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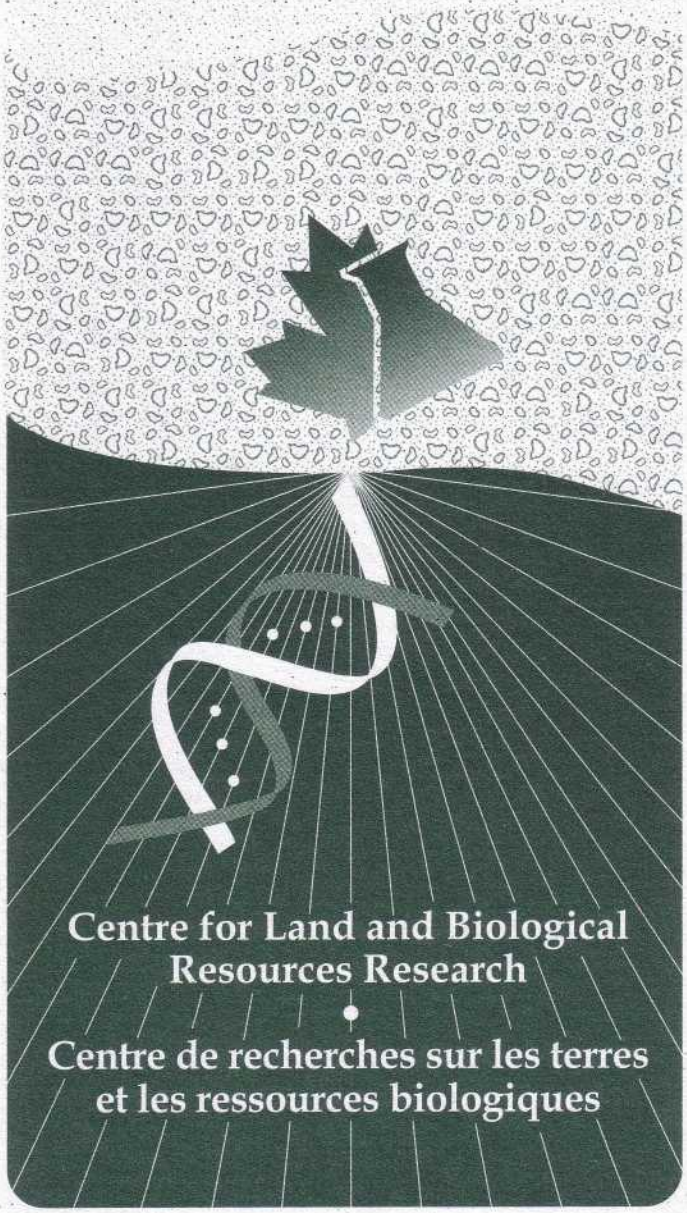

Centre for Land and Biological Resources Research

Centre de recherches sur les terres et les ressources biologiques

Alberta Soil Survey
Report No. 82I-SW

Soils of the Gleichen area, 82I-SW

Canada

Soils of the Gleichen area, 82I/SW

B.D. Walker and W.W. Pettapiece

Alberta Soil Survey Report No. 82I-SW

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The National Soils Data Base Unit, Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa, ON is acknowledged for digitizing and production of the accompanying map attached in the back pocket.

More detailed soil information (i.e. soil series descriptions and data) and copies of this report can be obtained by contacting:

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PREFACE

The soil resources of the Gleichen SW map sheet are presented at a moderate level of detail in generalized report and map form.. The accompanying report presents an overview of the physiography, climate, ecology, general soil patterns, and selected agricultural interpretations. Soil survey information was compiled from the Canada Land Inventory mapping effort in the mid 1960's, and subsequent updating activities of the late 1970's and late 1980's.

The soil map displays patterns of soils at a moderate level of detail (scale 1:126,720), and is enclosed in the back pocket. The soils were distinguished by patterns that relate to other landscape features such as landform and slope. Repeating patterns were organized into 75 soil map units identified by shorthand codes and briefly described on the map legend. An extended legend that provides additional descriptive comments for each map unit is furnished in Appendix A. An overview of the soil resources is presented below.

Soil and terrain characteristics were interpreted for three agricultural applications: production of spring-seeded small grains, irrigation, and range productivity. The generalized ratings or capability classes are intended as guidelines for land use planners and managers. Agricultural land use, land suitability for production, and land management are briefly discussed below; generalized ratings for each map unit are listed in Appendix B.

GENERAL CHARACTERISTICS OF THE AREA (82I/SW)

Location

The Gleichen SW map sheet (82I/SW) occupies about 396,400 ha in southwestern Alberta; an area bounded by 50°00' and 50°30' N latitude, 113°00' and 114°00' W longitude. Most of the area lies within the Western Alberta Plains Physiographic Region; the western edge extends into the Southern Alberta Uplands Physiographic Region (Pettapiece 1986). Several physiographic subdivisions are recognized (Fig. 1), based primarily on generalized elevation, topographic and surficial material features (Fig. 2).

Physiography and Surficial Materials

Western Alberta Plains

Little Bow Plain Physiographic District (Fig. 1) is an undulating plain with elevations of about 900 to 1050 m and local relief generally <5 m. This area is characterized by a moderately fine to medium textured blanket to veneer of water-laid (or eolian) origin overlying calcareous till (Fig. 2). Significant areas of moderately coarse textured, wind- or water-laid materials also occur, mainly along the Little Bow River eastwards from the Clear Lake area.

Vulcan Upland Physiographic District is a complex area comprised of rolling, bedrock-controlled hills encompassed within undulating to hummocky moraine. Local relief ranges from about 5 to 20 m. Moderately fine textured, calcareous till is typical of the area, and is frequently overlain by a moderately fine to medium textured veneer of water-laid (or eolian) origin. Shallow drift, probably <5 m thick, occurs on several hills. Elevations range from about 950 to 1100 m (Thigh Hills).

Southern Alberta Uplands

Porcupine Hills Physiographic District forms a conspicuous upland of rolling to ridged hills in the southwestern part of the map sheet. Elevations in this area range from about 1100 m along its eastern perimeter to 1590 m on a ridge at the western boundary. Local relief varies from over 250 m near the map boundary to about 100 m in perimeter areas. A discontinuous veneer to blanket of mixed till covers the gently dipping sandstone and shale strata that form the hills. Deeper till deposits, sometimes with fluvial fan and apron overburden, occupy many of the valleys. The tills are mostly moderately fine textured, commonly with a high silt content. Mixed water-laid and till deposits occur in some of the larger valleys.

Okotoks Upland Physiographic District is a complex area comprised of rolling, bedrock-controlled hills

encompassed within undulating to hummocky moraine. Moderately fine textured, calcareous till is typical of the area, and is frequently overlain by a moderately fine to medium textured veneer of water-laid (or eolian) origin. Gravelly to stony ice contact deposits are a common feature. Thickness of the drift is probably <5 m on several hills. Elevations range from about 1030 to 1150 m, and local relief ranges from 5 to 30 m.

Bedrock Geology

Three major geologic formations, oriented roughly north by south, underly the area (Green 1972, Fig. 3). They range in age from Cretaceous (St. Mary River Formation) in the east to Tertiary (Porcupine Hills Formation) in the west. Bedrock in the central area (Fig. 2) is identified by two names (Paskapoo and Willow Creek) that are of the same age but have slightly different stratigraphy. All three formations are primarily of non-marine origin and are dominated by sandstones. Siltstones, mudstones and/or shale form a significant part of each.

Drainage

More than three-quarters of the area – the eastern and northern sides – drain via the Little Bow River. The southwest corner drains via Willow Creek. Both join the Oldman-South Saskatchewan River drainage system southeast of the map area. Several smaller streams join the Little Bow R. and Willow Cr. The Porcupine Hills area in particular is drained by a network of small, mostly seasonal streams.

There are several small lakes in the area. Most, including Clear Lake, are semi-permanent or intermittent lakes and sloughs of glacial origin, and may be dry in some years. Their shorelines usually change seasonally and are often saline.

Climate

A semiarid to subhumid continental climate with warm summers and cold winters is characteristic of the area (Table 1). In all areas temperature changes can be sudden and extreme, especially in winter, because of chinook winds.

The growing season (mean daily temperature above 5°C) averages 180 to 190 days, beginning around April 17-20 in all areas but the Porcupine Hills (Kirkwood *et al.* 1993). Growing degree-days above 5°C range from 1330 to 1550. In the Porcupine Hills growing season length is estimated at 179 days, beginning about April 24, with about 1200 growing degree days above 5°C (Kirkwood *et al.* 1993). These values seem high for this highly variable area, but may be fairly representative of its more arable fringe. Frost-free period is about 115 days on the plains (AES 1982), and as low as 50 days in the Porcupine Hills.

Annual precipitation is roughly 400 mm on the east side and 500 mm on the west side (AES 1993). About 60-70% falls during the growing season (May to Sept.), and June is clearly the wettest month. Total precipitation in the Porcupine Hills varies from about 450 or 500 mm in its fringe areas to 600 mm or more in the higher elevation wooded parts. The low rainfall on the east side, combined with warm summer temperatures and frequent winds, result in large moisture deficits. These deminish towards the west.

Wind is a significant part of the regional climate, and an important factor in land management.

Table 1. Temperature and precipitation data (normals) for selected stations (AES 1993).

Gleichen 50°53'N, 113°03'W, 905m

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Daily mean (°C)	-11.8	-7.9	-2.8	4.7	10.7	15.0	17.3	16.7	11.1	5.8	-3.7	-9.9	3.8
Precipitation (mm)	15.8	10.7	16.2	26.0	47.8	62.7	47.7	37.7	41.9	12.8	16.0	16.0	351.4

Claresholm Waterworks 50°01'N, 113°43'W, 1018m

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Daily mean (°C)	-8.6	-4.8	-1.0	5.1	10.4	14.8	17.4	16.6	11.6	7.1	-1.4	-6.6	5.1
Precipitation (mm)	25.4	18.0	26.8	41.2	52.8	70.2	44.2	48.1	41.9	17.1	18.9	23.1	427.7

High River 50°29'N, 114°10'W, 1219m

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Daily mean (°C)	-9.2	-6.1	-2.6	3.5	8.7	12.9	15.2	14.7	9.8	5.5	-2.4	-7.7	3.5
Precipitation (mm)	23.0	22.6	26.5	40.9	60.3	86.8	58.6	55.5	47.1	19.9	18.8	25.2	485.2

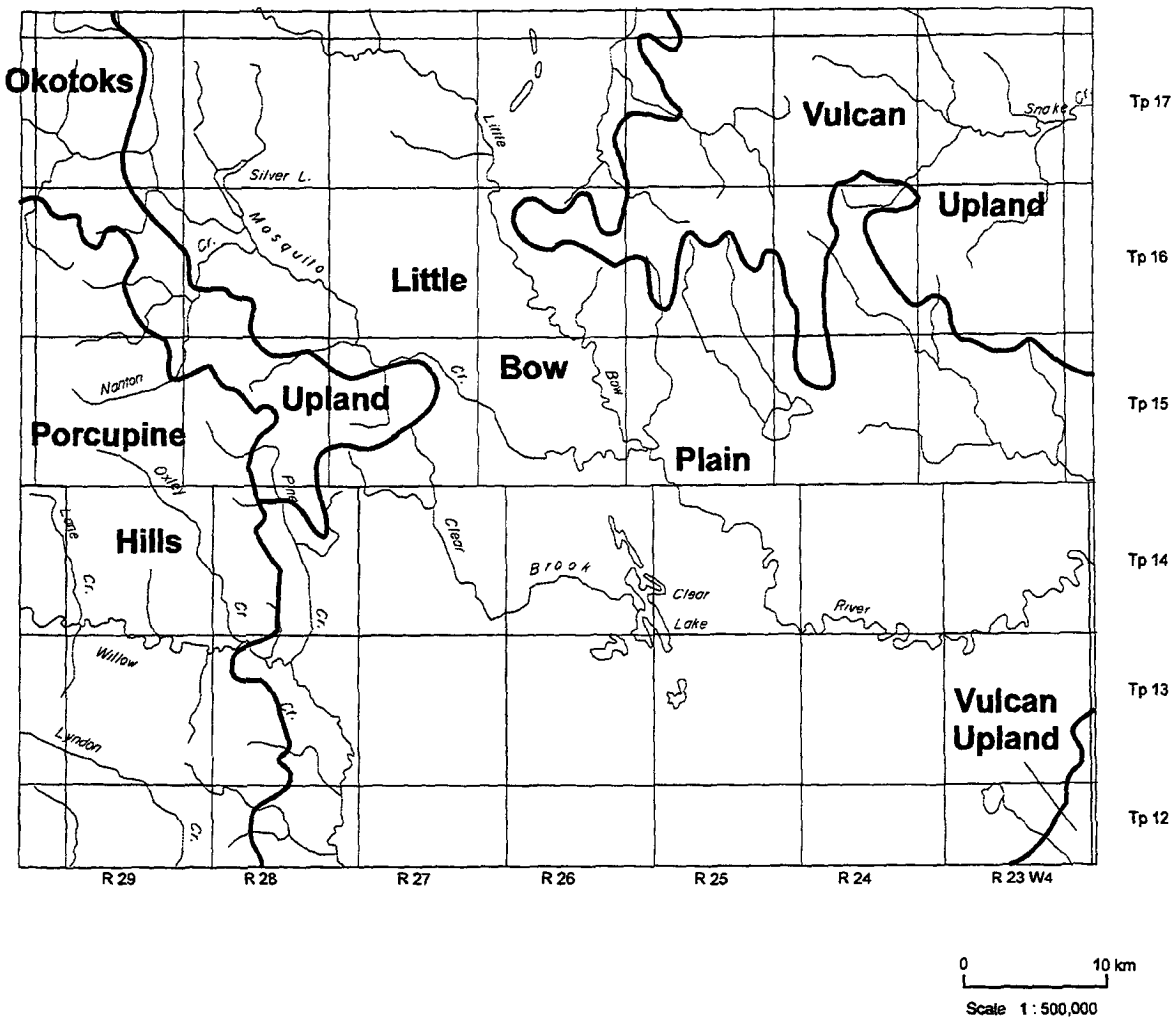


Figure 1. Physiographic subdivisions of the Gleichen SW map area, after Pettapiece (1986).

