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SOIL SURVEY
OF
WRITING-ON-STONE PROVINCIAL PARK STUDY AREA
AND
INTERPRETATION FOR RECREATIONAL USE

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PREFACE

This report is one of a series describing detailed and semi-detailed soil surveys, which were conducted in the following Alberta Provincial Parks during the summer of 1976: Cypress Hills, Writing-on-Stone, Dry Island Buffalo Jump, Jarvis Bay, Wabamun Lake, Thunder Lake, Moose Lake and Moonshine Lake. Also included were the Blue Lake Centre in William A. Switzer Provincial Park; as well as areas in the vicinities of Carseland and Hilliard's Bay (on the northwestern shore of Lesser Slave Lake). The total area mapped was approximately 30 000 ha.

A general guidebook has been prepared to accompany soil survey reports written for Alberta Provincial Parks and Recreation Areas (Greenlee, 1981). It includes general discussions of the following: soil formation; the Canadian soil classification system; soil characteristics and other factors that affect the use of soils for recreational and related purposes; Luvisolic, Organic, and Solonetzic soils; soil erosion; methodology; soil and landform maps that accompany the soil survey reports; an explanation of soil interpretations and guidelines for developing them; chemical and physical properties of soils; and the landform classification system used by Canadian soil pedologists. Also included is a glossary. Specific results and interpretations for the areas covered by this study are presented in the ensuing report.

ACKNOWLEDGMENTS

The Alberta Research Council provided the staff, and the Outdoor Recreation Planning Branch of Alberta Recreation and Parks contributed the funds for the 1976-77 provincial parks soil survey program. Costs included field, office, laboratory, drafting, editing, and printing; as well as equipment and supplies. Office and laboratory space were provided by the University of Alberta. Mrs. Sharon DeFelice and Mrs. Joan Checholik typed and assisted in compiling and proof reading the report. Mrs. J. Dlask drafted the soil, landform, and soil limitations for recreation maps, while Mr. J. Beres determined the soil physical properties. The soil chemical analyses were determined by the Alberta Soil and Feed Testing Laboratory. Able field assistance was given by Mr. M. Hennie.

Special acknowledgment is given to the Park Rangers and other park employees, who co-operated by allowing soil investigations to be conducted throughout the study area, and who invariably offered assistance when needed.

SUMMARY

The area mapped was about 145 ha, and is located about 30 km east and 8 km south of Milk River. The regional surface slope is from the west and south to the north and east; and the land surface is gently rolling and dissected by some deeply incised gullies or coulees. Surficial deposits throughout most of the study area are medium textured fluvial sediments; a few patches of very coarse textured sediments also occur. The climate is described as dry steppe or semi-arid, with cold winters, warm to hot summers, large annual temperature ranges, and meager, undependable rainfall. The study area is situated in the grasslands region, and the vegetation is classified as the needle-and-thread grass/blue grama grass type.

Ten map units were recognized in the study area. The key profile types are Orthic Regosols, Gleyed Regosols, Orthic Brown Chernozems, and Orthic Brown Chernozems Lithic phase. These are distributed over the landscape in relation to landform, parent material, and drainage. Each map unit consists of a single soil series, and the distribution of the map units is shown on the soil map.

Soil interpretations of each map unit are made for fully serviced campgrounds, picnic areas, lawns and landscaping, paths, buildings without basements, and road location. The soils best suited to recreational development in the mapped area are those of Map Unit 8, but only three small patches of these occur. Soils of all other map units have moderate limitations, and the most common is flooding hazard (overflow). Soils of Map Units 1, 3, 4, 6, 7, and 10 have only moderate limitations for road construction, and collectively these cover most of the study area. Again the most common limitation is flooding hazard (overflow). Careful study of the soil map and Tables 4 to 9 inclusive (soil limitation tables) will reveal areas suitable for particular uses.

A soil survey properly interpreted can be one of the most useful tools management has in making a proper design for a recreational area. However, all soil differences which occur in the field cannot be shown on the soil map. Thus, for design and construction of specific recreational facilities, an on-site investigation is usually required.

INTRODUCTION

SIZE AND LOCATION

The area mapped was approximately 145 ha, and is located about 30 km east and 8 km south of Milk River (Figure 1). Milk River is situated about 80 km southeast of Lethbridge along Highway 4. The study area is confined to a portion of the Milk River floodplain, and includes parts of the southeast, southwest, northwest, and northeast quarters of Section 35 and parts of the southwest, northwest, and northeast quarters of Section 36, Township 1, Range 13, West of the Fourth Meridian.

PHYSIOGRAPHY AND SURFICIAL DEPOSITS

The study area is situated in the Eastern Alberta Plains division of the Interior Plains physiographic region, bordering the northern boundary of the Milk River Ridge Division (Government and the University of Alberta, 1969). The regional surface slope is from the west and south to the north and east; and the land surface is gently rolling and dissected by some deeply incised gullies or coulees (Meyboom, 1960). The surface elevation in the study area is slightly less than 900 m, with a gradual decrease from west to east. The study area is drained by the Milk River, and the land surface slopes slightly from the outer edge of the floodplain toward the river. The bedrock has been classified as the Upper Cretaceous Milk River Formation, which includes both marine and non-marine beds (Green, 1972). Surficial deposits throughout most of the study area are medium textured fluvial sediments; a few patches of very coarse textured sediments also occur. Narrow bands of medium to very coarse textured till are often found along the outer edges of the floodplain.

CLIMATE

The climate of the mapped area is described by Trewartha and Horn (1980) as dry steppe or semi-arid, with cold winters, warm to hot summers, large annual temperature ranges, and meager, undependable rainfall. Average July temperatures range from 18 to 21°C, and average January temperatures range from -4 to -20°C.

Weather records for Milk River at an elevation of 975 m, kept over a recent 18 year period, show the following values (Environment Canada, 1982): the mean annual temperature is 5.2°C, and the average frost-free period is 124 days. July is the warmest month of the year with a mean temperature of 18.9°C, and January is the coldest month with a mean temperature of -10.8°C. The mean annual precipitation is 316 mm, and 73% falls as rain.

