE

Dorset Dr[1]
All phases of Dorset
Marringhurst Ma
All phases of Marringhurst:
e.g. slightly eroded, undulating, moderately stony phase Ma/1c2x

(1B) MODERATELY COARSE/VERY COARSE

Ashmore Am
All phases of Ashmore:
e.g. slightly eroded, undulating, very stony phase Am/1c3x
Miniota Ms
All phases of Miniota:
e.g. moderately eroded, undulating, slightly stony phase Ms/2c1x

(1C) COARSE/VERY COARSE

Wheatland Wh
All phases of Wheatland:
e.g. slightly eroded, undulating, slightly stony phase Wh/1c1x

(1D) MEDIUM-MODERATELY FINE/VERY COARSE

Croyon Cr
Croyon Undulating phase Cr/xcxx
Zarnet Zn
All phases of Zarnet:
e.g. slightly eroded, gently rolling phase Zn/1dxx

GROUP 2

Soils in this group are level to moderately rolling, coarse to moderately coarse textured and are well to moderately well drained. They have rapid to moderately rapid permeability and a low moisture retention capacity. These soils may have an overlay (25 to 75 cm) of medium to moderately fine sediments. Groundwater is low (below 8 feet) but may, on occasion, rise to within 5 feet of the surface.

Most of the soils in this group provide sites for residences and other low buildings. These sandy soils conduct water rapidly, are readily compacted, have a low shrinkage-swell ratio, are easily worked as a construction material, have very low to negligible compressibility when compacted, have little or no problems with frost heave, and have excellent shearing strength when compacted and saturated.

The surface textures in this group vary from loamy medium sand to sandy clay loam with underlying sediments of dominantly fine to very fine sand and medium sand. These materials, if disturbed or void of vegetation, are susceptible to erosion. The fine to very fine sandy loam soils are more suitable for residential use than the loamy sand soils. Grass sod can be established readily on the soils in this group. A top dressing of loamy material is needed on loamy sand soils before seeding grass or sodding.

Since these soils have good permeability, are not affected by a seasonal high water table and absorb sewage effluent rapidly, they are suitable as fields for septic tanks. Caution: All coarse to very coarse texture soils are subject to possible pollution hazard to groundwater. The soils are:

(2A) COARSE TEXTURE

Arizona Az
All phases of Arizona:
e.g. gently rolling phase Az/xdxx
Cactus Cc
All phases of Cactus:
e.g. slightly eroded, undulating phase Cc/1cxx
Shilox Sh
All phases of Shilox:
e.g. gently rolling phase Sh/xdxx
Stockton Sn
All phases of Stockton:
e.g. slightly eroded, gently rolling phase Sn/1dxx

(2B) MODERATELY COARSE

Brownridge Bn
All phases of Brownridge:
e.g. gently rolling phase Bn/xdxx
Porple Pp
All phases of Porple:
e.g. slightly eroded, gently rolling phase Pp/1dxx
Prosser Ps
All phases of Prosser:

e.g. slightly eroded, gently rolling phase Ps/1dxx

(2C) MEDIUM-MODERATELY FINE/ COARSE

Glenboro Gl[1]
All phases of Glenboro Gl[1]
Glenboro Gl
Glenboro undulating phase Gl/xcxx
Wellwood Wd
All phases of Wellwood:
e.g. slightly eroded, undulating phase Wd/1cxx

GROUP 3

This group consists of deep imperfectly drained, very coarse to moderately coarse textured soils. Included in this group are the soils having a moderately fine to coarse overlay. These soils are level to rolling and have a seasonal high water table. The rolling topographic pattern may restrict site location to certain areas.

These soils may suffer from periodic droughtiness in late summer and are susceptible to wind erosion if cultivated on a continuing basis. They have, therefore, only fair suitability for agricultural crops.

Soils in this group are only fair for building sites because of the seasonal high water table. (Areas of saline soils are often indicative of a discharge system or seepage). They have rapid permeability, low shrink-swell potential and compact readily. These soils become unstable and have a low bearing strength when saturated. Adequate drainage must be provided to avoid wet basements and improper functioning of on-site sewage disposal systems.

The soils in this group have limitations for use as septic tank filter fields because of the seasonal high water table. If used for this purpose, the distribution lines would be below water for significant periods, particularly in seasons of high rainfall. These soils are good for landscaping, but would benefit from a top dressing of loamy textured soil or addition of manure in some cases. The soils are:

(3A) VERY COARSE

Dexter Dt[1]
Mansfield Mf

(3B) COARSE

Hummerston Hm
All phases of Hummerston:
e.g. slightly eroded, gently rolling phase Hm/1dxx
Lavenham Lh
All phases of Lavenham:
e.g. slightly eroded, undulating phase Lh/1cxx
Onahan Oh
All phases of Onahan:
e.g. gently rolling phase Oh/xdxx

(3C) MODERATELY COARSE

Gateside Gt
Gateside saline phase Gt/xxxs
Pleasant Pl
All phases of Pleasant:
e.g. slightly eroded, gently rolling phase Pl/1dxx

(3D) COARSE/VERY COARSE

Gendzel Gz
All phases of Gendzel:
e.g. slightly eroded, gently rolling phase Gz/1d1x

(3E) MODERATELY COARSE/VERY COARSE

Kilmury Kl
All phases of Kilmury:
e.g. slightly eroded, undulating phase Kl/1cxx

(3F) MEDIUM/VERY COARSE

Capell Cp
All phases of Capell:
e.g. moderately stony phase Cp/xx2x
Druxman Dx

(3G) MEDIUM/COARSE

Grover Gr[1]
Grover Gr
Petrel Pt[1]
Petrel Pt

(3H) MODERATELY FINE/COARSE

Crookdale Ck
Oberon Ob
All phases of Oberon:
e.g. undulating phase Ob/xcxx

GROUP 4

This group consists of deep, well drained medium to moderately fine textured soils. These soils occupy level to gently rolling terrain. They have moderate to moderately slow permeability and good to poor bearing strength. These soils are excellent for agriculture and are capable of a wide range of crops.

These soils provide fair to good sites for residences and buildings. Suitability of these soils for foundations of low buildings is good to fair. Bearing capacity of the medium member is fair to good and that of the moderately fine member is fair to

poor due to their higher clay content. All of these soils are moderately susceptible to frost heaving.

This group of soils is suitable for sewage filter fields because of their good surface drainage, moderate permeability and freedom from high groundwater levels. However, percolation tests to determine their effluent absorption capacity would be desirable because of variable subsurface textures. All of these soils are good for landscaping and gardening because of their fertility and good tilth. The soils are:

(4A) MEDIUM

Durnan Dn
All phases of Durnan:
e.g. slightly eroded, undulating, slightly stony phase Dn/1c1x
Fairland Fd
All phases of Fairland:
e.g. slightly eroded, undulating phase Fd/1cxx
Knolls Ko
All phases of Knolls:
e.g. gently rolling phase Ko/xdxx
Traverse Tv
All phases of Traverse:
e.g. moderately eroded, undulating phase Tv/2cxx

(4B) MODERATELY FINE

Barren Br
All phases of Barren:
e.g. gently rolling phase Br/xdxx
Carroll Cl
All phases of Carroll:
e.g. slightly eroded,, undulating phase Cl/1cxx
Ramada Ra
All phases of Ramada:
e.g. slightly eroded phase Ra/1xxx
Rempel Rp

GROUP 5

This group consists of deep, imperfectly drained medium to moderately fine textured soils and the saline phase of these series. All of the soils in this group occupy level to undulating terrain and are affected by a seasonal high water table. These soils have moderately slow permeability and good to poor bearing strength.

These soils are good agricultural soils; the saline phases of these soils are only fair for agricultural use as the range of crops which can be grown is limited due to the salinity.

These soils provide only fair sites for residences and other buildings because of their moderately slow permeability, seasonal high water table and slow surface runoff of meltwater in the spring. The general suitability of these soils for foundations for low buildings is fair. Bearing capacity of the medium member is fair and that of the moderately fine member is fair to poor due to their higher clay content. Susceptibility to frost action in all of these soils is high. If they are used for low building foundations, granular fill material should be used to raise the foundations above the water table.

The soils in this group have severe limitations as fields for septic tanks. If they are used for this purpose, the distribution lines may be saturated for significant periods during periods of high rainfall. The soils in this group are:

(5A) MEDIUM

Taggart Tg
All phases of Taggart:
e.g. undulating, saline phase Tg/xcxs
Torcan Tc
All phases of Torcan:
e.g. undulating phase Tc/xcxx

(5B) MODERATELY FINE

Charman Cm
All phases of Charman:
e.g. undulating phase Cm/xcxx
Prodan Pr
All phases of Prodan:
e.g. slightly saline phase Pr/xxxs

GROUP 6

This group consists of well drained, medium to moderately fine textured till soils; thin, well drained fine textured soils overlying till, thin, very coarse overlying medium to moderately fine soils, moderately fine to moderately coarse textured soils overlying till and thin well drained coarse textured soils overlying the till. The condition of stoniness is common on these soils and variable. A stony, gravelly lag or lense frequently is found in the upper few inches of the till soils or at the contact of the overlay and the underlying till. Included in this group are the soils having a gravel layer of 10 to 40 cm between the overlay and till below. The subsurface layers in this group of soils are relatively uniform; they are quite hard when dry and firm when moist. Workability as construction material varies from fair to poor with degree of stoniness. Permeability is moderately slow to slow. The water table is not generally a problem in these soils. These soils are subject to erosion and are characterized by topographic variation which demands greater precautions in development.

The agricultural suitability of these soils ranges from good to poor for the till soils depending on the degree of surface stoniness. The thin gravelly deposits over the till are somewhat droughty. The fine textured soils over till have

variable problems of tilth and stoniness. The thin, moderately fine to moderately coarse textured soils over till are the best suited for agriculture in this group.

The till soils in this group and the subsurface materials of the thin overlay soils, all have fair bearing capacity when used as foundations for buildings. These soils have a moderately high to high shrink-swell potential and have a moderately high susceptibility to frost action.

The till soils and the fine textured soils over till have a fair suitability for septic tank fields because of their moderately slow permeability. The thin, coarse textured soils over till have moderate limitations to use as filter fields as there is usually only a shallow depth of rapidly permeable surface material overlying a moderately slow permeable substrate. The thin moderately fine to moderately coarse textured soils over till are the best suited for septic tank fields in this group.

The till soils and the thin, fine textured soils over till are good for landscaping where surface stones have been removed. This is the case, also with the moderately fine to moderately coarse textured soils over till. In landscaping the thin, coarse textured soils over till, a top dressing of loamy material is needed and some irrigation may be required to overcome seasonal droughtiness. The soils are:

(6A) TILL

Hilton Hn
All phases of Hilton:
e.g. moderately eroded, gently rolling, very stony phase Hn/2d3x
Bermont Bm
All phases of Bermont:
e.g. moderately eroded, undulating, slightly stony phase Bm/2c1x
Cordova Cv
All phases of Cordova:
e.g. slightly eroded, undulating phase Cf/1cxx
Rufford Rf
All phases of Rufford:
e.g. slightly eroded, undulating, slightly stony phase Rf/1c1x
Madill Md
All phases of Madill:
e.g. gently rolling, slightly stony phase Md/xd1x
Statley Sy
All phases of Statley:
e.g. slightly eroded, gently rolling, slightly stony phase Sy/1d1x
Stewart St
All phases of Stewart:
e.g. slightly eroded, slightly stony phase St/1x1x
Woodfield Wf
All phases of Woodfield:
e.g. moderately eroded, undulating, moderately stony phase Wf/2c2x

(6B) VERY COARSE/TILL

Chater Ch
All phases of Chater:
e.g. slightly eroded, undulating phase Ch/1cxx

(6C) COARSE/TILL

Kirkness Kk
All phases of Kirkness:
e.g. undulating phase Kk/xcxx

(6D) MODERATELY COARSE/TILL

Lockhart Lk
All phases of Lockhart:
e.g. slightly eroded, undulating, slightly stony phase Lk/1c1x

(6E) MEDIUM-MODERATELY FINE/VERY COARSE/TILL

Dogand Dg

(6F) MEDIUM-MODERATELY FINE/TILL

Chambers Cb
All phases of Chambers:
e.g. slightly eroded, gently rolling, slightly stony phase Cb/1d1x
Clementi Ct
All phases of Clementi:
e.g. undulating, slightly stony phase Ct/xc1x
Kleysen Ky
All phases of Kleysen:
e.g. slightly eroded phase Ky/1xxx
Roddan Rd
All phases of Roddan:
e.g. slightly eroded, gently rolling, slightly stony phase Rd/1d1x

(6G) FINE/TILL

Everton Ev
All phases of Everton:
e.g. slightly eroded phase Ev/1xxx

(6H) VERY COARSE/MEDIUM-MODERATELY FINE

Allard Al
All phases of Allard:
e.g. slightly eroded, undulating, very stony phase Al/1c3x
Axford Ax
All phases of Axford:
e.g. gently rolling phase Ax/xdxx

GROUP 7

The soils in this group are the imperfectly drained, medium to moderately fine textured till soils and thin (25 to 60 cm) imperfectly drained very coarse, coarse, moderately coarse, medium and moderately fine textured till substrate soils. A stony, gravelly lag may occur in the upper few inches of the tills and at the contact of the underlying till in the case of the soils with overlays. The subsurface layers in this group of soils are relatively uniform; they are quite hard when dry and firm when moist. Workability as construction material varies from fair to poor with the degree of stoniness. Permeability varies from rapid to moderately slow in all the subsurface materials. All the soils of this group have a seasonal high water table.

The agricultural suitability of these soils ranges from good to poor for the till soils, depending on the amount of surface stoniness, erosion and topography. The thin overlays on till have agricultural suitability ratings of fair to poor for the coarser textured overlays, and good to very good for the medium to moderately fine textured overlays. The saline phases are not suited to growing cultivated crops, but salt tolerant forage species can be grown.

Soils in this group make fair to poor sites for buildings because of seasonal high water table and slow runoff of meltwater in the spring. If these soils are used as building sites, some fill should be provided to raise the foundations above the spring water level and some artificial drainage should be provided. The subsurface material in all these soils has fair bearing capacity for foundations. They have a moderately high to high shrink-swell potential and have a high susceptibility to frost action.

These soils are not generally suitable for septic tank filter fields because of their high water table during spring runoff and the moderately slow permeability of the substrate materials.

It may be necessary to remove surface stones in order to landscape these soils. A loamy top dressing is needed to establish grass seeding or sodding on the coarse to moderately coarse till substrate soils and some artificial drainage may be needed during the spring runoff on all the soils. The soils are:

(7A) TILL

Barwood Bw
All phases of Barwood:
e.g. slightly eroded, moderately stony phase Bw/1x2x
Varcoe Vr
All phases of Varcoe:
e.g. slightly eroded, gently rolling phase Vr/1dxx
Wesley Ws
All phases of Wesley:
e.g. slightly eroded, undulating, very stone phase Ws/1c3x

(7B) VERY COARSE/TILL

Barager Bg

(7C) COARSE/TILL

Killeen Kn

(7D) MODERATELY COARSE/TILL

Lindstrom Ld
All phases of Lindstrom:
e.g. saline phase Ld/xxxs

(7E) MEDIUM TO MODERATELY FINE/TILL

Beresford Bd
All phases of Beresford:
e.g. slightly eroded, undulating, slightly stony phase Bd/1c1x
Cobfield Cf
All phases of Cobfield:
e.g. undulating, slightly stony phase Cf/xc1x

(7F) VERY COARST/MEDIUM TO MODERATELY FINE

Boswell Bo
undulating phase Bo/xcxx

(7G) MEDIUM-MODERATELY FINE/VERY COARST/TILL

Melland Ml
All phases of Melland:
e.g. very stony phase Ml/xx3x

GROUP 8

This group consists of imperfectly drained clay soils over till. They are characterized by a thin (usually 25 to 75 cm thick) fine textured surface layer overlying glacial till. the subsurface layers in this group of soils are relatively uniform; they are quite hard when dry and firm when moist. Workability as construction material varies from fair to poor depending on the degree of stoniness. Permeability is slow. These soils occur on nearly level to gently undulating terrain. Surface drainage is moderately slow, the waters collecting in the swale position.

The agricultural suitability of these soils ranges from good to poor, depending on the degree of surface stoniness, frequency of ridge and swales, and adequacy of artificial drainage. Stoniness,

topographic pattern, relatively small areas of uniform soil and in some cases wetness makes these soils range from fair to poor for building sites.

The bearing capacity of these soils when used as foundations for buildings range from fair to poor, depending on the degree of wetness. All of the soils in this group have a moderately high to high shrink-swell potential and have moderately high susceptibility to frost action. Artificial drainage is usually required in these complex areas.

These soils are not generally suitable for septic tank fields because of the small areas of uniform soil, their slow permeability, and their variable drainage condition related to topographic pattern. The soils included in this group are:

(8A) FINE/TILL

Forrest Ft
slightly saline phase Ft/xxxs
Justice Js
slightly saline phase Js/xxxs

Group 9

This group of moderately well drained, fine textured (clayey) soils have developed on thick, stratified, clayey deposits. They occur on nearly level to gently undulating terrain, have slow to very slow permeability and high moisture retention capacity. Runoff is moderately slow.

These fertile agricultural soils only provide poor to fair sites for housing areas. These clayey soils with a high shrink-swell potential are also susceptible to frost action. Their trafficability depends entirely on moisture content, ranging from poor when saturated to good when dry.

These soils are not suitable for septic tank disposal fields because of their very slow rates of effluent absorption. On-site sewage systems would require the use of sand and gravel filters to ensure satisfactory service. Disposal fields would require large sized lots. Intensive development would necessitate use of communal collection systems and lagoons. Soils in this group are adapted to landscaping, establishment of lawns and gardens. The soils are:

(9A) FINE

Bankton Ba
All phases of Bankton:
e.g. slightly eroded, undulating phase Ba/1cxx
Janick Jk

GROUP 10

This group consists of imperfectly drained clay soils. The soils occur on level to gently undulating terrain, have slow to very slow permeability and high moisture retention capacity. Runoff is slow and ponding in the spring and after heavy summer rains is common. The groundwater table will occur within five feet of the surface during the spring runoff period and gradually recede to below seven feet by mid summer. The sediments on which these soils have developed are frequently stratified with sandy loam to silty clay textured layers.

These are good agricultural soils if adequately drained. They are only fair for use as building sites. Their bearing capacity depends entirely on water content; good when dry and poor when saturated. They have a high shrink-swell potential and susceptibility to frost action is also high. If these soils are used for residential or commercial construction, fill material should be used to raise the foundation above the water table. Artificial drainage must be provided.

These soils are not suitable as fields for septic tanks because of their very slow permeability and high water table during spring runoff.

These soils are good for landscaping, including grass seeding and sodding for lawns and the planting of shrubs and trees. The clay textured surface layers are difficult to work as garden soil because of their plastic, sticky condition when wet and very hard, cloddy condition when dry. The soils are:

(10A) FINE

Harding Hg
All phases of Harding:
e.g. slightly saline phase Hg/xxxs
Sigmund Sg
slightly saline phase Sg/xxxs

GROUP 11

This group consists of moderately well drained, fine textured alluvial soils, found mainly along the smooth to very gently sloping levees. These soils are subject to slight periodic flooding, usually during the spring runoff. These soils are characterized by stratified layers of sediment that range from medium to moderately fine in texture. Permeability is moderately slow to very slow. They may have a high water table during spring.

These soils are excellent agricultural soils.

Soils in this group, however, provide only fair sites for building foundations. They have fairly good drainage, good to fair bearing strength and moderately high to high shrink-swell potential. They are susceptible to frost action. Their workability as building material is good.

These soils are only fair for septic tank fields, because of the heterogenous nature of the sediments and their moderately slow to very slow permeability. Percolation tests to determine their

absorptive capacity for sewage effluent are necessary before a septic tank is installed. These are excellent soils for landscaping. The soils are:

(11A) FINE

Manson Mn

GROUP 12

This group consists of imperfectly drained, medium to fine textured alluvial soils. They have a seasonal high water table and are subject to periodic flooding, during the spring runoff and in periods of high rainfall. They are characterized by strata that range in texture from moderately coarse to fine. Permeability is moderately slow to very slow.

Some of these soils flood infrequently and are good agricultural soils.

Soils in this group make poor sites for buildings and septic tank fields because of flooding and wetness. Bearing capacity is fair to poor and the shrink-swell potential is moderately high to high. Permeability is slow to very slow. Some areas may have value as parks and recreational areas. Most of these soils are still heavily treed and are suitable for wildlife habitat. Sites that are flooded infrequently make fair campsites and picnic areas. The soils are:

(12A) FINE

Assiniboine As

(12B) MEDIUM

Levine Lv
undulating phase Lv/xcxx

GROUP 13

This group consists of poorly to very poorly drained alluvial soils. All of these soils occur in depressions and have a high water table. Unless artificially drained they are seasonally ponded, and are subject to flooding throughout the year. Texture in the strata range from moderately coarse to fine. Bearing strength, permeability, shrink-swell potential and workability all depend on clay content and degree of wetness.

The agriculture suitability of these soils, even with artificial drainage is poor because of the continuous flooding hazard.

These soils make very poor sites for buildings because of wetness. Susceptibility to frost action is high, largely because of wetness. If these soils are used for buildings, fill material should be used to raise foundations above the water level. Artificial drainage must be provided. Trafficability of the soils is very poor.

These soils are not suitable as fields for septic tanks. If they are used for this purpose, districution lines will be below the water table for long periods.

These soils, because they occur in bottom land along rivers and streams, can be developed as habitat for wildlife and may have some value for parks and recreation. The soils are:

(13A) MEDIUM

Basker Bk
All phases of Basker:
e.g. undulating phase Bk/xcxx

(13B) FINE

Kerran Kr

GROUP 14

This group consists of poor to very poorly drained soils, developed on till, on coarse to fine material, on coarse to fine material over till, on moderately coarse to moderately fine over very coarse and on medium to moderately fine over coarse. Saline members are included. All of these soils occur in depressional areas and have a high water table over most of the year. Unless artificially drained, they are seasonally ponded. A few of these soils have a surface layer of peat up to sixteen inches (40 cm) thick, which is unstable and highly compressible. The bearing strength, permeability, shrink-swell potential and workability of these soils all depend on the clay content and the degree of wetness.

The agricultural suitability of these soils ranges from poor to fair, dependent on the amount of artificial drainage carried out and the degree of surface stoniness.

These soils make very poor sites for buildings because of wetness. If these soils are used for buildings, fill material must be added to raise the foundations above the water table. Artificial drainage must be provided. Susceptibility to frost action is high in these soils. Trafficability of all the soils is poor.

The soils in this group are not suitable as filter fields for septic tanks. If they are used for this purpose, the distribution lines will be below water for long periods.

The soils are poor for landscaping due to wetness. Some of these soils may be improved through use of ponds and dugouts for wildlife and for recreational value. The soils belonging to this group are:

(14A) TILL

Hickson Hk
slightly saline phase Hk/xxxs

(14B) MODERATELY COARSE/VERY COARSE

Bornett Bt
very stony phase Bt/xx3x

(14C) MEDIUM-MODERATELY FINE/VERY COARSE

Carvey Cy
moderately saline phase Cy/xxxt

(14D) MEDIUM-MODERATELY FINE/VERY COARSE/TILL

Marsden Mr
slightly saline phase Mr/xxxs

(14E) COARSE

Fortin Fr[1]
Mockry Mk
Sewell Sw
All phases of Sewell:
e.g. moderately saline phase Sw/xxxt

(14F) MODERATELY COARSE

Poolex Po
slightly saline phase Po/xxxs

(14G) MEDIUM

Vordas Vs
All phases of Vordas:
e.g. slightly saline phase Vs/xxxs

(14H) MODERATELY FINE

Tadpole Td
All phased of Tadpole:
e.g. peaty phase Tdp

(14I) FINE

Lowton Lt
All phases of Lowton:
e.g. moderately saline phase Lt/xxxt

(14J) MODERATELY COARSE/MODERATELY FINE

Lonery Ln
slightly saline phase Ln/xxxs

(14K) MEDIUM-MODERATELY FINE/TILL

Vodroll Vf
All phases of Vodroff:
e.g. moderately saline phase Vf/xxxt

(14L) FINE/TILL

Fenton Fn
slightly saline phase Fn/xxxs

(14M) MEDIUM/COARSE

Grayson Gn

(14N) MODERATELY FINE/COARSE

Sutton Su
slightly saline phase Su/xxxs

GROUP 15

This group consists of poorly to very poorly drained, deep organic soils underlain by sandy textured lacustrine deposits. All of these soils occur in depressions and have a very high water table. Unless they are artificially drained the water table remains at or near the surface throughout the year. The underlying mineral material is generally much below 1 meter of the surface. The peat material in these soils is unstable and very compressible.

These soils make very poor building sites due to extreme wetness and the unstable nature of the organic materials. Trafficability of this soil is poor. If used for roadways, the organic materials must be removed and sufficient fill added to raise the grade above the water table.

These soils are not suitable as fields for septic tanks.

Areas of these soils are suited as habitat for wildlife. The soil in this group is:

(15A) ORGANIC DEEP

Xavier Xv

F. SOILS AND RECREATION

This section is designed to help determine the suitability of the various soils in the map area for recreational development[1]. All soils can be used for recreational activities of some kind. Some soils are well suited for campsites, picnic areas, cabin sites, play areas, or natural study areas, whereas other soils are poorly suited for these uses.

Soils and their properties determine, to a large degree, the type and location of recreational facilities. The effects of a given soil quality often vary with different uses. The following are some of the soil qualities that singly or in combination with others commonly affect recreational uses of soils.

Soils subject to flooding have severe limitations for use as sites for camps and most recreation

[1] Guidelines and criteria used in this interpretive classification are taken from Chapter 10, "Use of Soil Surveys in Planning for Recreation", by P.H. Montgomery and F.C. Edminster in *Soil Surveys and Land Use Planning*, Bartelli, L.J., (ed) et al., Soil Science Society of America and American Society of Agronomy, 1966.

buildings. If soils subject to flooding are not protected by dikes, levees, or other flood prevention structures, they should not be developed for campsites or vacation cottages. These soils may be better suited for hiking or nature study areas, for for greenbelt open space, if the flooding is not too frequent.

Soils that are wet for all or most of the year, even if they are not flooded, are not suitable for campsites, recreational roads and trails, playgrounds, and picnic areas. Soils that are wet only part of the year or those that have a water table that moves up and down without reaching the surface are not easily detected by most people. These soils have severe limitations for most recreational uses. Soils that dry out slowly after rains present problems where intensive use is contemplated.

Droughty soils also have limitations for many recreational uses. On such sites, grass cover needed for playing fields is difficult to develop and manage. Access roads may be excessively dusty. Knowledge of these soil problems enables planners to use corrective conservation practices, such as irrigation, or to choose alternative locations.

The ability of a soil to support a load is important in many kinds of recreational activities. Some soils when wet fail to support structures such as access roads, trails, and buildings.

Slope affects the use of soils for recreation. Nearly level, well drained, permeable, stone-free soils have few or no limitations for use as playgrounds, campsites, sites for recreational buildings, roads, and trails. Soils with steep slopes often have severe limitations for most recreational uses. On the other hand, steeply sloping soils are essential for ski runs and are desirable for hiking areas, scenic values, and vacation cottage sites "with a view". Of course, deep, gently sloping, and moderately sloping soils can be leveled for campsites, playgrounds, and building sites where the cost is justified. Even on steep slopes the high cost of overcoming slope limitations is often justified. Then, it is especially urgent that effective soil conservation practices be applied based on the specific conditions.

Soil depth affects many uses. Soils underlain by bedrock at shallow depths cannot be leveled for playgrounds and campsites except at high cost. Roads, trails, and basements are very difficult to construct on these soils. It is difficult to establish vegetation on soils shallow to clay or rock thus making them poor locations for playing fields and other intensive use areas.

Surface soil texture is an important quality. High sand or clay content in the surface soils is undesirable for playgrounds, campsites, or other uses that involve heavy foot traffic by people or horses. Soils high in clay become sticky when wet and do not dry out quickly after rains. On the other hand, loose sandy soils are undesirable as they are unstable when dry. Sandy loam and loam surface textured soils having other favorable characteristics are the most desirable for recreational uses involving heavy use by people.

The presence of stones, rocks, cobbles, or gravel limits the use of some soils for recreational uses. Very stony, stony, rocky, or gravelly soils have severe to moderate limitations for use as campsites and playgrounds. In some instances it is feasible to remove the stones, thus eliminating the hazard. Rounded gravels present hazards on steeply sloping soils used for foot trails.

Sanitary facilities are essential for most modern recreational areas and septic tanks are often the only means of waste disposal. Some soils absorb septic tank effluent rapidly and other soils absorb it very slowly. Soils that are slowly permeable, poorly drained, shallow to rock, subject to flooding, or steeply sloping all have severe limitations for septic tank filter fields. In some cases where soils cannot handle the volume of waste involved, sewage lagoons can be used. These also are feasible only in soils that meet their special requirements.

Productive capacity of soils for vegetation of different kinds is closely related to the feasibility of many recreation enterprises. The ability of soils to grow sods that can take concentrated human traffic has already been noted as a factor in such areas as playgrounds and campsites. The development of such vegetative conservation practices as shade tree plantings, living fences, plant screens, and barriers to trespass is guided by soil conditions. The capacity of an area to produce economically harvestable crops of game is dependent, in part, on the productive ability of its soils.

Impounded waters reflect, in considerable measure, the kinds of soils beneath and above (on the watershed). Fertile soils, or soils capable of effective use of artificial fertilizers, generally make fertile waters. And fertile waters produce good fish crops which, with good management, product good fishing. On the other hand, extremely acid soils associated with a proposed water impoundment may be a critical limitation to the development of good fishing.

Thus we find that basic soil qualities and characteristics are closely associated with the various types of outdoor recreation activities. By knowing the characteristics and qualities of the different kinds of soils and their behavior, soil scientists and other specialists can develop soil interpretations for recreational uses. Interpretations for recreational uses can best be made loc-

ally by those familiar with the soils and conditions in the area. Soils in an area are normally grouped into three or five groups according to their limitations for a specific recreational use.

In Table 10 each soil in the map area is rated according to its soil features for a specific recreational use. The various features of each soil which are limitations affecting recreational use are listed in the last column. The ratings are based on soil features alone, and do not include aesthetic, economic or other physical considerations that may be important in selecting an area for the purpose stated. A rating of *none to slight* means the soil is suitable for the particular use; a rating of *moderate* indicates that the soil has limitations in use but that it can be used under good management; a rating of *severe* means that the soil has limiting characteristics that make its use for recreation purposes unsound or very expensive. Use of these soils often requires major soil reclamation work. In the following paragraphs, some limitations of soils for selected recreational uses are given.

1. SOIL LIMITATIONS FOR INTENSIVE PLAY AREAS

The ratings for this recreation purpose apply to areas to be developed for playgrounds, fields for baseball, football, tennis and similar organized games. These areas generally require a nearly level surface, good drainage, freedom from flooding and a soil texture and consistence that give a firm surface and will support intensive foot traffic.

2. SOIL LIMITATIONS FOR PICNIC AREAS SUBJECT TO INTENSIVE USE

These ratings are based on soil features only and do not consider other features such as shade trees and the number of lakes in an area which may affect the desirability of a site. The most desirable soil areas for this use have good drainage, not subject to flooding and are reasonably level and provide good footage.

3. SOIL LIMITATIONS FOR INTENSIVE CAMP AREAS

The ratings used apply to the suitability of soils as campsites for tents and trailers. The accompanying activities for outdoor living are also considered. These areas should require little site preparation to be made suitable for unsurfaced parking of cars and trailers and for heavy traffic by people and vehicles. The most desirable sites for intensive camp areas are level to gently sloping, have good drainage not subject to flooding, provide good footage in all kinds of weather and are not subject to blowing.

4. SOIL LIMITATIONS FOR PATHS AND TRAILS

These soil ratings apply to areas that are to be used for trails, cross-country hiking, bridle paths and nonintensive uses that allow for random movement of people. It is assumed that for these uses, the soil areas are to remain as they occur in nature. Characteristics considered are degree of wetness, degree of slope, soil texture and susceptibility to flooding. Soils such as swamps, marches, peat bogs and other poorly drained areas are considered to have a very severe limitation for this use.

5. SOIL LIMITATIONS FOR BUILDINGS IN RECREATIONAL AREAS

The ratings in Table 10 give preliminary information on the suitability of the soils for building sites. Detailed investigations are usually required for selection of a specific building site. More information about the suitability of the soils for building purposes is given in Section D, Engineering Interpretations, and Section E, Soils and Community Development. Soils that are most desirable for building sites in recreational areas have good drainage, are nearly level to gently sloping and are not subject to flooding.

G. THE ENGINEERING SIGNIFICANCE OF PEDOLOGY

Both Geological and Pedological Sciences identify soil deposits and soil profiles as they exist in the field. The nomenclature used in Surficial Geology defines the general characteristics of the sedimentary materials overlying the bedrock, that of Pedology further subdivides those sediments which constitute the parent material, primarily on the basis of chemical composition, and drainability.

Thus, the geological terms for a certain deposit may be "lacustrine silt", whereas the pedological designation for soil developed on this same deposit may recognize "Fairland Series — lacustrine, medium textured, moderately calcareous, well drained", or "Taggart Series — lacustrine, medium textured, moderately calcareous, imperfectly drained".

There is no conflict here between geology and pedology; rather, one science compliments the other and for the engineer concerned with the soil, pedology provides a very useful additional tool. To show how this can be effectively used, some of the fundamentals of the science as it can be applied to engineering are discussed below.

TABLE 10. Ratings and Limitations of Soils in the Brandon Map Area for Recreational Purposes.

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Am	Ashmore, loamy very fine sand	Moderate	Moderate	Moderate	None to slight	None to slight	Subject to droughtiness, vegetation cover may be difficult to maintain
Am/xcxx	Ashmore, undulating						
Am/1c1x	Ashmore, slightly eroded, undulating, slightly stony						
Am/xd1x	Ashmore, gently rolling, slightly stony						
Am/2xxx	Ashmore, moderately eroded	Severe	Moderate	Moderate	Moderate	None to slight	Moderately eroded, vegetation cover difficult to maintain, subject to erosion
Am/2cxx	Ashmore, moderately eroded, undulating						
Am/xd2x	Ashmore, gently rolling, moderately stony	Moderate	Moderate	Moderate	None to slight	Moderate	Gently rolling, moderately stony, as for Am
Am/1c3x	Ashmore, slightly eroded, undulating, very stony	Severe	Moderate	Severe	Moderate	Severe	Very stony, as for Am
Am/2f1x	Ashmore, moderately eroded, strongly rolling, slightly stony	Severe	Severe	Severe	Severe	Severe	Strongly rolling topography, moderately eroded, as for Am
Az	Arizona, loamy fine sand	Severe	Severe	Severe	Severe	None to slight	Very high sand content, droughtiness, difficult to maintain adequate vegetation; subject to blowing if relatively open and disturbed
Az/xcxx	Arizona, undulating						
Az/xdxx	Arizona, gently rolling						
Az/odxx	Arizona, overblown gently rolling						
As	Assiniboine, silty clay	Severe	Severe	Severe	Severe	Severe	Subject to flooding, very slippery when wet, low bearing capacity
Ax	Axford, loamy medium sand	Moderate	Moderate	Moderate	Moderate	None to slight	High sand content, subject to drought, vegetation cover may be difficult to maintain
Ax/xdxx	Axford, gently rolling						
Ax/xexx	Axford, moderately rolling	Severe	Moderate	Moderate	Moderate	Moderate	Moderately rolling, vegetation may be difficult to maintain
Ba	Bankton, clay	Severe	Moderate	Severe	Severe	Severe	Very slippery when wet, highly plastic high shrink-swell
Ba/1cxx	Bankton, slightly eroded, gently sloping						
Bd	Beresford, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Plastic, slippery when wet, somewhat poorly drained

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Bd/1xxx	Beresford, slightly eroded						
Bd/xx1x	Beresford, slightly stony						
Bd/xx2x	Beresford, moderately stony						
Bd/xxxs	Beresford, slightly saline	Severe	Severe	Severe	Severe	Severe	Slightly to moderately saline, salt will affect vegetation growth, slippery when wet, low bearing capacity when wet
Bd/xx1s	Beresford, slightly stony, slightly saline						
Bd/1xxs	Beresford, slightly eroded, slightly saline						
Bd/1cxx	Beresford, slightly eroded, gently sloping	Severe	Severe	Severe	Severe	Severe	Area subject to lateral seepage and perched water table, slippery when wet, low bearing strength when wet
Bd/1c1x	Beresford, slightly eroded, gently sloping, slightly stony						
Bd/xc1x	Beresford, gently sloping, slightly stony						
Bd/xDxx	Beresford, moderately sloping						
Bg	Barager, loamy sand	Moderate	Moderate	Moderate	Moderate	Moderate	High sand content, good bearing strength
Bk	Basker, silty clay loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, subject to flooding
Bk/xxxs	Basker, slightly saline						
Bm	Bermont, clay loam	Moderate	Moderate	Moderate	Moderate	Slight to moderate	Moderate plasticity, slippery when wet, low bearing strength when wet
Bm/xx1x	Bermont, slightly stony						
Bm/1x1x	Bermont, slightly eroded, slightly stony						
Bm/xc3x	Bermont, undulating, very stony	Severe	Moderate	Severe	Moderate	Severe	Very stony, moderate plasticity
Bm/xdxx	Bermont, moderately sloping	Moderate to severe	Moderate	Moderate	Moderate	Moderate	Moderately sloping, as for Bm
Bn	Brownridge, very fine sandy loam	Severe	Severe	Severe	Severe	Moderate	Surface eroded, difficult to establish and maintain vegetation, subject to wind erosion
Bn/xcxx	Brownridge, undulating						
Bn/xdxx	Brownridge, gently rolling						
Bo	Boswell, fine sandy loam	Moderate	Moderate	Moderate	Moderate	Moderate	Somewhat poorly drained

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Bo/xcxx	Boswell, gently sloping						
Br	Barren, silty clay loam	Severe	Severe	Severe	Severe	Moderate	Surface eroded, slippery when wet, moderate plasticity, subject to further erosion, difficult to maintain vegetation
Br/xcxx	Barren, undulating						
Br/xdxx	Barren, gently rolling	Severe	Severe	Severe	Severe	Moderate	Moderately and strongly sloping in rolling topography; as above
Bt	Bornett, fine sandy loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, low bearing strength
Br/xexx	Barren, moderately rolling						
Bt	Bornett, fine sandy loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, low bearing strength when wet
Btp	Bornett, peaty						
Bt/xx3x	Bornett, very stony	Severe	Severe	Severe	Severe	Severe	Very stony; as above
Bw	Barwood, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Somewhat poorly drained, moderate plasticity, slippery when wet, some stones
Bw/xx1x	Barwood, slightly stony						
Bw/xx2x	Barwood, moderately stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate	Moderately stony; as above
Bw/1x2x	Barwood, slightly eroded, moderately stony						
Bw/xxxs	Barwood, slightly saline	Severe	Severe	Severe	Severe	Severe	Soil contains appreciable soluble salts, will affect growth of vegetation, area subject to seepage
Cb	Chambers, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Slippery when wet, moderate plasticity, moderately well drained
Cb/1xxx	Chambers, slightly eroded						
Cb/1cxx	Chambers, slightly eroded, undulating						
Cb/1c1x	Chambers, slightly eroded, undulating, slightly stony						
Cb/2cxx	Chambers, moderately eroded, undulating	Severe	Severe	Severe	Severe	Moderate	Moderately eroded, difficult to maintain vegetation; as above
Cb/2dxx	Chambers, moderately eroded, gently rolling						
Cb/1d1x	Chambers, slightly eroded, gently rolling, slightly stony	Moderate to severe					Gently rolling topography, slightly eroded, as for Cb

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Cb/1dxx	Chambers, slightly eroded, gently rolling						
Cb/1exx	Chambers, slightly eroded, moderately rolling	Severe	Moderate	Moderate	Moderate	Moderate	Moderately rolling topography, slightly eroded, as for Cb
Cb/1elx	Chambers, slightly eroded, moderately rolling, slightly stony						
Cb/xfxx	Chambers, steeply sloping	Severe	Severe	Severe	Severe	Severe	Steeply to very strongly sloping, slippery when wet, as for Cb
Cb/xgxx	Chambers, very strongly sloping						
Cc	Cactus, loamy fine sand	Severe	Severe	Severe	Moderate to severe	None to slight	High sand content, subject to drought, may be difficult to maintain vegetation, soils subject to blowing if disturbed
Cc/1xxx	Cactus, slightly eroded						
Cc/1cxx	Cactus, slightly eroded, undulating						
Cc/2xxx	Cactus, moderately eroded	Severe	Severe	Severe	Severe	Moderate	Moderately eroded, subject to blowing difficult to maintain or establish vegetation
Cc/2cxx	Cactus, moderately eroded, undulating						
Cc/1Dxx	Cactus, slightly eroded, moderately sloping	Severe	Severe	Severe	Moderate to severe	Moderate	Moderately sloping topography, slightly eroded, as for Cc
Cc/1dxx	Cactus, slightly eroded, gently rolling						
Cf	Cobfield, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, moderate plasticity, slippery when wet, low bearing strength when wet, some stones
Cf/xx1x	Cobfield, slightly stony						
Cf/1xxx	Cobfield, slightly eroded						
Cf/1x1x	Cobfield, slightly eroded, slightly stony						
Cf/xx2x	Cobfield, moderately stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate (without basements)	Moderately stony; as above
Cf/1x2x	Cobfield, slightly eroded, moderately stony						
Cf/xc3x	Cobfield, gently sloping, very stony	Severe	Severe	Severe	Severe	Severe	Very stony, lower slope of undulating topography subject to lateral water seepage, low bearing strength and slippery when wet