Ecology and Native Vegetation

The map area encompasses parts of four ecoregions: Moist Mixed Grassland, Fescue Grassland, Aspen Parkland, and Northern Continental Divide (Ecological Stratification Working Group 1995). The first three correspond roughly to the Dark Brown, thin Black, and thick Black soil zones and subzones, respectively, as shown in Figure 4. The last ecoregion juts into the southwest corner of the map area, in the highest parts of the Porcupine Hills.

The Moist Mixed Grass Ecoregion, or Mixedgrass Subregion (Alberta Environmental Protection 1994), makes up the driest, warmest part of the map sheet. Agroclimate classes range from 2A to 2AH, east to west. This subtle gradient, which implies cooler, moister conditions from east to west, affects suitability ratings for crops. A native "reference ecosystem" (Strong 1992) is comprised of medium textured, moderately well to well drained, Dark Brown soils under needle (*Stipa viridula, S. comata* and *S. spartea)* and wheat grasses (*Agropyron dasystachyum* and *A. Smithii*).

The Fescue Grassland Ecoregion, or Foothills Fescue Subregion (Alberta Environmental Protection 1994), is associated with the thin Black soil subzone (Fig. 4). Heat units and moisture deficit are moderate for the area; agroclimate classes range from 2AH to 3H and 4H with increasing elevation. A native "reference ecosystem" (Strong 1992) is comprised of medium textured, moderately well drained, thin Black soils under rough fescue (*Festuca scabrella*) and Parry oat grass (*Danthonia parryi*).

In both the Moist Mixed Grassland and Fescue Grassland ecoregions, trees and tall shrubs are found only in the river valleys and in irrigated areas.

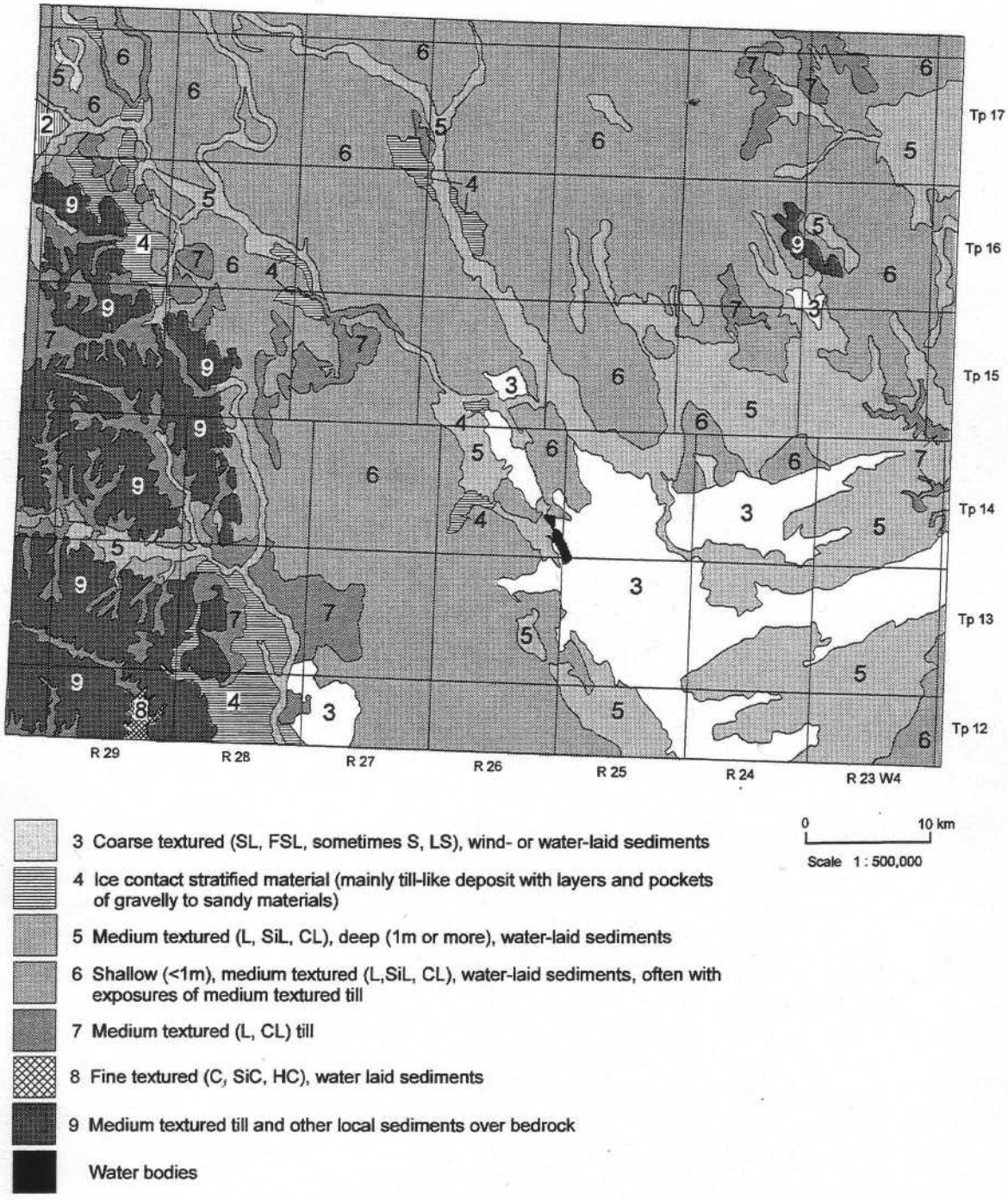
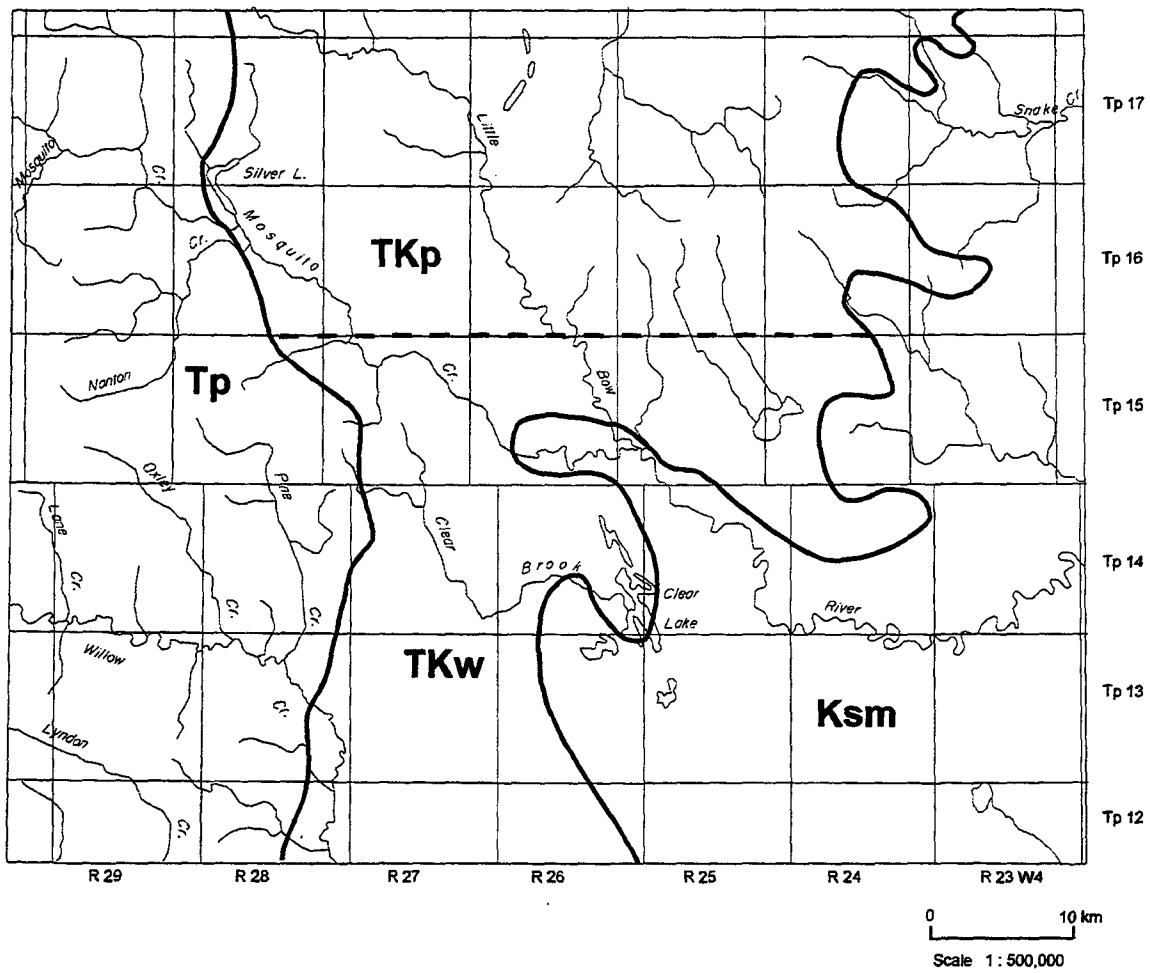


Figure 2. Surficial materials of the Gleichen SW map area.

The southern tip of the Aspen Parkland Ecoregion, or Foothills Parkland Subregion (Alberta Environmental Protection 1994), juts into the map area in the northern part of the Porcupine Hills, north of Willow Cr. It is associated with the thick Black subzone area centered around Nanton, Oxley and Lone creeks (Fig. 4). This cool, subhumid area is classed mainly as agroclimate 4H, but with some warmer drier conditions (agroclimate 3H) in valleys and on some south-facing slopes. Aspen Parkland

marks the eastern extent of aspen (*Populous tremuloides*) in southwestern Alberta. Clones of aspen dot the predominantly grassy landscape, accounting for about 15% to 50% cover in this area. A grassland component much like that of the Fescue Grassland dominates. Strong (1992) describes "reference ecosystems" for the grassland and aspen components.



Symbol	Formation Name	General Description
Tertiary		
Tp	Porcupine Hills	Calcareous sandstone and mudstone; nonmarine.
Tertiary and Cretaceous		
TKp	Paskapoo	Calcareous sandstone, siltstone and mudstone; minor conglomerate; thin limestone, coal and tuff beds; nonmarine.
TKw	Willow Creek	Calcareous sandstone and mudstone; thin limestone beds; nonmarine.
Cretaceous		
Ksm	St. Mary River	Calcareous sandstone, siltstone and mudstone; thin coal beds; limestone in basal part; nonmarine.

Figure 3. Generalized bedrock geology of the Gleichen SW area, after Green (1972).