VEGETATION

The study area is situated in the grasslands region, as classified by Hosie (1969). Several species of poplar are usually found along rivers and in moist locations with willows and some white spruce. The vegetation in the study area is classified by Wroe *et al.* (1979) as the needle-and-thread grass/blue grama grass type. Lands where this type grows have been called

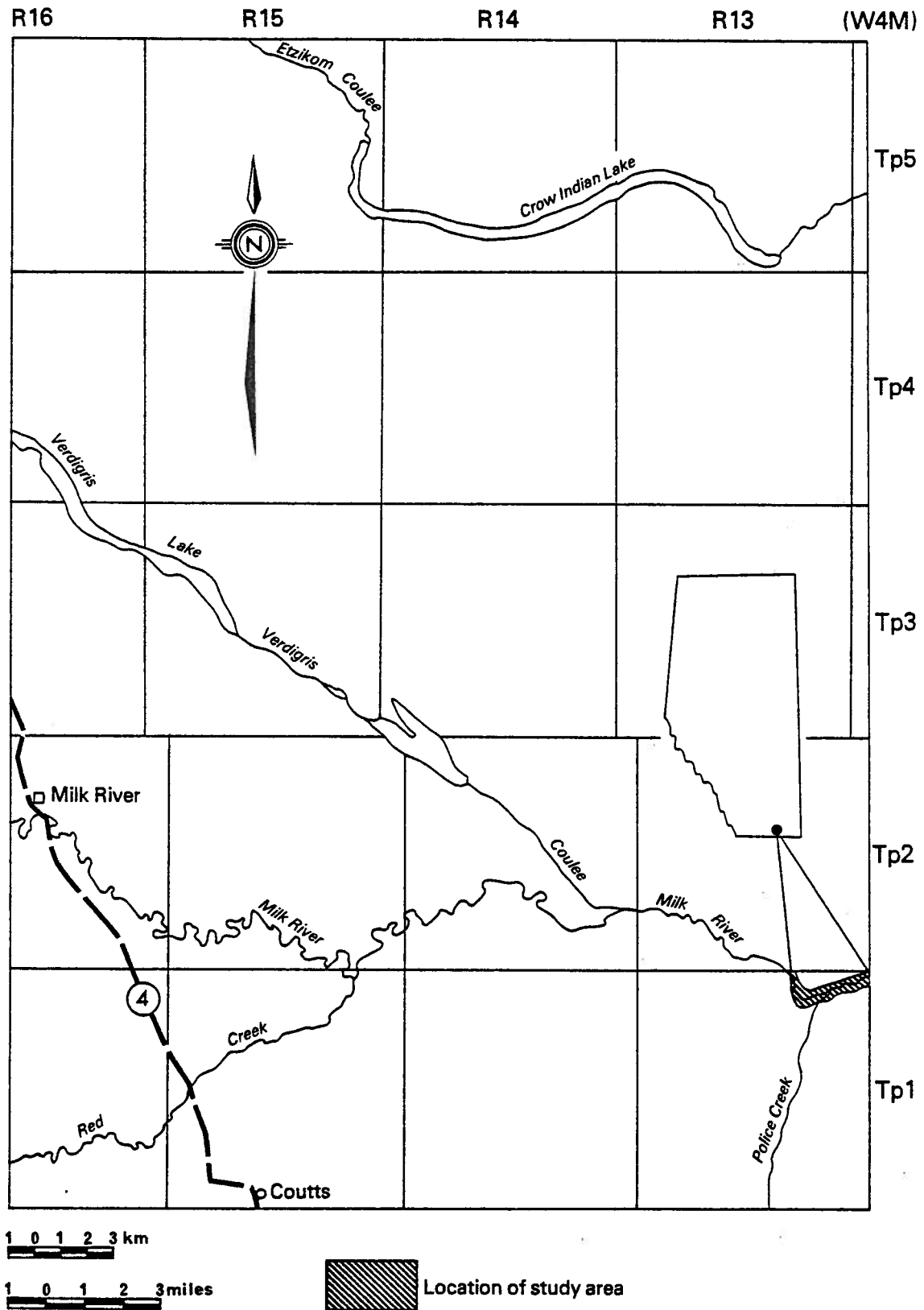


Figure 1. Map showing location of the study area.

the short-grass plains. Needle-and-thread and blue grama have the highest ground cover although other grasses may dominate locally. Needle-and-thread is abundant on deep loam soils, while thread-leaved sedge is abundant on eroded sites and hillsides.

The dominant vegetation throughout most of the study area is native grass and scattered sagebrush, with numerous patches of thorny buffalo-berry and some willow in the moister locations. Some clumps of cottonwood also occur near the river.

The Outdoor Recreation Planning Branch of Alberta Recreation and Parks carries out biological studies of provincial parks and recreation areas; therefore, the vegetation is not discussed extensively in this report. However, some of the more common plant species observed growing on different soils are indicated as part of the map unit descriptions, and these are listed as follows (Moss, 1959; Cormack, 1967): native grass (various species), sagebrush (Artemisia cana), cushion cactus (Mamillaria vivipara), prickly pear cactus (Opuntia polyacantha), thorny buffalo-berry (Shepherdia argentea), willow (Salix spp), wild rose (Rosa spp), buckbrush (Symphoricarpos occidentalis), choke cherry (Prunus virginiana), wild currant (Ribes spp), wild gooseberry (Ribes spp), horsetail (Equisetum spp), and cottonwood (Populus spp).

SOILS

Ten map units were recognized in the study area. The soils of six were classified in the Regosolic Order, and four in the Chernozemic Order of the Canadian soil classification system (Canada Soil Survey Committee, 1978). The system is outlined in Greenlee (1981). Pertinent features of the map units are outlined in Table 1.

Soils of the Regosolic Order are rapidly to imperfectly drained mineral soils with profile development too weakly expressed to meet the requirements for classification in any other order. They lack any expression of a B horizon and, therefore, reflect essentially the characteristics of the C horizons and parent materials from which they are formed.

Well drained Regosolic soils developed on medium textured fluvial sediments occur throughout most of the study area, and a few patches of rapidly drained Regosolic soils developed on very coarse textured fluvial sediments (sand) occur as well. A few patches of imperfectly drained Regosolic soils developed on very coarse textured fluvial sediments (sand) are found immediately adjacent to the Milk River. The floodplain deposits are of relatively recent deposition and insufficient time has elapsed for any marked soil profile development, except gleying in locations of fluctuating water tables.

Soils of the Chernozemic Order are well to imperfectly drained mineral soils of good structure, with very high natural fertility and productive capacity. They are characterized by dark colored surface virgin (Ah or Ahe) or cultivated (Ap) horizons, darkened by the accumulation of organic matter (humus) from the decomposition of grasses and forbs representative