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Ch	Chater, loamy sand	Moderate to severe	Moderate	Moderate	Moderate	Slight	High sand content, subject to droughtiness, difficult to maintain vegetation cover
$Ch/_{1xxx}$	Chater, slightly eroded						
$Ch/_{xx1x}$	Chater, slightly stony phase						
$Ch/_{xcxx}$	Chater, undulating						
$Ch/_{1cxx}$	Chater, slightly eroded, undulating						
$Ch/_{xx2x}$	Chater, moderately stony	Severe	Moderate	Moderate	Moderate	Moderate	Moderately stony; as above
$Ch/_{1d2x}$	Chater, slightly eroded, gently rolling, moderately stony						
$Ch/_{xdxx}$	Chater, gently rolling	Severe	Moderate	Moderate	Moderate	Slight	Gently rolling, as for Ch
$Ch/_{1dxx}$	Chater, slightly eroded, gently rolling						
$Ch/_{2e2x}$	Chater, moderately eroded, moderately rolling, moderately stony	Severe	Severe	Severe	Severe	Moderate	Moderately stony, moderately rolling, eroded; subject to blowing and erosion, as for Ch
Ck	Crookdale, sandy clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (if without basements)	Moderate plasticity, slippery when wet, seasonal water table within 1 m
Cl	Carroll, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Slippery when wet, moderate plasticity, low to medium bearing strength
$Cl/_{1cxx}$	Carroll, slightly eroded, undulating						
$Cl/_{2cxx}$	Carroll, moderately eroded, undulating	Severe	Moderate	Severe	Severe	Moderate	Moderately eroded, slippery when wet, undulating to gently rolling topography
$Cl/_{2dxx}$	Carroll, moderately eroded, gently rolling						
Cm	Charman, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, moderate plasticity, low bearing capacity when wet, slippery when wet
$Cm/_{1xxx}$	Charman, slightly eroded						
$Cm/_{xcxx}$	Charman, gently sloping						
$Cm/_{xxxs}$	Charman, slightly saline	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Soil contains appreciable soluble salts that affect vegetation growth, sulfate hazard to foundations; as above

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Cp	Capell, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Somewhat poorly drained, slippery when wet, moderate plasticity
$Cp/_{1xxx}$	Capell, slightly eroded						
$Cp/_{xx1x}$	Capell, slightly stony						
$Cp/_{1cxx}$	Capell, slightly eroded, gently sloping						
$Cp/_{xx2x}$	Capell, moderately stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate	Moderately stony, as above
$Cp/_{xxxs}$	Capell, slightly saline	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Appreciable salts affect vegetation, high seasonal groundwater and seepage, low bearing strength
$Cp/_{xxxt}$	Capell, moderately saline						
Cr	Croyon, loam	Slight	Slight	Slight	None to slight	None to slight	Good drainage, good bearing strength, some droughtiness
$Cr/_{xcxx}$	Croyon, undulating	Moderate	Slight	Slight	Slight	Slight	Undulating topography, as above
$Cr/_{1cxx}$	Croyon, slightly eroded, undulating						
$Cr/_{xc2x}$	Croyon, undulating, moderately stony	Moderate	Slight	Slight	Slight	Slight	Undulating, moderately stony, as for Cr
$Cr/_{2f2x}$	Croyon, moderately eroded, steeply sloping, moderately stony	Severe	Severe	Severe	Severe	Severe	Steeply sloping, eroded, moderately stony
$Cr/_{2G4x}$	Croyon, moderately eroded, very steeply sloping, exceedingly stony						Very steeply sloping, exceedingly stony
Ct	Clementi, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Moderately plastic, slippery when wet, some erosion, some stones, level to undulating
$Ct/_{1xxx}$	Clementi, slightly eroded						
$Ct/_{1x1x}$	Clementi, slightly eroded, slightly stony						
$Ct/_{xx1x}$	Clementi, slightly stony						
$Ct/_{xcxx}$	Clementi, undulating						
$Ct/_{1c1x}$	Clementi, slightly eroded, undulating, slightly stony	(Moderate to severe)					
$Ct/_{xc1x}$	Clementi, undulating, slightly stony						
$Ct/_{1cxx}$	Clementi, slightly eroded, undulating						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Ct/2c1x	Clementi, moderately eroded, undulating, slightly stony	Moderate to severe	Moderate	Moderate	Moderate to severe	Moderate	Moderately eroded, undulating, stony, slippery when wet
Ct/xx2x	Clementi, moderately stony	Moderate to severe	Moderate	Moderate	Moderate	Moderate	Moderately stony, undulating, moderately plastic, slippery when wet
Ct/xc2x	Clementi, undulating, moderately stony						
Ct/1c2x	Clementi, slightly eroded, undulating, moderately stony						
Ct/xx3x	Clementi, very stony	Severe	Moderate to severe	Moderate	Moderate	Severe	Very stony, moderate plasticity slippery when wet
Ct/xdxx	Clementi, gently rolling	Severe	Moderate	Moderate	Moderate	Moderate	Gently rolling, moderately plastic, slippery when wet
Ct/12xx	Clementi, slightly eroded, gently rolling						
Ct/xx4x	Clementi, exceedingly stony	Severe	Severe	Severe	Severe	Severe	Exceedingly stony
Ct/1c4x	Clementi, slightly eroded, undulating, exceedingly stony						
Ct/xc4x	Clementi, undulating, exceedingly stony						
Ct/1exx	Clementi, slightly eroded, moderately rolling	Severe	Moderate to severe	Moderate to severe	Moderate	Moderate	Moderately rolling, slightly eroded, slippery when wet, moderately plastic
Cv	Cordova, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Moderately plastic, slippery when wet, some erosion and stones
Cv/xx1x	Cordova, slightly stony						
Cv/1x1x	Cordova, slightly eroded, slightly stony						
Cv/xcxx	Cordova, undulating						
Cv/1cxx	Cordova, slightly eroded, undulating						
Cv/1c1x	Cordova, slightly eroded, undulating, slightly stony	Moderate to severe	Moderate	Moderate	Moderate	Moderate	Slightly to moderately stony, undulating moderately plastic, slippery when wet
Cv/xc2x	Cordova, undulating, moderately stony						
Cv/1Dxx	Cordova, slightly eroded, moderately sloping	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderately to strongly sloping, slightly to moderately eroded, some stones, slippery when wet, moderately plastic

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Cv/2dxx	Cordova, moderately eroded, gently rolling						
Cv/2elx	Cordova, moderately eroded, moderately rolling, slightly stony						
Cv/2flx	Cordova, moderately eroded, steeply sloping, slightly stony	Severe	Severe	Severe	Severe	Severe	Steeply sloping in strongly rolling topography, slippery when wet, eroded, stony
Cv/1f3x	Cordova, slightly eroded, steeply sloping, very stony						
Cy	Carvey, sandy clay loam	Severe	Severe	Severe	Severe	Severe	Wetness (poor drainage), slippery when wet; salinity
Cyp	Carvey, peaty						
Cy/xxxt	Carvey, moderately saline						
Dg	Dogand, sandy loam	Slight	Slight	Slight	None to slight	Slight	Good bearing strength, good drainage
Dn	Durnan, silt loam	Moderate	Moderate	Moderate	Moderate	Moderate	Slippery when wet, high silt content
Dn/1xxx	Durnan, slightly eroded						
Dn/2xxx	Durnan, moderately eroded						
Dn/xcxx	Durnan, undulating						
Dn/1cxx	Durnan, slightly eroded, undulating						
Dn/1clx	Durnan, slightly eroded, undulating, slightly stony						
Dn/xdxx	Durnan, gently rolling	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderate	Gently rolling, slippery when wet, low bearing strength when wet, erosive
Dn/1dxx	Durnan, slightly eroded, gently rolling						
Dn/2dxx	Durnan, moderately eroded, gently rolling	Severe	Severe	Severe	Moderate to severe	Moderate	Erosive, gently rolling, slippery when wet
Dn/1exx	Durnan, slightly eroded, moderately rolling	Severe	Severe	Severe	Moderate	Severe	Strongly sloping, slippery when wet, erosive
Drl	Dorset, loamy sand, sandy subsoil	Moderate	Moderate	Moderate	Moderate	Slight	Good bearing strength, subject to droughtiness and wind erosion if exposed
Drl/xcxx	Dorset, undulating,	As above	As above	As above	As above	As above	As above

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
$Dr1/_{2dxx}$	Dorset, moderately eroded, gently rolling, sandy subsoil	Severe	Severe	Mod. to severe	Mod. to severe	Moderate	Loose sandy footage, droughty, subject to wind erosion, moderate slopes
Dt1	Dexter, loamy sand, sandy subsoil	Moderate	Moderate	Moderate	Slight	Moderate (if without basement)	Seasonal water table within 1 m, somewhat poorly drained, loose sandy footage.
Dx	Druxman, loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m
Ev	Everton, clay	Severe	Moderate	Severe	Severe	Severe	Very slippery when wet, highly plastic, high shrink-swell, subject to some surface ponding
$Ev/_{1xxx}$	Everton, slightly eroded						
Fd	Fairland, silt loam	Moderate	Moderate	Moderate	Moderate	Moderate	Slippery when wet, high silt content, low bearing strength when wet, erosive
$Fd/_{1xxx}$	Fairland, slightly eroded						
$Fd/_{xx1x}$	Fairland, slightly stony						
$Fd/_{xcxx}$	Fairland, undulating						
$Fd/_{1cxx}$	Fairland, slightly eroded, undulating						
$Fd/_{2xxx}$	Fairland, moderately eroded	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Eroded, slippery when wet
$Fd/_{xDxx}$	Fairland, moderately sloping	Moderate to severe	Moderate	Moderate	Moderate	Moderate	Moderately sloping, slippery when wet, erosive
$Fd/_{xdxx}$	Fairland, gently rolling						
Fn	Fenton, silty clay	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface
$Fn/_{xxxs}$	Fenton, slightly saline						
Fr1	Fortin, loamy sand, sandy subsoil	Severe	Severe	Severe	Severe	Severe	Poorly drained, low bearing strength when wet
Ft	Forrest, silty clay	Severe	Severe	Severe	Severe	Severe	Somewhat poorly drained, subject to some ponding, high shrink-swell
$Ft/_{xxxs}$	Forrest, slightly saline						
Gl	Glenboro, loam	Slight	Slight	Slight	Slight	Slight	Good drainage, fair to good bearing strength
$Gl/_{1xxx}$	Glenboro, slightly eroded						
$Gl/_{xcxx}$	Glenboro, undulating	Moderate	Slight	Slight	Slight	Slight	Undulating

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Gl/$_{1cxx}$	Glenboro, slightly eroded, undulating						
Gl 1	Glenboro, loamy fine sand, clayey strata	Slight to mod.	Slight to mod.	Slight to mod.	Slight to mod.	Slight	Occasional droughtiness, loose sandy footage
Gl 1/$_{xcxx}$	Glenboro, undulating, clayey strata	Moderate	Moderate	Moderate	Moderate	Slight	Undulating
Gl 1/$_{1cxx}$	Glenboro, slightly eroded, undulating, clayey strata	Moderate	Moderate	Moderate	Moderate	Slight	Undulating and slightly eroded
Gn	Grayson, silt loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface
Gnl	Grayson, loamy fine sand, clayey strata	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface
Grl	Grover, loamy fine sand, clayey strata	Moderate	Moderate	Moderate	Moderate	Moderate basement)	Seasonal water table within 1 m, loose sandy footage
Gr	Grover, loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal water table within 1 m, good permeability, slippery when wet
Gr/$_{1xxx}$	Grover, slightly eroded						
Gt	Gateside, very fine sandy loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained
Gt/$_{xxxs}$	Gateside, slightly saline	Severe	Severe	Severe	Severe	Severe	Area subject to seepage, somewhat poorly drained, maintenance of vegetation affected by soluble salts
Gz	Gendzel, loamy fine sand	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, subject to wind erosion if exposed
Gz/$_{1cxx}$	Gendzel, slightly eroded, undulating						
Gz/$_{1dxx}$	Gendzel, slightly eroded, moderately sloping	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderate to severe	Subject to seepage in the lower slopes of gently rolling topography, somewhat poorly drained
Hg	Harding, clay	Severe	Moderate	Severe	Severe	Severe	Somewhat poorly drained, subject to ponding, high shrink-swell, very slippery when wet
Hg/$_{xxxs}$	Harding, slightly saline	Severe	Severe	Severe	Severe	Severe	Area has considerable soluble salts due to seepage, very slippery when wet, vegetation affected by soluble salts
Hg/$_{xxxu}$	Harding, strongly saline						
Hk	Hickson, clay loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Hk/xxxs	Hickson, slightly saline						
Hm	Hummerston, loamy fine sand	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained, subject to wind erosion
Hm/1xxx	Hummerston, slightly eroded						
Hm/xcxx	Hummerston, undulating						
Hm/1cxx	Hummerston, slightly eroded, undulating						
Hm/xxxs	Hummerston, slightly saline	Severe	Severe	Severe	Severe	Severe	Area subject to seepage, considerable solution salts affect vegetation; sulfate hazard
Hm/2xxx	Hummerston, moderately eroded	Severe	Moderate	Moderate	Moderate	Moderate	Considerably eroded, subject to further wind erosion if not protected
Hm/1dxx	Hummerston, slightly eroded, gently rolling	Moderate to severe	Moderate	Moderate	Moderate	Moderate	Moderately sloping, intermediate to lower slopes of gently rolling, seasonal water table within 1 m
Hn	Hilton, loam	Moderate	Moderate	Moderate	Slight	Moderate	Slippery when wet, few stones on surface
Hn/1xxx	Hilton, slightly eroded						
Hn/1x2x	Hilton, slightly eroded, moderately stony	Moderate to severe	Moderate	Moderate	Slight	Moderate	Moderately stony, slippery when wet
Hn/2d1x	Hilton, moderately eroded, gently rolling, slightly stony	Severe	Moderate to severe	Moderate to severe	Slight to moderate	Moderate	Moderately eroded, gently rolling, slightly stony, slippery when wet
Hn/2d3x	Hilton, moderately eroded, gently rolling, very stony	Severe	Severe	Severe	Moderate to severe	Severe	Very stony, gently rolling, moderately eroded, slippery when wet
Jk	Janick, clay	Moderate	Moderate	Moderate	Moderate	Moderate	Moderately well drained, sticky and slippery when wet
Js	Justice, clay	Severe	Severe	Severe	Severe	Severe	Somewhat poorly drained, possibly ponding, sticky and slippery when wet soluble salts could affect vegetation cover
Js/xxxs	Justice, slightly saline						
Kk	Kirkness, loamy fine sand	Moderate	Moderate	Moderate	Moderate	Slight to moderate	High sand content, loose sandy footage, some difficulty maintaining vegetation
Kk/1xxx	Kirkness, slightly eroded						
Kk/xcxx	Kirkness, undulating						
Kk/1cxx	Kirkness, slightly eroded, undulating						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Kl	Kilmury fine sandy loam	Moderate	Moderate	Moderate	Slight	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m
Kl/xx1x	Kilmury, slightly stony						
Kl/1cxx	Kilmury, slightly eroded, undulating						
Kl/xx3x	Kilmury, very stony	Severe	Moderate	Severe	Moderate	Severe	Very stony, as above
Kn	Killeen, loamy fine sand	Moderate	Moderate	Moderate	Slight	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m, high sand content
Ko	Knolls, silt loam	Severe	Moderate to severe	Moderate to severe	Moderate	Moderate	Eroded soils, difficult to maintain vegetation, slippery when wet
Ko/xcxx	Knolls, undulating						
Ko/xdxx	Knolls, gently rolling						
Kr	Kerran, silty clay	Severe	Severe	Severe	Severe	Severe	Poorly drained, often flooded, very slippery when wet, low bearing capacity
Ky	Kleysen, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Moderately plastic, slippery when wet, some erosion
Ky/1xxx	Kleysen, slightly eroded						
Ld	Lindstrom, loamy very fine sand	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m
Ld/xxxs	Lindstrom, slightly saline	Severe	Severe	Severe	Moderate to severe	Moderate to severe	Appreciable soluble salts, difficult to landscape or maintain vegetation, sulfate hazard
Ld/1c1x	Lindstrom, slightly eroded, undulating, slightly stony	Moderate	Moderate	Moderate	Moderate	Moderate	Soils are in lower and intermediate slope positions in undulating topography, somewhat poorly drained, slightly stony, slightly eroded
Lh	Lavenham, loamy fine sand	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal water table within 1 m, high sand content, loose sandy footage
Lh/1xxx	Lavenham, slightly eroded						
Lh/1cxx	Lavenham, slightly eroded, undulating						
Lh/1fxx	Lavenham, slightly eroded, strongly rolling	Severe	Severe	Severe	Moderate to severe	Severe	Irregular slopes forming banks of stream channels, some seepage problems and stability
Lk	Lockhart, loamy very fine sand	Slight	Slight	Slight	Slight	Slight	Good drainage, good permeability

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Lk/$_{1cxx}$	Lockhart, slightly eroded, undulating	Moderate	Slight	Slight	Slight	Slight	Gently sloping, good permeability
Lk/$_{1c1x}$	Lockhart, slightly eroded, undulating, slightly stony						
Ln	Lonery, very fine sand	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface, may contain soluble salts
Ln/$_{xxxs}$	Lonery, slightly saline						
Lt	Lowton, clay	Severe	Severe	Severe	Severe	Severe	Poorly drained, high clay content, very plastic, appreciable soluble salts
Lt/$_{xxxs}$	Lowton, slightly saline						
Lt/$_{xxxt}$	Lowton, moderately saline						
Ltp/$_{xxxt}$	Lowton, peaty, moderately saline						
Lv	Levine, loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, subject to flooding
Ma	Marringhurst, loamy sand	Moderate	Moderate	Moderate	Moderate	Slight	Good bearing strength, subject to droughtiness and wind erosion if exposed
Ma/$_{1xxx}$	Marringhurst, slightly eroded						
Ma/$_{xc1x}$	Marringhurst, undulating, slightly stony						
Ma/$_{xcxx}$	Marringhurst, undulating						
Ma/$_{1cxx}$	Marringhurst, slightly eroded, undulating						
Ma/$_{2cxx}$	Marringhurst, moderately eroded, undulating	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Slight to moderate	Moderately eroded, droughty, difficult to maintain vegetation under use
Ma/$_{xdxx}$	Marringhurst, gently rolling	Severe	Moderate	Moderate to severe	Moderate to severe	Slight to moderate	Moderate slopes, somewhat droughty, particularly in west area
Ma/$_{xDxx}$	Marringhurst, moderately sloping						
Ma/$_{2dxx}$	Marringhurst, moderately eroded, gently rolling	Severe	Severe	Moderate to severe	Moderate to severe	Moderate	Loose sandy footage, droughty, moderate slopes
Ma/$_{1d2x}$	Marringhurst, slightly eroded, gently rolling, moderately stony	Severe	Moderate	Moderate	Moderate	Moderate	Moderately sloping, moderately stony, slightly eroded
Ma/$_{xd3x}$	Marringhurst, gently rolling very stony	Severe	Moderate to severe	Severe	Moderate to severe	Severe	Very stony, moderately sloping, loose sandy footage, droughty
Ma/$_{1d3x}$	Marringhurst, slightly eroded, gently rolling, very stony						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Ma/xc4x	Marringhurst, undulating exceedingly stony	Severe	Severe	Severe	Severe	Severe	Exceedingly stony, droughty
Ma/xd4x	Marringhurst, gently rolling, exceedingly stony						
Ma/xexx	Marringhurst, moderately rolling	Severe	Moderate	Moderate	Moderate	Moderate	Strongly sloping
Ma/2exx	Marringhurst, moderately eroded, moderately rolling	Severe	Severe	Moderate to severe	Moderate to severe	Moderate	Moderately eroded, possibly erosion, drought, strongly sloping
Ma/2e2x	Marringhurst, moderately eroded, moderately rolling, moderately stony	Severe	Severe	Severe	Moderate to severe	Moderate	Strongly sloping, moderately eroded, moderately stony, droughty
Ma/2f2x	Marringhurst, moderately eroded, strongly rolling, moderately stony	Severe	Severe	Severe	Severe	Severe	Steeply sloping, moderately eroded, moderately to exceedingly stony
Ma/2f3x	Marringhurst, moderately eroded, strongly rolling, very stony						
Ma/2f4x	Marringhurst, moderately eroded, strongly rolling, exceedingly stony						
Ma/2g3x	Marringhurst, moderately eroded, hilly, very stony	Severe	Severe	Severe	Severe	Severe	Very steeply sloping, moderately eroded, very to exceedingly stony
Ma/2G4x	Marringhurst, moderately eroded, very steeply sloping, exceedingly stony						
Md	Madill, loam	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Severely eroded, difficult to maintain vegetation, slippery when wet
Md/xcxx	Madill, undulating						
Md/xd1x	Madill, gently rolling, slightly stony						
Md/xc3x	Madill, undulating, very stony	Severe	Severe	Severe	Moderate to severe	Severe	Very to exceedingly stony, gently to moderately sloping
Md/xe4x	Madill, moderately rolling, exceedingly stony						
Mf	Mansfield, loamy fine sand	Moderate	Moderate	Moderate	Slight	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained, loose sandy footage

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Mf 1	Mansfield, loamy sand, clayed strata	Moderate	Moderate	Moderate	Slight	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained, loose sandy footage
Mf/xc2x	Mansfield, undulating, moderately stony	Severe	Moderate	Moderate	Moderate	Moderate (without basements)	Moderately stony, as above
Mk	Mockry, loamy fine sand	Severe	Severe	Severe	Severe	Severe	Poorly drained
Mkp	Mockry, peaty	Severe	Severe	Severe	Severe	Severe	Poorly drained
Ml	Melland, loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal perched water condition within 1 m
Ml/xx1x	Melland, slightly stony						
Ml/xx3x	Melland, very stony	Severe	Moderate to severe	Severe	Moderate to severe	Severe	Very to exceedingly stony, seasonal perched water condition
Ml/xx4x	Melland, exceedingly stony						
Mn	Manson, silty clay	Severe	Moderate	Severe	Severe	Severe	Sticky and slippery when wet, possible flood hazard, highly plastic
Mr	Marsden, loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, may contain appreciable salts
Mr/xxxs	Marsden, slightly saline						
Ms	Miniota, fine sandy loam	Moderate	Slight	Slight	Slight	Slight	Somewhat droughty, very gently to gently sloping
Ms/xcxx	Miniota, undulating						
Ms/xc1x	Miniota, undulating, slightly stony						
Ms/xd1x	Miniota, gently rolling, slightly stony						
Ms/xx2x	Miniota, moderately stony	Moderate	Slight	Slight	Slight	Moderate	Moderately stony, good bearing strength, somewhat droughty
Ms/2cxx	Miniota, moderately eroded, undulating	Severe	Moderate	Moderate	Moderate	None to slight	Moderately eroded, vegetation cover difficult to maintain, subject to erosion
Ms/2g3x	Miniota, moderately eroded, hilly, very stony	Severe	Severe	Severe	Severe	Severe	Very stony, very steeply sloping
Ob	Oberon, sandy clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, not subject to ponding
Ob/xcxx	Oberon, undulating						
Ob/xxxs	Oberon, slightly saline	Severe	Severe	Severe	Moderate	Severe	Vegetation affected by appreciable soluble salts, some seepage, somewhat poorly drained

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Oh	Onahan, loamy fine sand	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate (without basements)	Seasonal water table within 1 m, loose sandy footage, subject to blowing if mismanaged or disturbed
Oh/xcxx	Onahan, undulating						
Oh/xdxx	Onahan, moderately sloping (in gently rolling topography)	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate (without basements)	Seasonal water table within 1 m, subject to blowing if disturbed or mismanaged
Pl	Pleasant, very fine sandy loam	Moderate	Moderate	Moderate	Slight to moderate	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained
Pl/1xxx	Pleasant, slightly eroded						
Pl/xxxs	Pleasant, slightly saline	Severe	Severe	Severe	Severe	Severe	Vegetation could be affected by appreciable soluble salts
Pl/xcxx	Pleasant, undulating	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Somewhat poorly drained and possible seepage; gentle to moderate slopes on intermediate to lower positions in undulating to gently rolling topography, possible seepage, seasonal water table within 1 m
Pl/1cxx	Pleasant, slightly eroded, undulating						
Pl/1dxx	Pleasant, slightly eroded, moderately sloping						
Po	Poolex, fine sandy loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, some seepage and appreciable soluble salts
Po/xxxs	Poolex, slightly saline						
Pp	Porple, fine sandy loam	Slight	Slight	Slight	Slight	Slight to moderate	Well drained, low to moderate bearing strength when wet
Pp/1xxx	Porple, slightly eroded						
Pp/xcxx	Porple, undulating	Moderate	Slight	Slight	Slight	Slight to moderate	Undulating, subject to erosion mismanaged or disturbed
Pp/1cxx	Porple, slightly eroded, undulating						
Pp/1dxx	Porple, slightly eroded, gently rolling	Moderate to severe	Slight to moderate	Slight to moderate	Slight	Slight to moderate	Gently rolling, slightly eroded
Pp/1exx	Porple, slightly eroded moderately rolling	Severe	Slight to moderate	Slight to moderate	Slight to moderate	Slight to moderate	Moderately rolling, slightly eroded
Pr	Prodan, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, plastic, sticky and slippery when wet, some stones
Pr/1xxx	Prodan, slightly eroded						
Pr/xx1x	Prodan, slightly stony						
Pr/xcxx	Prodan, undulating						
Pr/1cxx	Prodan, slightly eroded, undulating						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Pr/$_{2cxx}$	Prodan, moderately eroded, undulating	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderately eroded, gently sloping, slippery when wet
Pr/$_{xxxs}$	Prodan, slightly saline	Severe	Severe	Severe	Severe	Severe	Area subject to seepage, vegetation affected by soluble salts, slippery when wet, sulfate hazard
Pr/$_{1xxs}$	Prodan, slightly eroded, slightly saline						
Pr/$_{1xls}$	Prodan, slightly eroded, slightly stony, slightly saline						
Ps	Prosser, fine sandy loam to very fine sandy loam	Slight	Slight	Slight	Slight	Moderate	Good drainage, low to moderate bearing capacity when wet
Ps/$_{1xxx}$	Prosser, slightly eroded						
Ps/$_{1cxx}$	Prosser, slightly eroded, undulating	Moderate	Slight	Slight	Slight	Moderate	Undulating, as above
Ps/$_{xcxx}$	Prosser, undulating						
Ps/$_{xdxx}$	Prosser, gently rolling	Moderate to severe	Moderate	Slight to moderate	Slight	Moderate	Gently rolling, slightly eroded
Ps/$_{1dxx}$	Prosser, slightly eroded, gently rolling						
Pt	Petrel, loam	Moderate	Moderate	Moderate	Slight to moderate	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m
Ptl	Petrel, loamy fine sand, clayed strata	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Seasonal water table within 1 m, slippery when wet
Ra	Ramada, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, good drainage
Ra/$_{1xxx}$	Ramada, slightly eroded						
Ra/$_{xcxx}$	Ramada, undulating						
Ra/$_{1cxx}$	Ramada, slightly eroded, undulating						
Rd	Roddan, loam	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Topsoil eroded, slippery when wet, requires good management to establish and maintain vegetation, erosive
Rd/$_{xcxx}$	Roddan, undulating	Severe	Severe	Severe	Severe	Moderate	Undulating to gently rolling, topsoil eroded, slippery when wet, requires good management and fertilization to establish vegetation
Rd/$_{xdxx}$	Roddan, gently rolling						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Rd/xd1x	Roddan, gently rolling, slightly stony						
Rf	Rufford, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, some erosion and stones
Rf/1x1x	Rufford, slightly eroded, slightly stony						
Rf/1c1x	Rufford, slightly eroded, undulating, slightly stony						
Rf/2cxx	Rufford, moderately eroded, undulating	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderately eroded, requires good management for establishment of vegetation, slippery when wet, plastic
Rf/2c1x	Rufford, moderately eroded, undulating, slightly stony						
Rf/xdxx	Rufford, gently rolling	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderate	Gently rolling, plastic, slippery when wet
Rf/1e1x	Rufford, slightly eroded, moderately rolling, slightly stony	Severe	Severe	Severe	Moderate	Moderate to severe	Moderately rolling, plastic, slippery when wet, eroded, stony
Rf/2e1x	Rufford, moderately eroded, moderately rolling, slightly stony						
Rf/2e2x	Rufford, moderately eroded, moderately rolling, moderately stony						
Rf/1f1x	Rufford, slightly eroded, strongly rolling, slightly stony	Severe	Severe	Severe	Severe	Severe	Steeply sloping in strongly rolling, plastic, slippery when wet, eroded, stony
Rf/2f1x	Rufford, moderately eroded, strongly rolling, slightly stony						
Rf/1f2x	Rufford, slightly eroded, strongly rolling, moderately stony						
Rf/1f3x	Rufford, slightly eroded, strongly rolling, very stony						
Rf/2g1x	Rufford, moderately eroded, hilly, slightly stony						
Rp	Rempel, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, good drainage
Sg	Sigmund, clay	Severe	Moderate	Severe	Severe	Severe	Somewhat poorly drained, subject to ponding, very sticky and slippery when wet, vegetation may be affected by appreciable soluble salts
Sg/xxxs	Sigmund, slightly saline						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Sh	Shilox, loamy fine sand	Severe	Severe	Severe	Severe	Slight	Loose sandy footage, droughty, subject to blowing if disturbed
Sh/xcxx	Shilox, undulating						
Sh/xdxx	Shilox, gently rolling						
Sh/xexx	Shilox, moderately rolling	Severe	Severe	Severe	Severe	Moderate	Droughty, loose sandy footage, subject to blowing if disturbed, strongly sloping
Sh/xfxx	Shilo, strongly rolling	Severe	Severe	Severe	Severe	Severe	Droughty, loose sandy footage, steeply sloping, subject to blowing if disturbed
Sh/xgxx	Shilo, hilly	Severe	Severe	Severe	Severe	Severe	Droughty, very steeply sloping, loose sandy footage, subject to blowing if disturbed
Sn	Stockton, loamy fine sand	Moderate	Moderate	Moderate	Moderate	Slight	Somewhat droughty, loose sandy footage
Sn/1xxx	Stockton, slightly eroded						
Sn/xdxx	Stockton, undulating	Moderate	Moderate	Moderate	Moderate	Slight	Somewhat droughty, loose sandy footage
Sn/ocxx	Stockton, overblown, undulating	Moderate to severe	Moderate	Moderate	Moderate	Slight	Somewhat droughty, difficult to maintain vegetation under intensive use, loose sandy footage
Sn/1cxx	Stockton, slightly eroded, undulating						
Sn/odxx	Stockton, overblown, gently rolling	Severe	Moderate to severe	Moderate to severe	Moderate	Slight	Droughty, difficult to maintain vegetation under intensive use, moderately sloping, loose sandy footage
Sn/1dxx	Stockton, slightly eroded, gently rolling	Severe	Moderate to severe	Moderate to severe	Moderate	Slight	Droughty, difficult to maintain vegetation under intensive use, moderately sloping, loose sandy footage
St	Stewart, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, some erosion and stones, undulating
St/1x1x	Stewart, slightly eroded, slightly stony						
St/xcxx	Stewart, undulating						
St/2xxx	Stewart, moderately eroded	Moderate to severe	Moderate	Moderate to severe	Moderate to severe	Moderate	Moderately eroded, requires good management to establish and maintain vegetation
St/2cxx	Stewart, moderately eroded, undulating						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
St/1c2x	Stewart, slightly eroded, undulating, moderately stony	Severe	Moderate	Moderate to severe	Moderate	Severe	Very stony, undulating, plastic, sticky when wet
St/xc3x	Stewart, undulating, very stony						
St/1c3x	Stewart, slightly eroded, undulating, very stony						
St/1cxx	Stewart, slightly eroded, undulating						
St/xd2x	Stewart, gently rolling, moderately stony	Severe	Moderate to severe	Severe	Moderate	Moderate	Moderately stony, moderate slopes, slippery when wet
St/1d2x	Stewart, slightly eroded, gently rolling, moderately stony						
St/xd3x	Stewart, gently rolling, very stony	Severe	Severe	Severe	Moderate to severe	Severe	Very stony, moderate slopes, slippery when wet
St/1d3x	Stewart, slightly eroded, gently rolling						
St/2f3x	Stewart, moderately eroded, strongly rolling, very stony	Severe	Severe	Severe	Severe	Severe	Very stony, steeply sloping, slippery when wet
Su	Sutton, clay loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, low bearing capacity, slippery when wet, vegetation may be affected by soluble salts
Sup	Sutton, peaty	Severe	Severe	Severe	Severe	Severe	Poorly drained, very low bearing capacity
Su/xxxs	Sutton, slightly saline						
Sw	Sewell, fine sandy loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, some areas affected by appreciable soluble salts
Sw/xxxt	Sewell, moderately saline						
Sy	Statley, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, some erosion and stones, undulating
Sy/xc1x	Statley, undulating, slightly stony						
Sy/1c1x	Statley, slightly eroded, undulating, slightly stony						
Sy/xc2x	Statley, undulating, moderately stony						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Sy/xd1x	Statley, gently rolling, slightly stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate	Gently rolling, slightly to moderately stony, some erosion, slippery when wet
Sy/1d1x	Statley, slightly eroded, gently rolling, slightly stony						
Sy/xd2x	Statley, gently rolling, moderately stony						
Sy/xc3x	Statley, undulating, very stony	Severe	Severe	Severe	Moderate to severe	Severe	Very stony, undulating to gently rolling, slippery when wet
Sy/xd3x	Statley, gently rolling, very stony						
Sy/1d3x	Statley, slightly eroded, gently rolling, very stony						
Sy/1f3x	Statley, slightly eroded, strongly rolling, very stony	Severe	Severe	Severe	Severe	Severe	Very stony, strongly rolling, plastic, slippery when wet
Tc	Torcan, silt loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m, slippery when wet, intermediate to lower slopes of undulating topography
Tc/1xxx	Torcan, slightly eroded						
Tc/xcxx	Torcan, undulating						
Tc/xxxs	Torcan, slightly saline	Severe	Severe	Severe	Severe	Severe	Poorly drained, very slippery when wet, low bearing strength, may have peaty surface or appreciable soluble salts
Td	Tadpole, clay loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, very slippery when wet, low bearing strength, may have peaty surface or appreciable soluble salts
Tdp	Tadpole, peaty						
Tdp/xxxs	Tadpole, peaty, slightly saline						
Td/xxxs	Tadpole, slightly saline						
Td/xxxt	Tadpole, moderately saline						
Tg	Taggart, silt loam	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate (without basements)	Somewhat poorly drained, seasonal water table within 1 m, slippery when wet, some ponding in localized areas, low bearing strength when wet
Tg/xcxx	Taggart, undulating						
Tg/xxxs	Taggart, slightly saline	Severe	Severe	Severe	Severe	Severe	Somewhat poorly drained, subject to seepage, vegetation affected by soluble salts
Tg/xcxs	Taggart, undulating, slightly saline						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Tv	Traverse, silt loam	Moderate	Moderate	Moderate	Moderate	Moderate	Slippery when wet, high silt content, low bearing strength when wet, erosive
Tv/$_{1xxx}$	Traverse, slightly eroded						
Tv/$_{1cxx}$	Traverse, slightly eroded, undulating						
Tv/$_{2cxx}$	Traverse, moderately eroded, undulating	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Moderate	Moderately eroded, careful management required to maintain vegetation, slippery when wet
Vf	Vodroff, clay loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, water table at or near surface, very slippery when wet; may have considerable stones or appreciable salts
Vf/$_{xx2x}$	Vodroff, moderately stony						
Vf/$_{xxxs}$	Vodroff, slightly saline						
Vf/$_{xxxt}$	Vodroff, moderately saline						
Vfp/$_{xxxt}$	Vodroff, peaty, moderately saline						
Vs	Vordas, silt loam	Severe	Severe	Severe	Severe	Severe	Poorly drained, slippery when wet, may contain appreciable soluble salts
Vs/$_{xxxs}$	Vordas, slightly saline						
Vs/$_{xxxt}$	Vordas, moderately saline						
Vsp/$_{xxxs}$	Vordas, peaty, slightly saline						
Wd	Wellwood, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, good drainage
Wd/$_{xcxx}$	Wellwood, undulating						
Wd/$_{1cxx}$	Wellwood, slightly eroded, undulating						
Wd/$_{2dxx}$	Wellwood, moderately eroded, gently rolling	Severe	Moderate	Severe	Moderate to severe	Moderate	Moderately eroded, slippery when wet, plastic
Wf	Woodfield, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate	Plastic, slippery when wet, some erosion, some stones, very gently to gently sloping
Wf/$_{1cxx}$	Woodfield, slightly eroded, undulating						
Wf/$_{xc1x}$	Woodfield, undulating, slightly stony						
Wf/$_{1x2x}$	Woodfield, slightly eroded, moderately stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate	Moderately stony, plastic, slippery when wet, gently sloping
Wf/$_{1c2x}$	Woodfield, slightly eroded, undulating, moderately stony						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Wf/xc2x	Woodfield, undulating, moderately stony						
Wf/1d1x	Woodfield, slightly eroded, gently rolling, slightly stony	Moderate to severe	Moderate	Moderate to severe	Moderate	Moderate	Gently rolling, some erosion and stones
Wf/2cxx	Woodfield, moderately eroded, undulating	Severe	Moderate to severe	Severe	Moderate to severe	Moderate	Moderately eroded, careful management required to stabilize vegetation, slippery when wet, stony
Wf/2c2x	Woodfield, moderately eroded, undulating, moderately stony						
Wf/xd3x	Woodfield, gently rolling, very stony	Severe	Severe	Severe	Moderate to severe	Severe	Very stony, gently rolling, slippery when wet, some erosion
Wf/2d3x	Woodfield, moderately eroded, gently rolling, very stony						
Wf/1e3x	Woodfield, slightly eroded, moderately rolling, very stony	Severe	Severe	Severe	Severe	Severe	Strongly to steeply sloping, moderately to exceedingly stony, slightly to moderately eroded, plastic, slippery when wet
Wf/2e2x	Woodfield, moderately eroded, moderately rolling, moderately stony						
Wf/2e3x	Woodfield, moderately eroded, moderately rolling, very stony						
Wf/1e4x	Woodfield, slightly eroded, moderately rolling, exceedingly stony						
Wf/1f3x	Woodfield, slightly eroded, strongly rolling, very stony						
Wf/2g3x	Woodfield, moderately eroded, hilly, very stony						
Wh	Wheatland, loamy fine sand	Moderate to severe	Moderate	Moderate	Moderate	Slight	Loose sandy footage, droughty, difficult to maintain vegetation, subject to blowing if disturbed
Wh/xcxx	Wheatland, undulating						
Wh/1c1x	Wheatland, slightly eroded, undulating, slightly stony	Severe	Moderate	Moderate to severe	Moderate to severe	Slight	Loose sandy footage, difficult to maintain vegetation, droughty, subject to blowing if disturbed (and moderately stony)
Wh/2cxx	Wheatland, moderately eroded, undulating						

Map Symbol	Soil Name, Texture, Phase	Intensive Play Area	Intensive Picnic Area	Intensive Camp Area	Paths and Trails	Building Sites	Soil Features Affecting Use
Wh/xx2x	Wheatland, moderately stony						
Wh/2e2x	Wheatland, moderately eroded, moderately rolling, moderately stony	Severe	Severe	Severe	Severe	Moderate to severe	Strongly sloping, moderately stony, loose sandy footage, moderately eroded
Ws	Wesley, clay loam	Moderate	Moderate	Moderate	Moderate	Moderate (without basements)	Somewhat poorly drained, plastic, slippery when wet
Ws/xx1x	Wesley, slightly stony						
Ws/xc1x	Wesley, gently sloping, slightly stony						
Ws/1c3x	Wesley, slightly eroded, gently sloping, very stony	Severe	Moderate to severe	Severe	Moderate	Moderate (without basements)	Moderately to very stony, gently to moderately sloping, plastic, slippery when wet, possible seepage
Ws/xd2x	Wesley, moderately sloping, moderately stony						
Ws/xe2x	Wesley, strongly sloping, moderately stony	Severe	Severe	Severe	Moderate to severe	Moderate to severe	Strongly sloping, moderately stony, subject to seepage, slippery when wet
Wy	Wytonville, fine sandy loam	Moderate	Moderate	Moderate	Slight	Moderate (without basements)	Seasonal water table within 1 m, somewhat poorly drained
Xv	Xavier, mesic peat	Severe	Severe	Severe	Severe	Severe	Poorly drained, very low bearing capacity
Zn	Zarnet, loam	Slight	Slight	None to slight	Slight	Slight	Good drainage, good bearing strength, some droughtiness

1. THE PEDOLOGICAL CONCEPT

Of greatest consequence to the engineer is the fact that the science of pedology identifies the "in-place" soils profile — the texture and composition of the materials in situ and their variation with depth.

The pedological concept is based on the premise that similar parent materials, if subjected to identical environmental conditions of climate, biological activity, topography and time, will develop identical soil profiles. (Some idea of the complex processes involved in soil formation is given earlier in this report in Part III, "Soil Morphology and Soil Genesis").

Now, instead of trying to separately evaluate each different factor in soil formation (i.e. the effect of the parent material and the separate effects of each of the environmental factors), the pedologist has fortunately recognized their combined effects and got around this problem. He identifies the "in-place" soils profile which exhibits the effects of each of these environmental factors and these are then automatically included within the classification system.

2. THE SOIL PROFILE

It is this end product of the pedologist — the identified soil profile — which can be used as a very effective tool in engineering soil exploration, planning and design.

The Soil Profile is a vertical section of the soil through all its horizons and extending into the parent material. The figure (Figure 8) shows in a simplified form how many variations may be recognized in soil profiles. The science has developed over the years and the figure shows the nomenclature currently in use in Canada.

Despite considerable developments in this field the three major or master soil horizons A, B and C can generally be recognized. The surface layer (A horizon) is the zone of maximum removal of material in solution or maximum in situ accumulation of organic matter; the next layer, the B horizon is a transitional zone just below the A. The next horizon is C or the relatively unaltered parent material.