The eastern extremity of the Northern Continental Divide Ecoregion, labelled Montane Subregion by Alberta Environmental Protection (1994), protrudes into the southwest corner of the map area. It is associated with the southern-most thick Black area centered around Lyndon Creek (Fig. 4). Dark Gray soils are also present, but only under well established forest vegeation. Ecological conditions are highly variable in this area, mainly due to the complex topography. This cool, subhumid area is classed mainly as agroclimate 4H to 5H. A patchwork of vegetation types that include fescue grassland, aspen, lodgepole pine (*Pinus contorta*), white spruce (*Picea glauca*), Douglas fir (*Pseudotsuga menziesii*), and limber pine (*Pinus flexilis*) occur under a variety of climatic and edaphic conditions.

GENERAL SOIL FEATURES

Introduction

The map area spans the Dark Brown-Black soil zone transition in south-central Alberta (Fig. 4). Dark Brown zone soils occupy the eastern two-thirds of the area, Black zone soils the western third. The transition is equated with an annual precipitation of roughly 425 mm and a May-August moisture deficit of about -275 P-PE (A.I.W.G. 1995).

The majority of soils are well to moderately well drained and have developed on medium textured, moderately to strongly calcareous parent materials. Soil sola vary from about 30 to 70 cm to a calcareous C horizon. Topsoil (Ap or Ah horizon) thickness ranges from about 10-15 cm in the Dark Brown zone to 20-30 cm or more in the thick Black areas. Organic matter content of cultivated topsoil is about 3-5% in the Dark Brown zone, 3-9% in the Black zone. Most profiles have a neutral to slightly alkaline reaction. Subsoils, especially the till on the eastern side of the area, may be weakly saline at depth. Sodium salt concentrations occur at the surface where there is discharge of saline groundwater.

Descriptions and chemical and physical attributes of the soil series occurring in the map area can be obtained from Agriculture and Agr-Food Canada's Albert Land Resource Unit in Edmonton.

Dark Brown Zone Soils

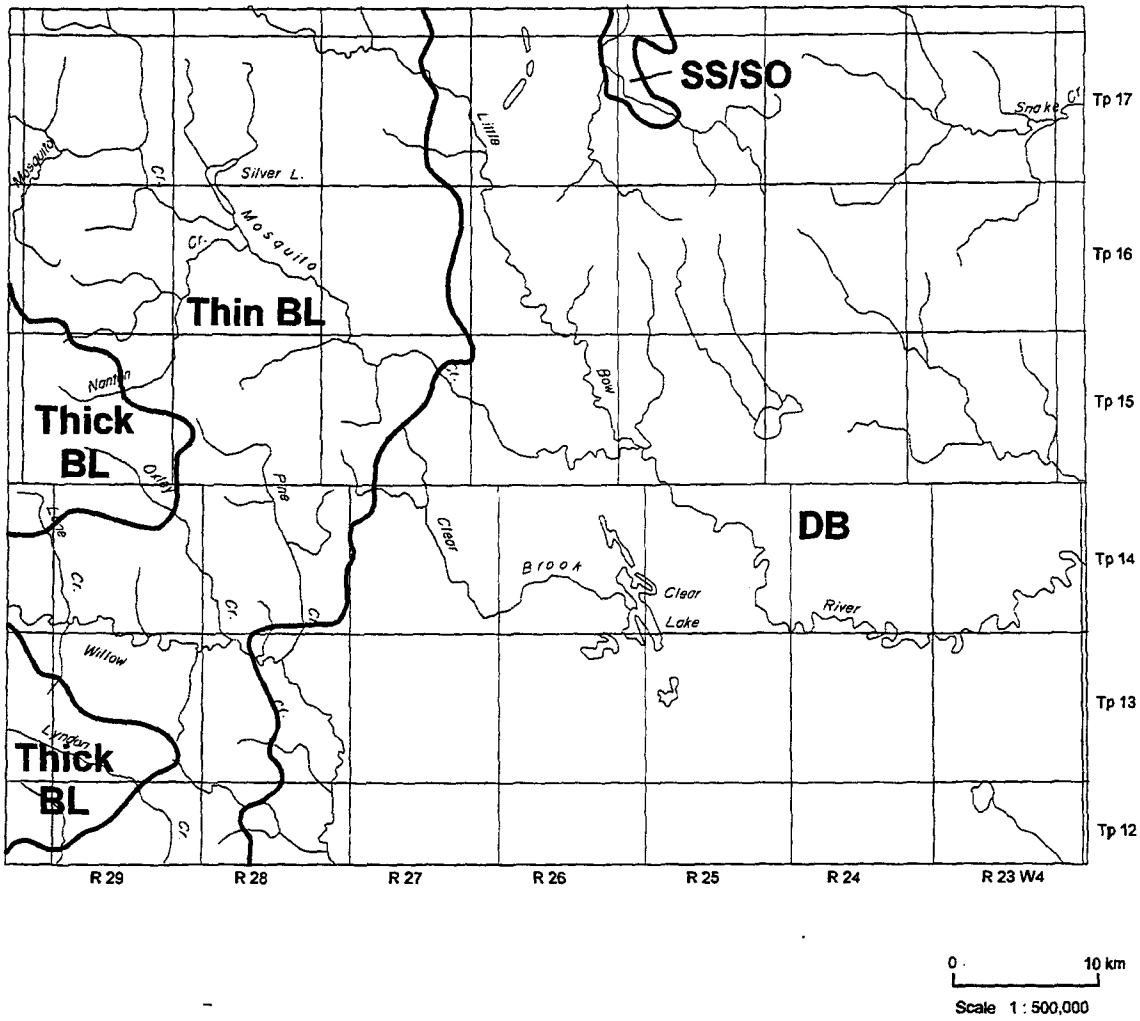
The Dark Brown zone is dominated by Chernozemic soils (Fig. 4). These are mainly developed on till (NEM, PUNE, and PUY units) and shallow, medium textured, fluvial or glaciolacustrine material overlying the till (PGT, RDPG, RDWN, WNLE, WNNE, WNPU, WNRD, and WNY units) on parts of the Vulcan Upland and Little Bow Plain (Fig. 1). Similar soils occur on deeper glaciolacustrine material (KCLE, LECL, and LET units) on much of the Little Bow Plain. Still others occur on coarse textured (including gravelly) or stratified deposits (KSCM, KSHR, KSR, MACF, OAS, and WOMA units) on parts of the Little Bow Plain, mainly in the Willow Creek and Clear Lake areas.

A small area dominated by Solodized Solonetz and Solod (Solonetzic) soils occurs along the north edge of the map sheet, on the Little Bow Plain but adjacent to the Vulcan Upland. The surficial material is medium textured glaciolacustrine material overlying till (LSKR unit).

Black Zone Soils

The Black zone is dominated by Chernozemic soils (Fig. 4). Under the drier, warmer conditions of the plains, the soils have relatively thin A horizons (about 10-15 cm) and sola (roughly 30-50 cm). In the cooler, moister uplands, the soils often have topsoil and sola greater than 20 and 50 cm thick, respectively.

The thin Black subzone is draped over three physiographic areas (Fig. 1): the northwestern part of the Little Bow Plain, the Okotoks Upland, and part of the Porcupine Hills. On the Okotoks Upland, thin Black soils developed on till and shallow, medium textured, fluvial or glaciolacustrine material overlying the till (ADRK, ADY, PSOK, and RKAD units) are common. The dominant Black soils of the Little Bow Plain occur on shallow to deep, mostly medium textured, fluvial or glaciolacustrine material overlying till (RKLT and RKV units). Thin Black soils developed on coarse textured (including gravelly), stratified, or intermixed deposits (RFAD, RKHP, and SARK units) occur sporadically on the Little Bow Plain and Okotoks Upland.



Code	Great Group Description
Thick BL	Black (Chernozemic) – A horizon generally >15 cm
Thin BL	Black (Chernozemic) – A horizon generally <15 cm
DB	Dark Brown (Chernozemic)
SS/SO	Solodized Solonetz and/or Solod (Dark Brown zone)

Figure 4. Generalized soil map (Great Group level) of the Gleichen SW map area.

The eastern and northern fringe of the Porcupine Hills, below about 1400 m (4500 ft) elevation, is dominated by thin Black soils. Similar Brunisolic soils with very thin Ah horizons (about 5 cm) are also common in the steeply sloping, hilly terrain. These soils are developed on shallow till deposits overlying bedrock (BZNF unit), with deeper till in most valleys (BZR unit). Larger valleys also have intermixed till and fine textured glaciolacustrine material (BZCT unit); fine textured glaciolacustine material (CWY unit); or deep, medium textured, fluvio- or glaciolacustrine material (SOF unit).

The thick Black subzone occupies the highest parts of the Porcupine Hills (Fig. 1 and 4), generally above 1250 m (4100 ft) on northerly aspects and 1400 m (4500 ft) on southerly aspects. Relatively moist, cool conditions prevail in this SW corner of the map sheet, and Dark Gray soils can be found on forested segments of the landscape. The soils are developed mainly on shallow till deposits overlying bedrock (DVOK units), with deeper till in some localities (DVG unit). Larger valleys, such as upper Lyndon Creek valley, have intermixed till and medium textured, fluvial material (DVMF unit).

AGRICULTURE AND LAND USE

Agricultural Land Use

Settlement by ranchers and farmers began in earnest with the arrival of the Canadian Pacific Railroad in 1883. Today most of the area is managed for dryland agriculture. The prevalent crop production systems under dryland conditions are mainly wheat-fallow rotations in the drier areas (i.e. east side) and continuous cereal-oilseed cropping in the Black zone. Irrigated crop production is minor, occurring sporadically, mainly along the Little Bow River. Very few specialty crops are included in the production systems.

A significant portion, consisting mainly of areas with rough topography, is managed as rangeland for livestock grazing. The Porcupine Hills in particular support a vigorous ranching industry; gentler sloping parts of the landscape are often cultivated for forage crop production to support the livestock enterprise.

Land Suitability for Agricultural Production

Suitability for Spring-Seeded Small Grains

The map units were interpreted as to suitability for production of spring-seeded small grains based on climate, soil, and landscape parameters (A.I.W.G. 1995). Suitability ratings were determined on "average" characteristics for each map unit (Appendix B). A general picture of land suitability across the map area is presented in Figure 5.

There are two main limitations to dryland agricultural production. The first, a growing-season moisture deficit caused by low rainfall and intensified by high evapotranspiration, most affects the eastern side of the map sheet. The second is growing season temperature and length, a factor on the western side.

The semi-arid moisture condition generates a best possible suitability rating of class 2 in the Dark Brown soil zone. However, medium soil textures, which dominate the area, further limit water supplying capacity. Thus the "best" Dark Brown soils were rated as class 2 or 3 depending on where they occur (Fig. 5). The southeastern part of the map sheet, near Barons, has the highest moisture deficit in the map area. Here the best possible rating for Dark Brown soils was class 3. Moisture is less limiting towards the west and on the Vulcan Upland where the "best" Dark Brown soils were interpreted as class 2.

Moisture is less of a concern in the Black soil zone, but growing season temperature and length become limiting. The restricted growing season, expressed in effective growing degree day (EGDD) values (A.I.W.G. 1995), creates a best possible suitability rating of class 2 in the thin Black subzone. Most of the thin Black soil areas on the Western Alberta Plains are rated as class 2 (Fig. 5).

In both the Dark Brown and thin Black soil zones, land areas with appreciable Solonetzic or saline soils, coarse textured materials or rough topography have substantially lower suitability ratings. Class 3 and 4 soil areas are also common on the plains (Fig. 5), due mostly to coarser soil textures, sometimes in conjunction with adverse topography.

In the Porcupine Hills (Fig. 1), inadequate heat units (subclass H) is the most limiting factor. When combined with shallow soil materials and rough topography, many soil areas were rated class 5 or 6 for the production of small grains (Fig. 5).

Land Capability Ratings for Irrigation

The map units were interpreted for irrigability based on soil and topographic parameters (Land Evaluation and Reclamation Branch 1992) with an added climatic component. The ratings were determined on "average" characteristics for each map unit (Appendix B). A generalized view of irrigability across the area is presented in Figure 6.

The climatic factor, expressed in energy or heat units (i.e. effective growing degree days, EGDD), introduces the concept of potential economic returns into the ratings procedure (Walker *et al.* 1991). The warmest areas, with EGDD of about 1500 or more as calculated by the A.I.W.G. (1995) method, have the broadest cropping options. Given the cool climate, class 2 land is the best possible rating in the area. Other factors such as low moisture holding capacity of the medium to coarse textured soils (subclass M) or adverse topography (subclass T) downgrade the

ratings slightly. Hence class 2 and 3 land is extensive on the Western Alberta Plains (Fig. 6). Class 5 land areas are also common, due mainly to significant wet (W) or saline (subclass N) "pothole" depressions in the landscape.