TABLE 1. Key to the Soils

| MAP UNIT | CLASSIFICATION | PARENT MATERIAL | SURFACE TEXTURE | SLOPE (class & gradient) | SURFACE STONINESS | DRAINAGE | COMMENTS AND LIMITATIONS |
|----------|--------------------------------------|---|--|--------------------------|-------------------|--------------|--|
| 1 | Orthic Regosol | medium textured fluvial sediments | loam to fine sandy loam | b,c (> 0.5 to 5%) | 0 | well drained | (1) Usually one or two sand lenses in the soil profile. (2) These soils occur on upper and lower floodplain terraces. Slight to severe limitations - flooding hazard (overflow), lack of Ah horizon, high lime content (soil nutrient imbalance). |
| 2 | Orthic Regosol | medium textured fluvial sediments. | silt loam | b (> 0.5 to 2%) | 0 | well drained | (1) Usually a layer of silty clay loam textured sediments and a sand lense occur in the soil profile. (2) These soils occur on upper and lower floodplain terraces. Moderate to severe limitations - slippery or sticky when wet, flooding hazard (overflow), lack of Ah horizon, high lime content (soil nutrient imbalance), susceptibility to frost heave, moderate shrink - swell potential. |
| 3 | Orthic Brown Chernozem, Lithic phase | moderately to very coarse textured till, overlying sandstone | sandy loam | C,F (> 2 to 30%) | 1 | well drained | These soils occur at the base of sandstone cliffs, along the outer edge of the river valley on the north side. Slight to severe limitations - shallow depth to bedrock, excessive slope, erosion hazard, thin Ah horizon, rapid permeability (droughtiness). |
| 4 | Orthic Regosol | medium textured fluvial sediments, overlying very coarse textured fluvial sediments (fine gravel) | loam, very fine sandy loam, or fine sandy loam | b (> 0.5 to 2%) | 0 | rapid | These soils occur on the lower floodplain terraces near the river. Slight to severe limitations - flooding hazard (overflow), rapid permeability (droughtiness), high lime content (soil nutrient imbalance), lack of Ah horizon. |
| 5 | Steyer Regosol | very coarse textured fluvial sediments (sand) | very fine sandy loam | a (0 to 0.5%) | 0 | imperfect | (1) Water table common about 90 to 120 cm below surface. (2) These soils occur in depressional locations on the lower floodplain terraces adjacent to the river. Slight to severe limitations - seasonally high groundwater table or surface ponding, flooding hazard (overflow), high lime content (soil nutrient imbalance), lack of Ah horizon. |

TABLE 1. Key to the Soils

| MAP UNIT | CLASSIFICATION | PARENT MATERIAL | SURFACE TEXTURE | SLOPE (class & gradient) | SURFACE STONINESS | DRAINAGE | COMMENTS AND LIMITATIONS |
|----------|------------------------|--|---|--------------------------|-------------------|--------------|--|
| 6 | Orthic Regosol | very coarse textured fluvial sediments (sand) | very fine sandy loam to fine sandy loam | b (> 0.5 to 2%) | 0 | rapid | These soils occur on upper and lower floodplain terraces. Slight to severe limitations - flooding hazard (overflow), rapid permeability (droughtiness) lack of Ah horizon, high lime content (soil nutrient imbalance). |
| 7 | Orthic Regosol | very coarse textured fluvial sediments (sand) | silt loam | b (> 0.5 to 2%) | 0 | rapid | These soils occur on the lower floodplain terraces. Moderate to severe limitations - slippery or sticky when wet, flooding hazard (overflow), rapid permeability (droughtiness), lack of Ah horizon. |
| 8 | Orthic Brown Chernozem | medium to moderately coarse textured till | loam to sandy loam | D (> 5 to 9%) | 1 | well drained | Textures of clay loam to silty clay loam sometimes found from 90 to more than 120 cm below the surface. Slight to severe limitations - thin Ah horizon, high shrink - swell potential and susceptibility to frost heave of the lower till. |
| 9 | Orthic Brown Chernozem | medium to very coarse textured fluvial sediments (sand), overlying moderately coarse textured till | loam to silty loam | b (> 0.5 to 2%) | 0 | well drained | Textures of clay loam to silty clay loam sometimes found from 90 to more than 120 cm below the surface. Slight to severe limitations - slippery or sticky when wet, flooding hazard (overflow), high shrink - swell potential and susceptibility to frost heave of lower till. |
| 10 | Orthic Brown Chernozem | moderately coarse to very coarse textured till | sandy loam | E (> 9 to 15%) | 1 | well drained | (1) Textures of clay loam to silty clay loam sometimes found from 90 to more than 120 cm below the surface. (2) These soils occur along the outer edge of the river valley on the south side. Moderate limitations - excessive slope, erosion hazard, thin Ah horizon. |

of grassland communities or of grassland-forest communities with associated shrubs and forbs. The A horizon is commonly referred to as "topsoil" and ranges from 10 to 25 cm in thickness. In some regions it is much thicker. Chernozemic soils are further divided into four major divisions, the Brown, Dark Brown, Black and Dark Gray Great Groups. These are distinguished by measurable differences in color of the A horizons, which together with other associated features of depth, organic matter content, and structure, reflect significant differences in the climates and vegetation under which they have developed, and which continue to influence and distinguish their characteristics and relative use capabilities.

In general, Brown Chernozemic soils have A horizons that are lower in organic matter content, lighter in color and thinner than those of the other Chernozemic Great Groups; and are found in southern and southeastern Alberta. Black Chernozemic soils have A horizons that are higher in organic matter content, darker in color and thicker than those of the other great groups; and are found in central and east-central Alberta. Dark Brown Chernozemic soils have A horizons with characteristics intermediate between those of the Browns and the Blacks; and are found in south-central and east-central Alberta. Dark Gray Chernozemic soils have A horizons with variable colors, thicknesses and modifications of structural pattern indicative of degradation of the typical Chernozemic A horizon. Under virgin conditions, the Dark Grays usually have leaf mats (L-H horizons) overlying the mineral soil, and degradation of the A horizons frequently causes a banded or "salt and pepper" effect. The organic matter content varies with the degree of degradation, from high accumulations in slightly degraded soils, comparable to that of Blacks; to significantly lower amounts in the more strongly degraded types. These latter types are intergrades to Dark Gray Luvisolic soils of the Luvisolic Order. Dark Gray Chernozemics are found primarily in transitional areas of grassland and forest in north-central Alberta and the Peace River region.

Narrow bands of well to rapidly drained Brown Chernozemic soils developed on medium to very coarse textured till occur along the outer edges of the floodplain, and on the north side of the river these soils are lithic. Also, one patch of well drained Brown Chernozemic soils developed on medium textured fluvial sediments overlying moderately coarse textured till is found on the south side of the river (Map Unit 9).

Very minor differences exist among some map units. However, the differences are usually significant with regard to a particular recreational or engineering use, and thus justify separation of different map units. They are described in chronological order, and horizon thicknesses represent averages. Thicknesses of comparative horizons in identical soil profiles often vary as much as 10 to 40 percent from the norm at different points in the landscape.

The dominant plant species are listed, using common names. These are very general lists, and not purported to be complete.

Map Unit 1

Classification: Orthic Regosol.
Parent material: medium textured fluvial sediments.
Landform: level fluvial (F1), fluvial terraces (Ft), undulating fluvial (Fu).
Slope: gently undulating to undulating (>0.5 to 5%).
Surface stoniness: nonstony (0).
Drainage: well drained.
Vegetation: dominantly native grass, scattered sage brush, cushion cactus, prickly pear cactus; patches of shrubs, including thorny buffalo-berry, wild rose, wild currant, choke cherry, buckbrush, willow.
Profile description: Orthic Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|----------------------------|-----------|---|
| Ck | 120+ | loam to fine sandy loam | amorphous | very friable, moist; slightly hard, dry |

Comments:

- (1) Soil profile textures of very fine sandy loam are often found.
- (2) Usually one or two sand lenses, 7 to 40 cm thick, occur in the soil profile, generally below the 20 cm depth.
- (3) Occasionally a layer of silt loam textured sediments, about 20 cm thick, is found, usually below the 20 cm depth.
- (4) These soils are found on both upper and lower floodplain terraces.