The A and B horizons are termed the "soil solum" and they reflect the effects of the climate, topography and vegetation. By the action of percolating water and many other factors, materials can be removed from the A horizon and deposited in the B horizon. Such transfers may occur as chemical solutions or as mechanical movements of soil particles. For example, in humid environments where the B horizon may be characterized by its compactness, this may be primarily due to filling of the voids with the fine particles carried mechanically from the A horizon. Such filling increases the percentage of fine-grained materials in the B horizon, often with an increase in plasticity and a decrease of permeability. The activity of clay horizons may be affected and cementing agents may product hardpan layers.

While knowledge concerning the A and B horizons can be of great value to the engineer, in certain specialized fields, e.g. estimating rainfall runoff in watersheds, pavement design, etc., it is the C horizon and materials below this that are of more general significance. It should be noted that the C horizon refers to the parent (mineral) soil which is comparatively unaffected by the pedogenic processes. Now, the following definitions may be confusing to engineers and should be noted carefully. The symbol C is used for the true parent material, the material in which the soil was formed. The next underlying material which is lithologically or geologically different from the C material is termed IIC and subsequent contrasting (geologically) materials are termed IIC, IVC, etc. The IIC layer is therefore not parent material, but it may have significance on the solum development.

In certain profiles, however, the C layer may be missing and, therefore, the profile may exhibit an A and B horizon directly overlying a IIC (non parent material) layer. It should also be noted that all single horizons may be subdivided by consecutive Arabic numerals for purposes of sampling; for example, Ck1, Ck2, and so on. Unlike Roman numeral prefixes, these symbols do not indicate major lithological discontinuities but rather accommodate minor differences that may or may not be apparent in the horizon.

Direct applications such as this are obviously not restricted to pavement design engineers — the hydrologic soil factors used in the U.S.A. in Soil Conservation Engineering and soil cement stabilization are other examples.

The Canadian System of Soil Classification is partly described in Part III, "Soils", and some coverage is given in the Glossary of this report. However, as the science of pedology has developed over the years, the system is now quite complex and for full treatment of the subject, the reader is referred to "The System of Soil Classification for Canada, Canada Agriculture, 1974".

The following brief resume should, meanwhile, permit the reader to better understand the pedological approach.

The Canadian System is heirarchical and in descending order, we have:

(i) Order
(ii) Great Group
(iii) Subgroup
(iv) Family

(v) Series
(vi Type

("Soil Phase" is not a category in this system and it can be used to subdivide any of the other classes).

It is the complete "Soil Profile" which is identified and classified and as we go from Order down to Type, the required number of differentiating characteristics in the profile increases.

Bedrock is denoted by R and particular attention should be paid to the pedologist's definition of a rock — "too hard to break with the hands or to dig with a spade when moist and greater than 3 on the mohs scale". The boundary between the R layer and any overlying unconsolidated material is termed a "lithic contact".

If the bedrock (R) or the IIC horizons exist at depths considered to be beyond the zone of their influence on the soil, then the pedologist may not record these horizons. The total depth of soil materials considered to constitute the "Soil Profile" in the Pedological sense, is normally less than 80 inches (2M).

3. PEDOLOGICAL CLASSIFICATION

The primary purpose of soil classification as far as the engineer is concerned is to make the soil recognizeable. If then, correlations with engineering properties can be made, engineering performance on similar soils can be predicted.

Highway engineers, especially those trained in Michigan, U.S.A. or similar schools have found that the pedological system can be adapted to their needs. This is because in areas of gentle relief where there are few deep cuts and fills, a subgrade on a particular soil series will perform the same wherever the location, because such important factors as rainfall, freeze-thaw, capillarity, etc, are all factors in the identification and classification. In no other system in use, are all these factors employed directly as part of the system. In this way, quite accurate pavement design and performance data can be exchanged between engineers in different parts of the country (and even in different countries).

For example, in the Chernozemic Order — No. 1, this requires that soil profile, among other things, must have a dark surface horizons Ah, Ahe, Ap and with B and C horizons of high base saturation with divelent cations, calcium being dominant.

In the Dark Gray, Great Group, further criteria must be satisfied, e.g. they must have developed under forrest cover in a moist cool region, with an A horizon displaying a "salt and pepper effect" and translocation of colloidal material into the B horizon (clay).

In the Gleyed Dark Gray Subgroup still further criteria must be met. The profile must exhibit "mottling due to periodic wetness in the A or B horizons".

There are eight Orders, 22 Great Groups and 189 Subgroups in the Canadian System and every soil profile in the country must be fitted into this grouping. Soil maps may be prepared at the level of the Order, the Great Group or the Subgroup, but these usually are generalizations on very small scales (1/1,000,000; 1/10,000,000 etc.)

To most people not well acquainted with the science, this is as far as pedology goes. In fact, it is just the beginning. In practise, pedological classification might be said to begin at the Soil Series level.

The Soil Family and Soil Type are respectively above the below the Soil Series in the heirarchical system. However, the "Soil Type" is a division of the series, which is definitely based on the testure of the Plow Layer. "Soil Family" is a grouping of Soil Series units which also have certain definite similarities, some of which are not applicable to engineering problems. Thus, for engineering and planning purposes, and incidentally, also for pedological reasons, the "Soil Series" is the most significant unit.

4. THE SIGNIFICANCE OF THE SOIL SERIES

The concept of the Soil Series has changed considerably since soils were first mapped and classified. With recent development, the soil series is now recognized as a three-dimensional body occupying a geographical position on the landscape.

As the science develops, revisions must necessarily occur in the definitions of what exactly a certain Soil Series represents and new Soil Series are being recognized in previously unsurveyed areas. There are at present over 3,000 recognized Soil Series, in Canada and the number increases as more work is being done. The reader is, therefore, warned that, when referring to a number of different soil maps, there may be significant differences in the terminology, depending on the dates of the surveys.

Perhaps the most difficult concept for the engineer (and planner) to fully appreciate, is the three-dimensional nature of the Soil Series. The vertical dimension and the depth limitations, have been discussed under the heading, Soil Profile. The horizontal aspects have been implied with reference to the soil series as a "landscape unit". The areal boundaries of the soil series on the landscape are determined, mostly by experience, to be " . . . wide enough to permit reasonable uniformity of all criteria over a practical-sized

area". The three-dimensional body is thus defined and this is represented on the soils map by its areal boundaries.

For sampling purposes, however, the minimum size of a soil body representing a Soil Series had recently been defined as the "pedon". This varies, but may often be one meter^2 in areal extent. As a mapping unit, however — in contrast to a sampling unit — the "pedon" is too small to be represented on a map and the Soil Series Mapping Unit can therefore, be regarded as being composed of several contiguous pedons or polypedons. In fact, the polypedon corresponds really to a Soil Individual and there may be, on the landscape, one or several Soil Individuals, whose properties may be individually different but all may be within the range defined for a given Soil Series.

There are, thus, differences between taxonomic units, sampling units and mapping units. Each may be termed "Soil Series". The taxonomic unit really is the "soil profile" — it is two dimensional in that it can be represented as a "profile", as a vertical slice through all the soil layers at one point on the landscape. The "pedon" is the sampling unit which really is the "test pit" used to define the "in situ" characteristics of that profile, to obtain samples for laboratory testing and to adequately express these characteristics as an average for a specified volume, also at one point on the landscape. The third unit, the "mapping unit", is also three dimensional but instead of representing one point on the landscape, it actually represents that landscape. But it is also implied, to a greater or lesser extent, that everywhere in that demarcated landscape unit, the actual sequence of soil layers are the same as those exhibited in the test pit (or "pedon") and the same as those described and classified in the "Soil Profile". The whole purpose of this of course, is to predict the behaviour or performance of these same demarcated landscape units when subjected to given sets of conditions. These conditions are primarily, (but not necessarily only), of an "agricultural" nature. The pedological concept was conceived initially, out of necessity, as a method by which soil and land performance could be predicted for its agricultural use, using deductive reasoning.

This predictive aspect of pedological mapping is rarely fully appreciated or understood by specialists in other disciplines because it is probably unique as far as earth sciences are in this respect. First of all a prediction is made that, within the boundaries shown as a mapping unit, the sequence of soil layers should be the same as those exhibited in the "pedon" and described under the heading "soil profile" — to a greater or lesser extent. In pedological terms, the latter phrase is partly covered by the term "accuracy" and partly covered by the description of the "mapping unit". Thus, the mapping unit may simply be a Soil Series and the "accuracy 85%".

This means that the pedologist has enough confidence to predict that if one digs a test pit anywhere in that area, there is an 85% chance of revealing a soil profile as given for that Soil Series. It also means that even if he knows the location of a soil deposit quite different from that series described, he will *not* show it on the published map if it is less than 15% of the area.

In mapping, therefore, the individual pedologist may set up broader more generalized mapping units. Undoubtedly in this sense the "accuracy" of the survey as far as the mapping unit itself is concerned, may be very high. For the same area using very detailed mapping units, much greater effort would be required to obtain the same mapping "accuracy".

However, the predictive nature of pedological mapping does not refer only to the quality of the mapping process in the field but also to the degree to which the interpretations concerning the use of the soil and the landscape are realistic. This can only be done if the scope of the mapping units are sufficiently detailed.

In addition to detailed mapping units, the interpretive specialist must also be knowledgeable of more than just the top few feet of soil: movement of moisture through the soil is but one example. To really understand this a general knowledge of the hydrology and geohydrology of the whole area is required. The mapping and interpretive process thus becomes progressively more interdisciplinary. At the same time, as more detailed work is done, the greater becomes the potential use of the survey for other disciplines like engineering and land use planning.

But at the same time, as more and more data is collected, it becomes progressively more difficult to communicate this to others.

APPENDIX I

APPENDIX I

BASIC FORMAT AND INTERPRETATION OF THE STRATIGRAPHIC CROSS-SECTION

The contents of the stratigraphic cross-section representation are: a title, surficial sectional grid, a legend, a stratigraphic cross-section and an elevation scale. The heading or title of the cross-section outlines the general area through which the stratigraphy is represented.

More specifically, the surficial section grid indicates the surficial boundary of the respective cross section. The square mile is the smallest single unit on the grid, with range and township boundaries. Towns, major highways and rivers are included to assist in locating the cross sectional boundary. Soil survey drill sites and the wells obtained from the Manitoba Water Well Drillers' Reports are represented on the brid by a series of dots. Once the points are plotted, they are joined by a solid line indicating the surface boundary of the stratigraphic cross section.

The most relative and information portion of the representation is the cross section, revealing the various stratigraphy. The materials encountered throughout are distinguished by solid boundaries. Heavier lines are used to separate the materials according to their mode of origin. These separations in turn have a respective symbol or number which is described in the accompanying legend. Well locations and depths are indicated by a solid vertical line with a short cross bar at the well's maximum depth. Wells on the grid, designated by points, correspond directly to those denoted in the cross section.

DESCRIPTION OF THE SURFICIAL DEPOSITS

CLAY LOAM TO LOAM (CL-L) GLACIAL TILL

The dominant texture of this till is a clay loam with some variability of clay or loam materials. The till consists of mixed materials derived from shale, limestone and granitic rock sediments. Clay loam to loam till is found to exist to considerable depths beneath a variable overlay, including the loamy till. With reference to the cross sections, the CL-L glacial till is found to be quite extensive over the Brandon area. Chemical analyses indicate that the carbonate level of this till ranges from 18 to 30%.

CLAY LOAM TO LOAM GLACIAL TILL WITH SAND AND GRAVEL LENSES

In a number of the cross sections, sand and gravel layers were present in the clay loam to loam till. These lenses were likely the result of some modification to the tills. The extent of these lenses is variable. In most instances, the water yielding capacity of till is increased with the presence of the coarser layers.

LOAMY GLACIAL TILL

This is a highly calcareous glacial till derived mainly from limestone and granitoid rocks and is low in shale material. The till is low in clay content and generally of a loam texture. Variable coarser materials may be present in this "higher-lime" till. Generally, the loamy glacial till overlies the clay loam till; however, the overlay is quite often too shallow to appear on the cross sections.

DOMINANTLY SANDY

Sandy includes three basic categories: sandy loam, loamy sand and sand. The modifier, dominantly, is used to account for limited variability in the materials.

DOMINANTLY CLAYEY

The dominantly claycy class consists of the heavier textured soils. With respect to the cross sections, the textures are silty clay, clay, clay loam and silty clay loam.

DOMINANTLY SILTY

The term silty includes the medium textured group. The textural classes are loam, silt loam and silt. Materials designated as dominantly silty in the cross sections are basically such; however, certain deviations may be encountered.

ORIGIN OF DEPOSITS

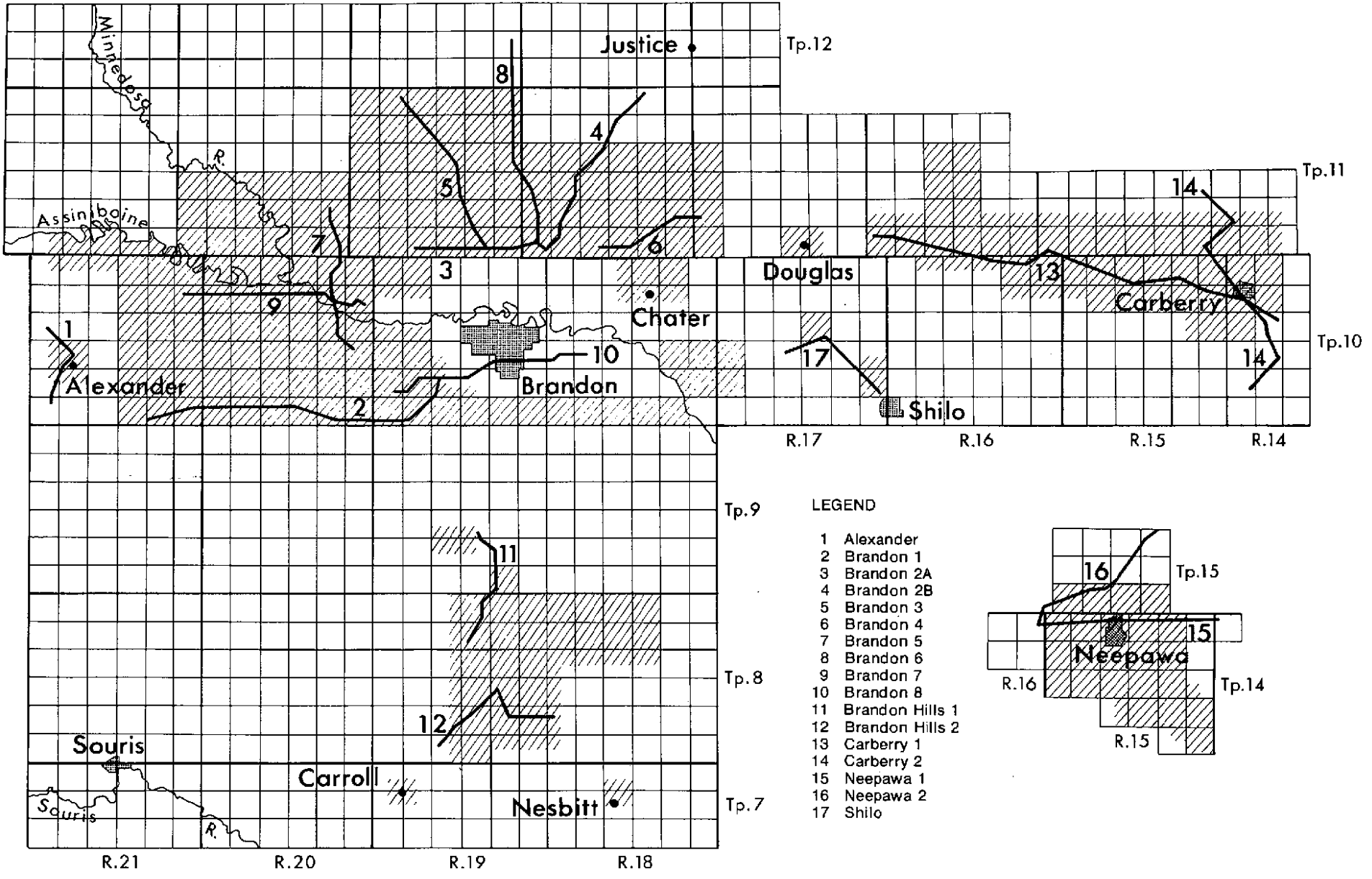
The stratigraphic cross section representation includes the mode of origin for the different deposits. The existing materials are separated as to their depositional origin. Four possibilities which are given include: alluvial, lacustrine, glacial till and bedrock. Each of these depositional features have characteristic deposits associated with them.

Alluvial deposits are those directly laid down by a river or stream and floodplain materials occurring adjacent to streams which may periodically overflow their banks. In general, the alluvial soils in the Brandon area are fine textured; however, sands and silts occur as well.

The lacustrine deposits occupy the beds of glacial lakes which existed during glacial times. The textures of the lacustrine deposits vary considerably including sands, silts and clays.

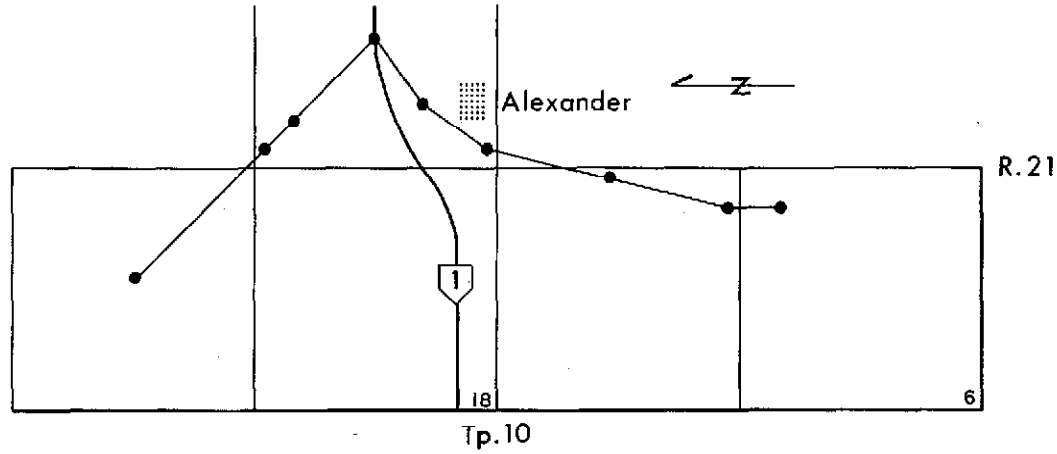
Glacial till materials occur extensively as surface deposits and as underlying deposits below the lacustrine and alluvial materials of basins and depressional areas. Till consists of a mixture of boulders, cobbles, gravel, sand, silt and clay. Ground moraines and end moraines are the most extensive till deposits.

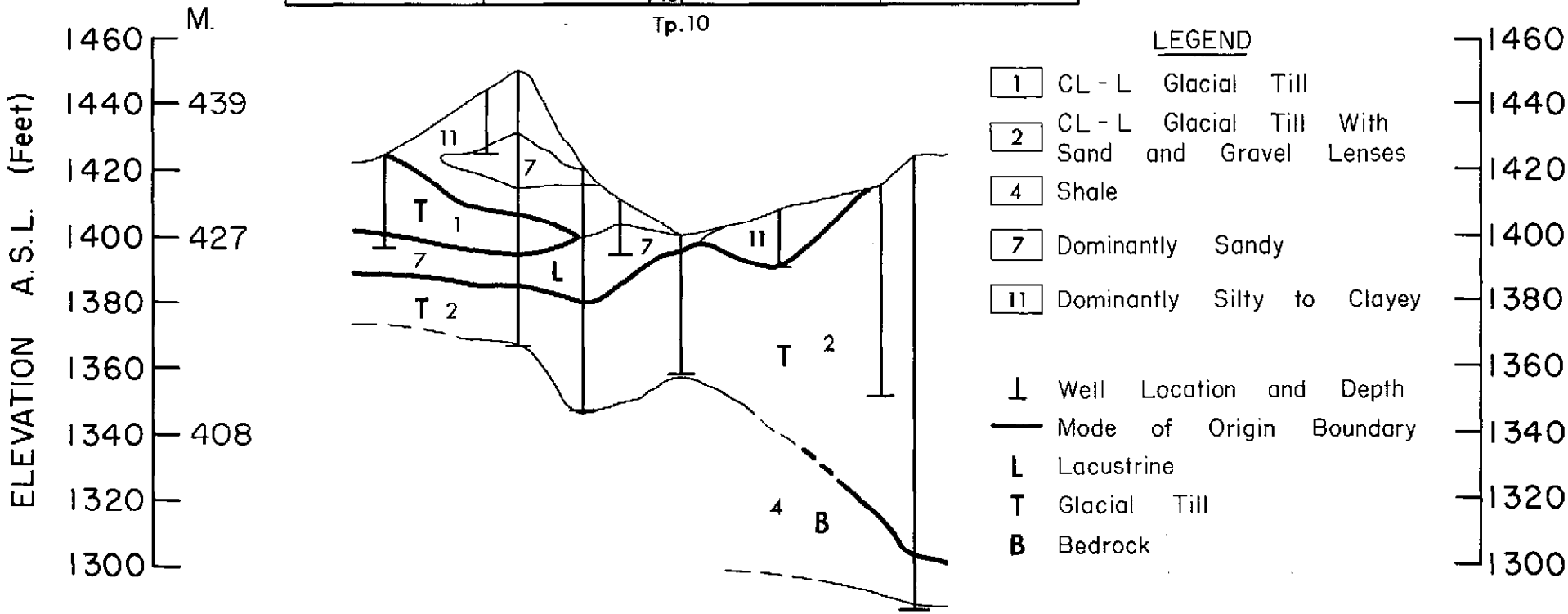
Bedrock occurs beneath the surface deposits. As indicated by the cross sections, the underlying bedrock is shale of the Riding Mtn. Formation; it consists of a light grey, hard shale and a soft, greenish shale.



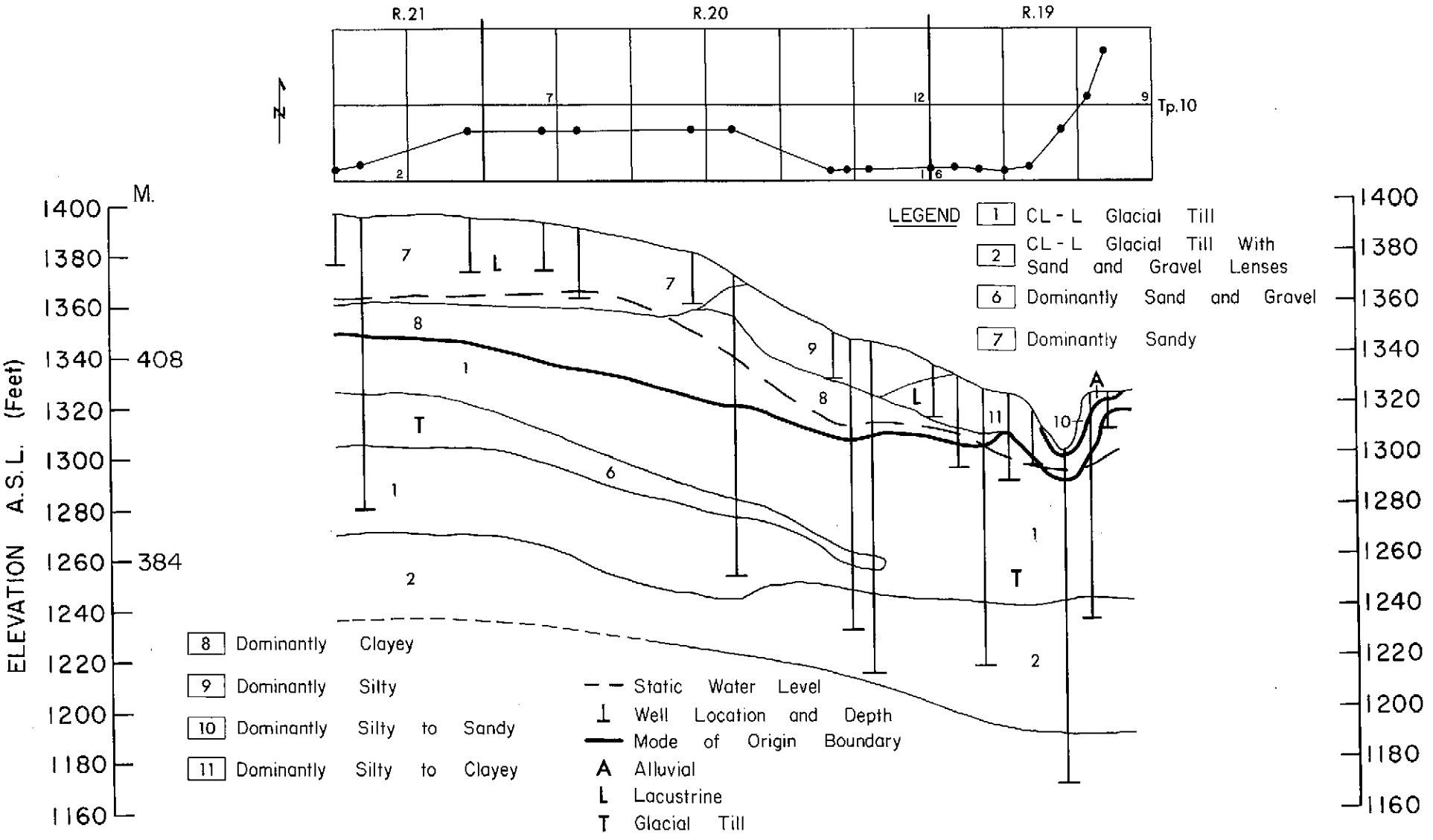
Guide Map of Stratigraphic Cross Sections

Stratigraphic Cross-Section — Alexander

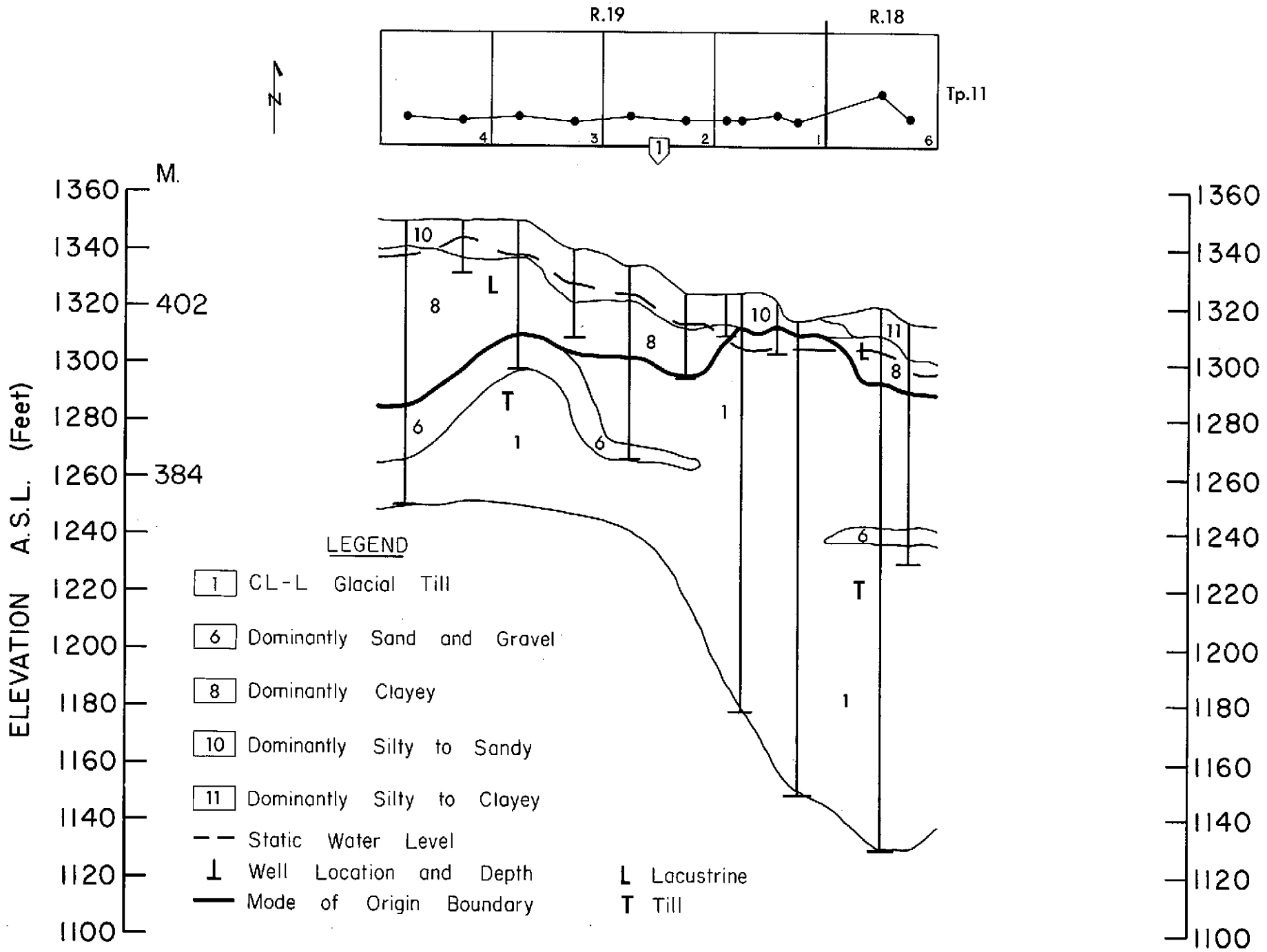




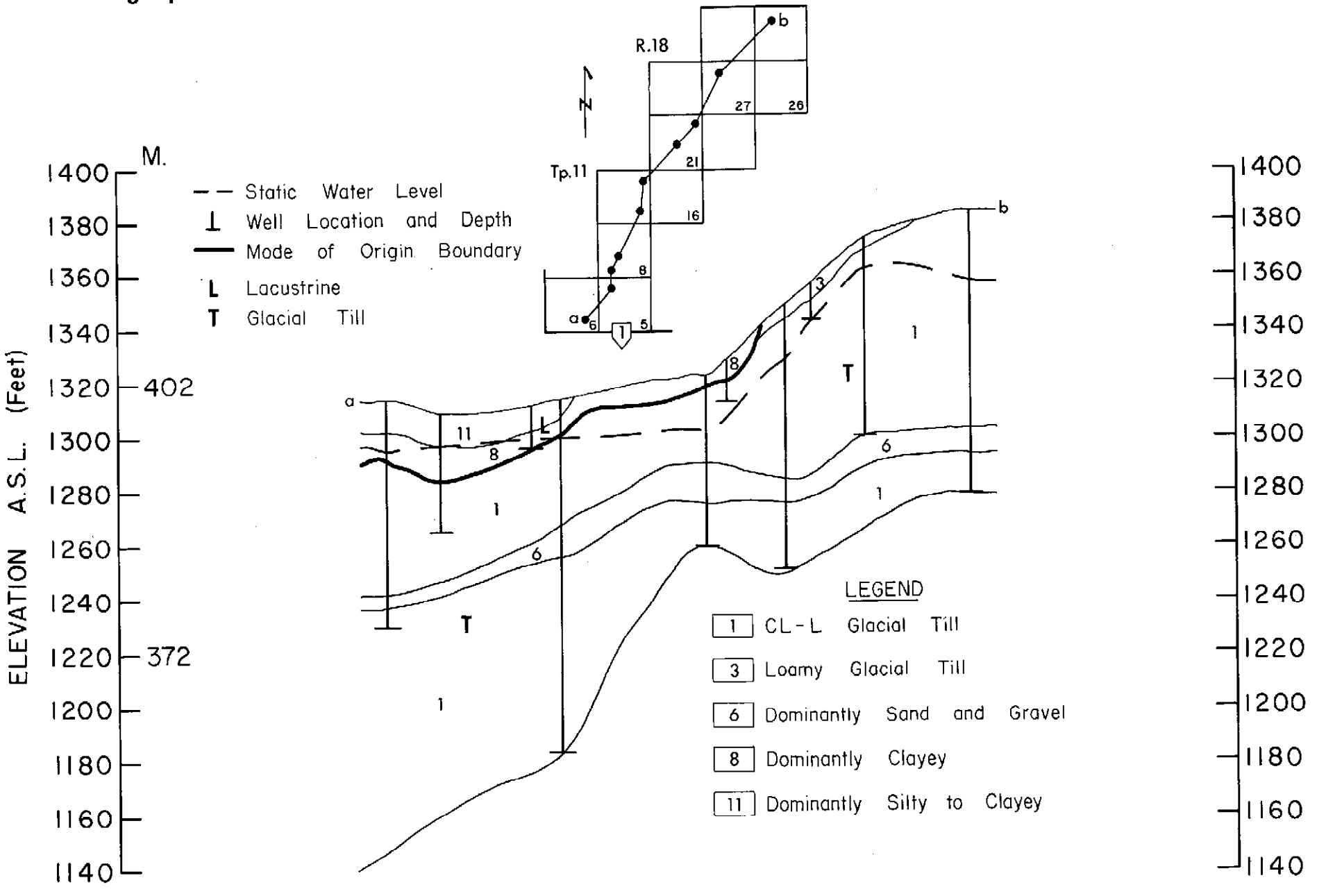
Stratigraphic Cross-Section — Brandon 1



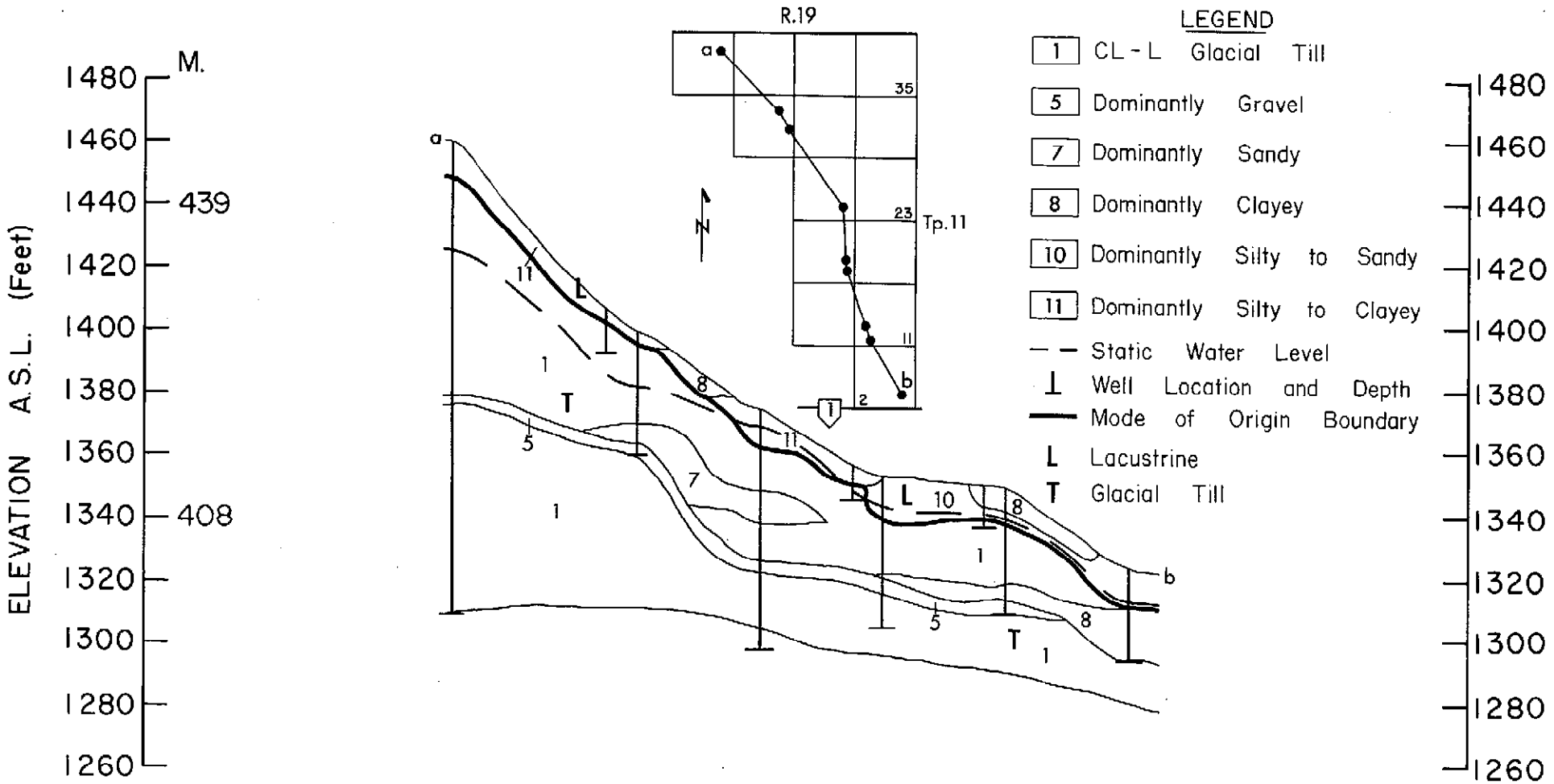
Stratigraphic Cross-Section — Brandon 2A



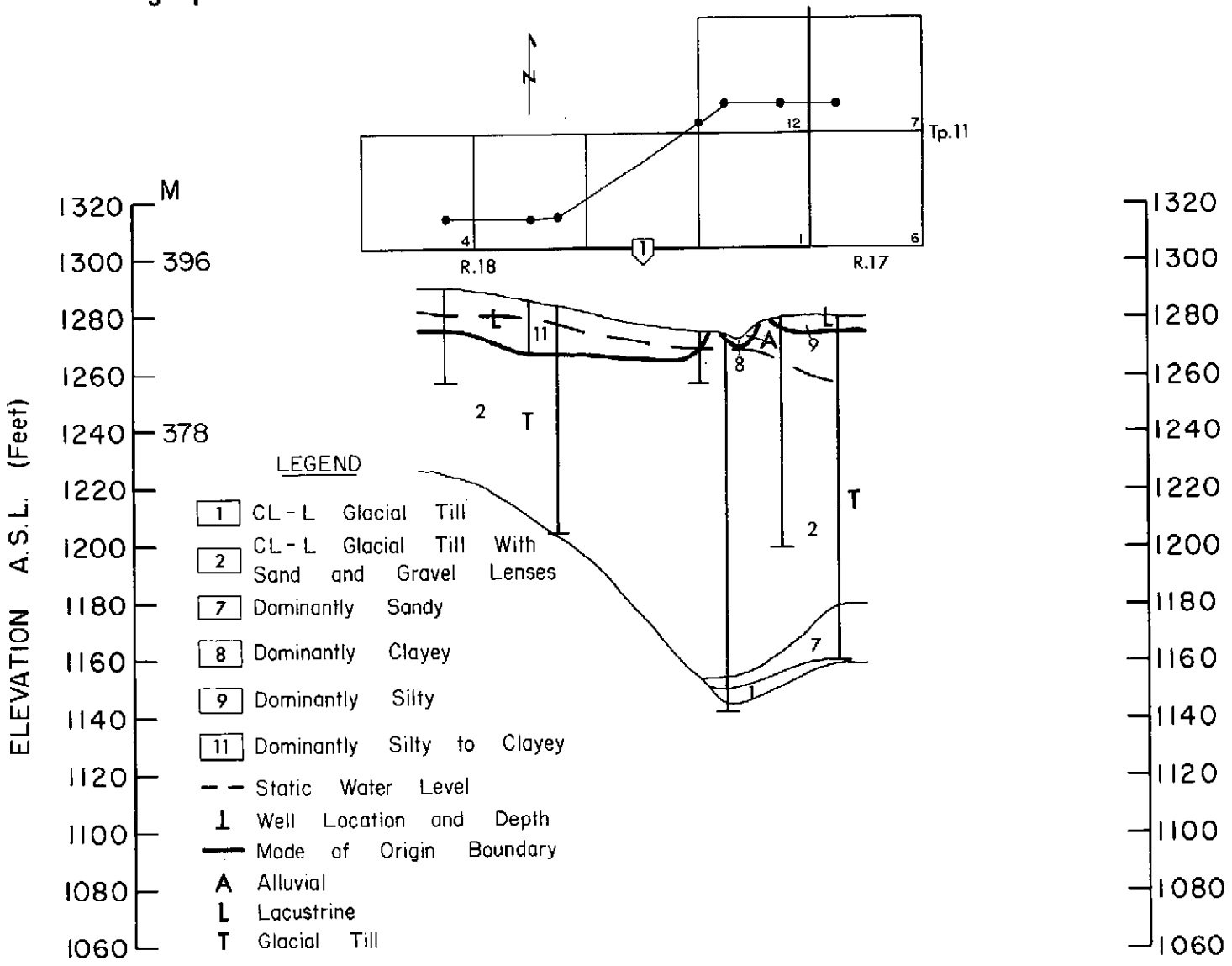
Stratigraphic Cross Section — Brandon 2B