Land Capability Ratings for Range Productivity

The map units were rated as to their capability to produce forage, mainly native or comparable grasses and forbs, for livestock grazing. The ratings are qualitative estimates based on climatic, soil, vegetative and topographic parameters. The methodology, described by Walker *et al.* (1991), evolved from range condition and stocking rate guildelines (Smoliak *et al.* 1988), and from a method of estimating range production using soil characteristics and precipitation (Cannon and Nielsen 1984). The capability ratings were determined on "average" characteristics for each map unit, and are listed, in Appendix B, for each map unit. A generalized picture of land capability for grazing across the map area is presented in Figure 7.

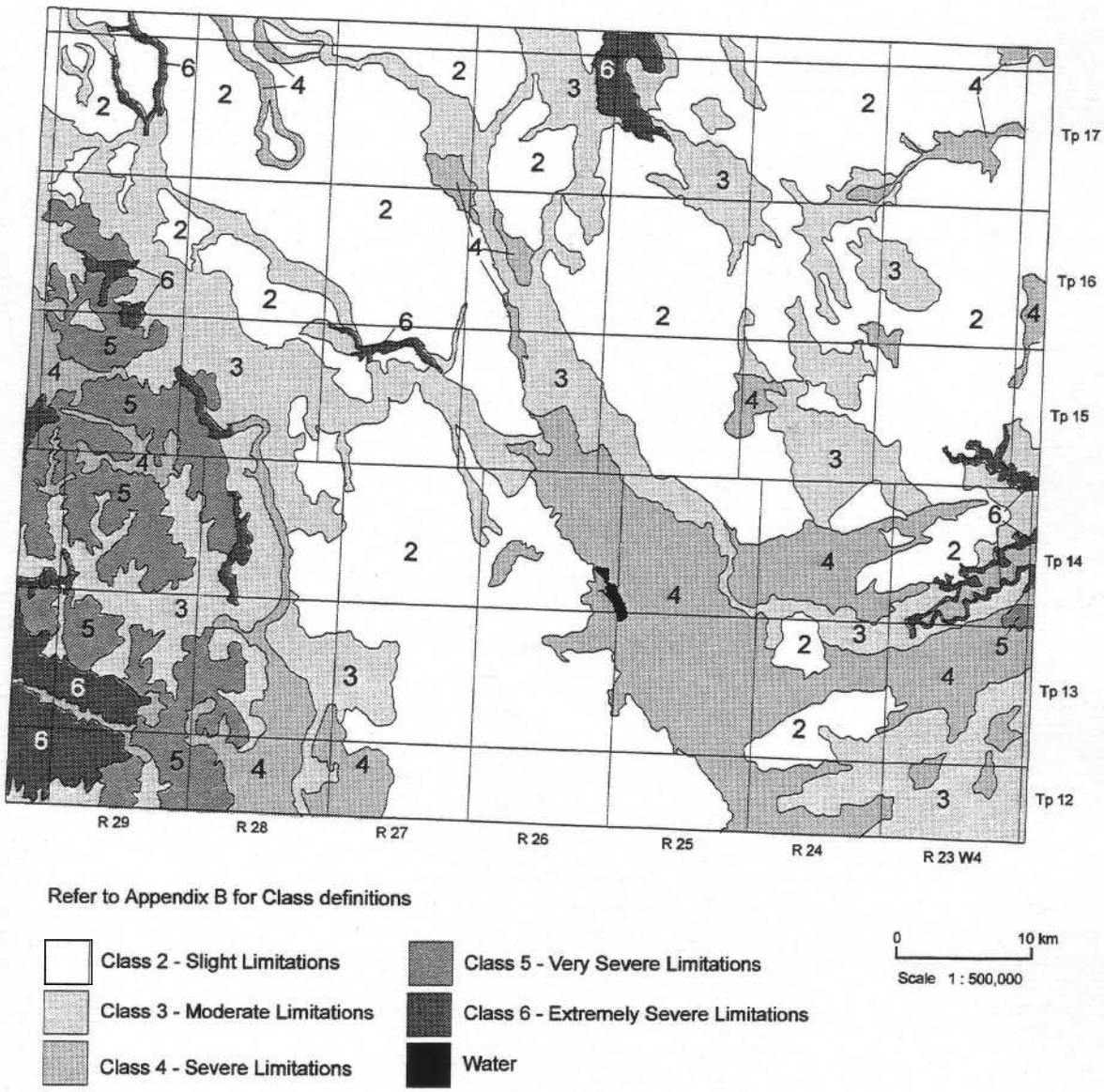


Figure 5. Generalized land suitability ratings for spring-seeded small grains.

Although grazing is practiced over much of the area, carrying capacities are relatively low because of the moisture deficit. These conditions generate "basic" capability ratings of class 1 in the thick Black "subzone", class 2 in the thin Black belt, and class 3 in the Dark Brown zone. Much of the land with the best potential for class 1, located in the Porcupine Hills, also has shallow depth to bedrock (subclass R) and adverse topography (subclass T) which override the favorable climate. Therefore, classes 2 and 3 are the most common (Fig. 7).

On the Western Alberta Plains, land areas with appreciable Solonetzic soils, coarse textured materials, or steep slopes (e.g. river banks) have lower capability ratings, usually 1 class lower than the basic rating. Higher carrying capacities (normally 1 class better than the basic rating) are associated with landscapes that have numerous sloughs and poorly drained depressions. The positive affects of poor drainage are negated, however, if the depressions are saline.

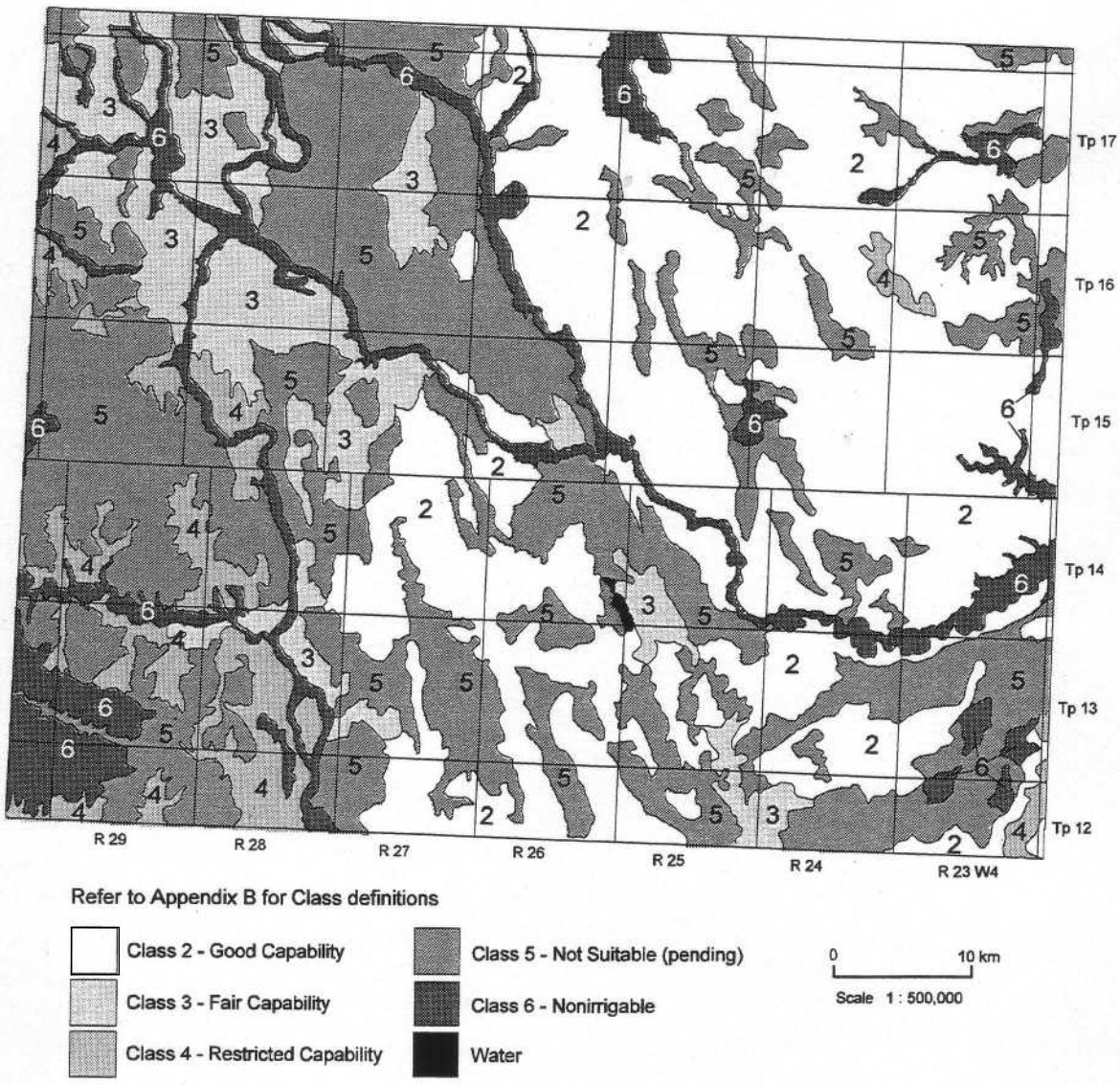


Figure 6. Generalized land capability ratings for irrigation.

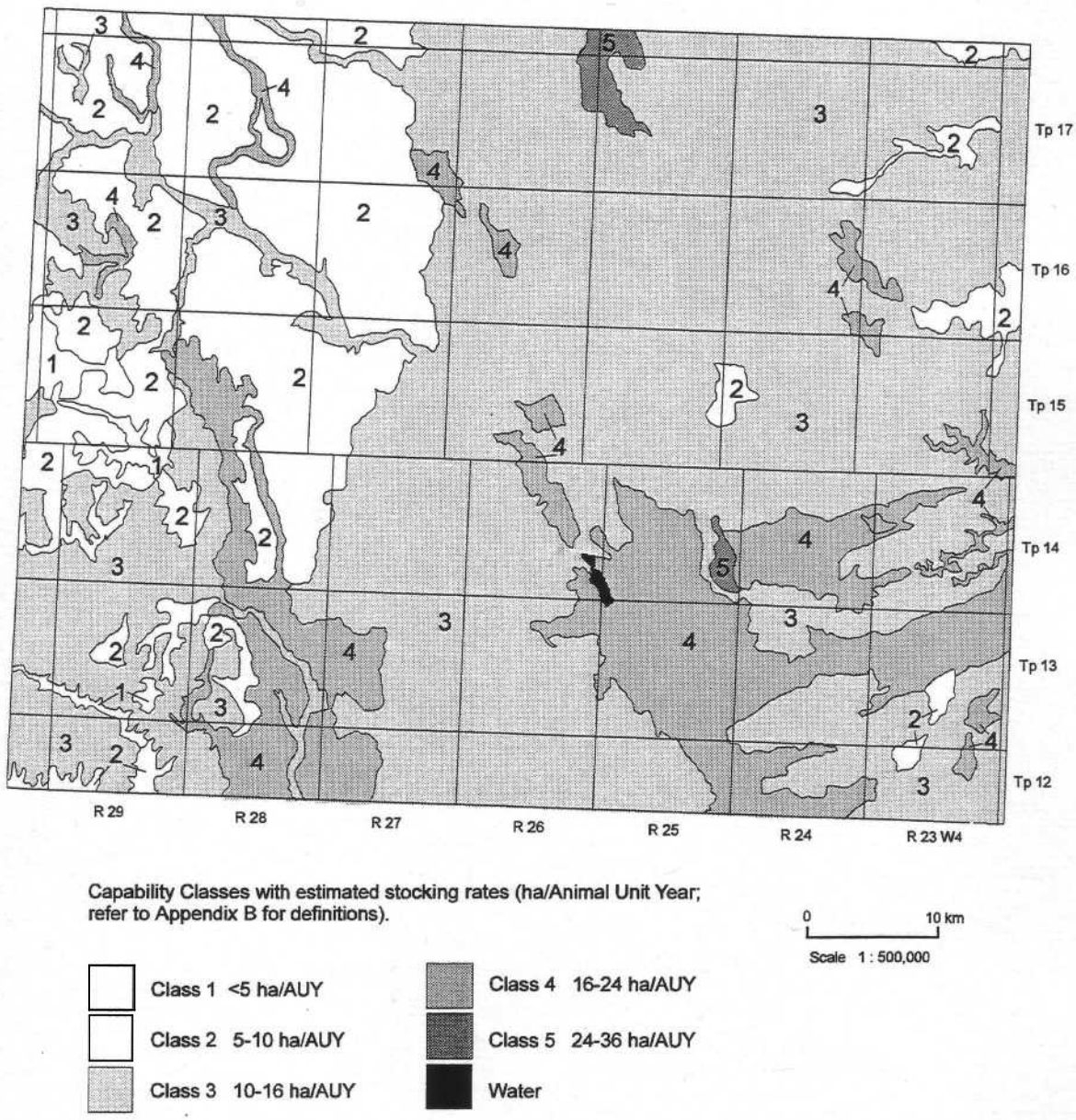


Figure 7. Generalized land capability ratings for range productivity.