Limitations: Slight to severe—slight for picnic areas and paths; moderate for campgrounds, lawns and landscaping, road location; severe for buildings. Specific limitations include flooding hazard (overflow), lack of Ah horizon, high line content (soil nutrient imbalance).

Map Unit 2

Classification: Orthic Regosol.

Parent Material: Medium textured fluvial sediments.

Landform: level fluvial (F1), fluvial terraces (Ft).

Slope: gently undulating (≥ 0.5 to 2%).

Surface stoniness: nonstony (0).

Drainage: well drained.

Vegetation: native grass with scattered cushion cactus, prickly pear cactus, and sagebrush; patches of thick shrub cover, including wild rose, wild currant, and thorny buffalo-berry.

Profile description: Orthic Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|------------------|-----------|----------------------------|
| Ck | 120+ | silt loam | amorphous | friable, to firm, moist |

Comments:

- (1) Usually a layer of silty clay loam textured sediments, 10 to 30 cm thick, occurs from 10 to 50 cm below the surface.
- (2) A 5 cm thick sand lense usually occurs about 50 cm below the surface.
- (3) these soils occur on both upper and lower floodplain terraces.

Limitations: Moderate to severe-moderate for campgrounds, picnic areas, lawns and landscaping, paths; severe for buildings and road location. Specific limitations include slippery or sticky when wet, flooding hazard (overflow), lack of Ah horizon, high lime content (soil nutrient imbalance), susceptibility to frost heave, moderate shrink-swell potential.

Map Unit 3

Classification: Orthic Brown Chernozem, Lithic phase.
Parent material: moderately to very coarse textured till, overlying sandstone.
Landform: Morainal veneer, overlying inclined bedrock (Mv/Ri).
Slope: gently to steeply sloping (>2 to 30%).
Surface stoniness: slightly stony (1).
Drainage: well drained.
Vegetation: native grass, with sagebrush, cushion cactus, prickly pear cactus.
Profile description: Orthic Brown Chernozem, Lithic phase.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|-----------------------------|---|---|
| Ah | 7-8 | sandy loam | granular | very friable, moist; slightly hard, dry |
| Bm | 7-18 | sandy loam | prismatic, breaking to subangular blocky | very friable, moist; slightly hard, dry |
| Cca | 50-85 | sandy loam to loamy sand | amorphous | very friable, moist; soft, dry |
| llCca | at 75-100 | sandstone | | |

Comment: These soils are found at the base of sandstone cliffs, along the outer edge of the river valley on the north side.

Limitations: Slight to severe-slight on suitable topography for picnic areas, and paths; moderate on suitable topography for campgrounds, lawns and landscaping, buildings, and road location. Specific limitations include shallow depth to bedrock, excessive slope, erosion hazard, thin Ah horizon, and rapid permeability (droughtiness).

Map Unit 4

Classification: Orthic Regosol.

Parent material: medium textured fluvial sediments, overlying very coarse textured fluvial sediments (fine gravel).

Landform: level fluvial (F1).

Slope: gently undulating (>0.5 to 2%).

Surface stoniness: Nonstony (0).

Drainage: rapid.

Vegetation: Native grass; patches of thorny buffalo-berry, and some cottonwood.

Profile description: Orthic Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|--|-----------|------------------------|
| Ck1 | 35 | loam, very fine sandy loam, or fine sandy loam | amorphous | very friable, moist |
| Ck2 | at 35 | fine gravel | amorphous | loose, moist or dry |

Comment: These soils occur on the lower floodplain terraces near the river.

Limitations: Slight to severe—slight for picnic areas and paths; moderate for campgrounds, and road location; severe for lawns and landscaping, and buildings. Specific limitations include flooding hazard (overflow), rapid permeability (droughtiness), high lime content (soil nutrient imbalance), and lack of Ah horizon.

Map Unit 5

Classification: Gleyed Regosol.

Parent material: very coarse textured fluvial sediments (sand).

Landform: level fluvial (F1).

Slope: nearly level (0 to 0.5%).
 Surface stoniness: nonstony (0).
 Drainage: imperfect.
 Vegetation: willow, grass, horsetail.
 Profile description: Gleyed Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|-------------------------|-----------------------|------------------------|
| Ckg1 | 20-35 | very fine sandy loam | amorphous to platy | very friable, moist |
| Ckg2 | at 20-35 | coarse sand | amorphous | loose, moist or dry |

Comments: (1) A water table is commonly found about 90 to 120 cm below the surface.
 (2) These soils occur in depressional locations on lower floodplain terraces adjacent to the river.

Limitations: Slight to severe-slight for picnic areas, and paths; moderate for campgrounds; severe for lawns and landscaping, buildings, and road location. Specific limitations include seasonally high groundwater table or surface ponding, flooding hazard (overflow), high lime content (soil nutrient imbalance), and lack of Ah horizon.

Map Unit 6

Classification: Orthic Regosol.
 Parent material: very coarse textured fluvial sediments (sand).
 Landform: Level fluvial (F1), fluvial terraces (Ft).
 Slope: gently undulating (>0.5 to 2%).
 Surface stoniness: nonstony (0).
 Drainage: rapid.

Vegetation: native grass; patches of thorny buffalo-berry, wild rose, wild currant, wild gooseberry, buckbrush, scattered willow and cottonwood; some patches of sagebrush.

Profile description: Orthic Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|---|-----------|---|
| Ck1 | 0-25 | very fine sandy loam to fine sandy loam | amorphous | very friable, moist |
| Ck2 | at 0-25 | sand to loamy fine sand | amorphous | loose to very friable, moist; loose to soft, dry |

Comments: (1) These soils are found on both upper and lower floodplain terraces.

(2) A layer of silt loam textured sediments, about 20 cm thick, is sometimes found below the 20 cm depth in the soil profile.

Limitations: Slight to severe-slight for picnic areas, and paths; moderate for campgrounds, and road location; severe for lawns and landscaping, and buildings. Specific limitations include flooding hazard (overflow), rapid permeability (droughtiness), lack of Ah horizon, and high lime content (soil nutrient imbalance).

Map Unit 7

Classification: Orthic Regosol.

Parent material: very coarse textured fluvial sediments (sand).

Landform: level fluvial (F1).

Slope: gently undulating (>0.5 to 2%).

Surface stoniness: nonstony (0).

Drainage: rapid.

Vegetation: native grass, thorny buffalo-berry, wild currant, wild rose, willow, buckbrush.

Profile description: Orthic Regosol.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|----------------------------|-----------|--|
| Ck1 | 15-20 | silt loam | platy | friable, moist |
| Ck2 | at 15-20 | sand to loamy fine sand | amorphous | loose to very friable, moist; loose to soft, dry |

Comment: These soils occur on the lower floodplain terraces.