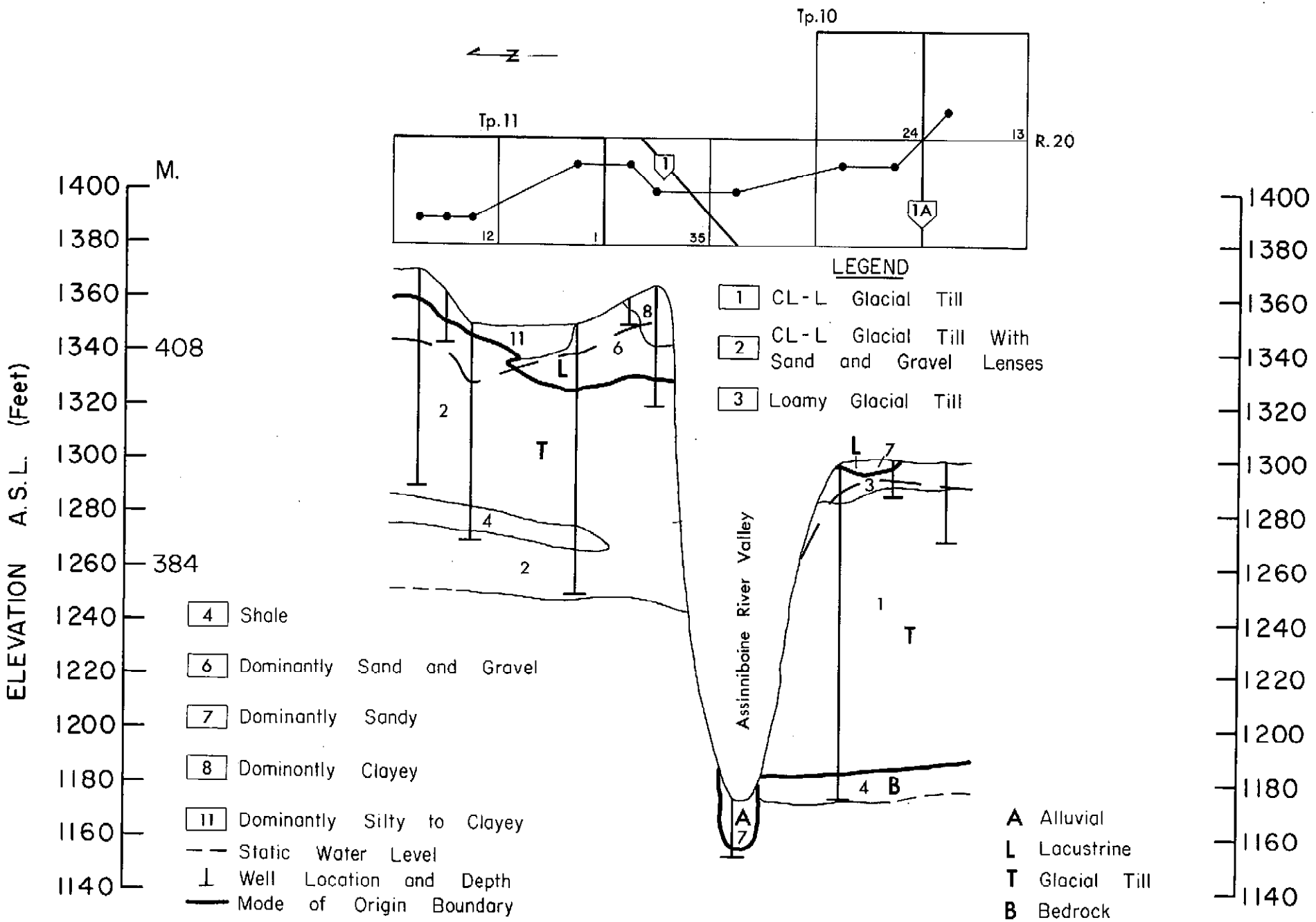
Stratigraphic Cross-Section — Brandon 3



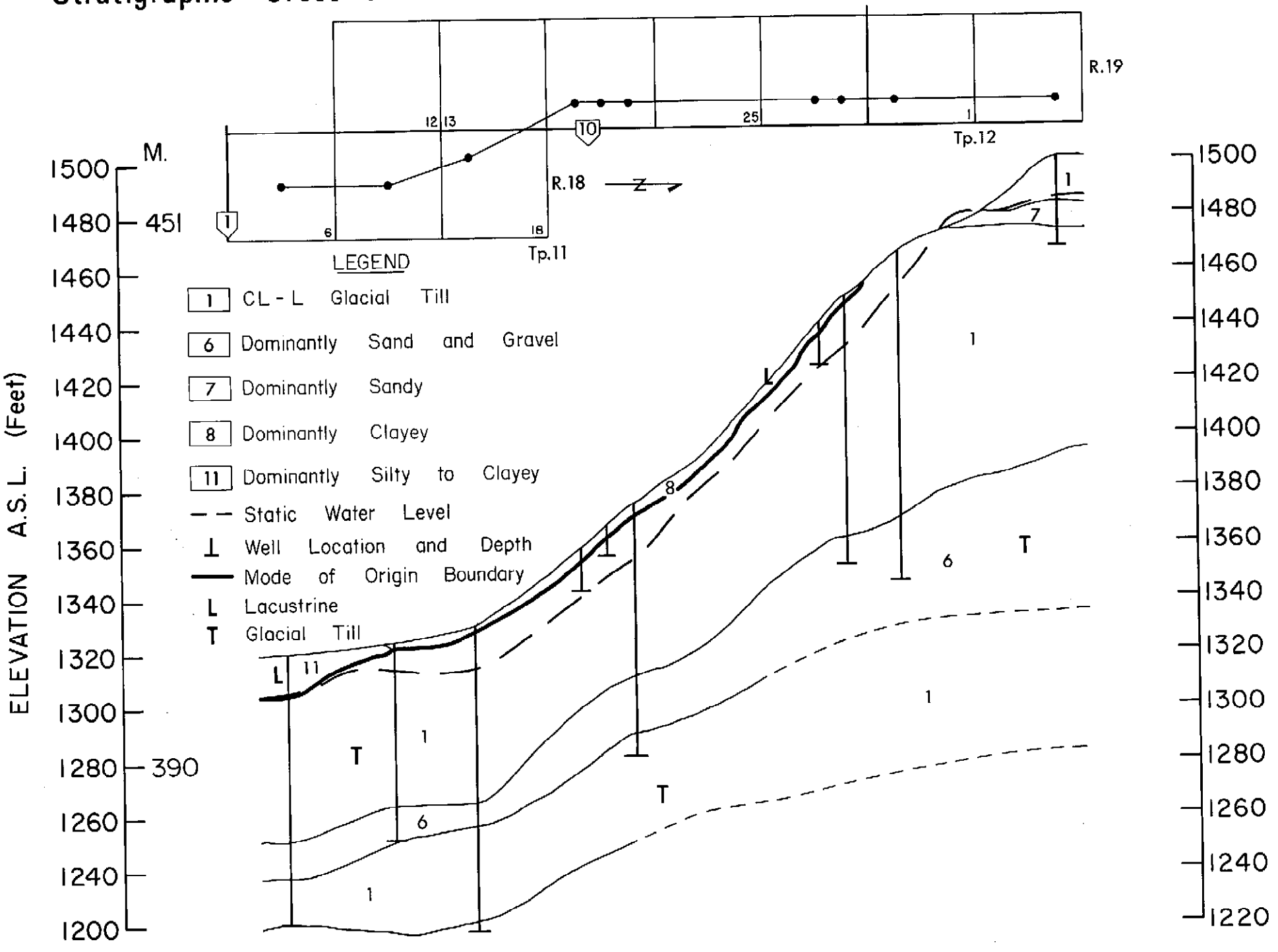
Stratigraphic Cross-Section — Brandon 4



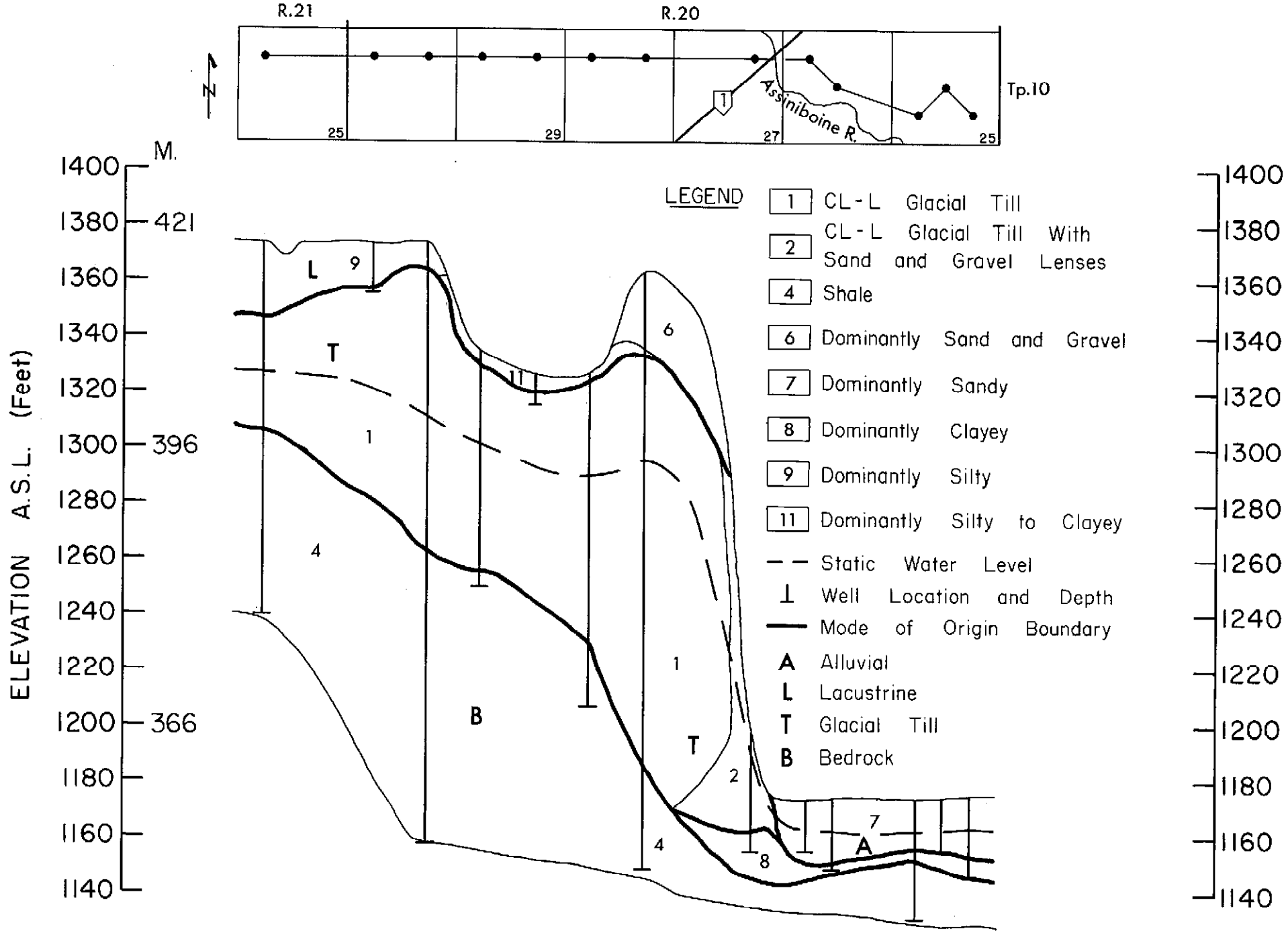
Stratigraphic Cross-Section — Brandon 5



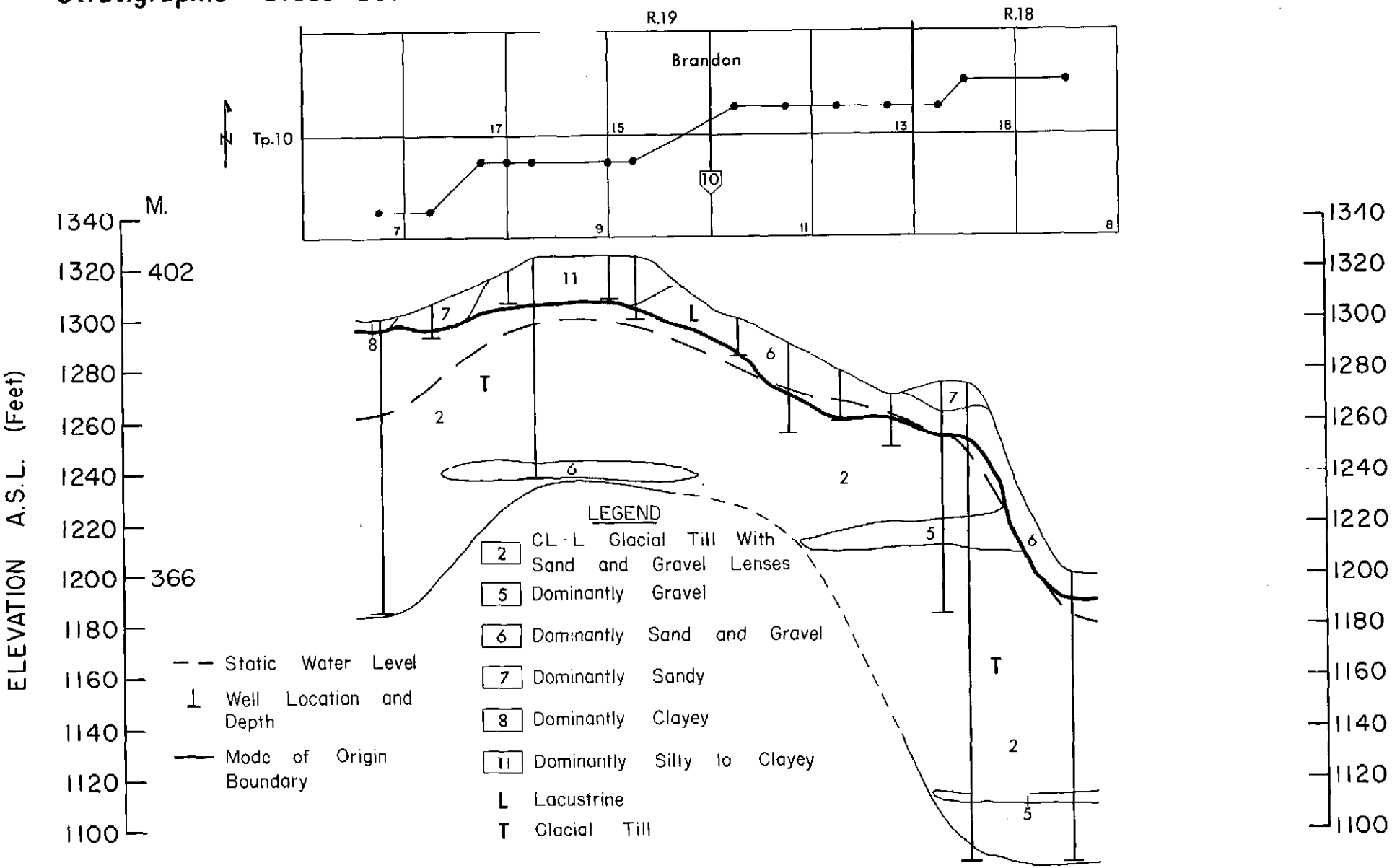
Stratigraphic Cross Section — Brandon 6



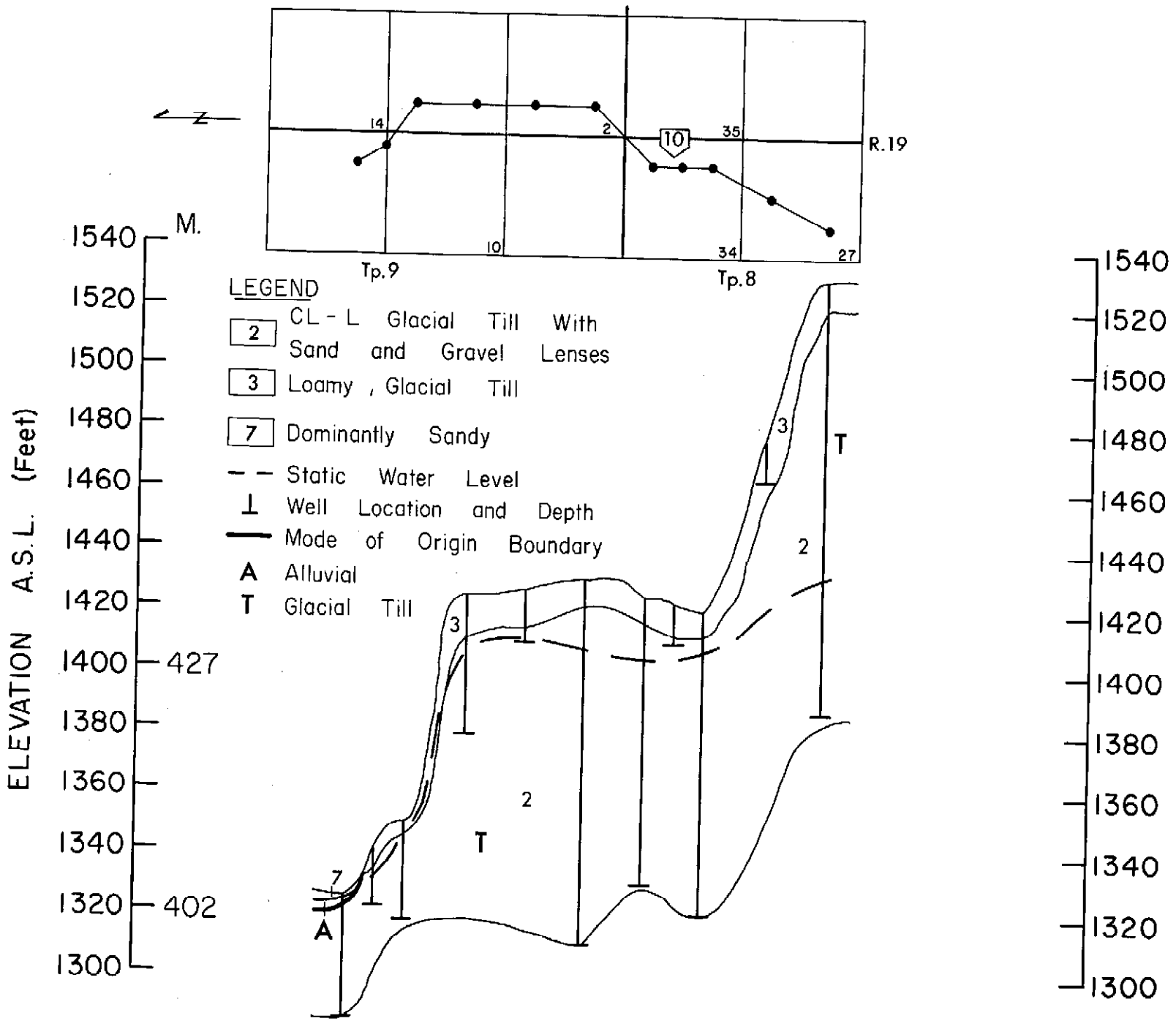
Stratigraphic Cross-Section — Brandon 7



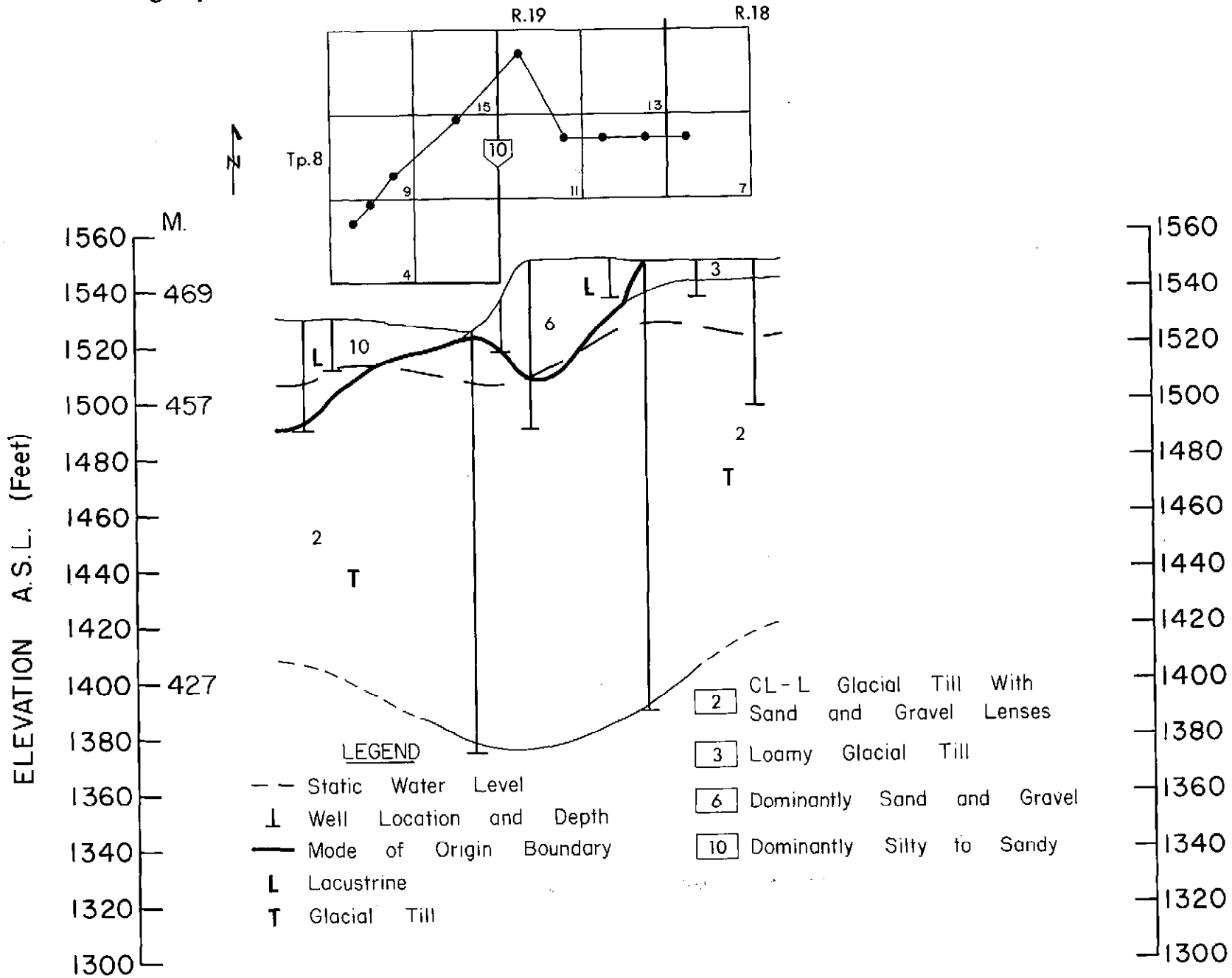
Stratigraphic Cross Section — Brandon 8



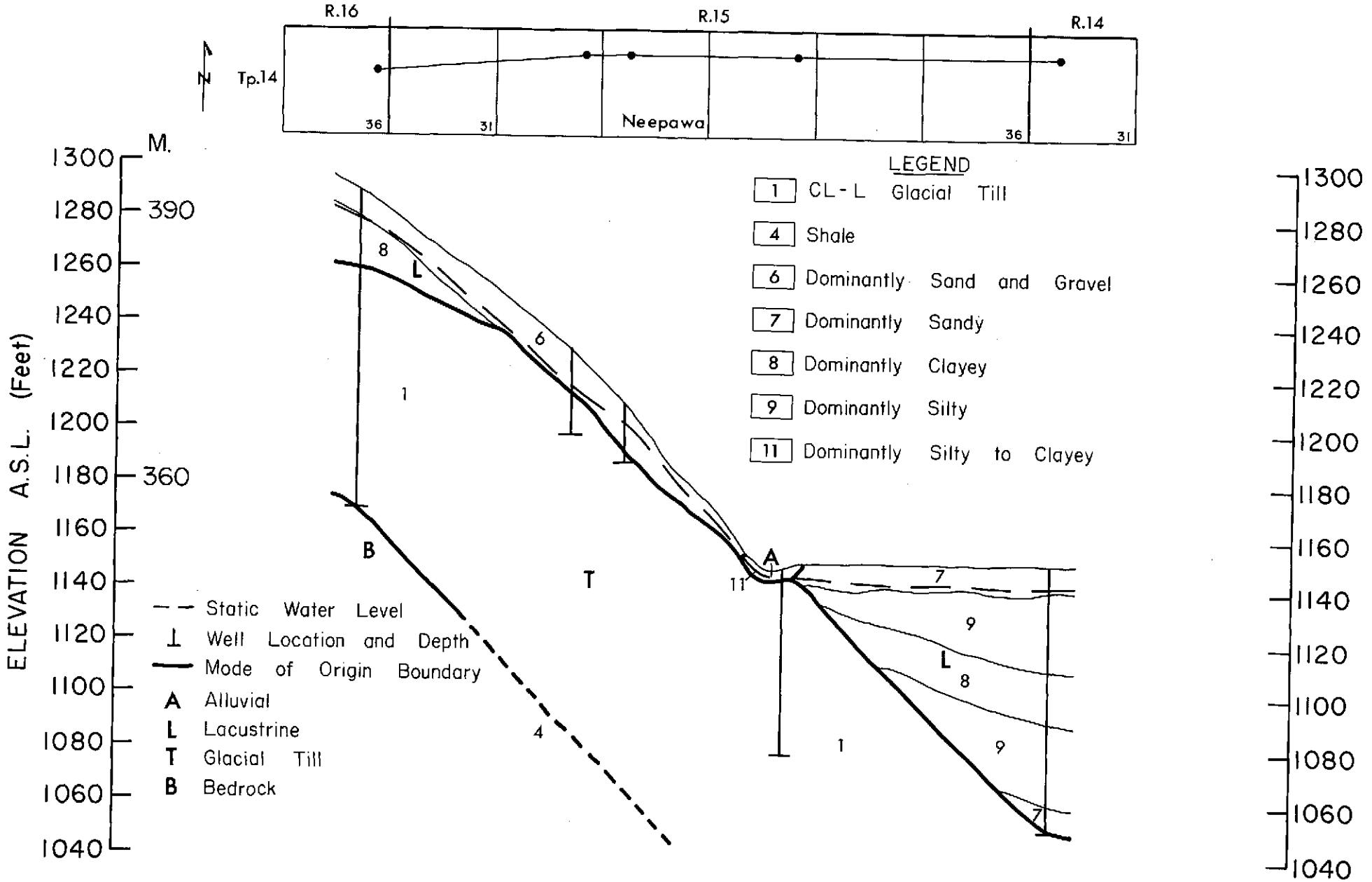
Stratigraphic Cross Section — Brandon Hills 1



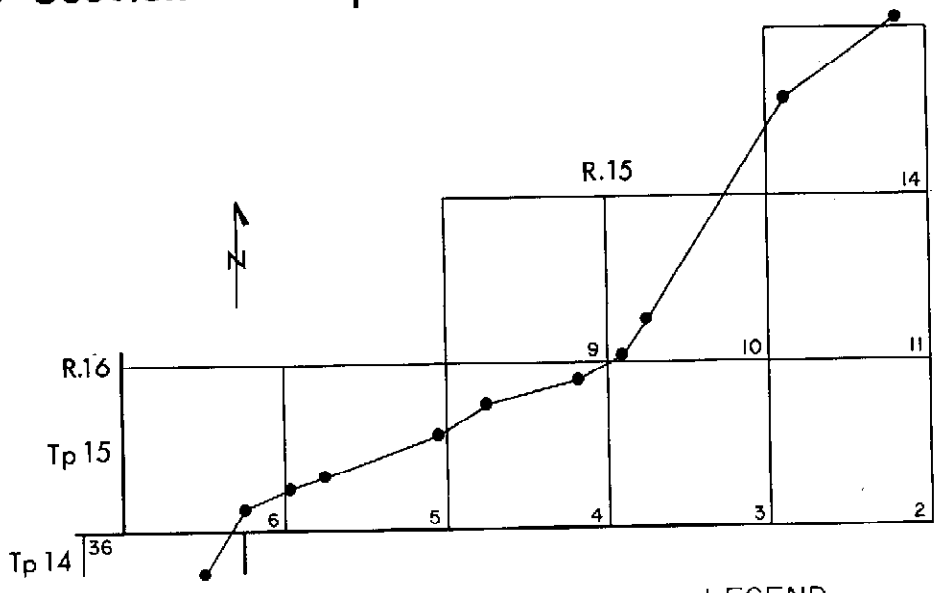
Stratigraphic Cross Section — Brandon Hills 2