Land Degradation and Management

Land degradation continues to be a concern in the area. Extensive cultivation over many decades since settlement has resulted in substantial loss of organic matter. Wind erosion, aggravated by the organic matter loss, is a constant threat, especially in the more sensitive sandy areas. Recent changes in cultural practices, such as conservation tillage and better residue management, have reduced soil loss by wind. Water erosion is mainly limited to areas where rough topography or long slopes are cultivated and left with insufficent protective cover.

Dryland salinity, while not extensive, can be severe in localized areas such as depressions and elongated valleys or drains. Salinity is of greater concern in irrigated areas, especially where shallow, coarse textured sediments overlie finer textured materials or bedrock, and where the soils have solonetzic characteristics.

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APPENDIX A
EXTENDED SOIL MAP LEGEND

A brief description of map legend and mapping symbol conventions is provided below. An extended version of the legend, which includes descriptive comments for the 75 map units, follows (Table A1).

The **Map Unit** column contains the symbols that link map polygons with legend information.

Examples	Terminology
LET3	Soil Unit; Numeric Modifier
2	Slope Class(es)
RDWN4	Soil Unit; Numeric Modifier
4R	Slope Class; Modifier

The Soil Unit consists of a 3 or 4 letter symbol that represents 1 or 2 soil series (variants), respectively. The names of those soil series are listed in the **Map Unit Name** column. The Numeric Modifier (Soil Unit Number) provides additional information about significant soils (see selected definitions below) in a map unit, as outlined below. The numbering system does not apply to miscellaneous map units (coded ***ZXX***), which are numbered independently.

1. Map unit dominated by the named soil(s).
2. Map unit has significant wetlands.
3. Map unit has significant saline soils, often with wetlands.
4. Map unit has significant Rego & Calcareous profiles, or soils with severely eroded upper horizons.
6. Map unit has significant soils that are coarser textured (including gravels) than the named soils.
7. Map unit has signifcant soils with solonetzic features.
8. Map unit has significant Rego, Calcareous and eroded profiles plus significant, often saline, wetlands.
9. Map unit has significant soils that are coarser textured (including gravels) than the named soils plus significant, sometimes saline, wetlands.

Slope Class indicates the steepness of slope expressed as a percentage range. Steepness is assessed on the most common restrictive slope of a unit which may be somewhat higher than the average or most common slope. Slope Class Modifier indicates dissected (i.e. gullied, **D**), bedrock-controlled (**R**), or terraced (**T**) terrain.

Slope Class	Percent Slope
2	0-2
3	2-5
4	5-9
5	9-15
6	15-30
7	30-45

The **Parent Material, Surface Expression and Slope** column briefly describes the soil parent materials (i.e. the surficial deposits) and the landform, including slope, for each map unit. Parent material information includes type, general texture, and a general indication of thickness if shallow or intermittent (i.e. blanket, veneer, discontinuous). The types of parent materials (e.g. glaciofluvial, fluvial, till, etc.) are defined in several reference documents (e.g. E.C.S.S. 1987) and reports (e.g. Walker *et al.* 1991).

Textural classes for the parent materials, defined in terms of sand, silt and clay content (Day 1983, E.C.S.S. 1987), are defined as follows.

Coarse textured group:

Very coarse textured – sand (S) and loamy sand (LS) textural classes.

Moderately coarse textured – sandy loam (SL) textural class except very fine sandy loam (VFSL).

Medium textured group:

Medium textured – very fine sandy loam (VFSL), loam (L), silt (Si), and silt loam (SiL) classes.

Moderately fine textured – sandy clay loam (SCL), clay loam (CL) and silty clay loam (SiCL) classes.

Fine textured group:

Fine textured – sandy clay (SC), clay (C), and silty clay (SiC) textural classes.

Very fine textured – heavy clay (HC) textural class.

Calcareousness and salinity of the parent materials are not indicated on the legend since there is not much variability. Most of the parent materials in the map area are moderately calcareous (5-15% $CaCO_3$ equivalent), some strongly calcareous (15-25% $CaCO_3$ equivalent). Most parent materials associated with Chernozemic soils are non to very weakly saline (electrical conductivity <4 dS/m), or weakly saline (E.C. 4-8 dS/m) at considerable depth. Parent materials associated with Solonetzic soils are weakly to moderately saline (E.C. 4-15 dS/m), often at fairly shallow depths. Local concentrations of salts, often visible at the surface, occur in polygons identified by "3", "8", and "9" map units.

The dominant type(s) of landform surface expression (e.g. hummocky, undulating, level, etc.) is listed for each map unit. These terms are defined in several documents (Day 1983, E.C.S.S. 1987, Walker *et al.* 1991). Surface form modifiers such as "gullied' are also indicated where important. Finally, the range in slope gradient, corresponding to the slope class(es) of the map unit, is listed.

The **Major Soils** column lists the dominant, codominant and significant soils of each map unit – soils that make up at least 20% of the landscape. Highly contrasting soils that range from a minimum of 10 or 15% are listed for some map units. However, minor soil inclusions, which do not affect interpretations at this scale, are mentioned only in the **Remarks** column of the extended legend. The listed soil information includes subgroup code (E.C.S.S. 1987, see below) and soil series symbol.

Code	Subgroup
Chernozemic soils:	
O.BL	Orthic Black
CA.BL	Calcareous Black
GLR.BL	Gleyed Rego Black
R.BL	Rego Black
SZ.BL	Solonetzic Black
O.DB	Orthic Dark Brown
CA.DB	Calcareous Dark Brown
GLR.DB	Gleyed Rego Dark Brown
R.DB	Rego Dark Brown
SZ.DB	Solonetzic Dark Brown
Solonetzic soils:	
DB.SO	Dark Brown Solod
DB.SS	Dark Brown Solodized Solonetz
Gleysolic soils:	
O.HG	Orthic Humic Gleysol
R.HG	Rego Humic Gleysol
Brunisolic soils:	
O.EB	Orthic Eutric Brunisol

A three-letter symbol denotes a soil series (e.g. ADY = Academy series). The Alberta Soil Names: Generation 2. User's Handbook (Alberta Soil Series Working Group 1993) defines all soil series and variants, and provides a link to more detailed profile characteristics.

Selected Definitions

Codominant – Two or more soils (or other features) of roughly equal proportion that together comprise the majority of a mapping unit or tract of land.

Dominant – The soil (or other feature) that comprises the majority of a mapping unit or tract of land, i.e. generally 30% or more.

Inclusion – A soil (or other feature) that comprises a minor portion of the mapping unit or tract of land. Commonly an inclusion is less than 20% of the landscape; less than 10 or 15% where the soil or feature is highly contrasting and significant to management of the land.

Major – The most general of the apportionment terms. It includes the dominant or codominant and significant soils that are necessary to form a concept of a mapping unit.

Series, soil – A category (or level) in the Canadian system of soil classification. This is the basic unit of soil classification, and consists of soils that are essentially alike in all major profile characteristics except the texture of the surface.

Significant – A major soil (or other feature) that is clearly subordinate (subdominant) to the dominant. In most cases a significant feature makes up at least 20% of the landscape. Highly contrasting features (soils) that would impact on management and range from a minimum of 10 or 15% are also listed as significant.

Variant, soil – A soil which is dissimilar from all existing series but occurs on only a small area, or is a potential soil series, may be designated as a variant of the most closely related, existing series. The series name plus a modifier identify the variant.