Limitations: Moderate to severe-moderate for campgrounds, picnic areas, paths, and road location; severe for lawns and landscaping, and buildings. Specific limitations include slippery or sticky when wet, flooding hazard (overflow), rapid permeability (droughtiness), and lack of Ah horizon.

Map Unit 8

Classification: Orthic Brown Chernozem.

Parent material: medium to moderately coarse textured till.

Landform: inclined morainal (Mi).

Slope: moderately sloping (>5 to 9%).

Surface stoniness: slightly stony (1).

Drainage: well drained.

Vegetation: native grass, cushion cactus, prickly pear cactus, sagebrush.

Profile description: Orthic Brown Chernozem.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|-----------------------|---|---|
| Ah | 7-8 | loam to sandy loam | granular | very friable, moist |
| Bm | 7-18 | loam to sandy loam | prismatic, breaking to subangular blocky | very friable, moist |
| Cca | at 15-25 | loam to sandy loam | amorphous to subangular blocky | very friable, moist; slightly hard, dry |

Comment: Textures of loam to sandy loam generally continue to a depth of 120 cm, but textures of clay loam to silty clay loam are sometimes found from 90 to more than 120 cm below the surface.

Limitations: Slight to severe-moderate for lawns and landscaping; severe for road location; slight for all other uses. Specific limitations include thin Ah horizon, high shrink-swell potential and susceptibility to frost heave of lower till.

Map Unit 9

Classification: Orthic Brown Chernozem.

Parent material: medium to very coarse textured fluvial sediments (sand), overlying moderately coarse textured till.

Landform: fluvial veneer and blanket, overlying level moraine (Fvb/M1).

Slope: gently undulating (>0.5 to 2%).

Surface stoniness: nonstony (0).

Drainage: well drained.

Vegetation: native grass, cushion cactus, prickly pear cactus, sagebrush.

Profile description: Orthic Brown Chernozem.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|------------------|-------------------|---------------------------------|---|---|
| Ah | 7-10 | loam to silt loam | granular | very friable, moist |
| Bm | 10-13 | Loam to silt loam | prismatic, breaking to subangular blocky | very friable, moist |
| Cca1 | 30 | silty clay loam | subangular blocky | firm, moist; slightly hard to hard, dry |
| Cca2 | 25 | silt loam | subangular blocky | slightly hard, dry |
| Cca3 | 15-45 | fine sand to fine sandy loam | amorphous to subangular blocky | loose to slightly hard, dry |
| lICca4 (till) | at 90-120 | sandy loam | amorphous | very friable, moist; soft, dry |

Comment: Textures of clay loam to silty clay loam are sometimes found in the till from 90 to more than 120 cm below the surface.

Limitations: Slight to severe-slight for lawns and landscaping; moderate for campgrounds, picnic areas, and paths; severe for buildings, and road location. Specific limitations include slippery or sticky when wet, flooding hazard (overflow), high shrink-swell potential and susceptibility to frost heave of lower till.

Map Unit 10

Classification: Orthic Brown Chernozem.

Parent material: moderately coarse to very coarse textured till.

Landform: inclined morainal (Mi).

Slope: strongly sloping (>9 to 15%).

Surface stoniness: slightly stony (1).

Drainage: well drained.

Vegetation: native grass, cushion cactus, prickly pear cactus, sagebrush.

Profile description: Orthic Brown Chernozem.

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---------|-------------------|----------------------------|---|---|
| Ah | 7-8 | sandy loam | granular | very friable, moist; slightly hard, dry |
| Bm | 7-18 | sandy loam | prismatic, breaking to subangular blocky | very friable, moist; slightly hard, dry |
| Cca | at 14-26 | sandy loam to loam sand | amorphous | very friable, moist; soft, dry |

Comments: (1) Textures of clay loam to silty clay loam are sometimes found from 90 to more than 120 cm below the surface.

(2) These soils are found along the outer edge of the river valley on the south side.

Limitations: Moderate for all uses. Specific limitations include excessive slope, erosion hazard, and thin Ah horizon.

SPECIAL FEATURES

The soils in Alberta have been classified into broad general zones (Figure 2) as established by Alberta Soil Survey during the normal course of soil surveys, and correlated with temperature and precipitation records. Annual precipitation amounts change gradually from one soil zone to another, and are not abrupt changes at the point where a boundary has been located. Thus a zone boundary is a broad transitional belt, which can be many kilometres across. Topsoil colors reflect this gradual change. For example, in the center of the Brown Soil Zone (annual precipitation about 30 to 33 cm), topsoil colors are brown. Similarly in the centre of the Dark Brown Soil Zone (annual precipitation about 38 cm), topsoil colors are dark brown. Between these two zones, topsoil colors are brown to dark brown, and annual precipitation is about 35 cm. The boundary between the two soil zones has been placed approximately at that midpoint.

Zonal soils are soils with well developed soil characteristics that reflect the zonal or normal influences of climate and living organisms, mainly vegetation, as active factors of soil genesis. Examples are Brown,