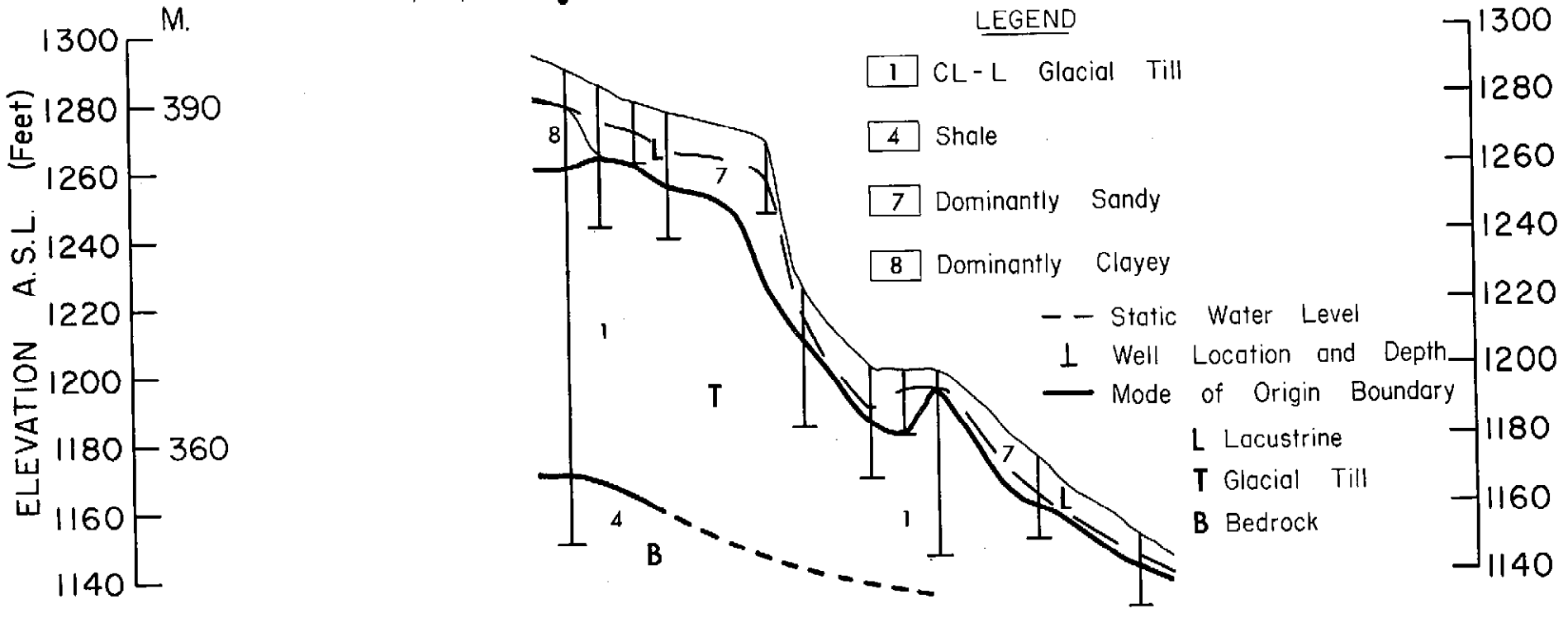


Stratigraphic Cross-Section — Neepawa 1

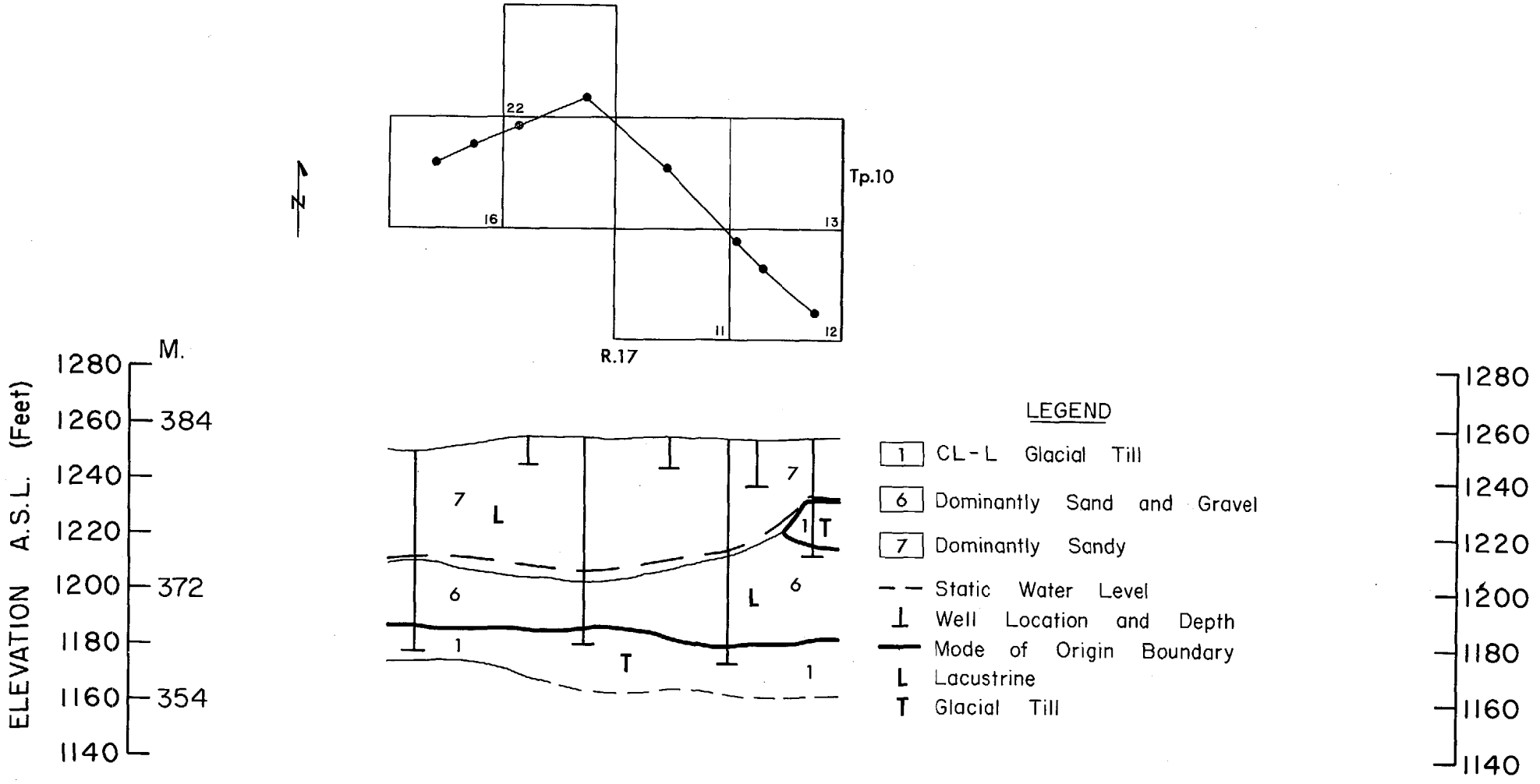


Stratigraphic Cross Section — Neepawa 2

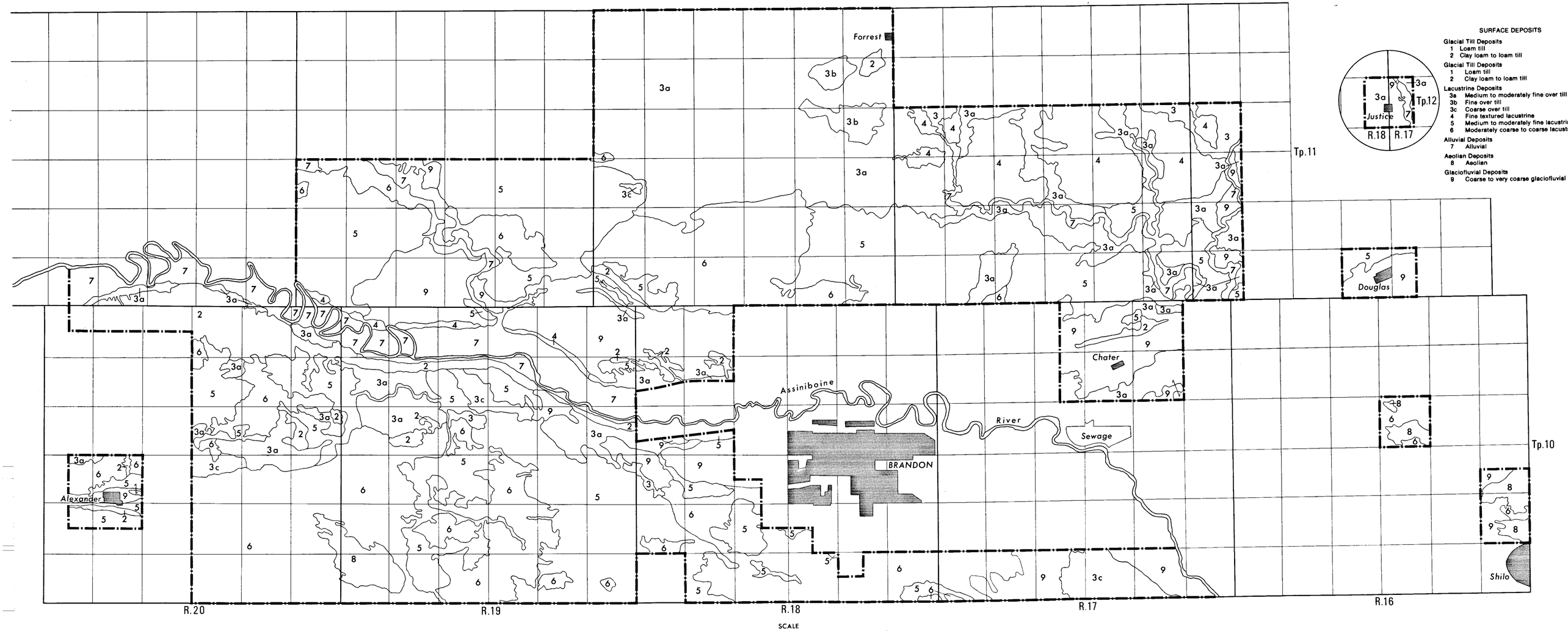




Stratigraphic Cross-Section — Shilo



APPENDIX II

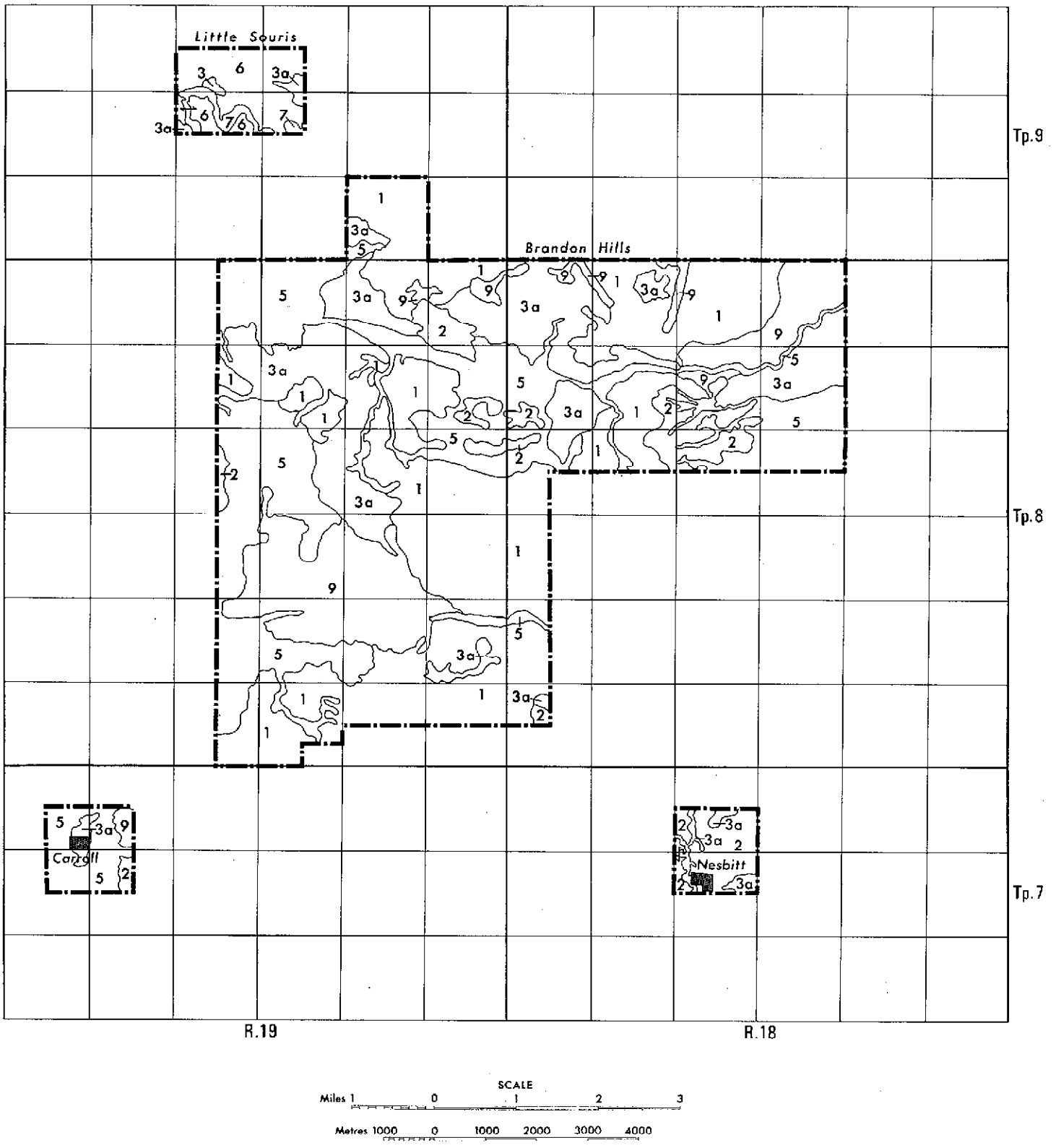


SCALE

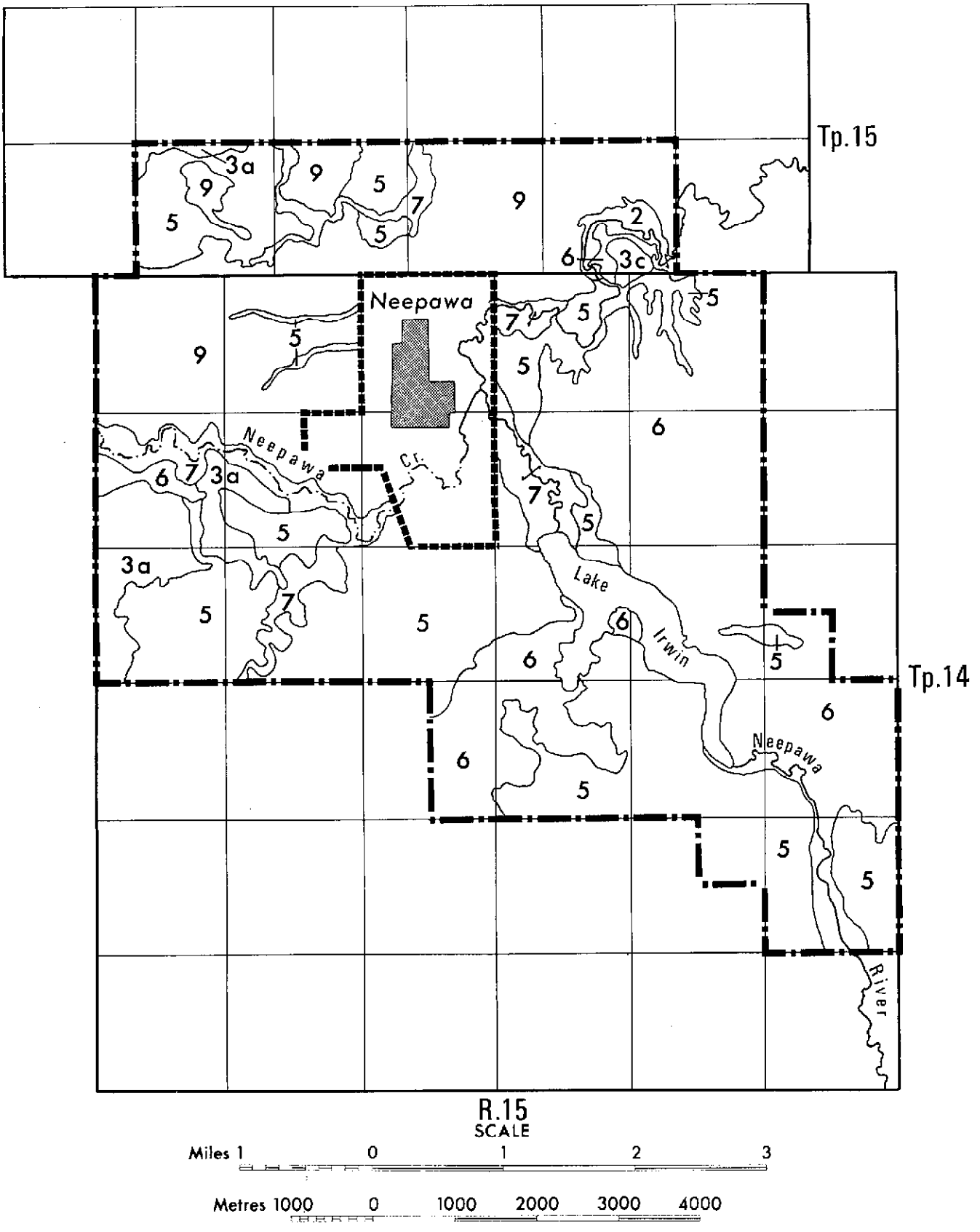
Miles 1 0 1 2 3

Metres 1000 0 1000 2000 3000 4000

Surface Deposits Map of Brandon Region Study Area
a) Brandon Area

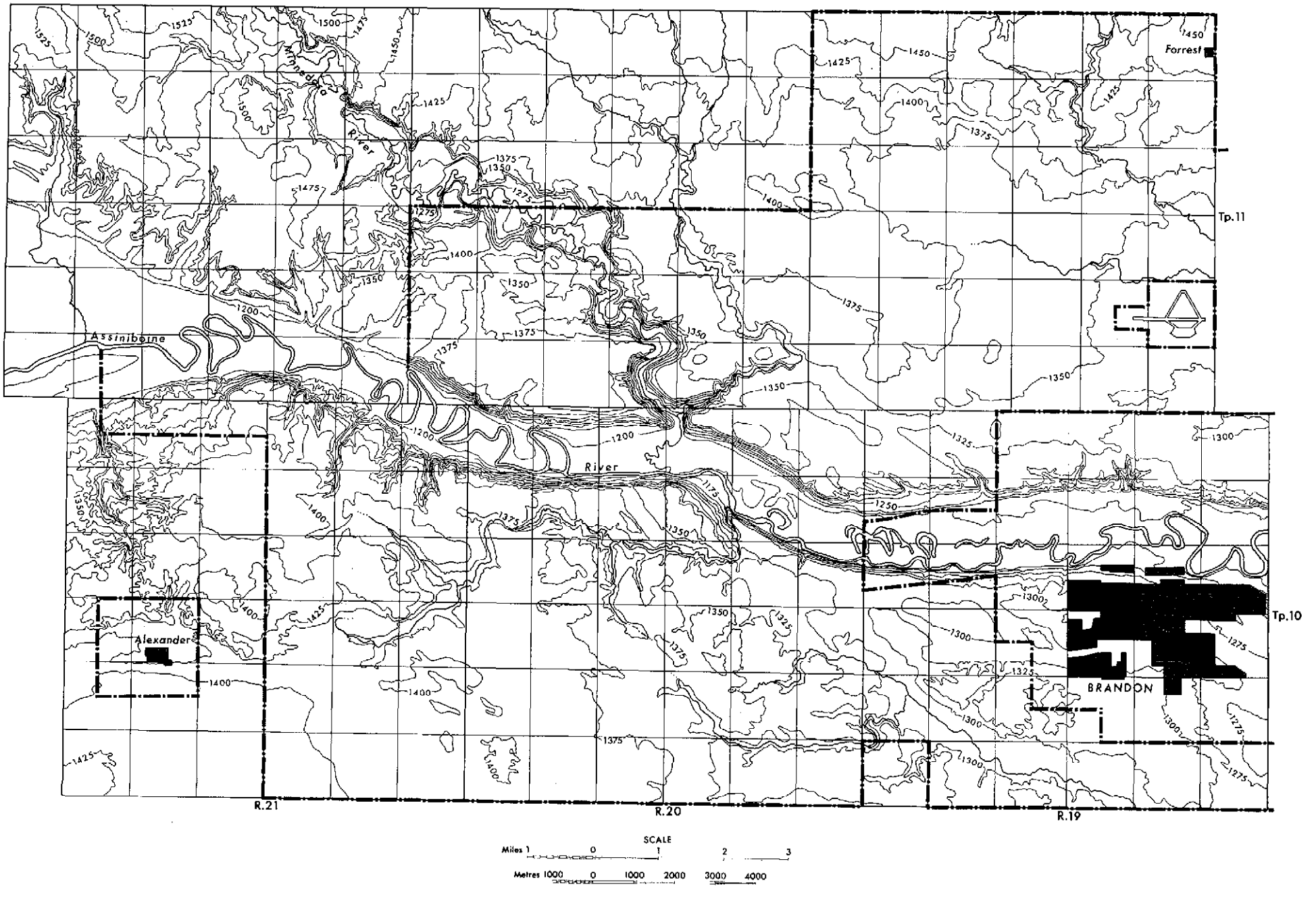


Surface Deposits Map of Brandon Region Study Area
b) Brandon Hills Area

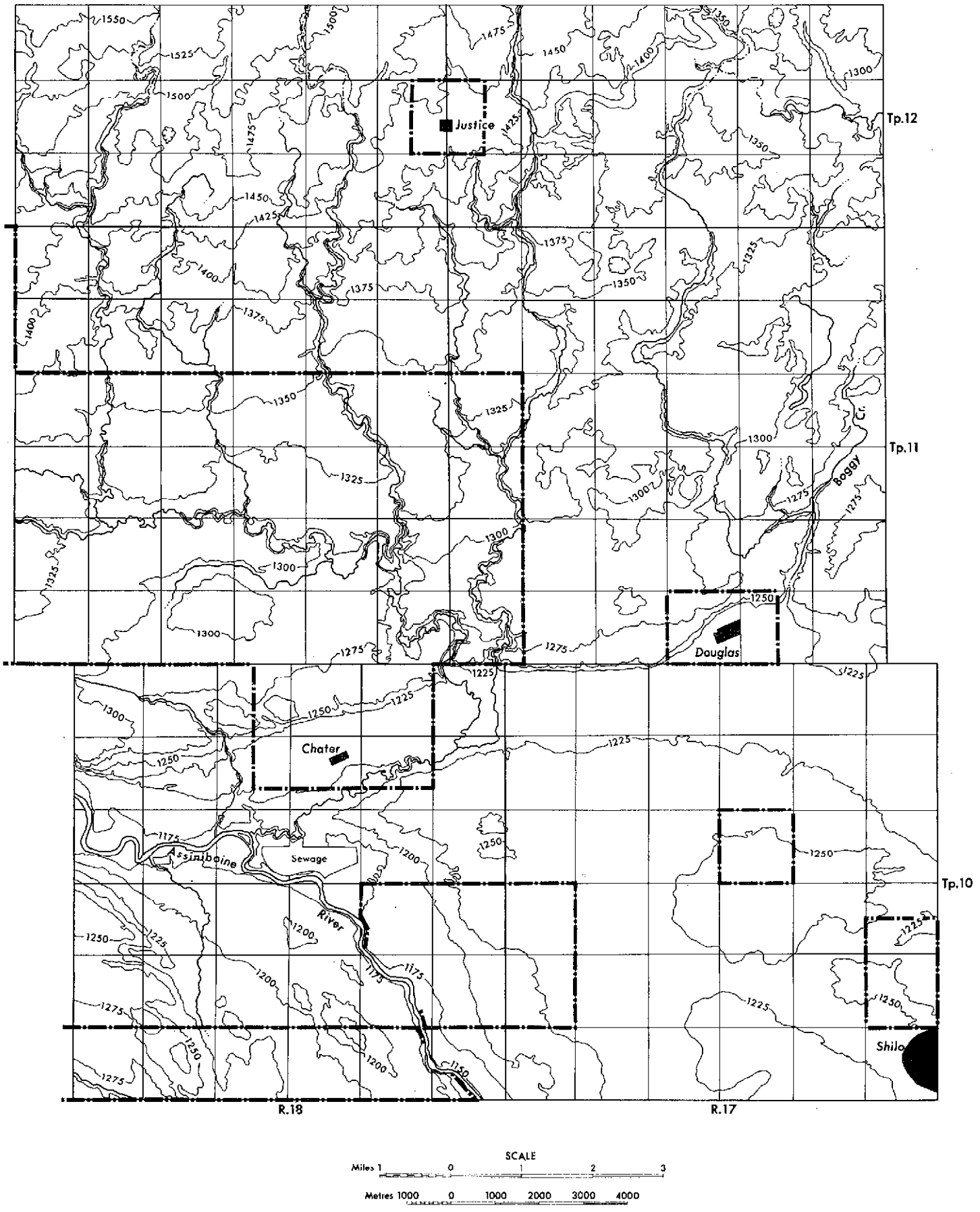


Surface Deposits Map of Brandon Region Study Area
c) Neepawa Area

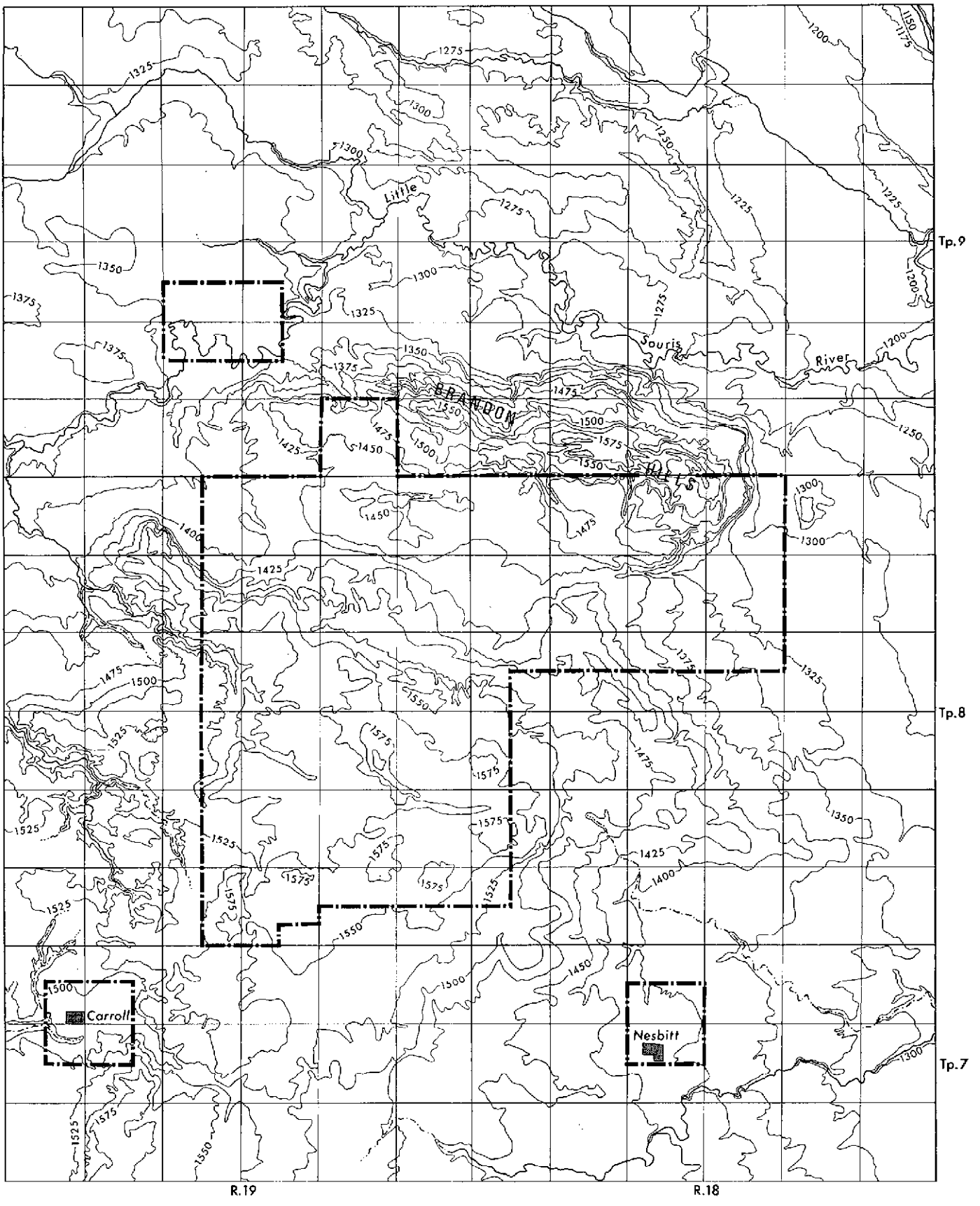
APPENDIX III



Relief and Drainage map of the Brandon Region Study Area — 25 ft. contour
a) Brandon West Area



Relief and Drainage map of the Brandon Region Study Area — 25 ft. contour
b) Brandon East Area



Relief and Drainage map of the Brandon Region Study Area — 25 ft. contour
c) Brandon Hills Area

SCALE
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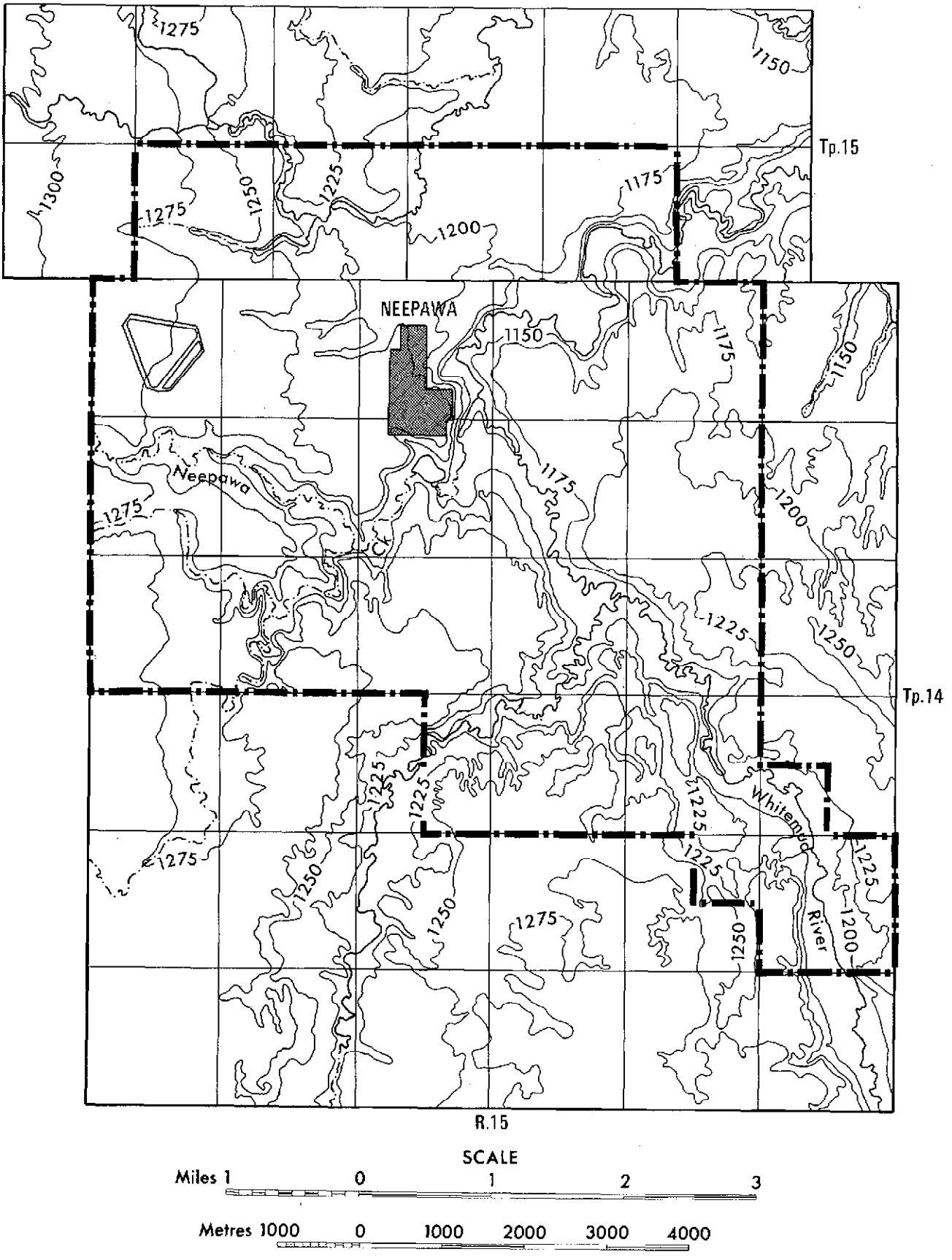
Metres 1000 0 1000 2000 3000 4000

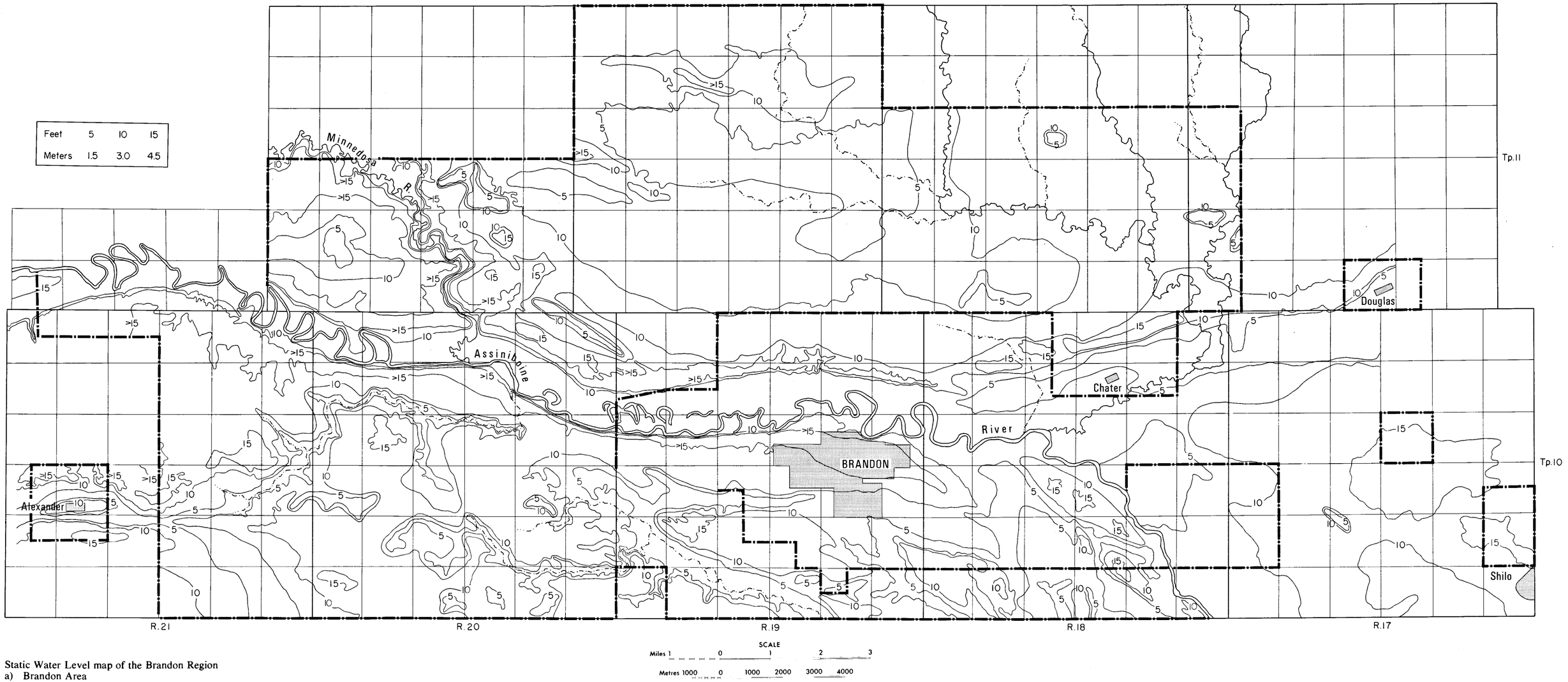


Relief and Drainage map of the Brandon Region Study Area — 25 ft. contour
d) Neepawa Area

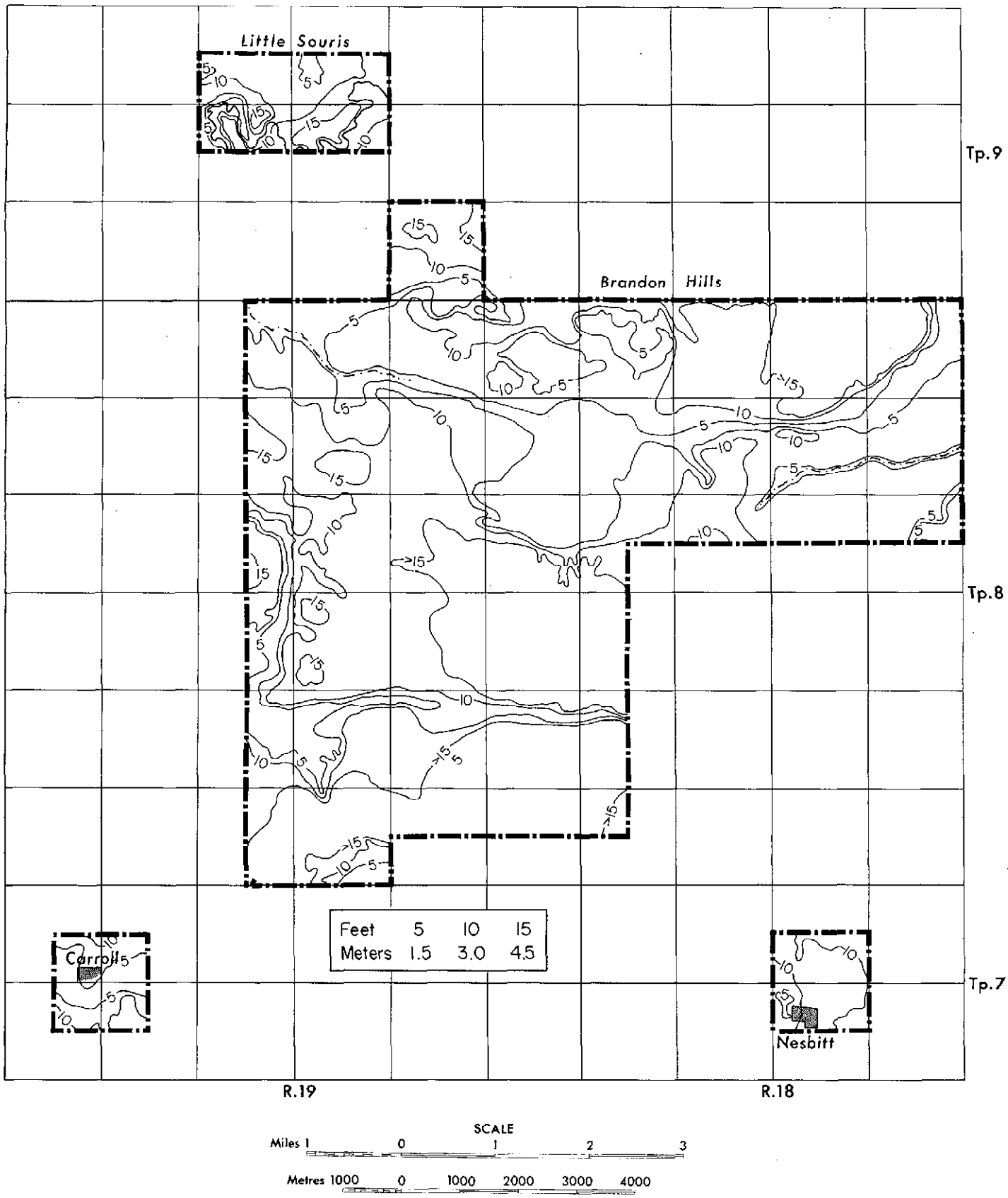
Relief is presented in feet above sea level, the following provides for conversion on the following figures. 1 Foot = 0.3048 Meters.

Feet To Meters	
1100	335
1125	343
1150	350
1175	358
1200	366
1225	373
1250	381
1275	388
1300	396
1325	404
1350	411
1375	419
1400	427
1425	434
1450	442
1475	449
1500	457
1525	465
1550	472
1575	480
1600	488

APPENDIX IV



Static Water Level map of the Brandon Region
a) Brandon Area



Static Water Level map of the Brandon Region
b) Brandon Hills Area

APPENDIX V

TABLE 11. Chemical Analyses of Assiniboine Silty Clay

Horizon	Depth cm	Texture USDA	Ph $CaCl_2$	Cond. mmhos/ cm^3	$CaCO_3$ Equiv. %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm.			
									Ca	Mg	K	Na
Ap	0-13	SiC	6.8	0.3	-	3.6	0.3	43.1	27.2	13.2	0.3	1.0
Ah	13-40	C	7.0	0.3	-	2.0	0.2	40.7	27.6	16.1	0.4	0.7
Cgj	40-80	SiC	7.3	0.2	-	0.9	-	37.4	23.2	15.9	0.5	0.6
Ckgj	80-100	SiC	7.6	0.3	3.0	-	-	34.5	-	-	-	-

TABLE 12. Physical Analyses of Assiniboine Silty Clay

Horizon	Depth cm	Mechanical Analysis			Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage		
		S %	Si %	C %				Limit	Ratio	Lineal
Ap	0-13	3	42	55						
Ah	13-40	3	38	59	61	30	31	11	1.82	15.6
Cgj	40-80	4	43	53						
Ckgj	80-100	2	45	53	63	29	34	11	1.92	17.9

TABLE 13. Deep Drill Log of Assiniboine Series (C 25-10-20W)

Depth ft.	Texture USDA	Cond. mmhos/ cm^3	Soluble Salts m.e./1					S.A.R.
			Ca	Mg	Na	SO^4	Cl	
0-1	C	0.4						
1-3	C-SiC	2.0	2.3	4.2	15.2	20.3	1.1	8.3
3-8	Strat. SiC-C	2.6						
8-12	Strat. SiC-C	2.7						
12-13	Strat. MS-SiL	1.5						
13-14	SCL	1.8	4.8	7.2	8.2	19.3	1.2	2.4
14-15	Strat. S-SiCL	1.4						
15-18	MS	1.5						

TABLE 14. Chemical Analyses of Barwood Series

Horizon	Depth cm	Texture USDA	pH $CaCl_2$	Cond. mmhos/ cm^3	$CaCO_3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Salts m.e./l						S.A.R.
											Ca	Mg	Na	SO_4	Cl	HCO_3	
Ahk	0-11	CL	7.7	1.1	5.6	1.3	4.0	4.7	0.4	30.9							
Cca	11-31	L	8.4	6.9	59.3	29.9	27.0	0.6	0.1	6.3	8.9	47.4	58.2	98.0	2.3	1.7	10.9
Ckgj	31-90	L	8.3	2.9	44.3	18.0	24.3			5.0	3.0	15.2	15.6	21.4	1.5	2.3	5.1
IICkgj	90-110+	L	8.1	1.2	22.5	11.1	10.5			12.4							

TABLE 15. Physical Analyses of Barwood Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage		
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio	Lineal
Ahk	0-11	4	2	4	7	9	11	36	31	47	30	17	22	1.61	8.6
Cca	11-31	8	2	3	5	8	10	45	27	28	20	8	19	1.81	5.1
Ckgj	31-90	5	3	4	7	14	12	42	18	18	12	6	10	2.03	5.1
IICkgj	90-110+	12	5	5	8	10	10	48	14	29	16	13	11	1.94	7.9

TABLE 16. Chemical Analyses of Beresford Series

Horizon	Depth cm	Texture USDA	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Salts m.e./l					
											Ca	Mg	Na	SO^4	Cl	HCO^3
Ahk	0-28	CL	7.8	0.6	17.4	7.9	8.8	3.1	0.3	26.6						
IICca	28-41	CL	8.2	1.3	49.4	28.4	19.3	0.6	0.1	13.5						
IICkgs	41-54	CL	8.4	4.6	32.1	14.9	15.9			13.9	12.8	64.4	6.2	80.0	2.4	6.4
IIICkgs	54-100	L	8.1	5.1	27.7	14.7	12.0			15.8	20.8	60.4	7.8	86.7	2.1	4.6

TABLE 17. Physical Analyses of Beresford Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage		
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio	Lineal
Ahk	0-28	3	2	3	5	0	23	33	34	45	27	18	19	1.76	8.8
IICca	28-41	8	2	3	4	6	7	38	40	39	20	19	16	1.80	7.9
IICkgs	41-54	5	3	4	6	10	8	39	30						
IIICkgs	54-100	9	3	5	7	11	10	10	26	37	17	20	13	1.92	8.6

TABLE 18. Deep Drill Log of Beresford Series (NE cr 24-11-19W)

Depth ft.	Texture USDA	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Cond. mmhos/ cm^3	Soluble Salts m.e./l					S.A.R.	Liquid Limit	Plastic Limit	Plasticity Index
						Ca	Mg	Na	SO^4	Cl				
0-1	CL	5.5	2.7	2.6	0.3							63	31	32
1-2	SiCL (till)	45.5	21.7	21.7	0.8							46	22	24
2-4	CL (till)	27.1	11.4	14.5	2.0	6.8	14.9	4.6	23.4	1.3	1.4			
4-6	CL (till)	21.4	8.2	12.2	4.4							38	19	19
6-8	CL (till)	21.3	9.1	11.2	4.2									
8-10	CL (till)	20.5	6.6	12.8	5.3	23.3	52.9	12.0	85.5	1.6	1.9			
10-11	CL (till)	24.6	9.9	13.5	4.6									

TABLE 19. Analyses of Brownridge Series

Horizon	Depth cm	Mechanical Analysis				pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
		FS %	VFS %	Si %	C %								
Apk	0-10	7	49	26	18	7.4	0.5	23.2	12.7	9.7	1.5	0.2	12.0
Ck1	10-30	4	57	32	7	7.6	0.4	33.1	13.2	18.3	0.5		8.6
Ck2	30-90	8	65	23	4	8.1	0.4	24.1	7.0	15.8			7.3

TABLE 20. Chemical Analyses of Capell Series

Horizon	Depth cm	Texture USDA	pH $CaCl^2$	Cond. mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
Ahk	0-28	SCL	7.9	1.4	3.0			5.9	0.5	32.3
ACk	28-33	SCL	8.1	1.1	18.6	16.3	2.1	2.6	0.2	19.3
IICca	33-48	gr SL	8.0	0.9	35.4	24.0	10.6	1.0	0.1	11.4
IICk1	48-70	gr SL	8.0	0.6	23.5	16.5	6.5			11.5
IICk2	70-100	gr S	7.9	0.3	23.8	9.7	13.3			6.1

TABLE 21. Physical Analyses of Capell Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage		
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio	Lineal
Ahk	0-28	3	3	6	32	10	4	21	24	46	31	15	16	1.59	8.8
ACk	28-33	5	2	6	33	8	3	22	26						
IICca	33-48	44	23	7	22	8	4	22	14	31	20	11	18	1.74	5.6
IICk1	48-70	75	11	10	30	13	6	16	14						
IICk2	70-100	67	44	30	16	3	1	3	3			NP			

TABLE 22. Deep Drill Log of Carroll Series

Depth Ft.	Texture USDA	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Cond. mmhos/ cm^3	Soluble ions m.e./1				
						Ca	Mg	Na	SO^4	Cl
0-2	SiL	6.0	4.3	1.6	0.6					
2-4	SiCL	21.7	9.4	11.4	2.9	20.2	11.4	0.3	31.0	0.7
4-6	SiL	21.6	7.3	13.2	1.4					
6-8	SiCL	25.1	4.1	19.3	0.8		(water table)			
8-10	SiCL	25.6	5.2	18.8	0.6					
10-12	SiCL	24.6	4.6	18.4	0.4					
12-15	SiCL	27.2	5.5	20.0	0.3					
15-18	SiCL	28.1	5.7	20.7	0.4					

TABLE 23. Analyses of Chambers Series

Horizon	Depth cm	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	pH CaCl²	Cond.mmhos/ cm³	CaCO³ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K
Ahk	0-23			2	7	19	44	28	7.5	0.4	0			5.3	0.4	30.0	25.1	4.8	0.1	0.6
IICk1	23-53					9	55	36	7.8	0.3	38.0	22.6	15.1	1.0	0.1	16.0				
IICk2	53-105	1	2	3	5	8	55	26	8.0	0.3	53.9	19.5	27.7			7.6				
IIICk	105+	3	5	8	11	10	44	19	8.1	0.7	24.8	10.5	12.2			12.5				

TABLE 24. Chemical Analyses of Clementi Series

Horizon	Depth cm	Texture USDA	pH CaCl²	Cond.mmhos/ cm³	CaCO³ Equiv. %	Cal-cite %	Dolo-mite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K
Ap	0-14	L	7.1	0.6	2.5			4.0	0.2	28.3				
Bm1	14-26	L	7.1	0.4	0			1.5	0.2	19.5	15.9	5.1	0.2	0.4
Bm2	26-37	L	7.2	0.4	0			0.9	0.1	19.7	14.9	6.7	0.1	0.4
IIBCk	37-44	L	7.4	0.3	19.9	2.7	15.9	0.1		14.7				
IICca	44-78	L	7.5	0.4	47.0	25.6	19.7			9.8				
IIICk	78-105	S	7.7	0.3	13.0	3.7	8.6			5.4				
IVCk	105+	L	7.8	0.4	38.4	8.6	27.4			9.9				

TABLE 25. Physical Analyses of Clementi Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Ratio
Ap	0-14	-	2	6	10	9	12	37	24					
Bm1	14-26	-	2	5	8	7	9	43	25	33	18	15	16	1.88
Bm2	26-37	3	4	7	8	7	10	37	27	31	17	14	11	1.98
IIBCk	37-44	19	11	11	10	9	7	33	19					
IICca	44-78	9	9	7	7	7	8	40	22	30	19	11	18	1.75
IIICk	78-105	-	8	19	44	17	2	6	4		NP			
IVCk	105+	13	5	7	9	11	10	43	15	25	16	9	15	1.82

TABLE 26. Deep Drill Log of Clementi Series (NE cr 12-8-19W)

Depth ft.	Texture	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	Cond.mmhos/ cm²	$CaCO^3$ Equiv. %	Cal-cite %	Dolo-mite %
0-1	CL								0.2	0		
1-3	L								0.3	49.4	29.0	18.8
3-5	L	4	4	7	10	9	38	25	0.3	40.6	15.9	22.8
5-7	SCL								0.3	24.6	11.9	11.7
7-9	SL-SCL	6	7	15	20	13	25	14	0.4	21.1	7.7	12.3
9-11	SL-SCL								0.3	19.5	7.8	10.8
11-13	SL	5	8	15	21	13	24	14	0.3	19.3	8.9	9.6

TABLE 27. Chemical Analyses of Croyon Series

Horizon	Depth cm	Texture USDA	pH $CaCl^2$	Cond.mmhos/ cm³	$CaCO^3$ Equiv. %	Cal-cite %	Dolo-mite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	H
LH	2-0		7.0	-	0			7.2	0.6	33.7	30.8	2.8	0.1	0
Ah	0-17	SCL	7.2	0.4	0			3.6	0.3	26.2	22.9	2.9	0.1	0
Bm	17-36	SCL	7.3	0.3	0			1.4	0.1	20.4	17.3	2.7	0.1	0
BCk	36-46	SL	7.4	0.3	1.1			0.8	0.1	14.6				
IICk1	46-70	SL	7.6	0.4	21.0	9.7	10.3			17.0				
IICk2	70-110	CS	7.8	0.3	27.8	7.7	18.5			3.4				
IICk3	110+	CS	7.8	0.3	24.0	9.7	13.1			3.6				

TABLE 28. Physical Analyses of Croyon Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Ratio	Lineal
LH	2-0														
Ah	0-17	-	2	5	8	20	17	27	21	37	25	12	22	1.65	7.4
Bm	17-36	-	3	5	8	22	17	24	21	28	17	11	22	1.76	4.0
BCk	36-46	7	4	8	16	25	16	15	16						
IICk1	46-70	35	16	13	9	9	7	28	18						
IICk2	70-110	55	46	18	20	8	3	3	2		NP				
IICk3	110+	59	17	33	28	12	4	4	2		NP				

TABLE 29. Chemical Analyses of Druxman Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm				
											Ca	Mg	Na	K	H
Ah	0-20	CL	7.1	0.2	0			4.1	0.3	29.1	26.0	2.6	0.1	0.4	0
Bm1	20-37	L	6.8	0.2	0			1.3	0.1	20.8	18.7	0.8	0.1	0.4	1.0
Bm2	37-56	L	6.7	0.1	0			0.8	0.1	16.3	15.8	0.6	0.1	0.4	1.0
IIBCk	56-68	LS	7.5	0.2	2.4			0.3		8.3					
IICk1	68-82	LS	7.7	0.2	6.3	1.0	4.9			7.2					
IICk2	82-110	CS	7.7	0.2	12.8	5.6	6.6			5.1					
IICk3	110+	CS	7.9	0.2	19.8	6.8	12.0			3.0					

TABLE 30. Physical Analyses of Druxman Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ah	0-20	-	3	7	14	12	7	23	34					
Bm1	20-37	-		4	10	10	11	41	24	30	20	10	13	1.83
Bm2	37-56	2	4	3	16	10	8	40	19	27	20	7	14	1.84
IIBCk	56-68	24	21	18	26	14	3	9	9		NP			
IICk1	68-82	8	5	16	38	23	5	7	6		NP			
IICk2	82-110	8	5	44	33	8	2	5	3		NP			
IICk3	110+	3	7	30	42	15	2	2	2		NP			

TABLE 31. Analyses of Fairland Series

Horizon	Depth cm	Mechanical Analysis FS %	VFS %	Si %	C %	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio
Ah	0-16	4	15	56	25	7.4	0.3	2.6			3.8	0.3	25.4	42	22	20	18	1.70
Bm	16-26	3	14	58	25	8.2	0.7	5.4	3.1	2.1	1.7	0.2	20.8					
Cca	26-40		9	62	9	8.5	0.6	52.4	32.3	18.5			10.7			NP		
Ck1	40-63		11	68	21	8.5	0.4	46.7	24.1	20.8			10.4	29	20	9	16	1.84
Ck2	63-100		7	82	11	8.1	0.4	26.9	4.6	20.6			7.8					

TABLE 32. Analyses of Gateside Series

Horizon	Depth cm	Mechanical Analysis MS %	FS %	VFS %	Si %	C %	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Cal-cite %	Dolo-mite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K	H
Ap	0-15	8	36	30	16	10	6.6	0.6	0			2.2	0.2	16.7	13.5	5.4	0.1	0.4	1.0
Ah	15-35	7	42	26	15	10	7.0	0.5	0			0.5	0.1	10.7	9.1	1.5	0.1	0.3	
Bm	35-60	8	47	20	16	9	7.5	0.4	0.2			0.2							
Cca	60-75	1	9	29	41	20	7.9	0.4	22.0	10.5	10.6	0.3		11.6					
Ckg1	75-90	9	58	8	16	9	7.8	0.4	9.4	4.6	4.5			7.9					
Ckg2	90+	1	4	37	41	17	7.8	0.3	15.3	6.3	8.2			13.2					

Cca	LL-28	PI-8	SL-14	SR-1.84
Ckg1		NP	SL-19	SR-1.65

TABLE 33. Chemical Analyses of Glenboro Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm				
											Ca	Mg	Na	K	H
Ah	0-22	SCL	5.7	0.3				3.3	0.3	22.4	16.9	2.1	0.1	0.6	5.5
AB	22-26	L	6.3	0.3				2.1	0.2	20.0	16.8	3.2	0.1	0.4	2.5
Bm	26-42	L	7.2	0.5				0.8	0.1	16.2	16.4	0.9	0.4	0.3	
Ck1	42-68	SL	7.8	0.4	15.0	8.7	5.9			16.8					
Ck2	68-72	VFSL	7.9	0.4	8.7	3.0	5.3			9.5					
Ck3	72-120	L	7.9	0.4	13.3	5.5	7.2			14.6					