Table A1. Gleichen SW (82I/SW) extended soil map legend

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
ADRK4/3	Academy-Rockyview	Discontinuous moderately fine to medium textured glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: ADY 30-40% RKV 20-30% R.BL: 20-30%	R.BL also refers to CA.BL and soils with little or no topsoil (Ap). These eroded soils are minor in one or two tracts (NW corner), dominant in another (Pine Coulee area).
ADRK8/3-2	Academy-Rockyview	Discontinuous moderately fine to medium textured glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: ADY 20-40% RKV 20-30% R.BL: 15-25% Saline/wet soils: 15-25%	R.BL also refers to CA.BL and soils with little or no topsoil (Ap). These eroded soils are minor in one tract near Cayley. Small pockets of 4 topography may occur.
ADRK8/3-4	Academy-Rockyview	Discontinuous moderately fine to medium textured glaciolacustrine veneer over moderately fine textured till. Undulating to hummocky. Slopes 2-9%.	O.BL: ADY 20-40% RKV 15-25% R.BL: 20-30% Saline/wet soils: 15-30%	R.BL also refers to CA.BL and soils with little or no topsoil (Ap). These eroded soils dominate one tract west of Pine Cr. In some localities wet soils are more prevalent than saline.
ADY4/4R	Academy	Moderately fine textured till, often overlying bedrock at about 1-5 m depth. Hummocky, ridged or rolling. Slopes 5-9%.	O.BL: ADY 40-60% R.BL: 20-40%	Hilly bedrock-controlled terrain. R.BL also refers to CA.BL and soils with thin Ap horizons. RKV included in most tracts; stratified, coarse textured soils in some. Class 3 topography significant in several tracts.
BZCT1/4D	Beazer-Cardston	Moderately fine textured till and fine textured glaciolacustrine material. Inclined & hummocky, gullied. Slopes 5-9%.	O.BL: BZR 40-60% CTN 20-40%	Valley bottoms in the Porcupine Hills. Moderately fine textured fluvial blanket soils (SOF) commonly included. Other inclusions are R.BL, thick Blacks and wet soils. Topography changes from class 3 near creeks to class 5 near the valley walls.
BZNF1/4-6	Beazer-North Fork	Moderately fine textured till veneer-blanket overlying large bedrock ridges and hummocks. Slopes 5-30%.	O.BL: BZR 40-60% O.EB: NFK 20-40%	Bedrock-controlled ridges and hills in the Porcupine Hills. BZR includes soils with very thin Ah. R.BL and other thin soils are common inclusions, especially where cultivation is extensive.
BZR1/4D	Beazer	Moderately fine to medium textured till. Inclined to hummocky, gullied. Slopes 5-9%.	O.BL: BZR 50-80%	Mainly tributary valleys in the Porcupine Hills. Textures often finer (SiCL-SiC) and profiles thinner than normal. Common inclusions: R.BL (cultivated), thick Blacks (DVG), fluvial overlay (SOF), and gravelly to stony knolls. R.BLs are major soils in two tracts south of Willow Creek Provincial Park.
CWY6/3	Cowley	Discontinuous moderately fine textured fluvial veneer over fine to very fine textured glaciolacustrine. Inclined & undulating, some gullies & channels. Slopes 2-5%.	CA.BL: CWY 40-60% Coarser* soils: 20-30%	Valley bottom & lower slope terrain associated with the Porcupine Hills; extends onto Okotoks Upland. CA.BL also refers to R.BL (CWYzr). *Coarser textured soils have SiCL-SiL-CL fluvial veneer over the clay. Fine textured O.BLs (CTN, PNR) are common inclusions.
DVG6/5	Dunvargan	Moderately fine textured till with gravelly, cobbly or stony knolls in places. Hummocky. Slopes 9-15%.	O.BL: DVG 40-60% Gravelly/stony soils: 20-30%	Hummocky terrain with some gravelly, cobbly or stony hilltops in the Porcupine Hills. Thin Black soils (BZR) are common inclusions. Fine textured soils (FSH) are common in the large tract along Secondary 533.
DVMF1/4D	Dunvargan-Maycroft	Medium to moderately fine textured fluvial blanket to veneer over moderately fine textured till. Inclined & undulating, usually gullied or channeled. Slopes 5-9%.	O.BL: DVG 30-60% MFT, MFTxt 20-40%	Valley bottoms in the Porcupine Hills. Fine textured soils (FSH) are commonly included, sometimes significant. Gravelly soils are often present, especially in 1 small tract.
DVOK1/4-6	Dunvargan-Ockey	Moderately fine textured morainal (till) blanket to veneer over bedrock. Ridged, rolling or hummocky. Slopes 5-30%.	O.BL: DVG 30-50% OKYaa 20-40% BZR 15-25%	Ridges and hills in the Porcupine Hills. Broad, gently sloping hilltops are often cultivated. Thin Black soils commonly included on dry exposed slopes. Gravelly/cobbly soils commonly included, important in a few localities. Fine textured soils (FSH) important in a few places.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
DVOK1/5-7	Dunvargan-Ockey	Moderately fine textured morainal (till) blanket to veneer over bedrock. Ridged or hummocky. Slopes 9-45%.	O.BL: DVG 30-40% OKYaa 30-40% PPE 10-30%	Most prominent ridges in the Porcupine Hills. Lithic soils usually 30-50%. Rego & Calcareous Blacks are commonly included. OKYaa & PPE soils dominate the highest, steepest ridge above Lane & Oxley creeks next to Secondary 533.
KCLE3/2-3	Kirkchamp-Lethbridge	Moderately fine over fine textured glaciolacustrine. Undulating to level, usually channelled. Slopes 0-5%.	SZ.DB: KCH 30-40% O.DB: LET, LETxc 15-30% Saline/wet soils: 15-25%	Small basins with stratified glaciolacustrine sediments and significant saline soils, usually in channels & depressions. R. & CA.DB soils commonly included, sometimes significant in place of the LET soils.
KSCM4/3	Kessler-Carmangay	Moderately coarse textured fluvio-eolian or glaciofluvial blanket to veneer over moderately fine textured glaciolacustrine. Undulating to ridged. Slopes 2-5%.	O.DB: KSR 30-40% CMY 20-30% R.DB: 20-30%	R.DB also refers to CA.DB and soils with little or no A horizon. CMY dominates a few tracts, R.DB a few others. Saline/wet soils commonly included; finer textured soils (LET/OAS) important in a few tracts.
KSCM8/3	Kessler-Carmangay	Moderately coarse textured fluvio-eolian or glaciofluvial blanket to veneer over moderately fine textured glaciolacustrine. Undulating to ridged. Slopes 2-5%.	O.DB: KSR 20-40% CMY 20-30% R.DB: 15-25% Saline/wet soils: 15-25%	R.DB soils, dominant in a few tracts, also refer to CA.DB & soils with little or no A horizon. CMY dominates a few tracts; occasionally either KSR or CMY are less than 20%. Significant class 4 topography in some localities.
KSHR4/3	Kessler-Heartbreak	Moderately coarse and very coarse textured fluvio-eolian. Undulating to ridged. Slopes 2-5%.	O.DB: KSR 30-40% HRKaa 20-30% R.DB: 20-30%	R.DB also refers to CA.DB and soils with little or no A horizon. HRKaa includes soils with SL veneer over LS-S textures.
KSHR4/4-5	Kessler-Heartbreak	Moderately coarse and very coarse textured fluvio-eolian or glaciofluvial. Ridged to hummocky. Slopes 5-15%.	O.DB: KSR 30-50% HRKaa 20-30% R.DB: 20-30%	R.DB also refers to CA.DB & soils with little or no A horizon. HRKaa includes soils with SL/LS-S textures, some with gravelly layers. Class 4 topography is dominant, class 5 significant or minor. A tract near Snake Cr & another NW of Champion are long eskers (class 5 topography) dominated by gravelly HRK, KSR and similar soils.
KSR6/2T	Kessler	Stratified, moderately coarse to very coarse glaciofluvial blanket to veneer over glaciofluvial gravels. Undulating terrace. Slopes 0-5%.	O.DB: KSR 40-60% Coarser soils: 20-40%	Terraced terrain consisting of stratified, coarse textured soils. Coarser soils refers to "dirty gravel" and sandy soils. Finer textured soils (LET, OAS) may be found.
LECL7/2	Lethbridge-Coaldale	Discontinuous, medium to moderately fine textured veneer over fine to very fine textured glaciolacustrine. Level to undulating. Slopes 0-2%.	O.DB: LET, LETxc 30-40% CLD 20-30% Solonetzic soils: 20-30%	Broad, nearly level basin west of Champion. Solonetzic soils include Solonetzic Dark Brown, Dark Brown Solod and others.
LET1/2	Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine. Level to undulating. Slopes 0-2%.	O.DB: LET 50-80%	R. & CA.DBs (DIM, CIO) are commonly included, sometimes significant. Class 3 topography often included, sometimes significant. A tract in Sec. 28-12-25-W4 may have shallow GLLC deposits over SL-FSL residual material (soft bedrock).
LET3/2	Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine. Level to undulating. Slopes 0-2%.	O.DB: LET 40-70% Saline/wet soils: 20-30%	Rego & Calcareous Dark Brown (DIM, CIO) and finer textured (LETxc, CLD) soils commonly included.
LET3/3	Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine. Undulating. Slopes 2-5%.	O.DB: LET 40-60% Saline/wet soils: 20-30%	Coarser textured (CMY, OAS, KSR) and R. & CA.DB (DIM, CIO) soils commonly included. CMY significant in a small tract south of Champion; WNY significant in a few tracts.
LET4/3	Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine. Undulating. Slopes 2-5%.	O.DB: LET 40-60% R.DB: DIM 20-40%	R.DB also refers to CA.DB (CIO) & soils with little or no A horizon. Coarser textured soils (CMY) & wet/saline depressional soils commonly included; coarser soils significant in 3 tracts.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
LET6/2T	Lethbridge	Stratified, moderately fine to moderately coarse textured glaciofluvial or glaciolacustrine. Terraced to undulating. Slopes 0-3%.	O.DB: LET 40-60% Coarser soils: 20-40%	Layered deposits. Coarser soils refers to those in which SL layers are prevalent (OAS, CMY & KSR); sometimes SL layers are gravelly. Terrain subtly terraced or bevelled; mostly wide level treads with short gently sloping risers. R. & CA.DB soils significant in a few tracts.
LET7/2-3	Lethbridge	Moderately fine to medium textured glaciolacustrine or fluvial. Undulating to level (apron). Slopes 0-5%.	O.DB: LET 40-70% Solonetzic soils: 20-40%	Solonetzic soils mainly SZ.DB (KCH), include DB.SO (AWD) & others. R. & CA.DB, coarser textured soils, wet/saline soils commonly included. Two tracts near Clear Lake have mainly class 2 topography. The third tract near Willow Cr. has mostly SZ.DB soils and class 3 topo.
LET8/3	Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine. Undulating. Slopes 2-5%.	O.DB: LET 30-50% R.DB: DIM 20-30% Saline/wet soils: 20-30%	Most knolls are eroded; R.DB also refers to Calcareous Dark Browns & soils with little or no A horizon. Depressions have wet (gleyed) saline soils.
LSKR8/2-3	Lakesend-Kirkcaldy	Moderately fine to medium textured glaciolacustrine veneer over moderately fine to fine textured till. Undulating, with channels. Slopes 0-5%.	DB.SS: LSD, LSDfi 20-40% DB.SO: KRK, KRKfi 15-25% Saline/wet soils: 15-25% Eroded soils: 15-25%	Basin dominated by SZ soils near Ensign. Some fine textured glaciolacustrine or till layers occur. Eroded soils were modified by cultivation: often the A horizon is thin or absent, or the Ae & AB horizons have been destroyed. An area of saline GLDB.SS soils on fine textured glaciolacustrine material could be distinguished on the west side of the tract.
LTRK9/3	Lyalta-Rockyview	Moderately fine to medium textured glaciolacustrine & moderately coarse glaciofluvial blanket to veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: LTA 20-30% RKV 15-25% Coarser soils: 20-30% Wet/saline soils: 20-30%	Complex ice contact stratified materials including, in places, upper layers of the underlying till. Coarser textured soils include gravelly soils, SAKaa, MDP, and HPVxt. A tract along Mosquito Cr has little or no RKV, mostly class 2 topography, and some very gravelly soils.
MACF1/3T	Macleod-Crowfoot	Discontinous, medium to moderately coarse textured veneer over very gravelly, very coarse textured glaciofluvial. Terraced. Slopes 0-5%.	CA.DB: MAC 30-60% R.DB: CFTzr 20-40%	MAC also refers to MACzr (R.DB); CFTzr to CFTca (CA.DB). Three tracts occur, each somewhat different in pattern of major soils. A tract near Willow Cr. Prov. Park has stratified, finer textured versions of MAC rather than substantial CFT soils.
NEM6/3	Nine Mile	Moderately fine to medium textured till plus gravelly to stony & moderately coarse textured ice contact deposits. Undulating. Slopes 2-5%.	CA.DB: NEM 40-60% Coarser soils: 20-40%	CA.DB also refers to R.DB (NEMzr). Coarser textured soils mainly gravelly to stony (WOL), include SL soils (KSR). NEM and a common inclusion, PUY, important in an uncultivated area north of Willow Cr. Prov. Park. Prominent ridges (hills) of class 4 topography in some tracts.
NEM9/3-4	Nine Mile	Moderately fine to medium textured till plus gravelly to stony & moderately coarse textured ice contact deposits. Undulating to hummocky or ridged. Slopes 2-9%.	CA.DB: NEM 30-50% Coarser soils: 20-30% Saline/wet soils: 15-25%	CA.DB also refers to R.DB (NEMzr). Coarser textured soils are mainly gravelly to stony (WOL) but include SL soils (KSR). Prominent ridges & hills often contain coarser textured soils.
OAS6/3	Oasis	Medium over coarse to very coarse textured glaciofluvial (ice contact stratified drift). Undulating, sometimes channelled. Slopes 2-5%.	O.DB: OAS 20-40% Coarser soils: 20-40% R.DB: 20-30%	Stratified materials. Coarser textured soils can have gravelly, very gravelly, SL, &/or LS-S layers. R.DB includes Calcareous Dark Brown & soils with little or no A horizon.
OAS9/2-3	Oasis	Medium over coarse to very coarse textured glaciofluvial (ice contact stratified drift). Undulating terrace, some channels. Slopes 0-5%.	O.DB: OAS 20-40% Coarser soils: 20-30% Wet/saline soils: 20-30%	Stratified materials. OAS includes slightly gravelly soils; coarser textured soils are mainly gravelly to very gravelly, in places SL (KSR). R. & CA.DB soils and Blacks (edge of Black zone) commonly included.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
ODPS6/4	Oldman-Parsons	Medium, moderately coarse & very coarse textured glaciofluvial &/or glaciolacustrine and moderately fine textured till. Hummocky to inclined, some gullies. Slopes 5-9%.	R.BL: ODM 30-50% PSO 20-30% Coarser soils: 20-30%	Complex ice contact stratified deposits. Coarser textured soils include gravelly, very gravelly & SL-LS textured soils. O.BL, mainly BZR, common where uncultivated. Close to DB zone; Dark Browns may be common.
PGT3/2-3	Pageant	Medium to moderately fine textured glaciolacustrine veneer over moderately fine textured till. Undulating, often with channels. Slopes 1-3%.	SZ.DB: PGT 30-40% Saline/wet soils: 20-30% DB.SO: KRK, KRKfi 10-30%	Shallow salt-affected basins. Finer textured (SiC-C) soils, Orthic Dark Browns (WNY/LET), and others are commonly included.
PSOK4/4-5	Parsons-Ockey	Moderately fine textured morainal (till) blanket to veneer over bedrock. Rolling to ridged or hummocky. Slopes 5-15%.	R.BL: PSO 30-50% OKYzr 20-30% O.BL: BZR 10-30%	Severely eroded hills with shallow soils. Orthic Black soils (BZR, OKY) significant where no cultivation. Broad hilltops may have significant class 3 topography.
PUNE6/4	Pulteney-Nine Mile	Moderately fine textured till and coarse to medium textured (gravelly - stony) glaciofluvial (ice contact) deposits. Hummocky or ridged. Slopes 5-9%.	O.DB: PUY 30-40% Coarser soils: 20-40% R.DB: NEMzr 15-25%	Variable ice contact deposits with till. Coarser textured soils include gravelly (mostly), stony, and less often, SL soils. NEMzr also refers to CA.DB (NEM) soils.
PUY4/4RD	Pulteney	Moderately fine textured morainal (till) blanket over bedrock. Ridged, inclined or hummocky, usually gullied. Slopes 5-9%.	O.DB: PUY 40-60% R.DB: 20-40%	Hilly terrain with eroded hilltops and long gullied side slopes. R.DB also refers to CA.DB and soils with little or no A horizon. WNY soils commonly included.
PUY4/5R	Pulteney	Moderately fine textured morainal (till) veneer to blanket over moderately coarse to medium textured residual & bedrock. Ridged to hummocky, some gullies. Slopes 9-30%.	O.DB: PUY 30-40% Paralithic: PUYxp 20-30% R.DB: 20-30%	Prominent "Thigh Hills". Sandstone bedrock close to surface across top of hills. Topography ranges from class 4 on broad top to class 6 on E side. Most R.DBs, which also refer to CA.DB and soils with little or no A horizon, are also paralithic.
RDPG8/4-5	Readymade-Pageant	Discontinuous medium to moderately fine textured fluvial or glaciolacustrine veneer over moderately fine textured till. Hummocky. Slopes 5-15%.	O.DB: RDM 20-40% SZ.DB: PGT 20-30% R.DB: 20-30% Wet/saline soils: 15-25%	Hummocky moraine includes ice contact deposits in a few areas. Class 4 topography dominant; class 5 significant to dominant in several localities. R.DBs, mainly on hilltops, also refer to CA.DBs and soils with little or no Ah horizon.
RDWN4/3	Readymade-Whitney	Discontinuous medium to moderately fine textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.DB: RDM 30-40% WNY 20-30% R.DB: 20-30%	Significant class 4 topography in some areas. SZ.DB (PGT) may be important in some localities. Wet/saline soils often included.
RDWN4/4R	Readymade-Whitney	Discontinuous medium to moderately fine textured fluvial or glaciolacustrine veneer over moderately fine textured till. Hummocky to rolling. Slopes 5-9%.	O.DB: RDM 30-40% WNY 20-30% R.DB: 20-30%	Usually underlain by bedrock (at about 1-5 m) but in some cases mainly deep till plus ice contact deposits. Coarser textured soils, mainly SL and gravelly soils, occasionally important.
RDWN8/3	Readymade-Whitney	Discontinuous medium to moderately fine textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating, some hummocky. Slopes 2-5%.	O.DB: RDM 20-40% WNY 20-30% R.DB: 20-30% Wet/saline soils: 15-25%	SZ.DB (PGT) may substitute for WNY in some areas. Class 4 topography is significant in some localities. R.DBs, mainly on hilltops, includes CA.DBs and soils with little or no Ah horizon.
RFAD4/3-4	Rockford-Academy	Stony to gravelly glaciofluvial (ice contact) and moderately fine textured till. Undulating, inclined & terraced, some channels. Slopes 2-9%.	O.BL: RFDaa 20-40% ADY, ADYgr 20-30% R.BL: 20-30%	Complex ice contact deposits plus till. R.BLs, including CA.BLs and soils with little or no A horizon, may also be gravelly to stony. RKV/RKVgr may replace ADY/ADYgr soils in some tracts. A small tract along Secondary 540 has mostly BOV & LTAgr soils and gentle (class 2-3) topography.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
RKAD7/3	Rockyview-Academy	Discontinuous, medium to moderately fine textured glaciolacustrine veneer over moderately fine textured till. Undulating to inclined, some channels. Slopes 2-5%.	O.BL: RKV 30-40% ADY 20-30% Solonetzic soils: 20-40%	Small basins with significant (in 1 case dominant) Solonetzic soils, mainly Black Solodized Solonetz, Black Solonetz and Solonetzic Black. Fine textured versions of the major soils occur in some localities.
RKHP1/3	Rockyview-Happy Valley	Medium to moderately fine textured glaciolacustrine and moderately coarse textured glaciofluvial veneers over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: RKV 40-60% R.BL: HPVxt 20-30%	Variable ice contact deposits over till. Inclusions of wet/saline soils, other Rego Blacks (RKVzr), and deeper GLFL/GLLC soils (MDP, LTA) are common.
RKLT4/3	Rockyview-Lyalta	Medium to moderately fine textured glaciolacustrine veneer to blanket over moderately fine textured till, some coarser textured layers. Undulating. Slopes 2-5%.	O.BL: RKV 20-40% LTA 20-30% R.BL: 20-30%	Major soils often a bit coarser textured than modal RKV & LTA; soils with coarser textured (SL or sometimes gravelly) subsoil layers common in several tracts. A large tract north of MacMillan & Mosquito creeks is a fluvial apron with gravelly & SL layers.
RKV1/2-3	Rockyview	Medium to moderately fine textured glaciolacustrine veneer over moderately fine textured till. Undulating to level. Slopes 0-5%.	O.BL: RKV 50-70%	RKV soils often a bit coarser textured than modal. R.BLs, till soils (ADY), wet/saline soils, and Dark Browns are common inclusions. A tract near Parkland has mostly class 3 topography and significant ADY soils.
RKV4/3	Rockyview	Medium to moderately fine textured glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: RKV 40-60% R.BL: 20-40%	RKV soils often a bit coarser textured than modal. R.BL also refers to CA.BL and soils with little or no A horizon. Till soils (ADY), wet/saline soils and deeper GLLC soils (LTA) are common inclusions. A tract near Willow Cr. has mostly R.BL soils.
RKV8/3	Rockyview	Medium to moderately fine textured glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.BL: RKV 30-40% R.BL: 20-30% Saline/wet soils: 20-30%	RKV soils often a bit coarser textured than modal. R.BL also refers to CA.BL and soils with little or no A horizon. Till soils (ADY) are common inclusions. In some areas depressions are mostly wet (Gleysolic) with little or no salinity.
RKV9/3	Rockyview	Medium to moderately fine textured glaciolacustrine veneer over "till", with moderately coarse to gravelly layers. Undulating apron or terraces. Slopes 2-5%.	O.BL: RKV 20-40% Coarser soils: 20-40% Saline/wet soils: 15-25%	Complex stratified materials, either ice contact or till-like mudflow. RKV soils often bit coarser textured than modal. Coarser textured soils have SL &/or gravelly layers. Deeper LTA soils and R. & CA.BLs often included. A tract along Nanton Cr. has significant class 2 topography.
SARK6/2-3	Sakalo-Rockyview	Stratified, medium, moderately coarse & very coarse (including gravel) ice contact deposits & "till". Undulating terraces or apron. Slopes 0-5%.	O.BL: SAKaa 20-30% RKV 15-25% LTA 10-25% Coarser soils: 20-30%	Complex, stratified, ice contact materials. RKV and LTA soils are slightly coarser textured than modal and often gravelly. Coarser textured soils include SL (MDP), gravelly and very gravelly soils. Rego & Calcareous Blacks are commonly included, sometimes significant.
SOF1/3-4	Standoff	Medium to moderately fine textured fluvio- or glaciolacustrine. Undulating apron, channelled. Slopes 2-9%.	O.BL: SOF 30-50% SOFtk 20-30% R. & CA.BL: 10-30%	"Valley fill" deposits in the Porcupine Hills. High lime parent materials. SOFtk soils have very thick (30+ cm) A horizons. R. & CA.BL soils are common where cultivated.
WNLE1/3	Whitney-Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine veneer to blanket over moderately fine textured till. Undulating. Slopes 2-5%.	O.DB: WNY 40-60% LET 20-40%	Rego & Calcareous Dark Brown soils are common inclusions.
WNLE1/3R	Whitney-Lethbridge	Moderately fine to medium textured glaciolacustrine veneer-blanket over shallow till over coarse to medium textured residuum. Very gently rolling hills. Slopes 2-5%.	O.DB: WNY 20-40% LET 20-30% Paralithic soils: 20-30%	Each tract is a large, subtle convexity with very long, very gentle, smooth slopes. Shallow till may be a veneer or blanket. Paralithic soils have SL-SCL-L lower subsoil (residual material). R. & CA.DB soils are common inclusions.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
WNLE1/4D	Whitney-Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine veneer to blanket over moderately fine textured till. Inclined, gullied. Slopes 4-10%.	O.DB: WNY 40-60% LET 20-30%	Long, inclined, bedrock-controlled slopes. Topography ranges from long uniform class 3 to low class 5. R. & CA.DB and till (RDM, PUY) soils are common inclusions. Coarse textured soft bedrock materials common at <1 m in the smaller tract.
WNLE4/2	Whitney-Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine veneer-blanket over moderately fine textured till. Level to undulating. Slopes 0-2%.	O.DB: WNY 30-50% LET 20-40% R. & CA.DB: 20-30%	R. & CA.DBs, including DIM & CIO, also refer to soils with little or no A horizon. Wet &/or saline soils are common inclusions. Coarser textured (mainly L), stratified soils are common in some localities.
WNLE4/3	Whitney-Lethbridge	Moderately fine to medium textured fluvial or glaciolacustrine veneer to blanket over moderately fine textured till. Undulating. Slopes 2-5%.	O.DB: WNY 30-40% LET 20-30% R. & CA.DB: 20-30%	R. & CA.DBs, including DIM & CIO, also refer to soils with little or no A horizon. Wet &/or saline soils are common inclusions. Coarser textured (mainly L), stratified soils are common in some localities.
WNNE9/4-5	Whitney-Nine Mile	Discontinuous, medium textured fluvial or glaciolacustrine veneer over moderately fine textured to stratified "till". Ridged & hummocky. Slopes 5-15%.	O.DB: WNY 20-30% Coarser soils: 20-30% CA.DB: NEM 20-30% Wet/saline soils: 15-25%	Complex terrain and soils with eskers & kames. Sometimes WNY is minimal (<20%), replaced by coarser textured soils or till soils (NEM, PUY). Coarser soils are mainly gravelly, sometimes SL or very gravelly. O.DB till soils (PUY) are common inclusions. CA.DB also refers to R.DB (NEMzr) and soils with little or no A horizon.
WNPU4/3R	Whitney-Pulteney	Discontinuous, moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till blanket over bedrock. Rolling. Slopes 2-5%.	O.DB: WNY 20-50% PUY 20-40% R. & CA.DB: 20-30%	Gently sloping hills are usually bedrock-controlled (at 1-5m) and often include some class 4 topography. R. & CA.DB soils occur mainly on till (NEMzr, NEM). Paralithic soils are common inclusions. A few tracts have deep till without bedrock control.
WNRD1/3	Whitney-Readymade	Discontinuous, moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.DB: WNY 40-60% RDM 20-30%	Rego & Calcareous Dark Browns and saline/wet soils are common inclusions.
WNY4/2	Whitney	Moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till. Level to undulating. Slopes 0-2%.	O.DB: WNY 40-60% R. & CA.DB: 20-30%	R. & CA.DBs include profiles with little or no A horizon, and may be developed on till. Saline &/or wet soils are common inclusions.
WNY4/3	Whitney	Moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating. Slopes 2-5%.	O.DB: WNY 40-60% R. & CA.DB: 20-30%	R. & CA.DBs include profiles with little or no A horizon, and may be developed on till. Saline &/or wet soils and deeper water-laid deposits (LET) are common inclusions.
WNY6/3-4	Whitney	Stratified medium, moderately fine & coarse textured glacial deposits including glaciolacustrine & till. Undulating, ridged & hummocky, often channelled. Slopes 2-9%.	O.DB: WNY 20-40% PUY 10-30% Coarser soils: 20-30% CA. & R.DB: 15-25%	Complex terrain and soils, usually with eskers & kames. Sometimes till (PUY) or coarser textured soils are more common than WNY. Coarser textured soils are mainly gravelly, less often SL. CA. & R.DB soils, common where cultivated, include soils with little or no A horizon.
WNY7/2-3	Whitney	Moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating to level. Slopes 0-5%.	O.DB: WNY 30-50% SZ.DB: PGT 20-30% R. & CA.DB: 10-25%	Saline/wet soils are common inclusions. DB.SO (KRK) sometimes occurs with the PGT soils.
WNY8/3	Whitney	Moderately fine to medium textured fluvial or glaciolacustrine veneer over moderately fine textured till. Undulating, sometimes channeled. Slopes 2-5%.	O.DB: WNY 30-40% R. & CA.DB: 20-30% Saline/wet soils: 20-30%	Landscape with wet (gleyed soils) depressions and eroded knolls. Most depressional soils are also saline. R. & CA.DB soils of knolls sometimes occur in till, and may be less than 20% in a few areas. Solonetzic variants (PGT, KRK) are included in some tracts.