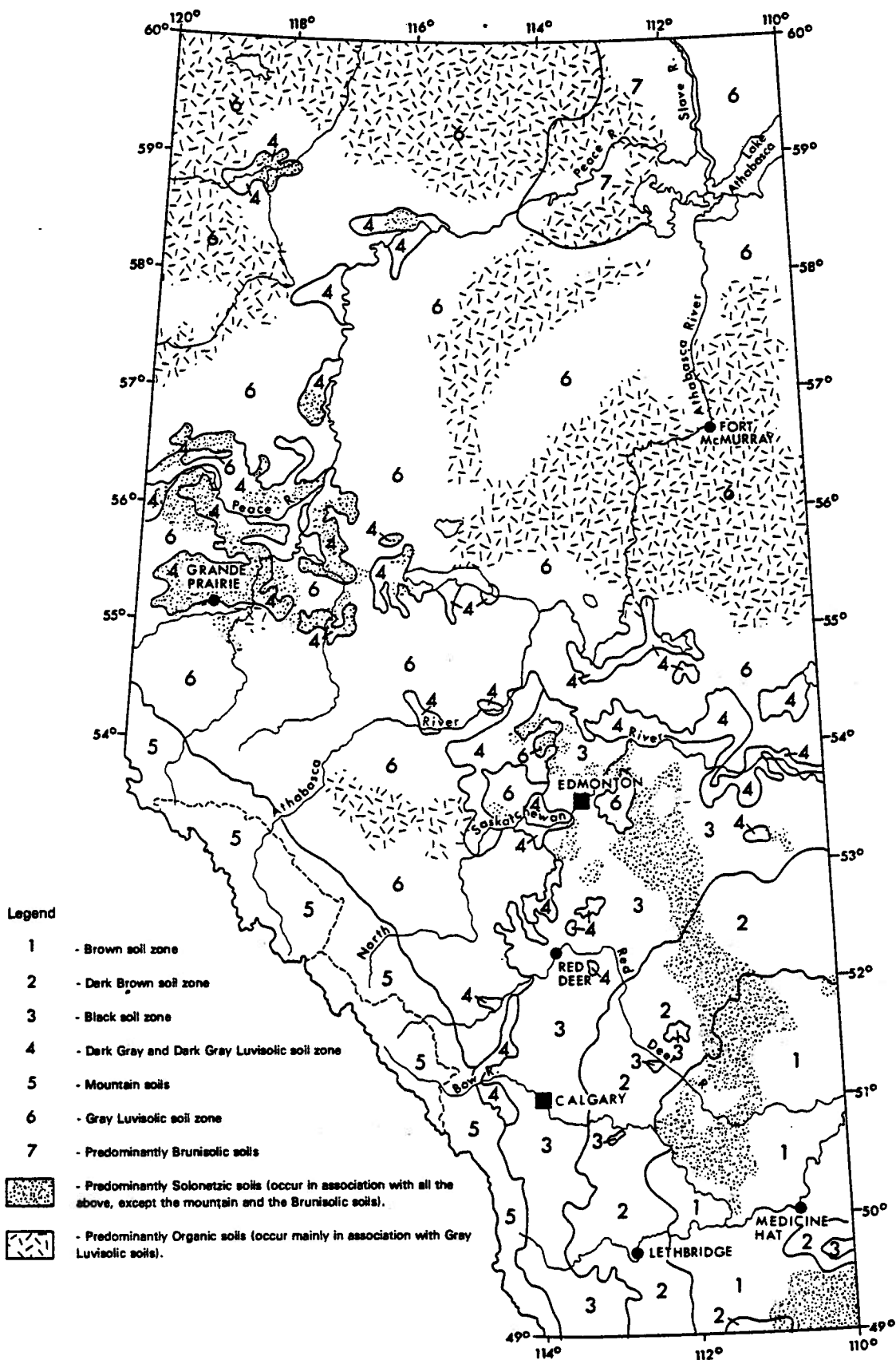


Figure 2. Map showing soil zones of Alberta (from Soil Group Map of Alberta, Alberta Institute of Pedology, undated).


Dark Brown, or Black soils of the Brown, Dark Brown or Black Soil Zones respectively. Intrazonal soils are soils with morphology that reflects the influence of some local factor of relief, parent material, or age; rather than of climate and vegetation. An example is Solonetzic soils, which develop as a result of salinization. This may originate internally from a saline parent material, or from saturation by external saline waters. Solonetzic soils are found across many soil zones (Figure 2). Azonal soils are soils without distinct genetic horizons, and are represented by Regosolic soils in Canada. These are found across all the soil zones.


The study area is situated in the Brown Soil Zone, and only a small percentage of the soils are classified as Brown Chernozemic, which are zonally normal. The majority are classified as Regosolic soils, which are azonal. Soils of the study area can be considered typical locally, but rather atypical on a regional basis. Regosolic soils are commonly found on floodplains of rivers and streams; however, Chernozemic soils are dominant

throughout uplands of the general region (Kjearsgaard, 1972; Wyatt et al., 1941).

Special features of soils in the mapped area are their generally high lime content, and the lack of Ah horizons in the Regosolic soils. High lime contents may restrict the availability of certain nutrients to plants, resulting in deficiencies and imbalances in plant nutrition (Greenlee, 1981). High rates of fertilization may be required to attain desired levels of plant growth. Ah horizons generally have relatively high contents of organic matter and available nutrients, are well aggregated, and resilient to compaction. These desirable features of surface soils are absent wherever Ah horizons are lacking, and plant growth is difficult to maintain in park use areas.

MISCELLANEOUS SYMBOLS

 This symbol indicates escarpments.

 This symbol indicates the location of a shallow narrow drainage channel. It has steep banks on either side.

SOIL INTERPRETATIONS

An explanation of soil interpretations and definitions of the soil limitation ratings are given in Greenlee (1981). The results of soil chemical and physical analyses are given in Tables 2 and 3.

The soils best suited for recreational development in the mapped area are those of Map Unit 8; however, only three small patches of these occur, bordering the outer boundary of the floodplain on the south side of the river. Soils of all other map units have moderate limitations, and the most common is flooding hazard (overflow). Others are slippery or sticky when wet, shallow depth to bedrock, seasonally high groundwater table or surface ponding, excessive slope, and erosion hazard.

Soils of Map Units 1, 3, 4, 6, 7, and 10 have only moderate limitations for road construction, and collectively these cover most of the study area.

TABLE 2. Chemical Analysis of Selected Map Units ¹

| MAP UNIT | DEPTH CM | pH H ₂ O | ² EC | ³ Na | ³ SO ₄ | ³ OM | ³ CaCO ₃ |
|----------|----------|---------------------|-----------------|-----------------|------------------------------|-----------------|--------------------------------|
| 1 | 0 - 15 | 8.3 | 0.3 | L- | ⁴ nd | M- | M+ |
| | 15 - 30 | 8.4 | 0.3 | L- | nd | M- | M+ |
| 1 | 0 - 15 | 7.9 | 0.4 | L- | nd | M- | M+ |
| | 15 - 30 | 8.4 | 0.2 | L- | nd | M- | M+ |
| 2 | 0 - 15 | 7.9 | 0.4 | L- | nd | M- | nd |
| | 15 - 30 | 8.3 | 0.4 | L- | nd | M- | L+ |
| 3 | 0 - 15 | 8.3 | 0.3 | L- | nd | M- | L+ |
| | 15 - 30 | 8.4 | 0.3 | L- | nd | M- | M+ |
| 4 | 0 - 15 | 8.4 | 0.4 | L | nd | M- | H- |
| | 15 - 30 | 8.5 | 0.3 | L- | nd | M- | H- |
| 5 | 0 - 15 | 8.4 | 0.4 | L- | nd | M- | H+ |
| | 15 - 30 | 8.5 | 0.3 | L- | nd | M- | H+ |
| 6 | 0 - 15 | 8.2 | 0.4 | L | nd | M- | M+ |
| | 15 - 30 | 8.3 | 0.3 | L- | nd | M- | H- |
| 7 | 0 - 15 | 7.9 | 0.6 | L+ | nd | M- | M |
| | 15 - 30 | 8.5 | 0.6 | L+ | nd | M- | M |
| 8 | 0 - 15 | 8.1 | 0.4 | L | nd | M- | L- |
| | 15 - 30 | 8.5 | 0.4 | L | nd | M- | M- |
| 9 | 0 - 15 | 8.0 | 0.4 | L | nd | M- | nd |
| | 15 - 30 | 8.0 | 0.2 | L- | nd | M- | nd |
| 10 | 0 - 15 | 8.0 | 0.2 | L- | nd | M- | nd |
| | 15 - 30 | 8.5 | 0.2 | L- | nd | M- | H- |

¹Chemical Analyses done by Alberta Soil and Feed Testing Laboratory

²EC - electrical conductivity, millimhos/cm, ³These tests are rated into 4 categories: High(H), Medium (M), Low (L), and none (-). The degree within each category is indicated by a + or - sign. The tests for OM (organic matter) and CaCO₃ (free lime) are visual estimates only. ⁴nd - not determined.