TABLE 34. Physical Analyses of Glenboro Series

Horizon	Depth cm	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ah	0-22			3	13	37	26	21	36	29	7	24	1.59
AB	22-26			3	10	32	32	23					
Bm	26-42			6	12	30	30	22	28	22	6	17	1.78
Ck1	42-68	3	3	7	14	33	20	20					
Ck2	68-72				24	55	9	12		NP			
Ck3	72-120				3	35	39	23	30	21	9	16	1.79

TABLE 35. Analyses of Kerran Series

Horizon	Depth cm	Mechanical Analysis				pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
		FS %	VFS %	Si %	C %								
Ckg	0-12.5		1	53	46	7.4	0.5	8.9	2.8	5.7	2.9	0.3	32.5
Ahbkg	12.5-25		1	55	44	7.4	0.5	6.5	1.6	4.5	3.0	0.3	32.6
Ckg1	25-35		1	58	40	7.3	0.3	9.5	3.9	5.2	1.2	0.1	25.8
Ckg2	35-43		5	57	38	7.5	0.4	10.1	3.7	5.9			26.2
Ckg3	43-68		10	55	35	7.6	0.4	8.6	2.0	6.1			24.2
Ckg4	68-93	39	21	20	20	7.6	0.6	10.0	5.7	3.9			16.8
Ckg5	93-108		1	55	44	7.6	0.5	9.1	4.1	4.6			29.9

TABLE 36. Analyses of Kilmury Series

Horizon	Depth cm	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Ions m.e./1 Ca	Mg	Na	K	SO^4	Cl	HCO^3	SAR
Ap	0-15		2	16	28	15	18	21	7.4	0.8	0.4			3.7	0.3	24.8								
Ah	15-36		3	25	33	8	15	16	7.7	1.2	0			2.6	0.2	21.0	22.8*	1.8*	0.4*	0.3*				
ACk	36-48		4	34	27	6	14	15	7.9	3.6				1.0	0.1	12.6	29.8	19.6	6.5		119.2	3.7	4.0	1.3
Cca	48-54		5	39	18	3	23	12	8.2	3.3	20.2	15.1	4.7			7.7	16.2	22.4	9.6		35.1	1.7	4.6	2.2
IICk1	54-78		8	51	25	3	6	7	8.2	2.1	13.7	6.3	6.8			3.7	10.1	12.3	4.4		18.2	4.5	3.5	1.3
IICk2	78+	5	9	23	35	3	12	14	8.1	1.9	17.2	8.6	7.9			9.4	7.6	16.4	4.4		13.9	1.8	7.5	1.8

* Exchangeable Cations m.e./100 gm

Note: Ap LL-34 PI-10 SL-19 SR-1.65
Ah LL-31 PI-9 SL-18 SR-1.63

TABLE 37. Chemical Analyses of Kleysen Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Ions m.e./1 Ca	Mg	Na	K	SO^4	Cl	HCO^3	SAR
Ah	0-17	SiCL	7.5	0.7	0			7.6	0.6	44.0	36.1*	9.6*	0.1*	1.1*				
Bmk	17-30	SiCL	7.8	0.9	17.2	3.0	13.1	2.7	0.3	26.0								
IICca	30-45	SiCL	8.3	3.2	53.6	30.4	21.4	1.0	0.1	13.6	6.2	43.0	3.6		36.0	4.9	5.8	0.7
IICk	45-80	SiL	8.3	1.9	47.0	18.6	26.5			11.6	3.0	19.8	2.4		17.7	3.2	3.5	0.7
IIICk	80-100	L	8.2	0.5	26.5	10.0	15.2			12.7								

* Exchangeable Cations m.e./100 gm soil

TABLE 38. Physical Analyses of Kleysen Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ah	0-17			2	3	5	8	45	37					
Bmk	17-30	2	2	2	3	4	5	56	28	46	27	19	18	1.71
IICca	30-45	2					10	54	36					
IICk	45-80	5	2	1	1	4	5	61	26	37	22	15	16	1.79
IIICk	80-100	6	2	5	8	11	10	40	24	31	16	15	13	1.85

TABLE 39. Chemical Analyses of Levine Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Ions m.e./l						SAR
											Ca	Mg	Na	SO^4	Cl	HCO^3	
Ck1	0-25	VFSL	7.5	0.7	15.0	5.7	8.5	0.6	0.1	12.4							
Ahkb1	25-60	L	7.5	1.9	14.6	5.2	8.7	1.5	0.1	17.7	21.0	6.1	0.9	22.7	1.2	2.9	0.2
Ck2	60-67	L	7.5	1.9	16.8	6.4	9.7	1.5	0.1	14.8	20.4	6.8	0.8	24.9	1.5	4.1	0.2
Ahkb2	67-92	SiCL	7.5	1.1	18.0	5.8	11.2	2.4	0.2	25.2							
Ck3	92+	SiCL	7.5	1.0	11.2	4.0	6.7	1.8	0.2	24.2							

TABLE 40. Physical Analyses of Levine Series

Horizon	Depth cm	Mechanical Analysis				Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		FS %	VFS %	Si %	C %				Limit	Ratio
Ck1	0-25	22	43	24	11					
Ahkb1	25-60	7	35	35	23	37	24	13	19	1.67
Ck2	60-67	6	38	34	22					
Ahkb2	67-92		8	63	29	55	36	19	24	1.52
Ck3	92+		10	60	30					

TABLE 41. Analyses of Marringhurst Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	pH CaCl²	Cond.mmhos/ cm³	CaCO³ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K	H
LH/Ah	2-0									7.2		5.8			6.7	0.6	27.6					
Ah	0-13	4	15	16	20	12	5	17	15	6.6	0.4	0			2.9	0.4	19.1	17.9	2.2	0.1	0.3	2.4
Bm	13-18	11	3	12	20	15	8	25	17	6.8	0.4	0			2.4	0.3	20.4	18.7	4.6	0.2	0.2	1.0
Ck1	18-38	45	33	27	21	9	3	6	1	7.2	0.4	37.4	10.5	24.8			6.2					
Ck2	38-51	43	30	22	20	12	6	8	2	7.3	0.4	49.1	26.8	20.6			5.1					
Ck3	51-114	36	21	41	23	7	3	4	1	7.5	0.2	22.6	7.7	13.7			2.1					
Ck4	114-117	3	6	6	10	14	18	37	9	7.5	0.3	31.3	14.2	15.8			7.9					
Ck5	117+	39	30	29	21	11	3	5	1	7.6	0.3	27.7	9.0	17.2			2.3					

TABLE 42. Chemical Analyses of Melland Series

Horizon	Depth cm	Texture	pH CaCl²	Cond.mmhos/ cm³	CaCO³ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
Ahk	0-37	SL	7.5	0.4	4.3	0.4	3.6	5.3	0.4	33.4
IICk1	37-88	GrS	8.0	0.3	21.7	9.4	11.4	0.2		3.6
IIICk1	88-105	L	7.9	0.3	53.1	11.2	38.6			5.9
IIICk2	105+	CL	8.0	0.3	47.9	9.7	35.2			12.6

TABLE 43. Physical Analyses of Melland Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Ratio
Ahk	0-37	19	5	13	17	14	9	23	19	44	31	13	24	1.50
IICk1	37-88	63	24	17	34	16	3	4	2		NP			
IIICk1	88-105	9	4	6	9	9	8	44	20	19	14	5	10	1.99
IIICk2	105+	16	4	3	3	6	5	47	32	31	17	14	12	1.86

TABLE 44. Chemical Analyses of Pleasant Series

Horizon	Depth cm	Texture	pH CaCl²	Cond.mmhos/ cm³	CaCO³ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
Ahk	0-15	FSL	7.4	0.5	6.7	3.9	2.6	2.1	0.2	12.1
ACk	15-35	FSL	7.6	0.4	12.7	9.6	2.9	1.2	0.1	11.3
Cca	35-65	FSL	8.2	1.0	22.8	14.7	7.4			7.1
Ckg	65-100	LFS	8.3	3.2	13.8	6.6	6.7			6.7

TABLE 45. Physical Analyses of Pleasant Series

Horizon	Depth cm	Mechanical Alalysis						Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage		
		CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio	Lineal
Ahk	0-15	2	7	23	40	13	15						
ACk	15-35	2	6	19	44	13	16	26	21	5	19	1.72	4.4
Cca	35-65	3	5	22	41	13	16	24	21	3	18	1.74	4.3
Ckg	65-100	3	7	24	49	9	8		NP				

TABLE 46. Chemical Analyses of Prodan Series (slightly saline phase)

Horizon	Depth cm	Texture USDA	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Ions m.e./1						S.A.R.
											Ca	Mg	Na	SO^4	Cl	HCO^3	
Apks	0- 15	CL	7.8	4.2	2.0	-	-	4.2	0.3	29.1	26.0	27.8	9.2	47.5	1.8	6.4	1.7
Ahks	15- 28	CL	8.3	4.9	14.2	10.5	3.5	1.6	0.2	20.5	10.0	31.6	29.1	57.6	2.2	6.4	6.4
ACks	28- 37	SiCL	8.5	6.3	27.8	21.0	6.3	1.1	0.1	17.0	8.2	46.0	38.7	80.4	1.8	6.4	7.4
Ccas	37- 55	SiCL	8.6	7.3	39.7	27.3	11.5	0.6	0.1	12.3	8.8	69.1	41.1	104.9	1.8	7.6	6.6
Cks1	55- 74	L	8.4	7.4	28.6	14.1	13.4	-	-	10.5	12.6	77.4	35.0	106.1	1.7	5.3	5.2
Cks2	74-100	SiL	8.2	3.8	25.3	5.2	18.5	-	-	12.9	7.8	25.2	20.0	41.0	2.8	5.2	4.9
Cks3	100-125	SiL	8.2	1.5	26.8	5.8	19.3	-	-	10.4	1.8	4.4	10.2	9.7	1.2	3.5	3.8

TABLE 47. Physical Analyses of Prodan Series (slightly saline phase)

Horizon	Depth cm	Mechanical Analysis				Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		FS %	VFS %	Si %	C %				Limit	Ratio
Apks	0- 15	5	21	44	30					
Ahks	15- 28	3	18	47	32	45	22	23	18	1.73
ACks	28- 37	2	17	44	37					
Ccas	37- 55		10	50	40	35	19	16	18	1.81
Cks1	55- 74	2	45	35	18					
Cks2	74-100		10	75	15	33	25	12	20	1.68
Cks3	100-125	1	30	56	13					

TABLE 48. Chemical Analyses of Ramada Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm			
											Ca	Mg	Na	K
Ap	0- 10	CL	7.5	0.4	2.5	-	-	1.9	0.2	26.6				
Bm	10- 20	L	7.5	0.5	0	-	-	2.4	0.3	29.5	28.0	4.7	0.1	1.1
BCk	20- 25	SiCL	7.6	0.4	17.1	9.9	6.6	1.1	0.1	24.9				
Cca	25- 40	SiC	7.4	0.4	38.2	25.2	12.1			18.9				
Ck1	40- 75	SiCL	8.3	0.5	29.5	20.4	8.4			19.7				
Ck2	75-100	L	8.3	0.6	23.8	10.6	12.1			17.6				

TABLE 49. Physical Analyses of Ramada Series

Horizon	Depth cm	Mechanical Analysis				Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		FS %	VFS %	Si %	C %				Limit	Ratio
Ap	0- 10	10	16	38	36	48	24	24	14	1.84
Bm	10- 20	13	23	47	17					
BCk	20- 25	8	9	47	36					
Cca	25- 40		8	45	47	52	27	25	25	1.72
Ck1	40- 75	10	11	51	38	51	26	25	18	1.73
Ck2	75-100	5	20	50	25	43	24	19	14	1.83

TABLE 50. Analyses of Shilox Series

Horizon	Depth cm	Mechanical Analysis						pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm				
		CS %	MS %	FS %	VFS %	Si %	C %							Ca	Mg	Na	K	H
LH/Ah	0-5							6.4	0.2		3.7	0.3	16.9	13.8	2.6	0.1	0.6	1.9
Ah	5-20	12	51	27	4	3	3	6.4	0.1		0.8	0.1	5.7	4.7	2.5	0.1	0.2	0.9
C	20-135	9	48	33	4	5	1	6.5	0.1		0.1		2.7	2.0	0.8	0.1	0.1	0.2
Ck	135+	1	8	54	22	10	5	7.7	0.2	6.5			6.3					

TABLE 51. Chemical Analyses of Sigmund Series (moderately saline phase)

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Soluble Ions m.e./1						S.A.R.
											Ca	Mg	Na	SO^4	Cl	HCO^3	
Ahs	0- 29	C	8.1	10.1	1.4			2.9	0.3	41.9	24.4	54.4	74.4	140.4	13.5	6.4	11.8
Cks	29- 80	C	8.5	14.8	24.0	16.8	6.6	0.7	0.1	25.2	22.2	77.3	114.8	156.3	59.4	7.0	16.2
Ckgs	80-100	C	8.3	16.0	27.0	16.5	9.7			21.9	23.1	87.3	107.7	138.3	62.2	6.4	14.5

TABLE 52. Physical Analyses of Sigmund Series (moderately saline phase)

Horizon	Depth cm	Mechanical Analysis			Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		S %	Si %	C %				Limit	Ratio
Ahs	0- 29	7	38	55					
Cks	29- 80	5	32	63	59	23	36	14	1.88
Ckgs	80-100	12	37	52	48	23	25	20	1.73

TABLE 53. Chemical Analyses of Statley Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm				
											Ca	Mg	Na	K	H
LH	2- 0		6.9					47.6	1.3	79.1	63.1	8.2	0.2	1.5	2.0
Ah	0- 7	LS	7.0	0.5				1.9	0.1	8.5	9.5	1.8	0.1	0.4	0
Aej	7- 13	LS	7.1	0.7				0.2		5.2	4.0	0.9	0.1	0.2	0
Btj	13- 36	FSL	6.7	0.2				0.3		12.8	9.0	2.3	0.1	0.4	3.0
BCk	36- 50	FSL	7.3	0.3	19.5	7.9	10.6			7.0					
Cca	50- 62	L	7.4	0.3	40.2	28.3	11.0			9.7					
Ck1	62-135	L	7.6	0.3	24.7	12.7	11.0			8.7					
Ck2	135-155	SL	7.7	0.3	21.6	10.4	10.3			8.6					
Ck3	155+	L	7.8	0.3	18.0	7.5	9.7			8.4					

TABLE 54. Physical Analyses of Statley Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis							Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
			VCS %	CS %	MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ah	0- 7	2	4	9	19	30	15	16	7		NP			
Aej	7- 13	4	7	9	21	34	14	10	5		NP			
Btj	13- 36	2	4	6	16	30	16	11	17	22	16	6	12	1.93
BCk	36- 50	4	2	4	15	31	19	18	11		NP			
Cca	50- 62	17	6	6	9	12	10	37	20	29	23	6	21	1.68
Ck1	62-135	14	9	6	10	15	9	36	15		NP			
Ck2	135-155	4	4	6	10	19	15	34	12		NP			
Ck3	155+	2	8	6	10	17	10	36	13		NP			

TABLE 55. Chemical Analyses of Stewart Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond. mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
LH	3- 0		6.3					32.6	0.9	42.6
Ahk1	0- 12	L	7.0	0.5	10.2	4.0	5.7	3.2	0.4	17.3
Ahk2	12- 22	L	7.1	0.4	23.8	13.4	9.6	2.3	0.2	16.8
ACk	22- 28	L	7.1	0.4	29.3	17.4	11.0	1.4	0.2	14.0
Cca	28- 40	L	7.2	0.4	31.3	18.6	11.7			11.9
Ck1	40- 70	L	7.6	0.3	25.3	7.4	16.5			10.1
Ck2	70-110	FSL	8.0	0.4	23.1	6.7	15.1			10.8
Ck3	110-130	FSL	8.0	0.3	18.3	6.3	11.0			7.4
Ck4	130+	SL	8.1	0.4	19.8	6.4	12.3			8.2

TABLE 56. Physical Analyses of Stewart Series

Horizon	Depth cm	Particles >2 mm Wt. %	Mechanical Analysis VCS %	CS %	MS %	FS %	VFS %	Si %	C %	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio
Ahk1	0- 12	8	5	6	10	13	12	29	25					
Ahk2	12- 22	8	3	5	10	14	11	34	23	36	23	13	17	1.69
ACk	22- 28	4	3	5	9	12	13	37	21					
Cca	28- 40	8	5	5	9	11	13	35	22	32	21	11	15	1.84
Ck1	40- 70	8	4	6	12	15	14	36	13		NP			
Ck2	70-110	8		2	21	25	4	33	15		NP			
Ck3	110-130	2		3	7	13	35	32	10		NP			
Ck4	130+	7	3	5	10	13	24	33	12		NP			

TABLE 57. Analyses of Stockton Series

Horizon	Depth cm	Mechanical Analysis MS %	FS %	VFS %	Si %	C %	pH $CaCl^2$	Cond. mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K
Ah	0- 25	4	40	40	2	14	7.2	0.2				1.3	0.1	10.6	10.1	1.4	0.1	0.2
Bm	25- 43	25	48	11	6	10	7.2	0.2				0.4		8.4	7.8	1.4	0.1	0.2
BCk	43- 78		27	49	12	12	7.7	0.2	9.1	4.2	4.6	0.3		5.5				
Ck1	78-130		40	55	2	3	7.8	0.1	7.3	3.0	4.0			3.7				
Ck2	130+		23	71	1	5	7.8	0.1	8.4	2.9	5.0			3.4				

TABLE 58. Chemical Analyses of Taggart Series

Horizon	Depth cm		pH $CaCl^2$	Cond. mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm Ca	Mg	Na	K
Ap	0- 15	FSL	7.0	0.4				2.9	0.2	21.7	18.1	4.2	0.2	0.6
Ah	15- 34	FSL	7.0	0.4				2.4	0.2	22.7	18.2	5.0	0.1	0.5
ACk	34- 48	SCL	8.2	0.5	7.4	0.6	6.3	1.0	0.1	17.7				
Cca	48- 72	SCL	8.4	0.7	24.1	24.1				13.8				
Ckgj1	72- 88	VFSL	8.4	0.7	23.2	13.5	9.0			10.1				
Ckgj2	88-100	LVFS	8.2	0.6	31.9	15.0	15.6			8.2				

TABLE 59. Physical Analyses of Taggart Series

Horizon	Depth cm	Mechanical Analysis					Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ap	0- 15	3	47	23	12	15					
Ah	15- 34	2	33	31	16	18	34	24	10	17	1.66
ACk	34- 48	1	29	25	21	24	36	19	17	15	1.76
Cca	48- 72	1	27	23	22	27	40	24	16	15	1.63
Ckgj1	72- 88		15	39	27	19	28	23	5	17	1.76
Ckgj2	88-100		18	64	12	6		NP			

TABLE 60. Chemical Analyses of Traverse Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm
Ahk	0- 15	L	7.5	0.4	15.7	6.7	8.3	2.1	0.2	18.4
Bmk	15- 27	L	7.6	0.3	22.3	10.3	11.0	1.6	0.2	17.0
BCk	27- 31	SiL	7.6	0.4	34.7	19.1	14.4	0.9	0.1	12.8
Ck1	31- 38	SiL	7.6	0.3	34.4	18.7	14.5	0.6		11.0
Ck2	38- 70	CL	7.7	0.3	32.1	11.3	19.2			9.6
Ck3	70-100	L	7.8	0.3	29.2	11.2	16.6			10.7

TABLE 61. Physical Analyses of Traverse Series

Horizon	Depth cm	Mechanical Analysis				Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		FS %	VFS %	Si %	C %				Limit	Ratio
Apk	0- 15	3	41	32	24	33	24	9	17	1.66
Bmk	15- 27	2	41	48	9		NP			
BCk	27- 31	2	38	53	7		NP			
Ck1	31- 38	2	27	66	5		NP			
Ck2	38- 70	1	37	26	36	28	23	5	20	1.71
Ck3	70-100	3	44	36	17	29	23	6	19	1.65

TABLE 62. Chemical Analyses of Wellwood Series

Horizon	Depth cm	Texture	pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm			
											Ca	Mg	Na	K
Ah	0- 23	SCL	7.1	0.7				3.2	0.3	24.1	22.7	2.6	0.2	0.8
Bm	23- 40	SCL	7.6	0.6	2.5			1.0	0.3	18.7				
Cca	40- 48	CL	7.8	0.7	29.8	22.3	6.9			12.4				
IICk	48-100	LFS	7.7	0.4	13.0	4.8	7.5			6.3				

TABLE 63. Physical Analyses of Wellwood Series

Horizon	Depth cm	Mechanical Analysis					Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage	
		MS %	FS %	VFS %	Si %	C %				Limit	Ratio
Ah	0- 23	4	33	22	21	20					
Bm	23- 40	4	40	11	20	25	33	18	15	13	1.88
Cca	40- 48	3	29	10	30	28	36	23	13	19	1.70
IICk	48-100		38	46	9	7		NP			

TABLE 64. Analyses of Wheatland Series

Horizon	Depth cm	Mechanical Analysis							pH $CaCl^2$	Cond.mmhos/ cm^3	$CaCO^3$ Equiv. %	Calcite %	Dolomite %	Org. C %	Total N %	C.E.C. m.e./ 100 gm	Exchangeable Cations m.e./100 gm			
		VCS %	CS %	MS %	FS %	VFS %	Si %	C %									Ca	Mg	Na	K
Ah	0- 21	1	27	37	4	3	15	13	7.6	0.4				2.8	0.3	17.5	17.4	2.5	0.2	0.3
Bm	21- 38	3	30	47	3	2	6	9	7.8	0.4	7.7	2.6	4.7	1.1	0.1	8.4				
Ck1	38- 62	2	42	47	2	2	2	3	7.9	0.2	15.7	7.9	7.2			2.0				
Ck2	62-100	1	35	58	3	1	1	1	7.9	0.2	17.9	7.4	9.6			1.7				

APPENDIX VI

GLOSSARY OF TERMS

ACIDITY (ALKALINITY) — The degree of acidity of the soil expressed in pH values, or in words, as follows:

	pH (water)
medium acid	5.6-6.0
slightly acid	6.0-6.5
neutral	6.6-7.3
mildly alkaline	7.4-7.8
moderately alkaline	7.9-8.4
strongly alkaline	8.4-9.0

CALCAREOUS — A soil containing calcium carbonate. It effervesces visibly when treated with hydrochloric acid.

CALCIUM CARBONATE EQUIVALENT — refers to percent of carbonates in the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate content in soils include:

noncalcareous	less than 2%
weakly calcareous	2- 5%
moderately calcareous	6-15%
strongly calcareous	16-25%
very strongly calcareous	26-40%
extremely calcareous	greater than 40%

CATION EXCHANGE CAPACITY (CEC) — A measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milli-equivalents per 100 gms. of soil.

CLAY — As a soil separate, the mineral soil particles less than .002 mm in diameter. As a soil textural class, soil materials that contain 40% or more of clay, less than 45% sand and less than 40% silt.

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

CONDUCTIVITY, ELECTRICAL — The reciprocal of the resistance in ohms of a conductor which is one cm long and has a cross sectional area of one cm^2. It is expressed in reciprocal ohms per centimeter or mhos per centimeter (or millimhos per centimeter) at 25°C. It is used to express the concentration of salt in irrigation water or soil extracts.

CONSISTENCE — The combination of properties of soil material that determine its resistance to crushing and its ability to be molded or changed in shape.

CONTOUR — An imaginary line connecting points of equal elevation on the land surface.

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

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

Erosion 2—moderately eroded — soil had all of the A horizon and a part of the B or other lower lying horizons removed. The plow layer consists mainly of the original horizons below the A (or below the original plow layer) with severely eroded soils that have practically all of the original surface soil removed have been classified as Regosolic members of the respective catenas.

FRIABLE — Soil aggregates that are soft and easily crushed between thumb and forefinger.

GRANULAR STRUCTURE — Soil structure in which the individual grains are grouped into small block-like aggregates with indistinct or rounded edges (spheroidal).

GROUNDWATER — Water that fills all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

HYDRAULIC CONDUCTIVITY — refers to the effective flow velocity or discharge velocity in soil at unit hydraulic gradient. It is an approximation of the permeability of the soil and is expressed in inches per hour.

HYDROPHYTE — Plants growing in water or dependent upon being partially immersed in liquid at all times.

MESOPHYTE — Plants requiring intermediate moisture conditions and are not very resistant to drought.

SALINE SOIL — A saline soil is a soil containing soluble salts in such quantities that they interfere with growth of most crop plants. The electrical conductivity of the saturated extract is greater than 4 millimhos per centimeter at 25°C. Approximate limits of salinity classes are:

x nonsaline or minimal

salinity	0 - 4 millimhos/cm.
s slightly saline	4 - 8 millimhos/cm.
t moderately saline	8 - 15 millimhos/cm.
u strongly saline	15 millimhos/cm.

SAND — Individual rock or mineral fragments in soils having diameters ranging from 0.05 mm to 2.00 mm. The textural class name of any soil that contains 85% or more of sand and not more than 10% of clay.

SATURATION PERCENTAGE — The moisture percentage of a saturated soil paste, expressed on an oven dry weight basis.

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

SODIUM-ADSORPTION RATIO (S.A.R.) — A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with soil.

$$\text{S.A.R.} = \frac{Na+}{\sqrt{(Ca{+}{+} \text{ plus } Mg{+}{+})/2}}$$

Where the ionic concentrations are expressed as milli-equivalents per litre.

SURFACE DEPOSITS

ALLUVIAL DEPOSITS — deposits formed by streams and may occur either as flood plain deposition or alluvial fans.

BEACH DEPOSITS — deposits of gravel and sands marking the beach lines of former glacial lakes or present lakes.

LACUSTRINE DEPOSITS — clays, silts and sands laid down in glacial or former lakes.

TEXTURE OR TEXTURAL CLASS — Names given to soil material according to U.S.D.A. Systems, and refers to the proportion of various soil separates, sand, silt and clay making up the soil mass. A soil texture diagram is presented showing the textural class names and the limits of each class. For convenience, the soil texture classes are grouped together into five classes. These are as follows:

Coarse textured —
sands, loamy sand, loamy fine sand

Moderately coarse textured —
loamy very fine sand, sandy loam, fine sandy loam, very fine sand

Medium textured —
very fine sandy loam, loam, silt loam, silt

Moderately fine textured —
clay loam, silty clay loam, sandy clay loam

Fine textured —
sandy clay, silty clay, clay

GLACIAL DRIFT — consists of all the materials picked up, mixed, disintegrated, transported, and deposited through the action of glacial ice or of water resulting primarily from melting of glaciers.

TILL OR GLACIAL TILL — an unstratified, unconsolidated, heterogeneous mixture of clay, silt, sand, gravel and sometimes boulders deposited directly by ice with little transportation by water.

XEROPHYTE — plants capable of surviving extended periods of soil drought.

STONINESS — refers to degree of stones within the soil. Classes of stoniness are based on the relative amount of stones as they affect agricultural practices, but they may be used as a general guide to the hindrance to installation of services, roads, septic fields, etc.

Class 0: no stones or too few to interfere with tillage.

Class 1: slightly stony, having some stones that offer only slight to no hindrance to cultivation.

Class 2: moderately stony, having enough stones to cause some interference with cultivation.

Class 3: very stony, having sufficient stones to constitute a serious handicap to cultivation; some clearing is required.

Class 4: exceedingly stony, having sufficient stones to prevent cultivation until considerable clearing is done.

TOPOGRAPHY — refers to the percent slope and the pattern or frequency of slopes in different directions. Capital letters are used to denote single slopes, and lower-case letters are used for multiple slopes (irregular surface).

Single slopes class name	Complex slopes class name	Percent slope
A level	a nearly level	0 - 0.5
B very gently sloping	b gently undulating	0.5 - 2
C gently sloping	c undulating	2 - 5
D moderately sloping	d gently rolling	5 - 9
E strongly sloping	e moderately rolling	9 - 15
F steeply sloping	f strongly rolling	15 - 30
G very steeply sloping	g hilly	30 - 60

METHOD OF SOIL ANALYSIS

pH AND CONDUCTIVITY — determined on a saturated paste as outlined in "Saline and Alkali Soils", U.S.D.A. Handbook No. 60.

CARBON — Total and Inorganic — A wet combusion method adopted from Adams: J. Md. Eng. Chem. Anal. Ed. 6:227, 1934 and Waynick: J. Amer. Soc. Agron. 28: 337-351, 1936.

CATION EXCHANGE CAPACITY — as outlined in "Chemical Methods of Soil Analysis, Ottawa, 1958".

CALCIUM AND MAGNESIUM — Versenate Method with modification from Cheng, K.L. and Bray, R.H. Soil Sci. 72:449, 1951 and Lott, P.F. and Cheng, K.L. Chemist Analysis Vol. 46, No. 2, 1957.

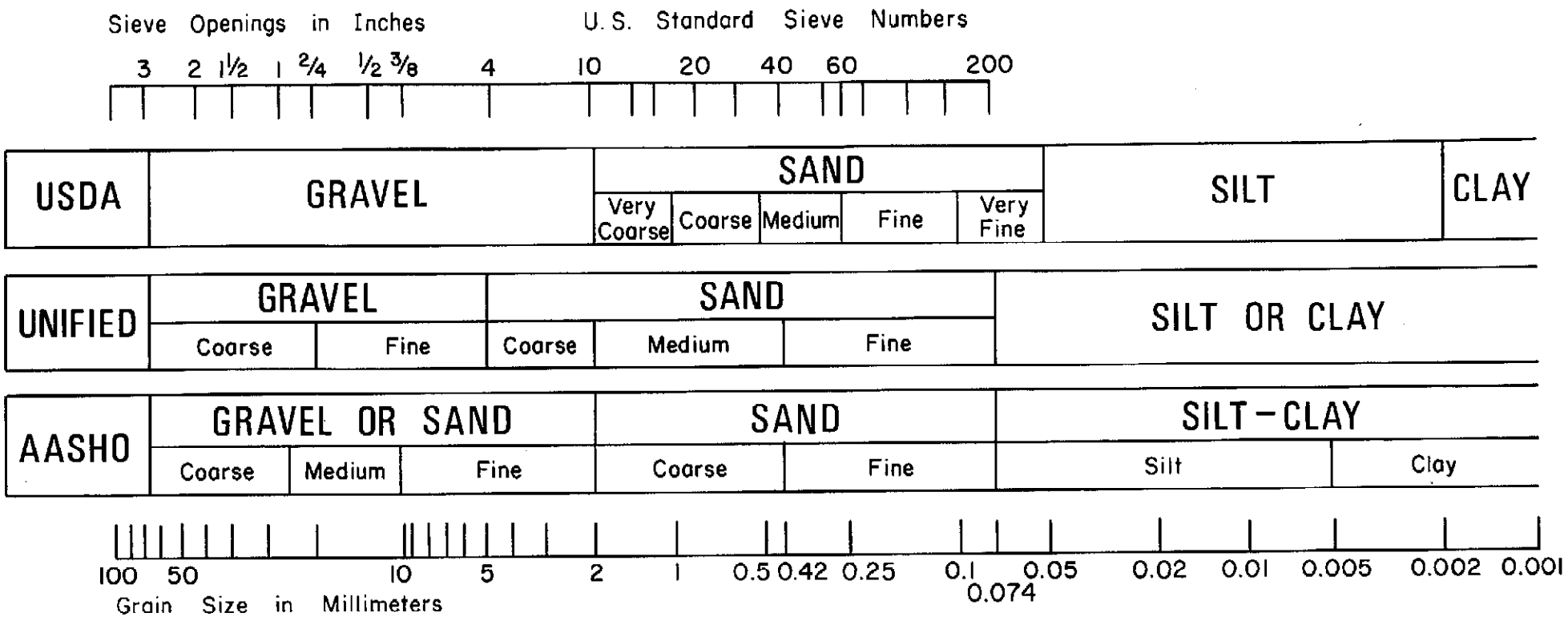
MECHANICAL ANALYSIS — Kilmer, V.J. and Alexander, L.T. Method of making Mechanical Analysis, Soil Sci. 68:15-24, 1949.

LIQUID LIMIT — as outlined in "Procedure for Testing Soils" by American Society for Testing Materials, April, 1958, A.S.T.M. Designation D 423-54T pp. 94-98.

PLASTIC LIMIT AND PLASTICITY INDEX — as outlined in "Procedure for Testing Soils", 1958, ASTM Designation 0434-54T. pp. 99-101.

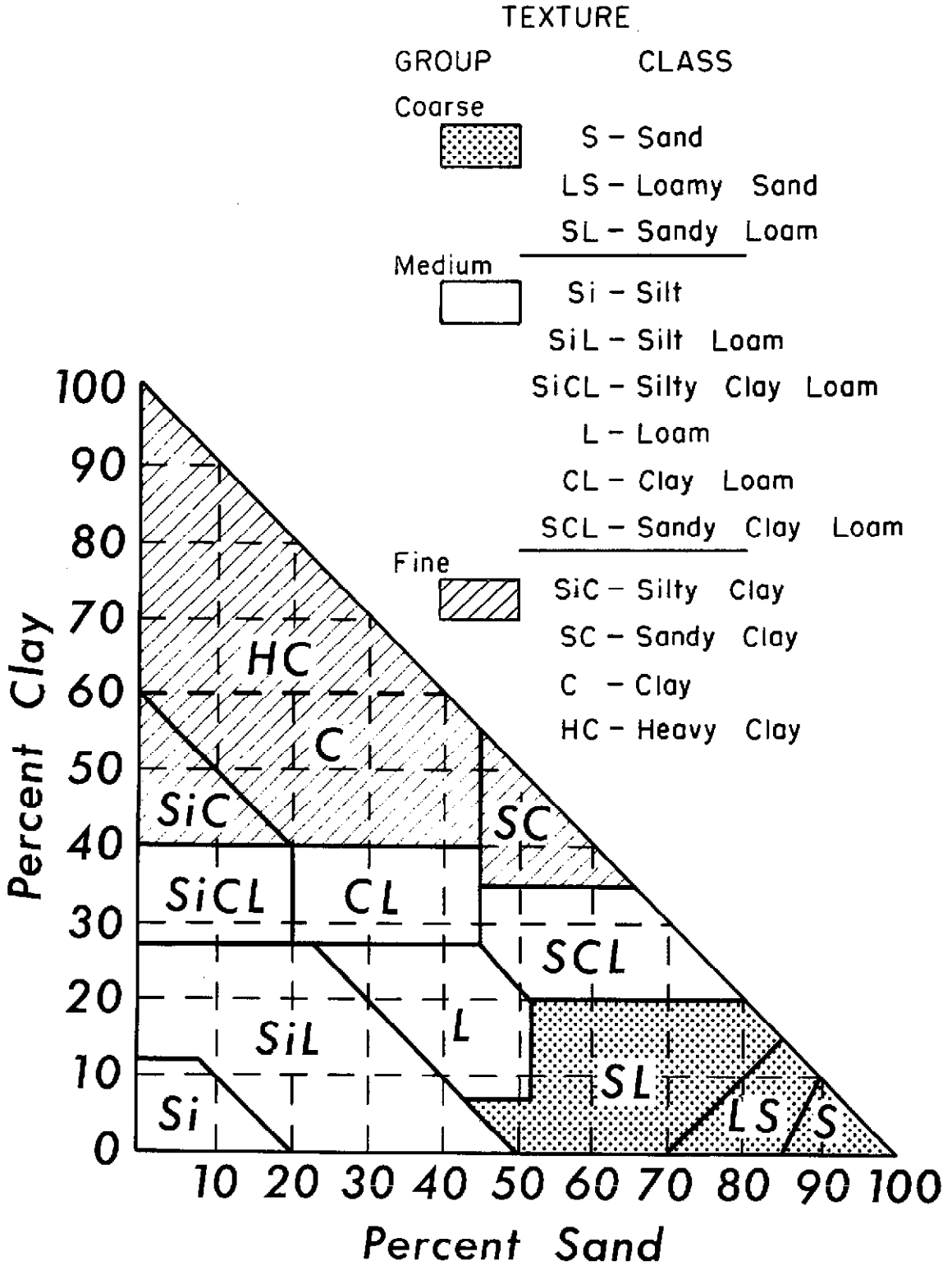
SHRINKAGE LIMIT AND SHRINKAGE RATIO — as outlined in "Procedure for Testing Soils", April, 1958, ASTM Designation D 427-39, pp. 76-79.

SATURATION PERCENTAGE AND HYDRAULIC CONDUCTIVITY — as outlined in "Saline and Alkali Soils", Handbook No. 60, U.S.D.A.



Comparison of soil particle size for the USDA, Unified and AASHO system of textural classification commonly used in Canada.

DEFINITIONS:
U.S.D.A. — being the United States Department of Agriculture System.
UNIFIED — Unified Soil Classification
AASHO — American Association of State Highways Officials Systems.



Soil texture classes (USDA)

LEGEND
BRANDON REGION SOIL STUDY AREA

Map Symbol	Soil Name	Surface Texture	Drainage	Subgroup
Az	Arizona	Loamy fine sand	Well	Orthic Regosol
Am	Ashmore	Loamy very fine sand	Well	Rego Black
As	Assiniboine	Silty clay	Imperfect	Gleyed Cumulic Regosol
Ax	Axford	Loamy medium sand	Well to mod. well	Orthic Regosol
Bk	Basker	Silty clay loam	Poor to very poor	Carb. Rego Humic Gleysol
Ba	Bankton	Clay	Well to mod. well	Rego Black
Bg	Barager	Loamy sand	Imperfect	Gleyed Carb. Rego Black
Br	Barren	Silty clay loam	Well to mod. well	Orthic Regosol
Bw	Barwood	Clay loam	Imperfect	Gleyed Carb. Rego Black
Bm	Bermont	Clay loam	Well	Rego Black
Bd	Beresford	Clay loam	Imperfect	Gleyed Carb. Rego Black
Bo	Boswell	Fine sandy loam	Imperfect	Gleyed Carb. Rego Black
Bn	Brownridge	Very fine sandy loam	Well	Orthic Regosol
Bt	Bornett	Fine sandy loam	Poor	Carb. Rego Humic Gleysol
Cc	Cactus	Loamy fine sand	Well	Rego Black
Cp	Capell	Clay loam	Imperfect	Gleyed Carb. Rego Black
Cl	Carroll	Clay loam	Well to mod. well	Rego Black
Cy	Carvey	Sandy clay loam	Poor	Carb. Rego Humic Gleysol
Cb	Chambers	Loam	Well to mod. well	Rego Black
Cm	Charman	Clay loam	Imperfect	Gleyed Carb. Rego Black
Ch	Chater	Loamy sand	Well	Calcareous Black
Ct	Clementi	Clay loam	Well to mod. well	Orthic Black
Cf	Cobfield	Clay loam	Imperfect	Gleyed Orthic Black
Cv	Cordova	Clay loam	Well to mod. well	Calcareous Black
Cr	Croyon	Loam	Well	Orthic Black
Ck	Crookdale	Sandy clay loam	Imperfect	Gleyed Orthic Black
Dg	Dogand	Sandy loam	Well to mod. well	Calcareous Black
Dr	Dorset	Loamy sand	Well to mod. well	Orthic Black
Dt	Texter	Loamy sand	Imperfect	Gleyed Orthic Black
Dx	Druxman	Loam	Imperfect	Gleyed Orthic Black
Dn	Durnan	Silt loam	Well to mod. well	Rego Black
Ev	Everton	Clay	Well to mod. well	Orthic Black
Fd	Fairland	Loam	Well	Orthic Black
Fn	Fenton	Silty clay	Poor	Carb. Rego Humic Gleysol
Fr	Fortin	Loamy sand	Poor	Carb. Rego Humic Gleysol
Ft	Forrest	Silty clay	Imperfect	Gleyed Carb. Rego Black
Gt	Gateside	Fine sandy loam	Imperfect	Gleyed Orthic Black
Gz	Gendzel	Loamy fine sand	Imperfect	Gleyed Carb. Rego Black
Gl	Glenboro	Loam	Well	Orthic Black
Gn	Grayson	Silt loam	Poor	Carb. Rego Humic Gleysol
Gr	Grover	Sandy clay loam	Imperfect	Gleyed Carb. Rego Black
Hg	Harding	Clay	Imperfect	Gleyed Orthic Black
Hk	Hickson	Clay loam	Poor	Carb. Rego Humic Gleysol
Hn	Hilton	Loam	Well to mod. well	Orthic Black
Hm	Hummerston	Loamy fine sand	Imperfect	Gleyed Carb. Rego Black
Js	Justice	Clay	Imperfect	Gleyed Orthic Black
Jk	Janick	Clay	Well to mod. well	Orthic Black
Kr	Kerran	Silty clay	Poor to very poor	Carb. Rego Humic Gleysol
Kn	Killeen	Loamy fine sand	Imperfect	Gleyed Carb. Rego Black
Kl	Kilmury	Fine sandy loam	Imperfect	Gleyed Carb. Rego Black
Kk	Kirkness	Loamy fine sand	Well to mod. well	Orthic Black
Ky	Kleysen	Clay loam	Well to mod. well	Calcareous Black
Ko	Knolls	Loam	Well	Orthic Regosol
Lh	Lavenham	Loamy fine sand	Imperfect	Gleyed Orthic Black
Lv	Levine	Loam	Imperfect	Gleyed Cumulic Regosol
Ld	Lindstrom	Loamy very fine sand	Imperfect	Gleyed Carb. Rego Black
Lk	Lockhart	Loamy very fine sand	Well to mod. well	Orthic Black
Ln	Lonery	Loamy very fine sand	Poor	Carb. Rego Humic Gleysol
Lt	Lowton	Clay	Poor	Carb. Rego Humic Gleysol
Md	Madill	Loam	Well	Orthic Regosol
Mf	Mansfield	Loamy fine sand	Imperfect	Gleyed Carb. Rego Black
Mn	Manson	Silty clay	Well	Cumulic Regosol
Ma	Marringhurst	Loamy sand	Well	Calcareous Black
Mr	Marsden	Loam	Poor	Carb. Rego Humic Gleysol
Ml	Melland	Sandy loam	Imperfect	Gleyed Carb. Rego Black
Ms	Miniota	Fine sandy loam	Well	Orthic Black
Mk	Mockry	Loamy fine sand	Poor	Carb. Rego Humic Gleysol
Ob	Oberon	Sandy clay loam	Imperfect	Gleyed Orthic Black
Oh	Onahan	Loamy sand	Imperfect	Gleyed Orthic Regosol
Pt	Petrel	Loam	Imperfect	Gleyed Orthic Black

Map Symbol	Soil Name	Surface Texture	Drainage	Subgroup
Pl	Pleasant	Very fine sandy loam	Imperfect	Gleyed Carb. Rego Black
Po	Poolex	Fine sandy loam	Poor	Carb. Rego Humic Gleysol
Pp	Porple	Fine sandy loam	Well to mod. well	Rego Black
Pr	Prodan	Clay loam	Imperfect	Gleyed Carb. Rego Black
Ps	Prosser	Fine sandy loam	Well to mod. well	Orthic Black
Ra	Ramada	Clay loam	Well to mod. well	Orthic Black
Re	Rempel	Clay loam	Well to mod. well	Calcareous Black
Rd	Roddan	Loam	Well	Orthic Regosol
Rf	Rufford	Loam	Well to mod. well	Rego Black
Sw	Sewell	Loamy fine sand	Poor	Carb. Rego Humic Gleysol
Sh	Shilox	Fine sand	Well	Orthic Regosol
Sg	Sigmund	Clay	Imperfect	Gleyed Carb. Rego Black
Sy	Statley	Loam	Well to mod. well	Orthic Dark Gray
St	Stewart	Clay loam	Well	Rego Black
Sn	Stockton	Loamy fine sand	Well to mod. well	Orthic Black
Su	Sutton	Clay loam	Poor	Carb. Rego Humic Gleysol
Td	Tadpole	Clay loam	Poor	Carb. Rego Humic Gleysol
Tg	Taggart	Silt loam	Imperfect	Gleyed Carb. Rego Black
Tc	Torcan	Silt loam	Imperfect	Gleyed Orthic Black
Tv	Traverse	Silt loam	Well to mod. well	Clacareous Black
Vr	Varcoe	Loam	Imperfect	Gleyed Carb. Rego Black
Vs	Vordas	Silt loam	Poor	Carb. Rego Humic Gleysol
Vf	Vodroff	Clay loam	Poor	Carb. Rego Humic Gleysol
Wd	Wellwood	Clay loam	Well to mod. well	Orthic Black
Ws	Wesley	Clay loam	Imperfect	Gleyed Carb. Rego Black
Wh	Wheatland	Loamy fine sand	Well	Orthic Black
Wf	Woodfield	Clay loam	Well	Calcareous Black
Wy	Wytonville	Fine sandy loam	Imperfect	Gleyed Orthic Black
Xv	Xavier	Mesic peat	Very poor	Typic Mesisol
Zn	Zarnet	Loam	Well	Rego Black

INTERPRETATION OF MAP UNITS

The Soil Series Map Unit was indicated by two alphabetic letters e.g. Ma (Marringhurst). The phase of the series was indicated by alphabet or numeric symbols below the soil series symbol. Four possible phases or combinations of phases were presented as follows:

a) first space, numeric, indicated degree of erosion;
b) second space, alphabetic, indicated topography;
c) third space, numeric, indicated degree of stoniness; and
d) fourth space, alphabetic, indicated degree of salinity.