Map Unit	Map Unit Name	Parent Material, Surface Expression, and Slope	Major Soils	Remarks
WNY9/3-4	Whitney	Stratified medium, moderately fine & coarse textured glacial deposits including glaciolacustrine & till. Undulating, ridged & hummocky, often channelled. Slopes 2-9%.	O.DB: WNY 20-40% PUY 10-25% Coarser soils: 20-30% Saline/wet soils: 15-25%	Complex terrain and soils, usually with eskers & kames. Coarser textured soils are mainly gravelly to SL. R. & CA.DB soils are commonly included, sometimes significant.
WOMA1/3T	Wollim-Macleod	Gravelly, medium to moderately coarse textured glaciofluvial veneer to blanket over medium to moderately fine textured till. Terraced, few channels & hills. Slopes 0-5%	R.DB: WOL 30-60% CA.DB: MACfi 20-30% NEM 10-25%	Irregular terraces that include prominent ridges or hills in a few localities. CA.DB version of WOL is common. MACfi is a loamy-skeletal variant of MAC. O.DBs and wet/saline soils are common inclusions; NEM is significant (20% or more) in one tract.
WOMA3/3	Wollim-Macleod	Gravelly, medium to moderately coarse textured glaciofluvial veneer to blanket over medium to moderately fine textured till. Undulating to terraced. Slopes 2-5%.	R.DB: WOL 30-40% CA.DB: MACfi 20-30% Saline/wet soils: 20-30%	Saline seeps are a feature. CA.DB version of WOL is common. MACfi is a loamy-skeletal variant of MAC. Till (NEM), Solonetzic, and fluviolacustrine veneer to blanket (CFTzr, CIO) soils are common inclusions.
ZAV1	Alluvium	Medium to moderately coarse textured, stratified, fluvial deposits. Floodplain & terraces (slopes 0-5%) with short risers & banks (slopes >9%).	R.DB/BL: 30-60% O.DB/BL: 20-50%	Broad stream channels dominated by fluvial floodplain and terraces. Dark Brown soils occur in the Dark Brown zone, Black in the Black zone. Rego profiles (plus CA.DB or BL intergrades) dominate many tracts, Orthic profiles a few. Wet/saline soils are common inclusions.
ZAV3	Alluvium	Medium to moderately coarse textured, often stratified, fluvial deposits. Floodplain & terraces (slopes 0-5%) with short risers & banks (slopes >9%).	Saline/wet soils: 30-50% R.BL: 30-40% O.BL: 10-30%	Prominent stream channels with saline bottomlands and moderately long banks. Saline soils are mostly Rego Chernozemic with varying degrees of gleying. CA.BL intergrades also common. Pine Coulee tract extends into the Dark Brown zone. Solonetzic soils may occur.
ZGL3	Gleysolic	Variable fluvial & lacustrine deposits, usually moderately fine to fine or very fine textured. Undulating to level. Slopes 0-5%.	R. & O.HG, saline: 40-70% Gleyed Chernozemics, saline: 15-30%	Imperfectly to very poorly drained depressional terrain (mainly slough/lake bottoms and seeps) dominated by wet saline soils. Water bodies and O.DB soils often included. Solonetzic var., coarser textured soils, and R.G profiles are infrequent inclusions, but important in a few tracts.
ZRB1	Rough broken	Variably textured undifferentiated deposits, mainly glacial. Inclined. Slopes >15%.	R. & CA.DB: 30-60% O.DB: 20-50%	Long, steep, stream-cut, erosional banks of variable aspect. Regosolic and other soils with very little or no Ah horizon are common inclusions.
ZRB4	Rough broken	Variably textured undifferentiated deposits, mainly glacial & fluvial. Narrow floodplain & terraces (slopes 0-5%) between steep banks (slopes >15%).	R. & CA.DB/BL: 30-60% O.DB/BL: 20-50%	Prominent ravines or gullies: opposing stream-cut erosional banks plus narrow floodplain-terrace bottomland between them. Dark Brown soils occur in the Dark Brown zone, Black soils in the Black zone. Saline/wet and Regosolic soils are common inclusions; shallow soils and bedrock outcrops are important in some tracts.
ZSA	Saline patches	Medium to moderately fine to fine textured fluvial or glaciolacustrine. Level to undulating. Slopes 0-5%.	GLR.DB/BL, saline: 30-50% O.DB/BL: LET, LTA 20-30% Gleysolics, saline: 20-30%	Apron-like terrain, below hills, that is affected by seepage. Dark Brown soils occur in the Dark Brown zone, Black in the Black zone (only one small tract). R./CA.DB or BL and Solonetzic soils are common inclusions.