The most common limitation is flooding hazard (overflow), and others are shallow depth to bedrock, excessive slope, and erosion hazard. Other soils have severe limitations due to susceptibility to frost heave, moderate to high shrink-swell potential, and seasonally high groundwater table or surface ponding.

Specific limitations of the various soils for selected uses are shown in Tables 4 to 9 inclusive. The ratings were determined on the basis of morphological, physical, and chemical properties of the soils, as well as steepness of slope. The principal limiting properties are indicated, and are generally listed in decreasing order of importance. Limitations due to slope are not further subdivided once the slope becomes steep enough to cause a very severe limitation for a specified use. It follows, however, that the steeper the slope, the more severe the limitation, and this fact should be kept in mind while using the soil interpretation tables. The soil limitations for various uses have been designated as none to slight, moderate, severe, and very severe.

TABLE 4. Soil Limitations for Fully Serviced Campgrounds

| MAP ¹ SYMBOL | DEGREE OF LIMITATION ² | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|--------------------------------------|-----------------|------------------------------|
| $\frac{1}{b0}$ $\frac{1}{c0}$ | M - Flood, other- wise SL | $\frac{6}{b0}$ | M - Flood, other- wise SL |
| $\frac{2}{b0}$ | M - Slip, Flood | $\frac{7}{b0}$ | M - Slip, Flood |
| $\frac{3}{c1}$ | M - BR, otherwise SL | $\frac{8}{d1}$ | SL |
| $\frac{3}{f1}$ | S - Slope, BR, Er | $\frac{9}{b0}$ | M - Slip, Flood |
| $\frac{4}{b0}$ | M - Flood, other- wise SL | $\frac{10}{e1}$ | M - Slope, Er |
| $\frac{5}{a0}$ | M - Wet, Flood | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - very severe.

ABBREVIATIONS

BR - Shallow depth to bedrock
 Clay - High clay content
 Er - Erosion hazard
 Flood - Flooding hazard (overflow)
 Org - Organic soil
 Org Surf - Organic surface layer
 > 15 cm thick
 Sandy - Sandy surface texture

Slip - Slippery or sticky when wet
 Slope - Excessive slope
 Sl Perm - Slow permeability
 Solz - Solonetzic soil
 Stony - Surface stoniness
 Wet - Seasonally high ground-
 water table or surface
 ponding

TABLE 5. Soil Limitations for Picnic Areas

| MAP ¹ SYMBOL | DEGREE OF LIMITATION ² | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|--------------------------------------|-----------------|-----------------------------|
| $\frac{1}{b0}$ $\frac{1}{c0}$ | SL | $\frac{7}{b0}$ | M - Slip, other- wise SL |
| $\frac{2}{b0}$ | M - Slip, other- wise SL | $\frac{8}{D1}$ | SL |
| $\frac{3}{C1}$ | SL | $\frac{9}{b0}$ | M - Slip, other- wise SL |
| $\frac{3}{F1}$ | S - Slope, Er, BR | $\frac{10}{ET}$ | M - Slope, Er |
| $\frac{4}{b0}$ | SL | | |
| $\frac{5}{a0}$ | SL | | |
| $\frac{6}{b0}$ | SL | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - very severe.

ABBREVIATIONS

BR - Shallow depth to bedrock
 Clay - High clay content
 Er - Erosion hazard
 Flood - Flooding hazard (overflow)
 Org - Organic soil
 Org Surf - Organic surface layer
 > 15 cm thick
 Sandy - Sandy surface texture

Slip - Slippery or sticky
 when wet
 Slope - Excessive slope
 Sl Perm - Slow permeability
 Solz - Solonetzic soil
 Stony - Surface stoniness
 Wet - Seasonally high ground-
 water table or surface
 ponding

TABLE 6. Soil Limitations for Lawns and Landscaping

| MAP SYMBOL | DEGREE OF LIMITATION | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|---------------------------|-----------------|---------------------------|
| $\frac{1}{b0}$ $\frac{1}{e0}$ | M - Thin Ah, Lime | $\frac{6}{b0}$ | S - R Perm, Thin Ah, Lime |
| $\frac{2}{b0}$ | M - Thin Ah, Lime | $\frac{7}{b0}$ | S - R Perm, Thin Ah, Lime |
| $\frac{3}{c1}$ | M - Thin Ah, R Perm | $\frac{8}{d1}$ | M - Thin Ah, otherwise SL |
| $\frac{3}{f1}$ | S - Slope, Er, BR | $\frac{9}{b0}$ | SL |
| $\frac{4}{b0}$ | S - R Perm, Lime, Thin Ah | $\frac{10}{e1}$ | M - Slope, Er, Thin Ah |
| $\frac{5}{a0}$ | S - Lime, Thin Ah | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

ABBREVIATIONS

BR - Shallow depth to bedrock
 Clay - High clay content
 Er - Erosion hazard
 Flood - Flooding hazard (overflow)
 Lime - High lime content (soil nutrient imbalance)
 Org - Organic soil
 Org Surf - Organic surface layer > 15 cm thick

R Perm - Rapid permeability (droughtiness)
 Saline - Surface soil salinity
 Sandy - Sandy surface texture
 Slope - Excessive slope
 Sl Perm - Slow permeability
 Solz - Solonetzic soil
 Stony - Surface stoniness
 Thin Ah - Thin or no Ah horizon
 Wet - Seasonally high groundwater table or surface ponding

TABLE 7. Soil Limitations for Paths

| MAP ¹ SYMBOL | DEGREE OF LIMITATION ² | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|--------------------------------------|-----------------|-----------------------------|
| $\frac{1}{b0}$ $\frac{1}{c0}$ | SL | $\frac{6}{b0}$ | SL |
| $\frac{2}{b0}$ | M - Slip, other- wise SL | $\frac{7}{b0}$ | M - Slip, other- wise SL |
| $\frac{3}{c1}$ | SL | $\frac{8}{d1}$ | SL |
| $\frac{3}{f1}$ | S - Slope, Er, BR | $\frac{9}{b0}$ | M - Slip, other- wise SL |
| $\frac{4}{b0}$ | SL | $\frac{10}{e1}$ | M - Slope, Er |
| $\frac{5}{a0}$ | SL | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

ABBREVIATIONS

Clay - High clay content
 Er - Erosion hazard
 Flood - Flooding hazard (overflow)
 Org - Organic soil
 Org Surf - Organic surface layer
 > 15 cm thick
 Sandy - Sandy surface texture

Slip - Slippery or sticky when wet
 Slope - Excessive slope
 Solz - Solonetzic soil
 Stony - Surface stoniness
 Wet - Seasonally high groundwater
 table or surface ponding