An "x" was used to designate that the phase condition was minimal as described for the soil series. The symbol "p" following the series indicated the peaty phase; a raised numeric symbol following the series indicated the percentile of that series in the Map Unit.

An example of a complex map unit is given as:

$$\frac{St^4}{1c2x} \qquad \frac{Sy^4}{1d3x} \qquad \frac{Ct^2}{1c2x}$$

and indicates the landscape unit consists of 40% Stewart series, slightly eroded, gently undulating slopes, moderately stony, non-saline; to percent Statley, slightly eroded, gently rolling slopes (5 to 9%), very stony, non-saline; 20% Clementi, slightly eroded, gently undulating (2 to 5%), moderately stony, non-saline.

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

Examples of single map units are:

(1) Td (2) $\frac{Tdp}{XXXS}$ (3) Dtl

(1) which represents a landscape consisting entirely of the Tadpole series, with phase features absent or minimal;

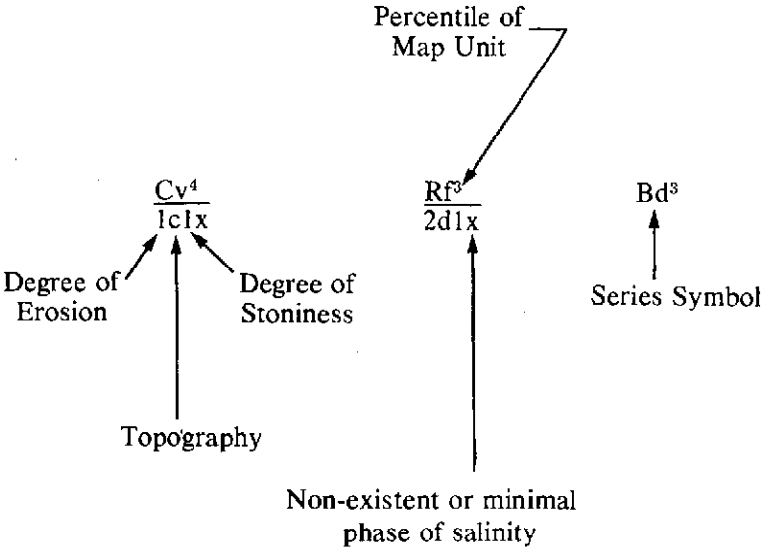
(2) Tadpole Series, peaty phase (p) and slightly saline.

The term peaty phase is applied to any mineral soil with a surface covering of 15 to 40 cm peat other than fibric moss peat. The three X characters indicate that erosion, topography and stoniness were minimal.

(3) Dexter Series with clayey strata; the 1 indicates a variant of the normal series, which in the Dexter Series refers to a third clayey strate within the profile.

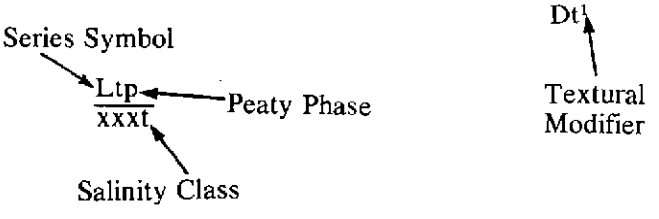
SYMBOLS

Complex Map Unit:



This complex map unit consists of 40% Cordova, 30% Rufford, and 30% Beresford.

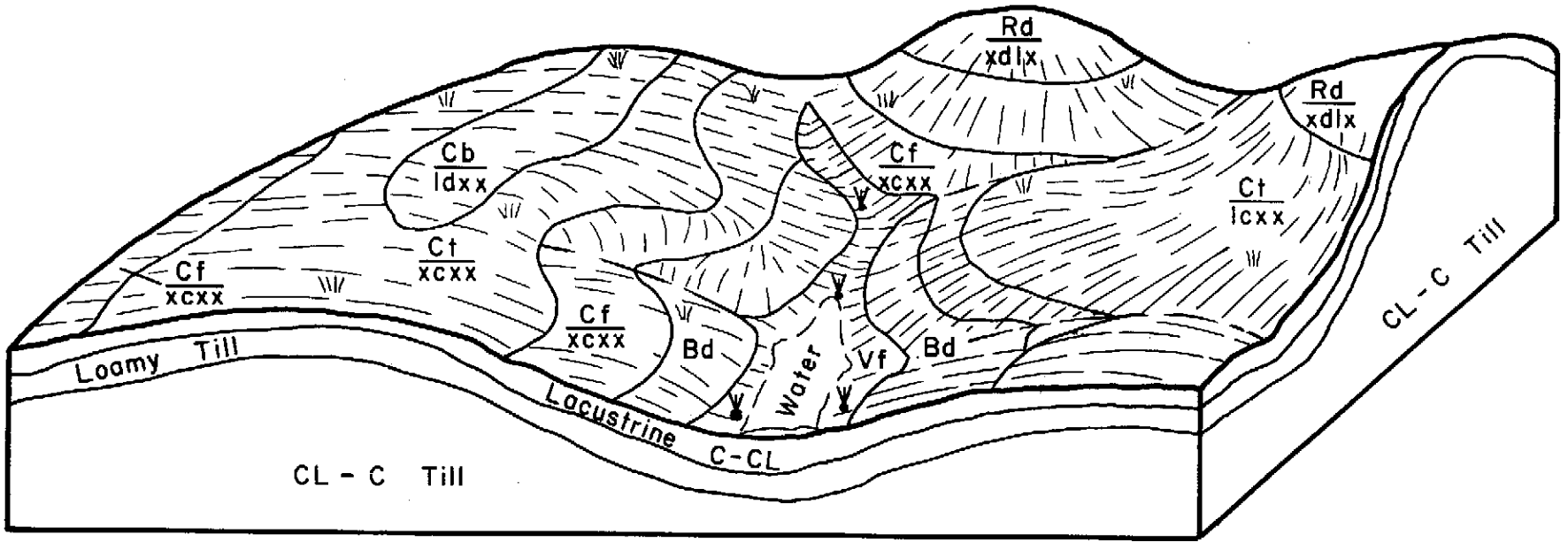
Single Map Unit:



For definitions and ratings on erosion, topography, stoniness and salinity, refer to Glossary.

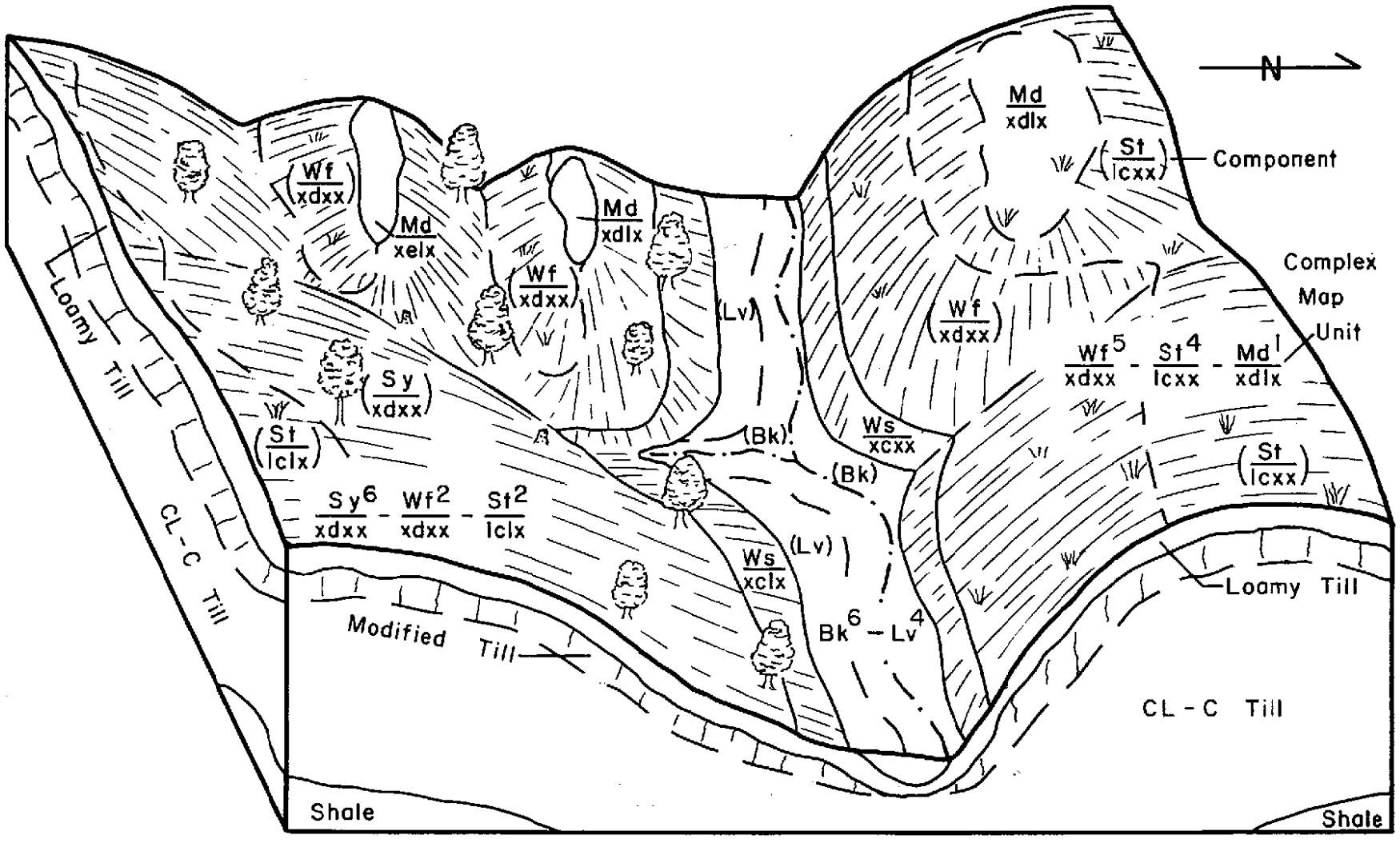
The following block diagrams are designed to show how topography, parent material, and natural vegetation are related to soil patterns that exist in certain landscapes.

Block diagram showing distribution of single map units over a landscape.



Series: Bd — Beresford, Cb — Chambers, Cf — Cobfield, Ct — Clementi, Rd — Roddan, Vf — Vodroff

Block Diagram showing distribution of complex map units and their components.



Series: Bk — Basker, Lv — Levine, Md — Madill, St — Stewart, Sy — Stanley, Ws — Wesley, Wf — Woodfield

METRIC CONVERSION TABLE
Approximate conversions to metric measures

When You Know	Multiply by	To Find	Symbol
LENGTH			
inches	2.5	centimetres	cm
feet	0.3	metres	m
yards	0.9	metres	m
miles	1.6	kilometres	km
AREA			
square inches	6.5	square centimetres	cm^2
square feet	0.09	square metres	m^2
square yards	0.8	square metres	m^2
square miles	2.6	square kilometres	km^2
acres	0.4	hectares	ha
MASS			
ounces	28	grams	g
pounds	0.45	kilograms	kg
short tons(2000lb)	0.9	tonnes	t
VOLUME			
fluid ounces	28	millilitres	ml
pints	0.57	litres	(
quarts	1.14	litres	(
gallons	4.5	litres	(
cubic feet	0.03	cubic metres	m^3
cubic yards	0.76	cubic metres	m^3
TEMPERATURE (exact)			
Fahrenheit		Celsius	°C

°F - 32 x 5/9 = °C

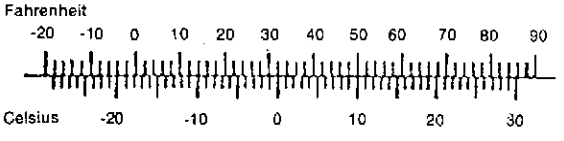
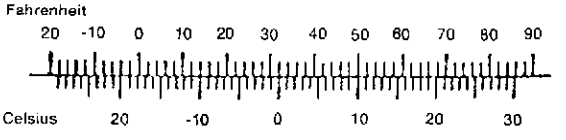


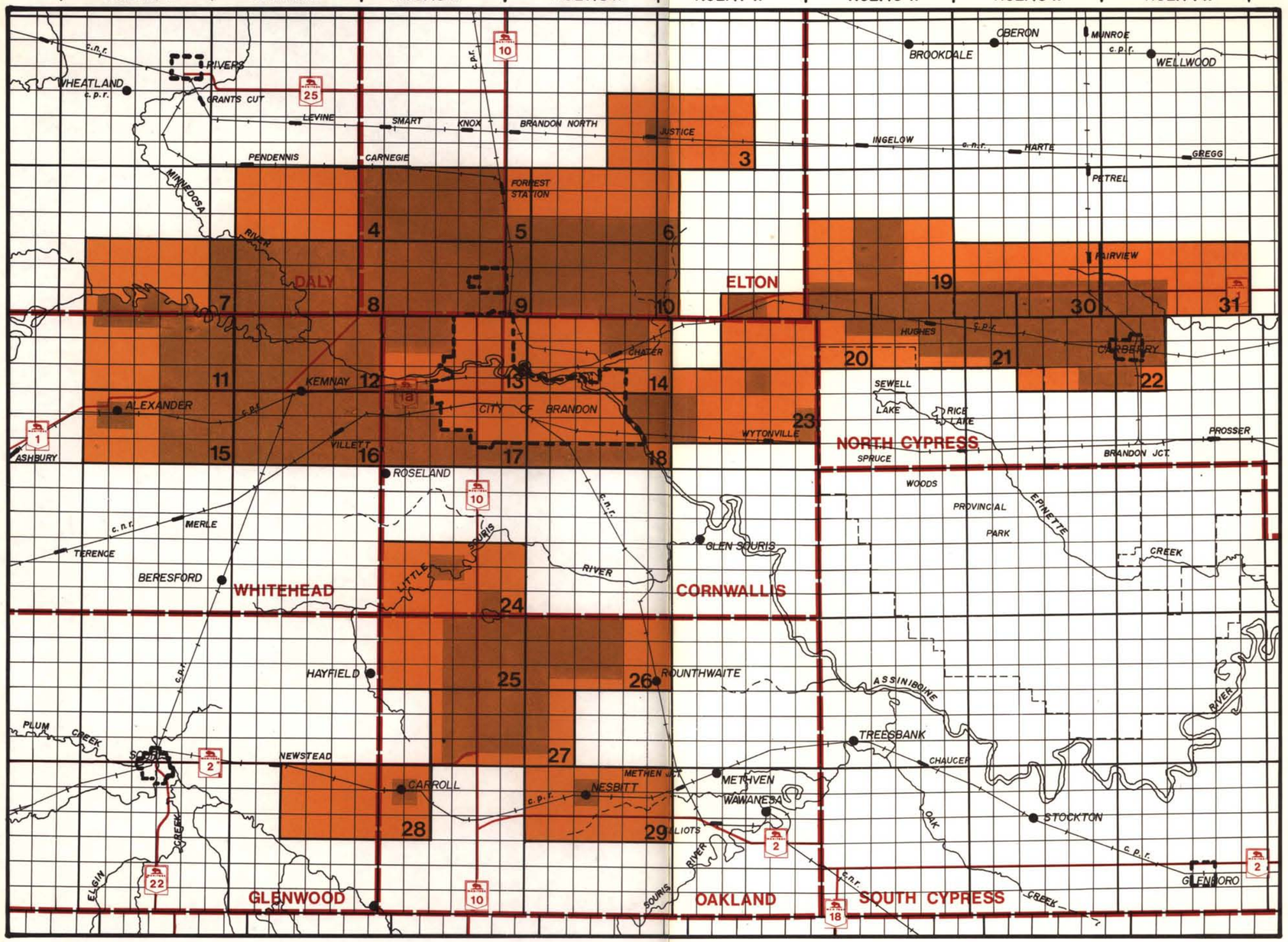
TABLE DE CONVERSION MÉTRIQUE
Conversion approximative aux unités métriques de mesure

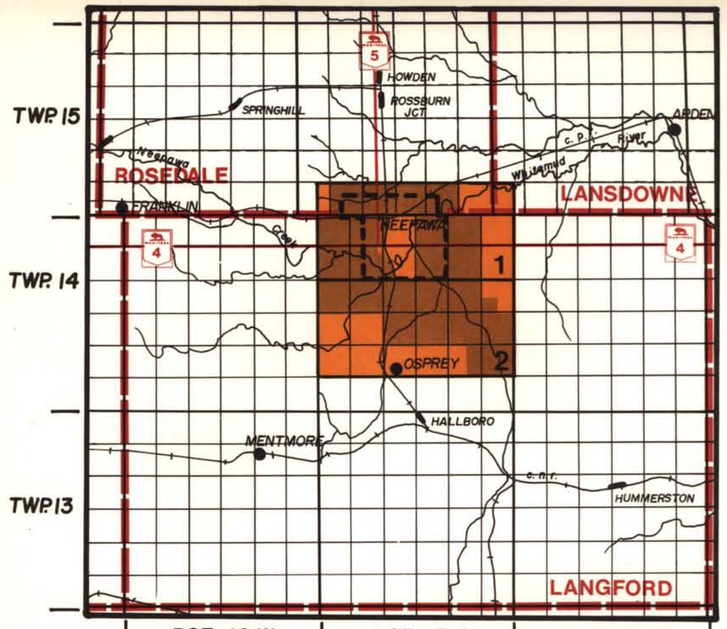
Lorsque vous connaissez les mesures en	Multipliez par	pour obtenir	Symbole
LONGUEUR			
pouces	2.5	centimètres	cm
pieds	0.3	mètres	m
verges	0.9	mètres	m
milles	1.6	kilomètres	km
SUPERFICE			
pouces carrés	6.5	centimètres carrés	cm^2
pieds carrés	0.09	mètres carrés	m^2
verges carrées	0.8	mètres carrés	m^2
milles carrés	2.6	kilomètres carrés	km^2
acres	0.4	hectares	ha
MASSE			
onces	28	grammes	g
livres	0.45	kilogrammes	kg
tonnes courtes (2000 lb)	0.9	tonnes	t
VOLUME			
onces liquides	28	millilitres	ml
chopines	0.57	litres	(
pintes	1.14	litres	(
gallons	4.5	litres	(
pieds cubes	0.03	mètres cubes	m^3
verges cubes	0.76	mètres cubes	m^3
TEMPÉRATURE (exacte)			
Fahrenheit		Celsius	°C

°F -32 x 5/9 = °C



APPENDIX VII





4 0 4 8
SCALE IN MILES

NORTH

LEGEND

24	MAP NUMBER
	MAP SHEET AREA
	SOIL SURVEY COVERAGE
	RURAL MUNICIPAL BOUNDARY

Prepared by: DEPARTMENT OF MUNICIPAL AFFAIRS
MUNICIPAL PLANNING BRANCH

SOIL MAP INDEX

R.M. of Lansdowne Sec. 6 • Twp. 15 • Rge. 14W.
R.M. of Rosedale Sec. 1-5 • Twp. 15 • Rge. 15W.
R.M. of Langford Sec. 25-36 • Twp. 14 • Rge. 15W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 1

R.M. of Langford
Sec. 7-24 • Twp. 14 • Rge. 15W.

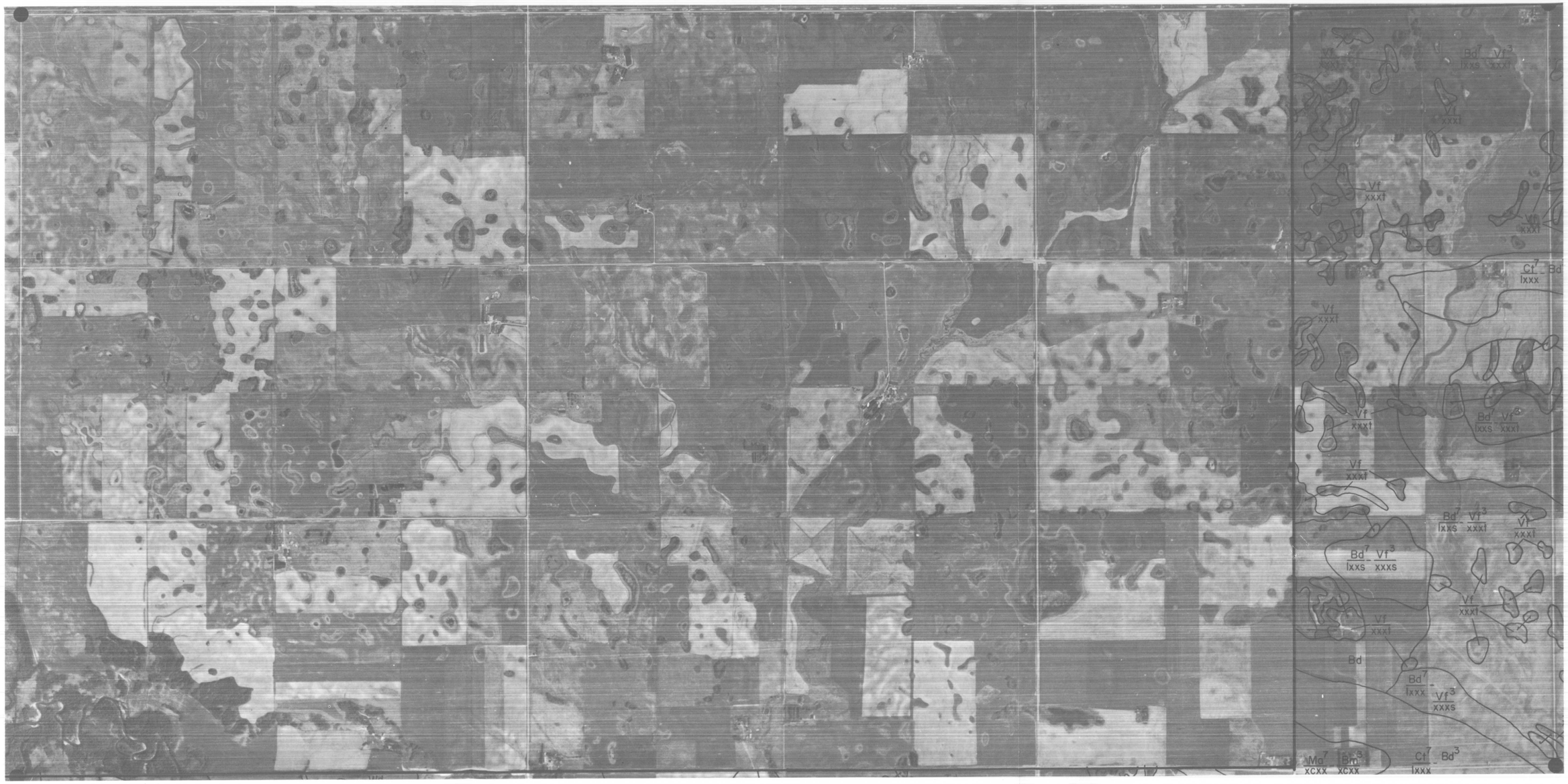
MAP NO. 2

MILES 1 1/2 0
SCALE 1000
METRES 0
NORTH

R.M. of Elton
Sec. 3-10, 15-18 • Twp. 12 • Rge. 17W.
Sec. 1-2, 11-14 • Twp. 12 • Rge. 18W.

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH

MAP NO. 3



R.M. of Elton Sec. 19, 30, 31 • Twp. 11 • Rge. 19W.
R.M. of Daly Sec. 20-29, 32-36 • Twp. 11 • Rge. 20W.

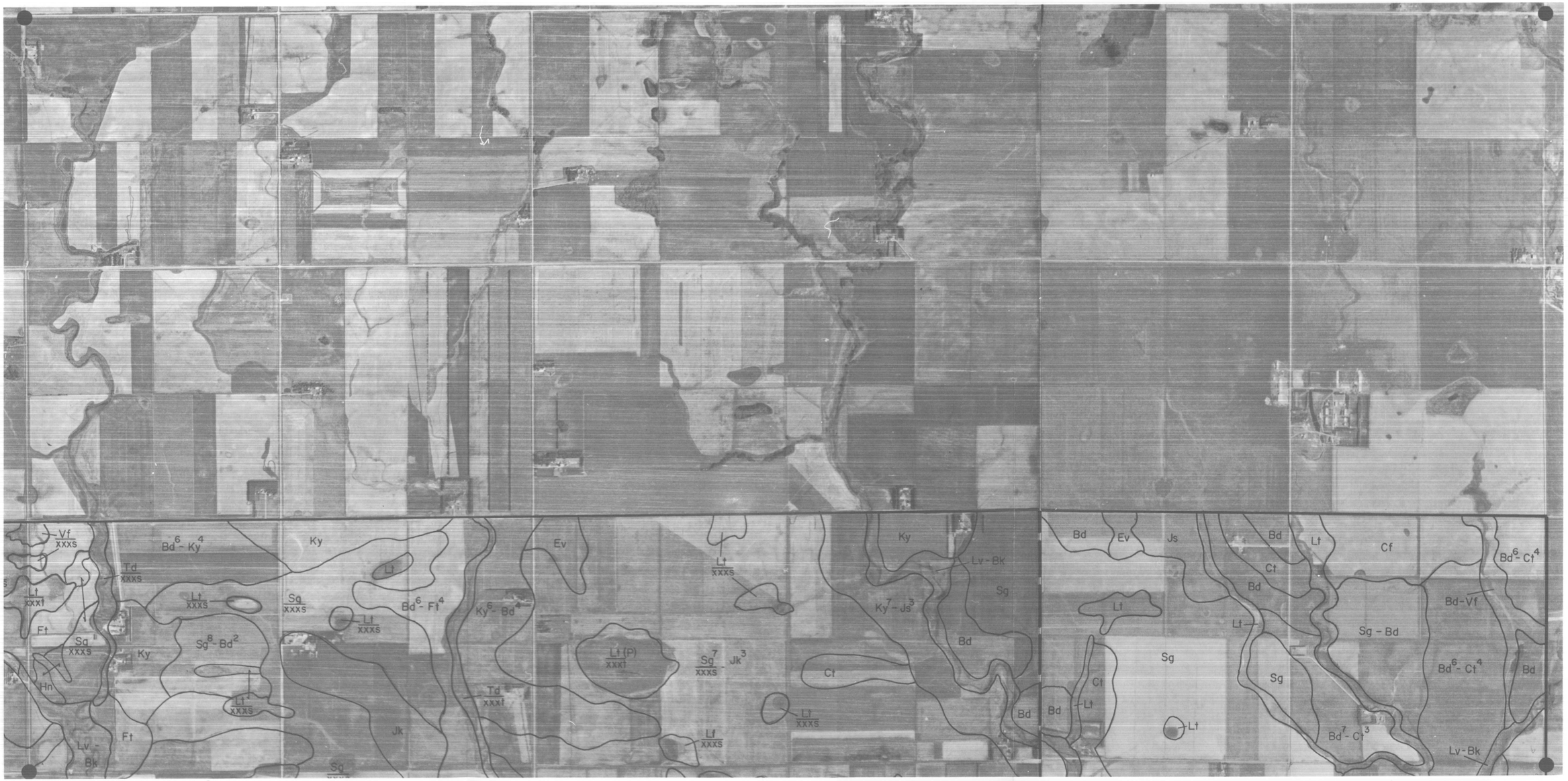
MAP NO. 4

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

R.M. of Elton
Sec. 20-29, 32-36 • Twp. 11 • Rge. 19W.
Sec. 19, 30, 31 • Twp. 11 • Rge. 18W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

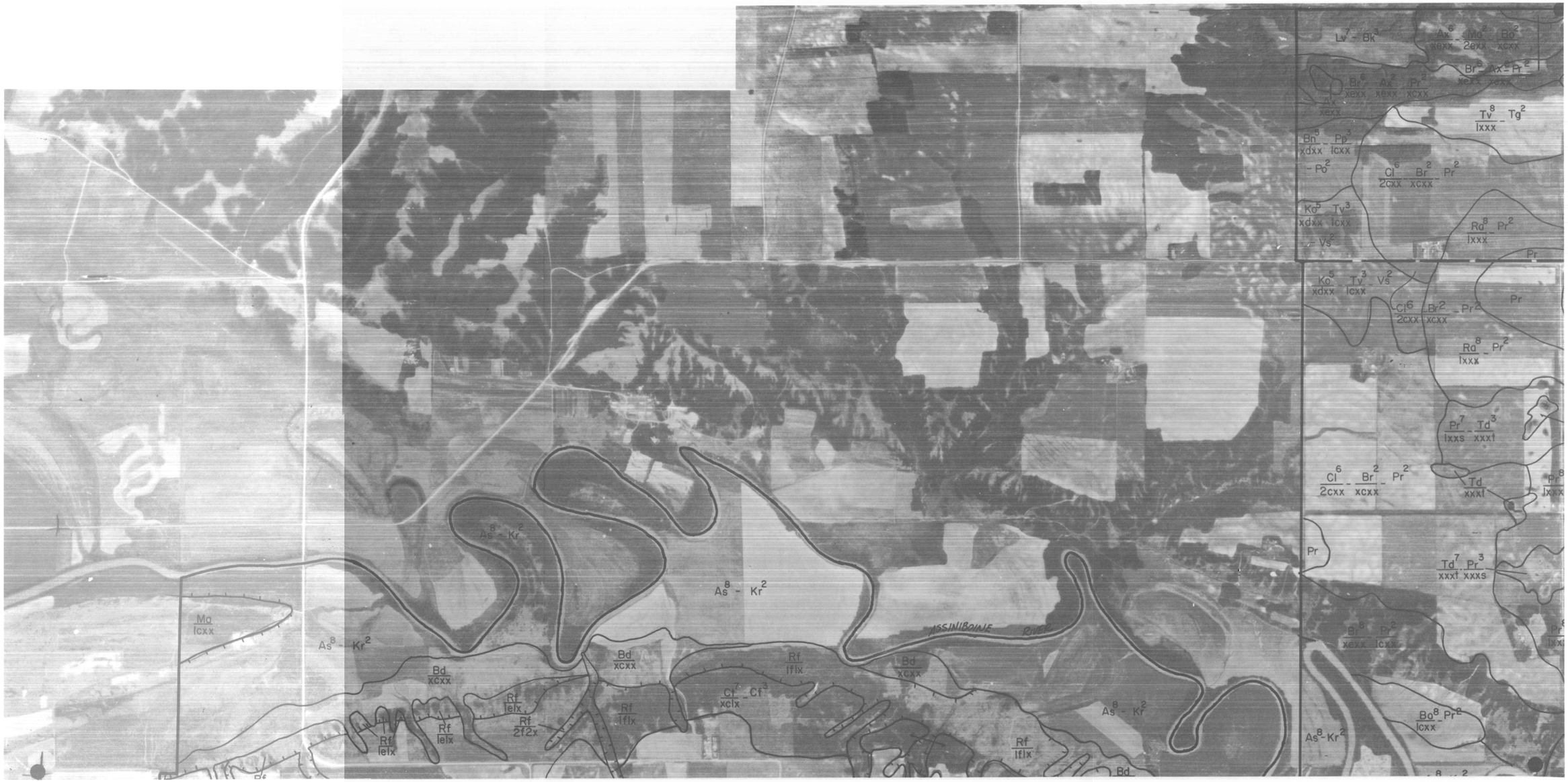
MAP NO. 5



R.M. of Elton
Sec. 19, 30, 31 • Twp. 11 • Rge. 17W.
Sec. 20-29, 32-36 • Twp. 11 • Rge. 18W.

MAP NO. 6

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH



R.M. of Daly
Sec. 6, 7, 18 • Twp. 11 • Rge. 20W.
Sec. 1-5, 8-17 • Twp. 11 • Rge. 21W.

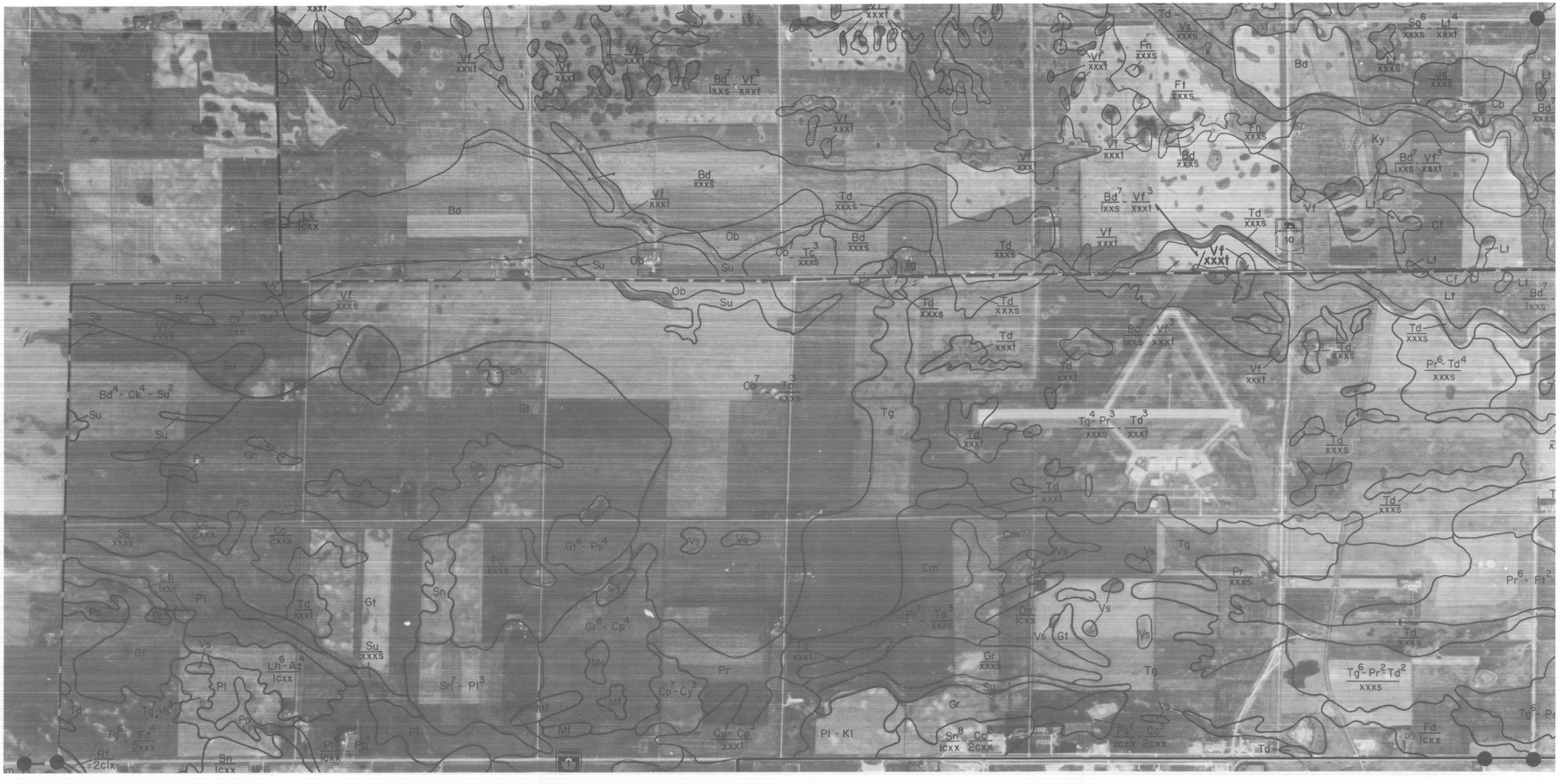
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 7

R.M. of Elton Sec. 6, 7, 18 • Twp. 11 • Rge. 19W.
R.M. of Daly Sec. 1-5, 8-17 • Twp. 11 • Rge. 20W.

MAP NO. 8

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH



R.M. of Elton
Sec. 6, 7, 18 • Twp. 11 • Rge. 18W.
Sec. 1-5, 8-17 • Twp. 11 • Rge. 19W.

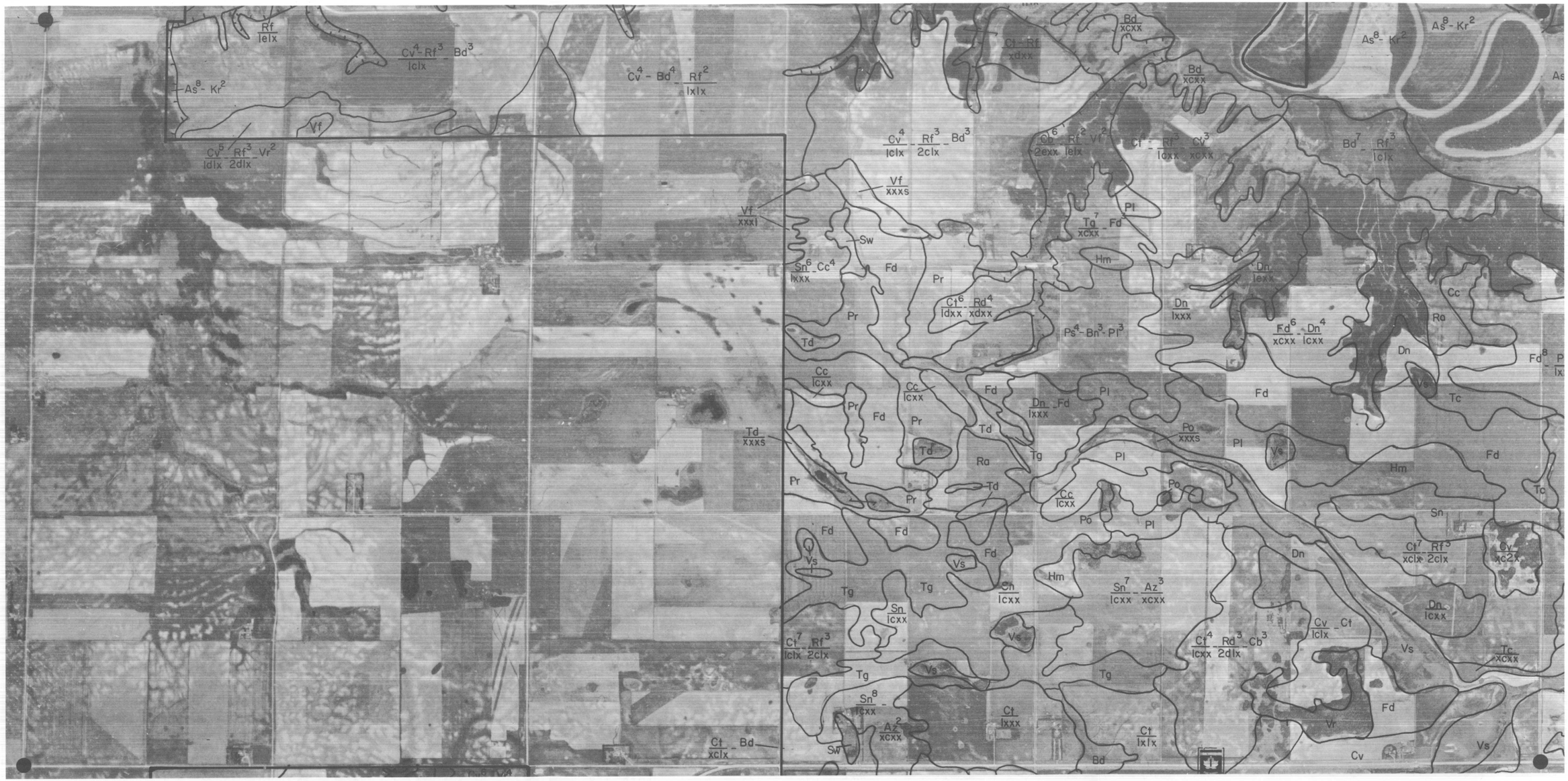
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 9

R.M. of Elton
Sec. 6, 7, 18 • Twp. 11 • Rge. 17W.
Sec. 1-5, 8-17 • Twp. 11 • Rge. 18W.