TABLE 8. Soil Limitations for Buildings Without Basements

| MAP ¹ SYMBOL | DEGREE OF LIMITATION ² | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|--------------------------------------|-----------------|------------------------------|
| $\frac{1}{b0}$ $\frac{1}{c0}$ | S - Flood, other- wise SL | $\frac{6}{b0}$ | S - Flood, other- wise SL |
| $\frac{2}{b0}$ | S - Flood, other- wise SL | $\frac{7}{b0}$ | S - Flood, other- wise SL |
| $\frac{3}{c1}$ | M - BR, otherwise SL | $\frac{8}{d1}$ | SL |
| $\frac{3}{f1}$ | S - Slope, BR | $\frac{9}{b0}$ | S - Flood, other- wise SL |
| $\frac{4}{b0}$ | S - Flood, other- wise SL | $\frac{10}{e1}$ | M - Slope, other- wise SL |
| $\frac{5}{a0}$ | S - Flood, Wet | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

ABBREVIATIONS

BR - Shallow depth to bedrock
Flood - Flooding hazard (overflow)
Org - Organic soil
Slope - Excessive slope

Stony - Surface stoniness
Wet - Seasonally high ground-
water table or surface
ponding

TABLE 9. Soil Limitations for Road Location

| MAP SYMBOL | DEGREE OF LIMITATION | MAP SYMBOL | DEGREE OF LIMITATION |
|-------------------------------|-------------------------------|-----------------|------------------------------|
| $\frac{1}{b0}$ $\frac{1}{c0}$ | M - Flood, other- wise SL | $\frac{6}{b0}$ | M - Flood, other- wise SL |
| $\frac{2}{b0}$ | S - Frost, M Sh- Sw, Flood | $\frac{7}{b0}$ | M - Flood, other- wise SL |
| $\frac{3}{c1}$ | M - BR, otherwise SL | $\frac{8}{d1}$ | S - Sh-Sw, Frost |
| $\frac{3}{f1}$ | S - Slope, Er, BR | $\frac{9}{b0}$ | S - Sh-Sw, Frost, Flood |
| $\frac{4}{b0}$ | M - Flood, other- wise SL | $\frac{10}{e1}$ | M - Slope, Er |
| $\frac{5}{a0}$ | S - Wet, Flood | | |

1. For explanation, see Soil Map.

2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

ABBREVIATIONS

BR - Shallow depth to bedrock
 Clay - High clay content
 Er - Erosion hazard
 Flood - Flooding hazard (overflow)
 Frost - Susceptibility to frost
 heave
 M Sh-Sw - Moderate shrink - swell
 potential

Org - Organic soil
 Sh-Sw - High shrink - swell
 potential
 Slope - Excessive slope
 Stony - Surface stoniness
 Wet - Seasonally high ground-
 water table or surface
 ponding

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SOIL MAP OF WRITING-ON-STONE PROVINCIAL PARK STUDY AREA

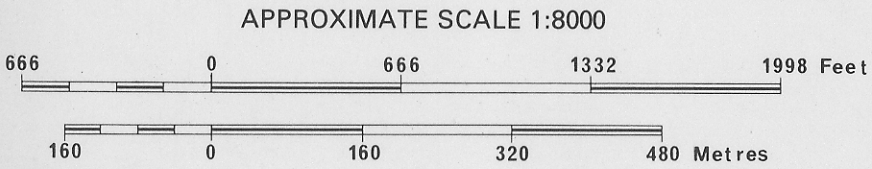
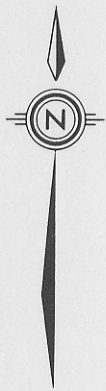
Tp 1, R 13, W 4 M



| SOIL CLASSIFICATION | | | |
|---------------------|-------------|--------------------------------------|--|
| MAP UNIT | SOIL ORDER | SOIL SUBGROUP | SOIL PARENT MATERIAL |
| 1 | Regosolic | Orthic Regosol | medium textured fluvial sediments |
| 2 | Regosolic | Orthic Regosol | medium textured fluvial sediments |
| 3 | Chernozemic | Orthic Brown Chernozem, Lithic phase | moderately to very coarse till, overlying sandstone |
| 4 | Regosolic | Orthic Regosol | medium textured fluvial sediments, overlying very coarse textured fluvial sediments (fine gravel) |
| 5 | Regosolic | Gleyed Regosol | very coarse textured fluvial sediments (sand) |
| 6 | Regosolic | Orthic Regosol | very coarse textured fluvial sediments (sand) |
| 7 | Regosolic | Orthic Regosol | very coarse textured fluvial sediments (sand) |
| 8 | Chernozemic | Orthic Brown Chernozem | medium to moderately coarse textured till |
| 9 | Chernozemic | Orthic Brown Chernozem | medium to very coarse textured fluvial sediments (sand), overlying moderately coarse textured till |
| 10 | Chernozemic | Orthic Brown Chernozem | moderately coarse to very coarse textured till |

LEGEND:

- Map Symbol:
- 6/b0 ← map unit
← surface stoniness rating
← topographic class
 - soil line
 - - - boundary of mapped area
 - escarpment
 - - - drainage channel
 - ← direction of slope



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LANDFORM MAP OF WRITING-ON-STONE PROVINCIAL PARK STUDY AREA

Tp 1, R 13, W 4 M



LEGEND:

F - Fluvial

- Fl - level fluvial
- Ft - fluvial terrace
- Fu - undulating fluvial
- Fvb
MI - fluvial veneer and blanket,
overlying level morainal

M - Morainal

- Mi - inclined morainal
- Mv
Ri - morainal veneer,
overlying inclined bedrock

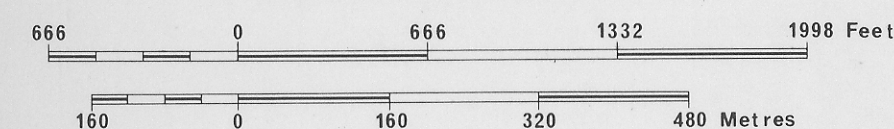


LEGEND:

- - - - - landform line
- - - - - boundary of mapped area
- ||||| - escarpment
- - - - - drainage channel
- ← - direction of slope

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APPROXIMATE SCALE 1:8000



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SOIL LIMITATIONS FOR RECREATION IN WRITING-ON-STONE PROVINCIAL PARK STUDY AREA

Tp 1, R 13, W 4 M



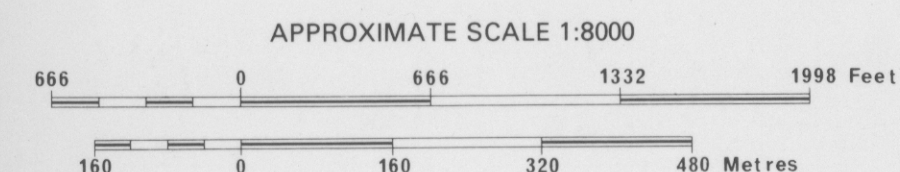
LEGEND:

- SL - none to slight soil limitations
- M - moderate soil limitations
- S - severe soil limitations
- VS - very severe soil limitations



LEGEND:

- soil limitation line
- boundary of mapped area
- escarpment
- drainage channel
- direction of slope



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