MAP NO. 10

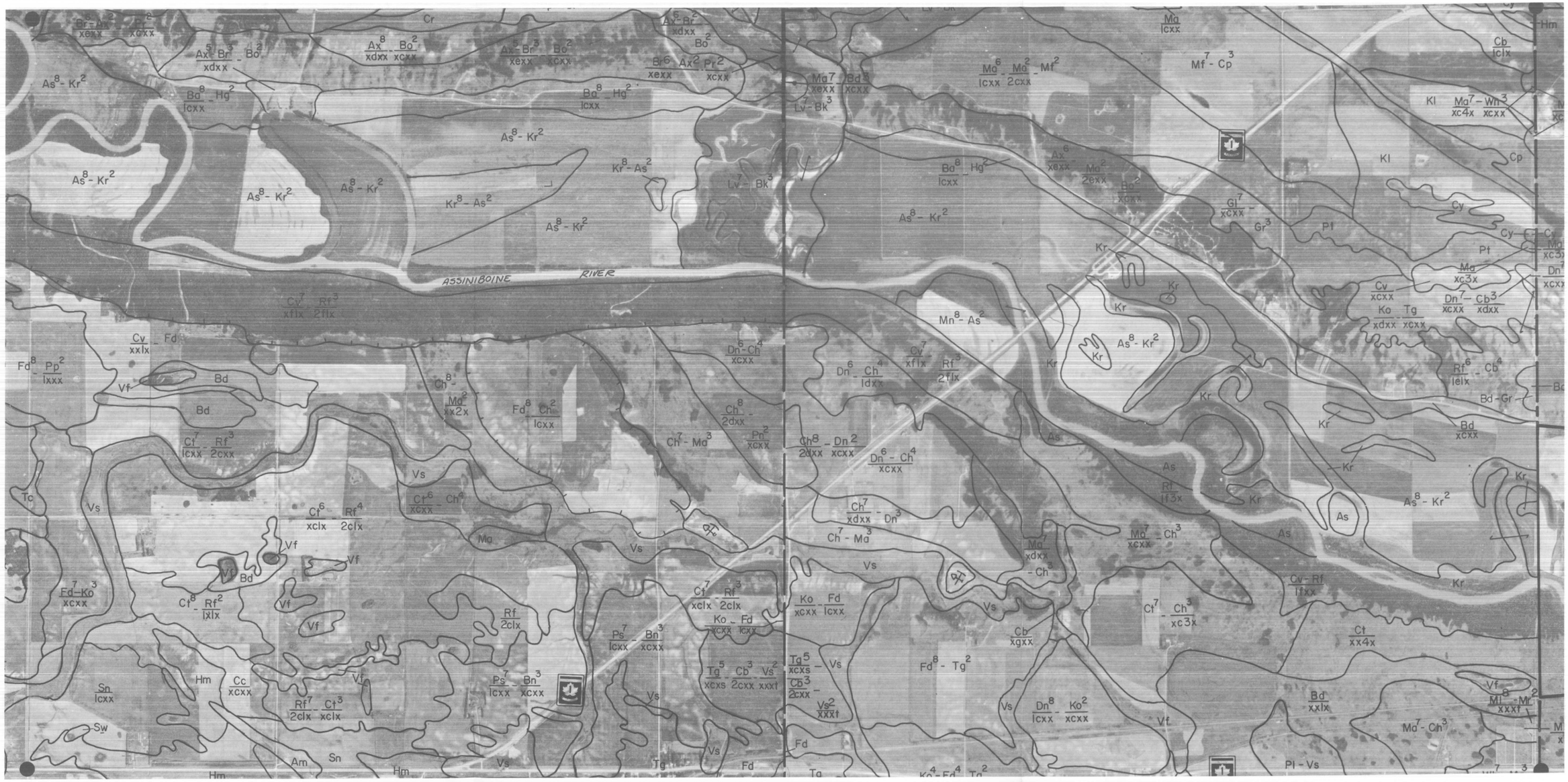
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH



R.M. of Whitehead
Sec. 19-36 • Twp. 10 • Rge. 21W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 11



R.M. of Whitehead
Sec. 19-36 • Twp. 10 • Rge. 20W.

MAP NO. 12

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

R.M. of Cornwallis
Sec. 19-36 • Twp. 10 • Rge. 19W.

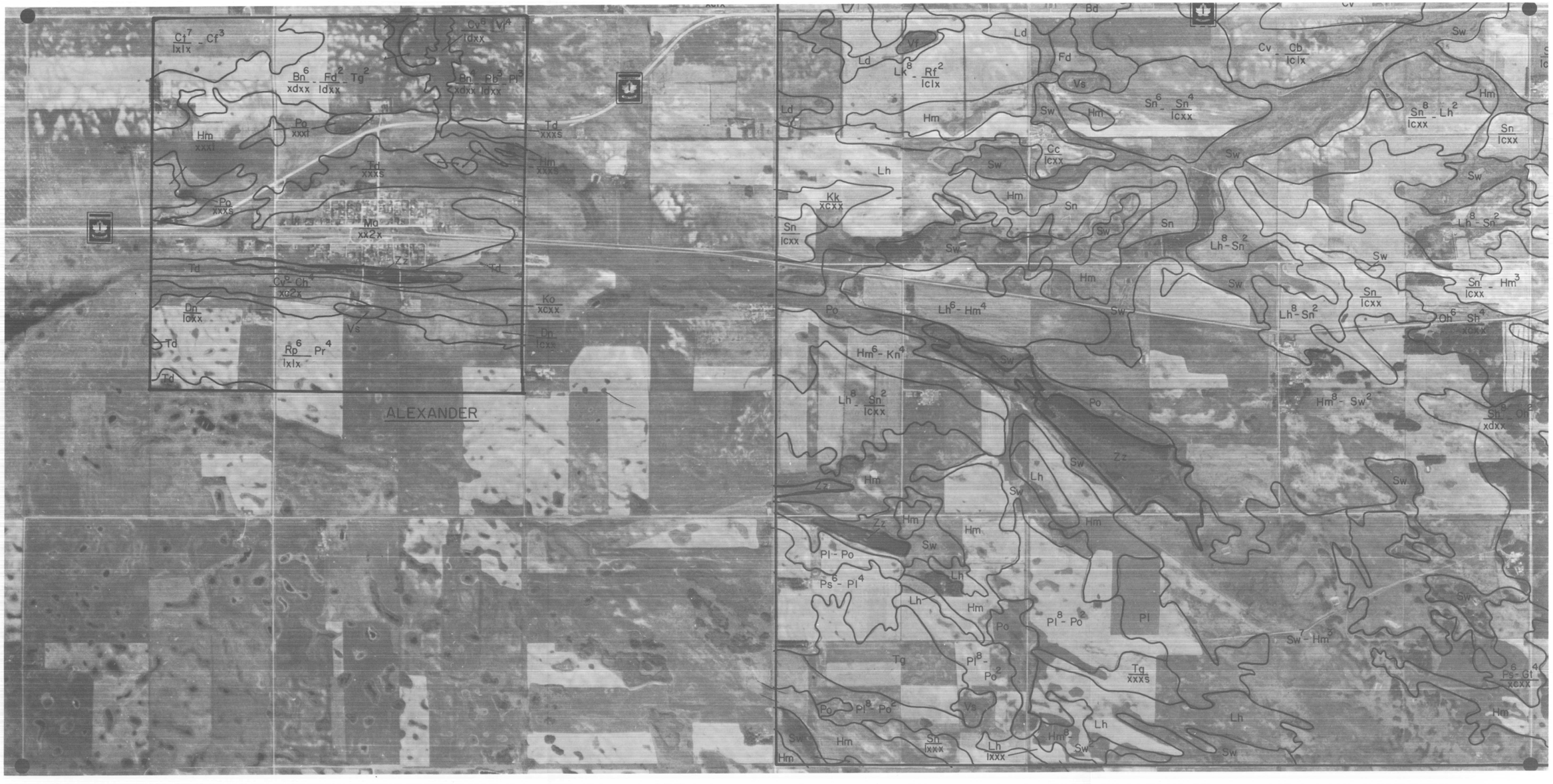
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 13

R.M. of Cornwallis
Sec. 19-36 • Twp. 10 • Rge. 18W.

MAP NO. 14

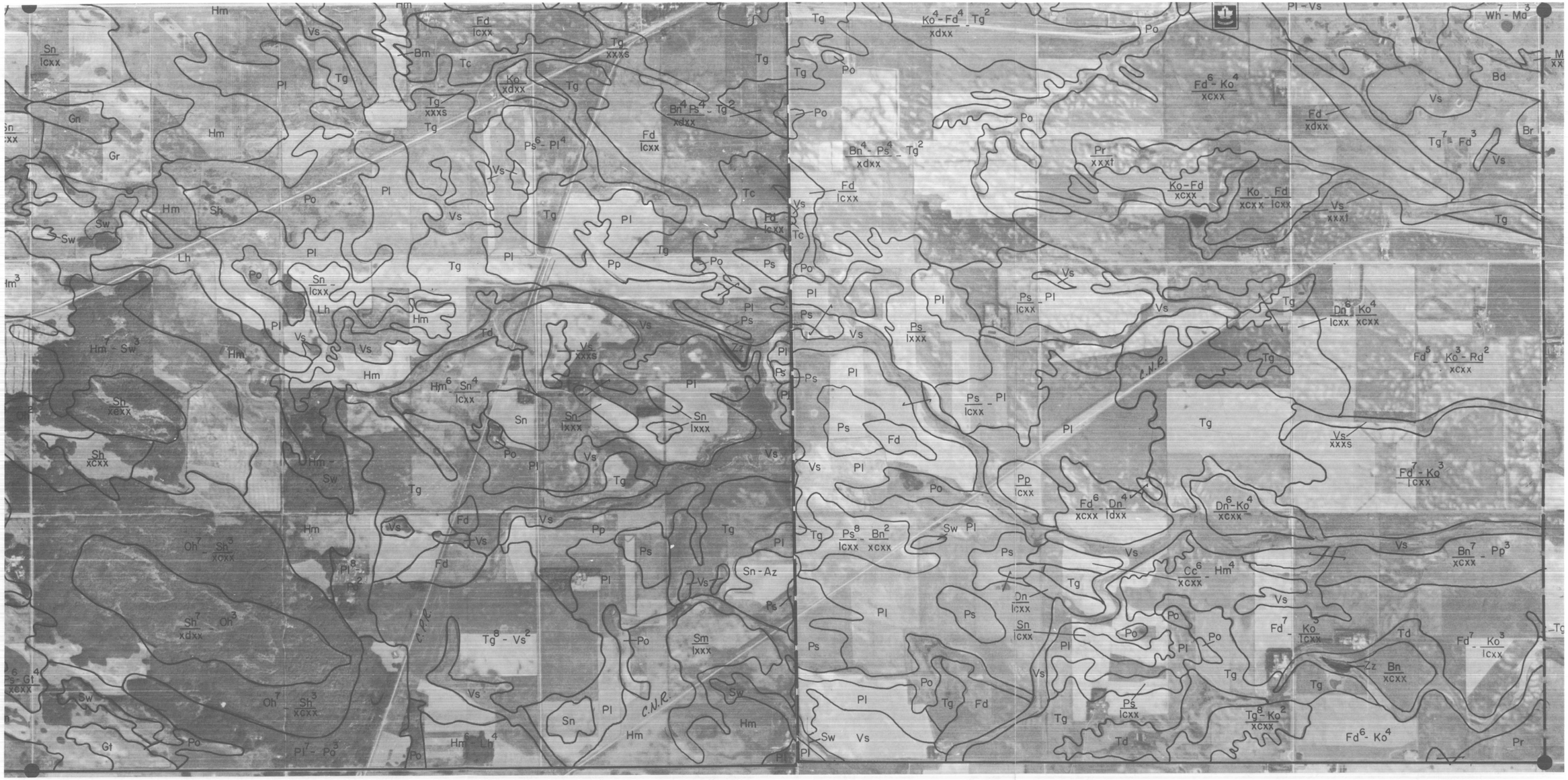
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH



R.M. of Whitehead
Sec. 1-18 • Twp. 10 • Rge. 21W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 15



R.M. of Whitehead
Sec. 1-18 • Twp. 10 • Rge. 20W.

MAP NO. 16

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH

R.M. of Cornwallis
Sec. 1-18 • Twp. 10 • Rge. 19W.

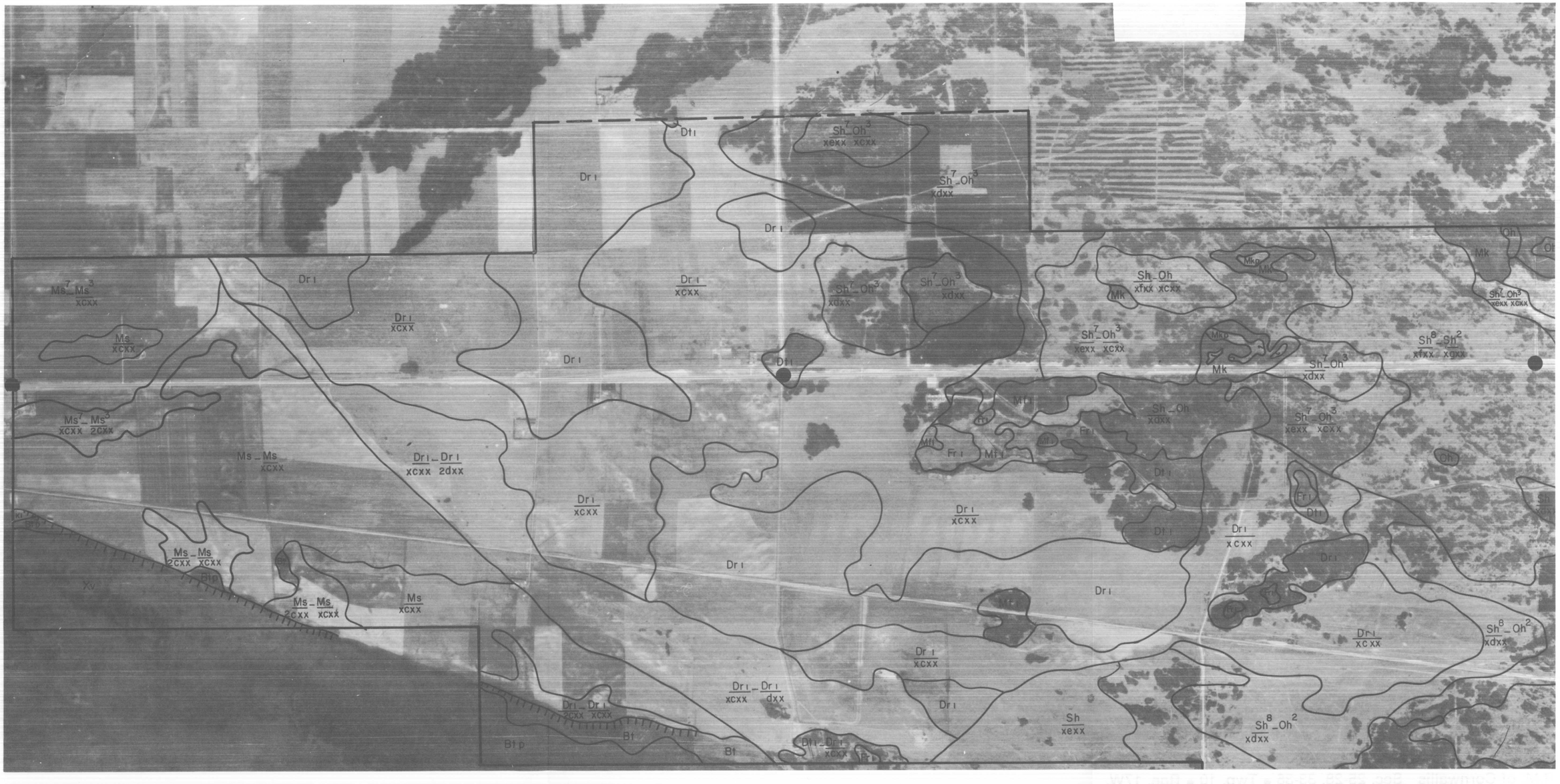
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 17

R.M. of Cornwallis
Sec. 1-18 • Twp. 10 • Rge. 18W.

MAP NO. 18

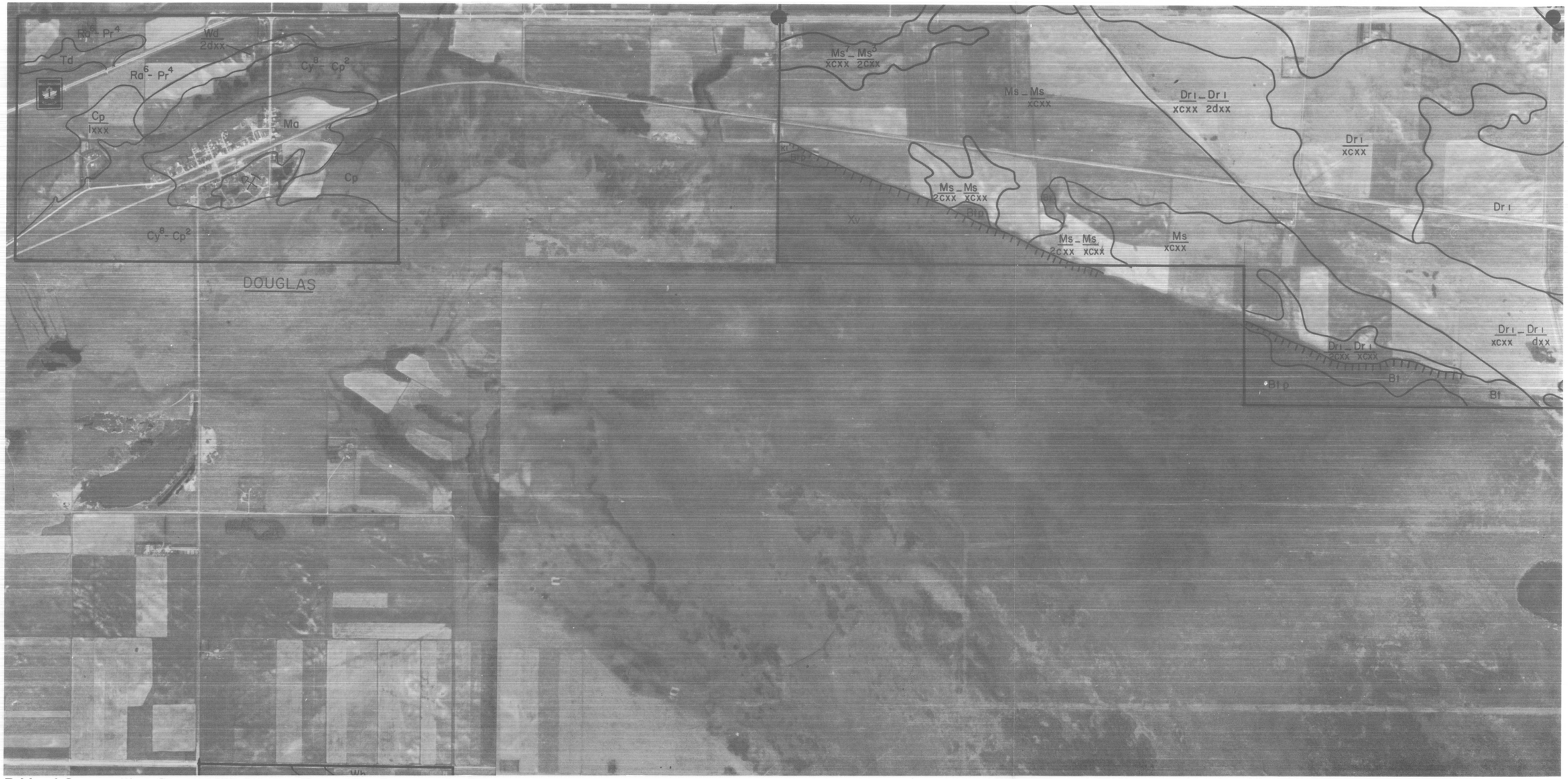
MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH



R.M. of North Cypress
Sec. 7-24 • Twp. 11 • Rge. 16W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

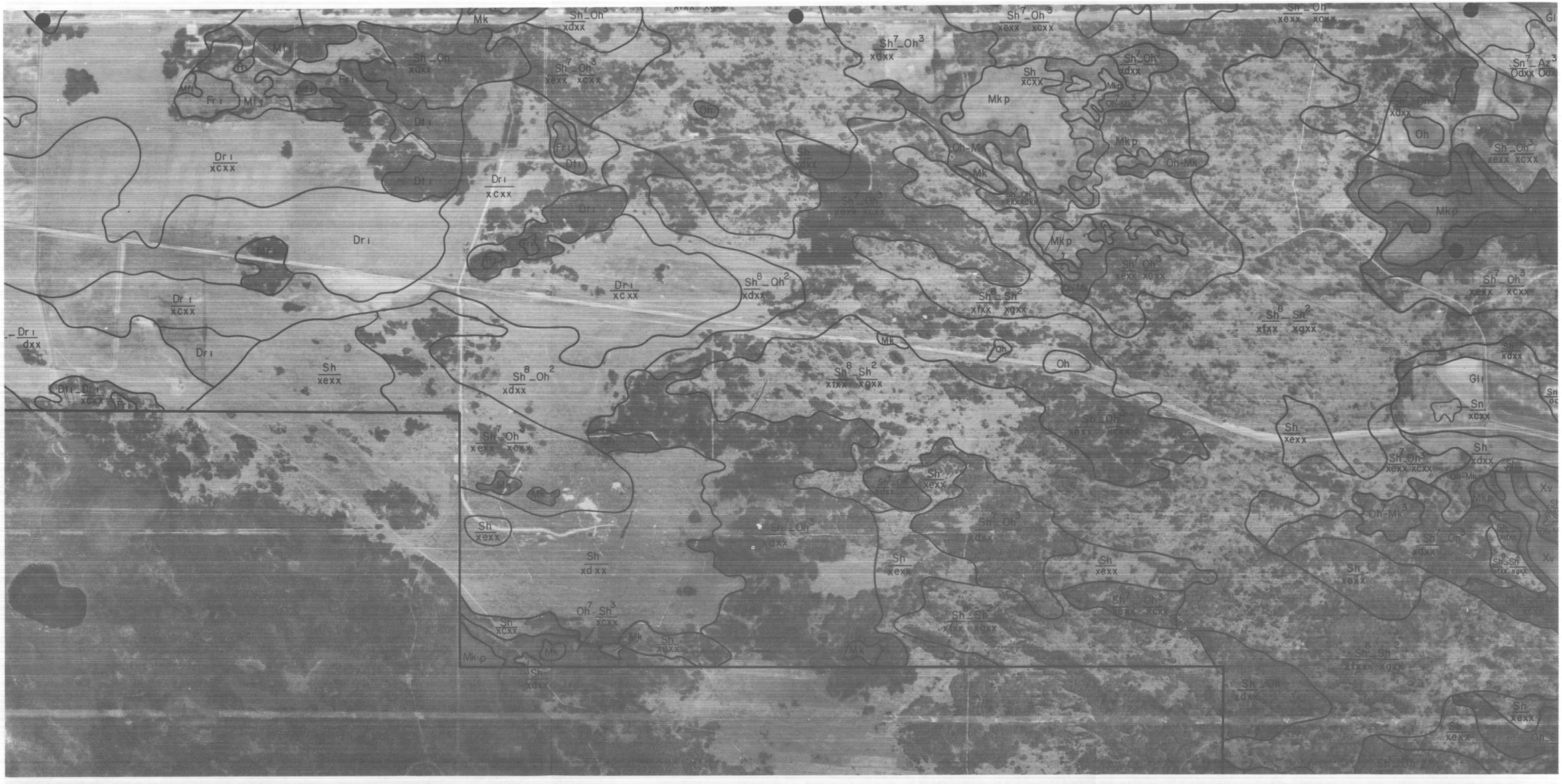
MAP NO. 19



R.M. of Cornwallis Sec. 25-28, 33-36 • Twp. 10 • Rge. 17W.
R.M. of North Cypress
Sec. 4-6 • Twp. 11 • Rge. 16W. Sec. 29-32 • Twp. 10 • Rge. 16W.
R.M. of Elton Sec. 1-4 • Twp. 11 • Rge. 17W.

MAP NO. 20

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH



R.M. of North Cypress Sec. 4-6 • Twp. 11 • Rge. 15W.
Sec. 1-4 • Twp. 11 • Rge. 16W. Sec. 29-32 • Twp. 10 • Rge. 15W.
Sec. 25-28, 33-36 • Twp. 10 • Rge. 16W.

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH

MAP NO. 21

R.M. of North Cypress
Sec. 19-20 • Twp. 10 • Rge. 14W. Sec. 21-28 • Twp. 10 • Rge. 15W.
Sec. 29-32 • Twp. 10 • Rge. 14W. Sec. 33-36 • Twp. 10 • Rge. 15W.

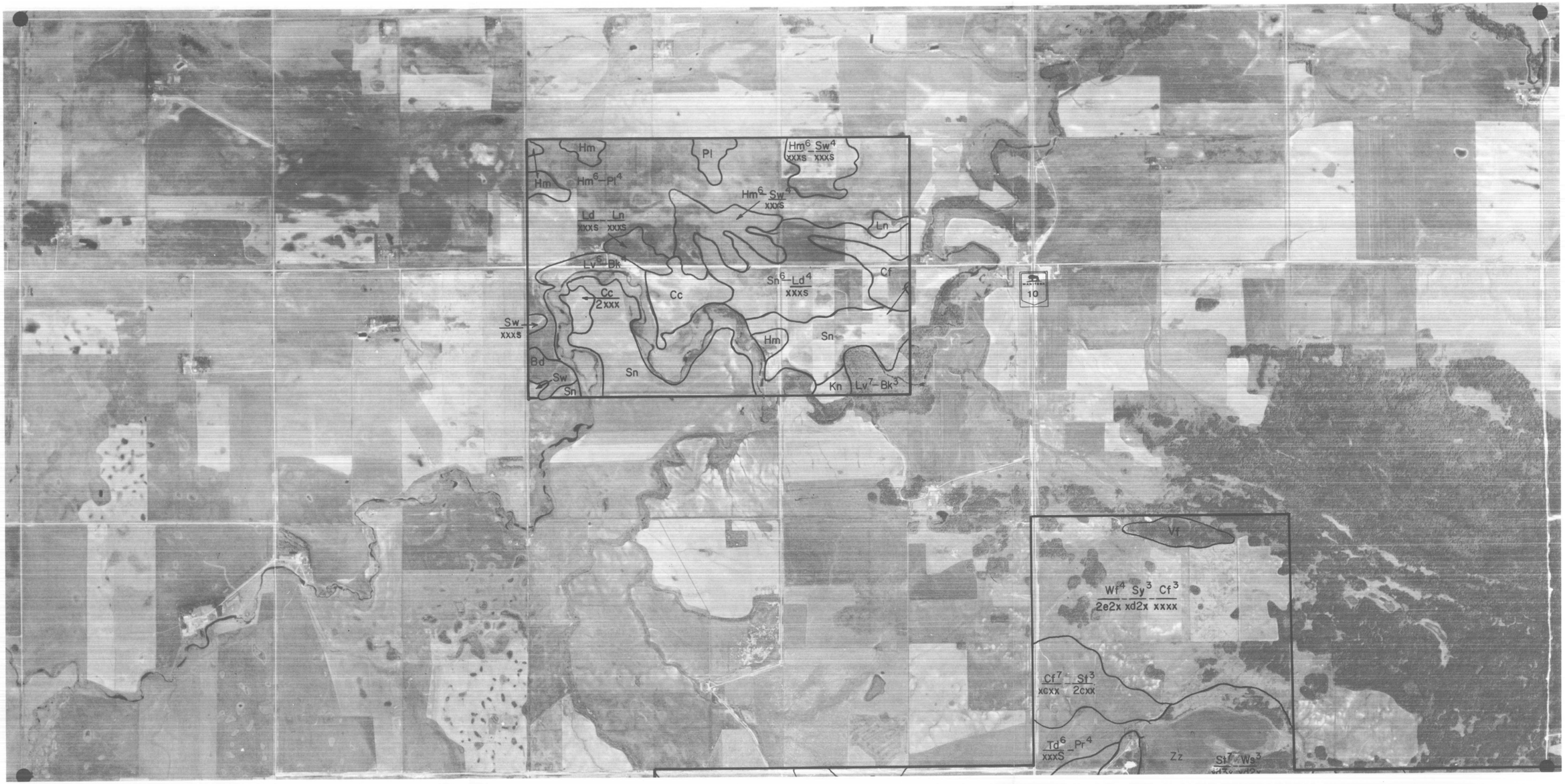
MAP NO. 22

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH

R.M. of Cornwallis
Sec. 7-24 • Twp. 10 • Rge. 17W.

MILES 1 1/2 0
SCALE
METRES 1000 0 NORTH

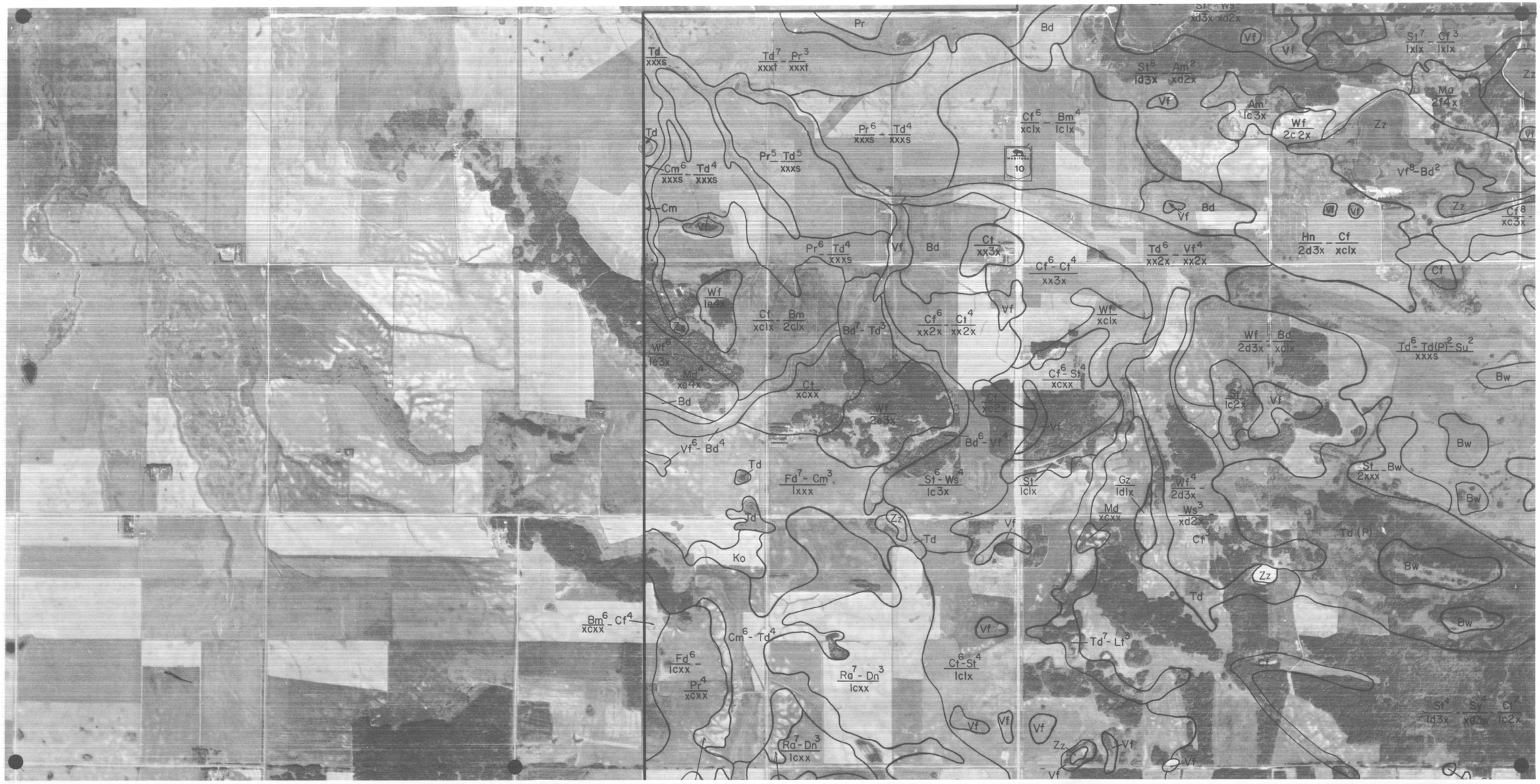
MAP NO. 23



R.M. of Cornwallis
Sec. 1-18 • Twp. 9 • Rge. 19W.

MAP NO. 24

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

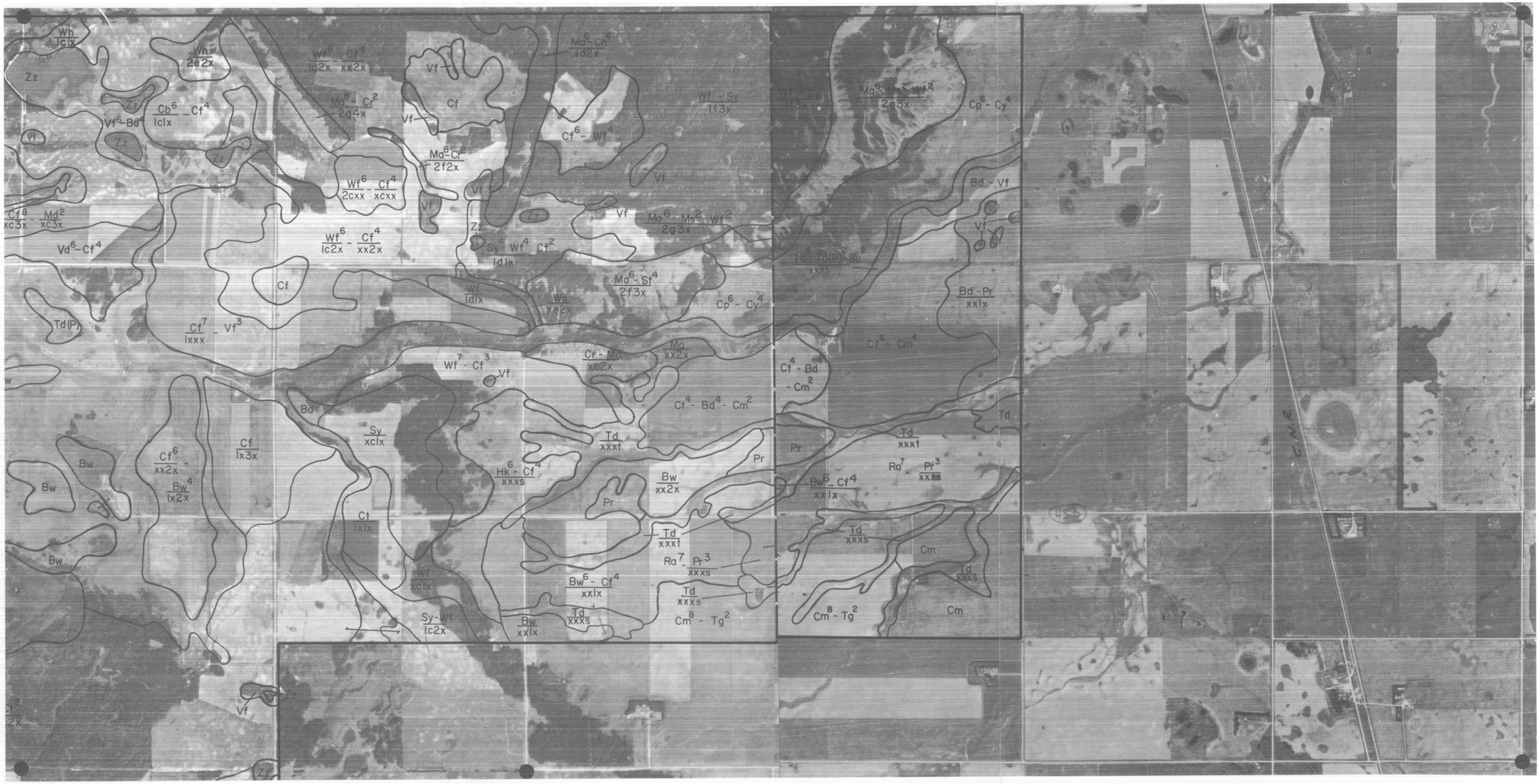


R.M. of Oakland
Sec. 19-36 • Twp. 8 • Rge. 19W.

MILES 1 1/2 0
SCALE 1000 0
METRES

NORTH

MAP NO. 25



R.M. of Oakland
Sec. 19-36 • Twp. 8 • Rge. 18W.

MAP NO. 26

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

R.M. of Oakland
Sec. 1-4, 9-16 • Twp. 8 • Rge. 19W.
Sec. 5-8, 17-18 • Twp. 8 • Rge. 18W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 27

R.M. of Oakland Sec. 19-20, 29-32 • Twp. 7 • Rge. 19W.
R.M. of Glenwood Sec. 21-28, 33-36 • Twp. 7 • Rge. 20W.

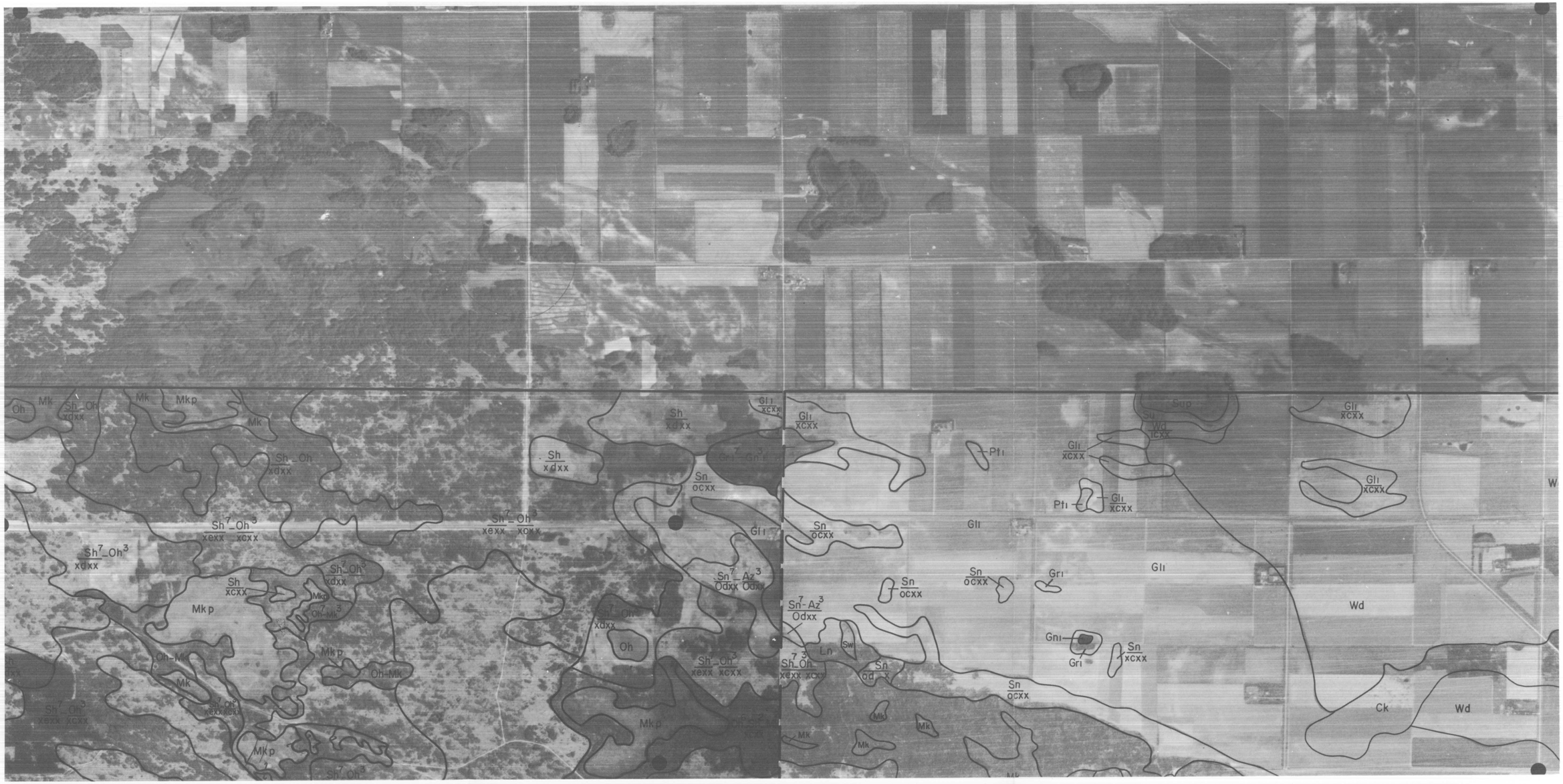
MAP NO. 28

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

R.M. of Oakland
Sec. 19-36 • Twp. 7 • Rge. 18W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 29



R.M. of North Cypress
Sec. 1-18 • Twp. 11 • Rge. 15W.

MAP NO. 30

MILES 1 1/2 0
SCALE
METRES 1000 0

NORTH

R.M. of North Cypress
Sec. 1-18 • Twp. 11 • Rge. 14W.

MILES 1 1/2 0
SCALE
METRES 1000 0
NORTH

MAP NO. 31