APPENDIX B
LAND CAPABILITY RATINGS FOR AGRICULTURAL PRODUCTION

Ratings for spring-seeded small grain production, irrigation, and range productivity are listed (Table B2). Information on the 3 rating systems, including class and subclass definitions, are also provided.

Land Suitability for Spring-Seeded Small Grains

The land suitability rating system for spring-seeded small grains (A.I.W.G. 1995) is comprised of two categories: "Classes" describe the degree of limitation, "subclasses" the kind of limitation.

Suitablity Class	Definition
1	No significant limitations (excellent)
2	Slight limitations (good)
3	Moderate limitations (fair)
4	Severe limitations (marginal)
5	Very severe limitations (poor)
6	Extremely severe limitations (very poor)
7	Unsuitable

Subclass	Definition
D	Undesirable soil structure / low permeability
E	Thin Ap or Ah due to erosion
F	Low organic matter content (low fertility)
H	Inadequate heat units for crop (climate)
K	Landscape with strongly contrasting soil areas impacts management
M	Low water holding capacity (due to soil characteristics)
N	Excessive soluble salt content
P	Excessive stoniness or gravel content
R	Shallowness to bedrock
T	Adversely steep slopes
V	Adverse pH
W	Excessive wetness

Complex ratings were put on patterned landscapes in which sub-areas are strongly contrasting but can be managed separately. For example, an area classed as $3M^{80}$ $5NW^{20}$ has 80% dry upland soils and 20% saline wetland soils, likely in depressions.

Land Capability Ratings for Irrigation

Generalized irrigability ratings were calculated for each map unit, based on soil and topographic parameters (Land Evaluation and Reclamation Branch 1992) with an added climatic component. The climatic factor broaches the concept of potential economic returns into the ratings procedure (Walker *et al.* 1991). The rating system is comprised of two categories: "Land classes" indicate the capability of the land for irrigation (degree of limitation) and "subclasses" describe the kind of limitation.

Land Class	Definition
1	Excellent capability with no significant limitations
2	Good capability with moderate limitations
3	Fair capability with moderately severe limitations
4	Restricted capability (severe limitations); need special designs / management
5	Not suitable (pending); potential in smaller areas or with improvements
6	Nonirrigable

Subclass definitions are as above with the following exceptions: inadequate heat units (climate, **C**) and variable geological (surficial) deposit (**G**).

Complex ratings for patterned landscapes are not supported. Ratings for different soils or segments of a landscape were factored into the overall rating according to their proportion. If a significant portion of the terrain is nonirrigable, then the overall rating is class 6 (nonirrigable).

Land Capability Ratings for Range Productivity

Generalized ratings were estimated for each map unit, based on climatic, soil, vegetative and topographic parameters. The rating system is basically a qualitative assessment of capability to produce forage for livestock grazing. Assumptions for determining the seven classes include: 12 kg/day forage requirement per animal unit, 45% carry-over to maintain good range condition, and average yield estimated for good range condition (about half the potential yield for excellent range condition).

Classes are based mainly on climate; inadequate moisture (**C**) is a subclass factor for some map units. Other soil and landscape factors can adjust classes

up or down. Symbols for the subclass factors are as listed for small grains above. Factors used for the Gleichen map units include: Solonetzic soils (**D**), Rego and Calcareous subgroups or Regosolics (**E**), coarse textured or gravel (**M**), salinity (**N**), shallow depth to bedrock (**R**), and topography (**T**).

Complex ratings for patterned landscapes are not appropriate. Ratings for different soils or landscape segments were factored into the overall rating according to their proportion. For example, the occurrence of nonsaline wetland depressions improved the ratings for many map units.

Table B1. Range capability classes.

Capability Class	Stocking Rate (ha / AUY)[1]	Average Yield (kg / ha)[2]
1	<5	>1550
2	5 - 10	1550 - 775
3	10 - 16	775 - 500
4	16 - 24	500 - 325
5	24 - 36	325 - 220
6	36 - 60	220 - 130
7	>60	<130

[1] Hectares per Animal Unit Year; divide by 5 for acres per animal unit month

[2] Kilograms per hectare; multiply by 0.9 for pounds per acre

Table B2. Selected agricultural interpretations for the Gleichen SW map units

Map Unit	Suitability Rating for Spring-seeded Small Grains	Irrigation Capability	Range Productivity
ADRK4/3	2M	3C	2C
ADRK8/3-2	$2MK^{80}$; $5NW^{20}$	5NW	2C
ADRK8/3-4	$3TK^{80}$; $5NW^{20}$	5NW	2C
ADY4/4R	3T	3C	2C
BZCT1/4D	3H	4C	2C
BZNF1/4-6	5TK	5RT	3RT
BZR1/4D	3H	4C	2C
CWY6/3	3H	4C	2C
DVG6/5	4HT	5C	1
DVMF1/4D	4H	5C	1
DVOK1/4-6	5TK	5TC	2RT
DVOK1/5-7	6TK	6T	3RT
KCLE3/2-3	$2M^{80}$; $5NW^{20}$	2DG	3C
KSCM4/3	4MF	2M	4M
KSCM8/3	$4MF^{80}$; $5NW^{20}$	5NW	4M
KSHR4/3	4M	2M	4M
KSHR4/4-5	4M	3T	4M
KSR6/2T	4M	2MT	5M
LECL7/2	3MD	2D	3C
LET1/2	3M	2C	3C
LET3/2	$2MK^{70*}$; $5NW^{30}$	5N	3C
LET3/3	$2MTK^{70*}$; $5NW^{30}$	5N	3C
LET4/3	2M	2T	3C
LET6/2T	3M	2T	3C
LET7/2-3	2MD	2T	3C
LET8/3	$2MTK^{80}$; $5NW^{20}$	5NW	3C
LSKR8/2-3	6DNM	6N	5DNE
LTRK9/3	$2MTK^{80}$; $4WN^{20}$	5W	2C
MACF1/3	5M	6M	4C
NEM6/3	3M	3C	4E

* Rated class 3 rather than 2 (e.g. 3M vs 2M) in the southeast corner of the map sheet where the moisture deficit is considered to be most severe.

Map Unit	Suitability Rating for Spring-seeded Small Grains	Irrigation Capability	Range Productivity
NEM9/3	3M[80]; 5NW[20]	5NW	4E
OAS6/3	4M	2M	4M
OAS9/2-3	4M[70]; 4WN[30]	5W	4M
ODPS6/4	3MVT	4C	3E
PGT3/2-3	3MD[80]; 5NW[20]	5NW	3C
PSOK4/4-5	3MRT	4RT	4ER
PUNE6/4	3M	2MT	3C
PUY4/4RD	2MT	2RT	3C
PUY4/5R	3MDT	4RT	4R
RDPG8/4-5	4TK	5W	2C
RDWN4/3	2M	2CT	3C
RDWN4/4R	2MT	2GT	3C
RDWN8/3	2MTK[80]; 4W[20]	5NW	2C
RFAD4/3-4	3MTP	3C	2C
RKAD7/3	3MD	3C	2C
RKHP1/3	2M	3C	2C
RKLT4/3	2M	3C	2C
RKV1/2-3	2M	3C	2C
RKV4/3	2M	3C	2C
RKV8/3	2MTK[70]; 5NW[30]	5NW	2C
RKV9/3	2MTK[80]; 4NW[20]	5NW	2C
SARK6/2-3	3M	3C	3M
SOF1/3-4	3H	4C	2C
WNLE1/3	2M*	2CT	3C
WNLE1/3R	2MD	2RT	3C
WNLE1/4D	3MTK	4T	3C
WNLE4/2	3M	2C	3C
WNLE4/3	3M	2CT	3C
WNNE9/4-5	4TK	5WN	3C
WNPU4/3R	2MF	2RT	3C
WNRD1/3	2M	2CT	3C
WNY4/2	2M	2C	3C
WNY4/3	2M	2CT	3C
WNY6/3-4	3MTP	2MT	3C
WNY7/2-3	3MD	2DT	3C
WNY8/3	2MTK[70]; 5NW[30]	5NW	3C
WNY9/3-4	3MTK[80]; 5NW[20]	5NW	3C
WOMA1/3T	4M	4M	4E
WOMA3/3	4M[70]; 5NW[30]	6NM	4E
ZAV1	3MF[80]; 5T[20]	6T	3E/4E†
ZAV3	4N[80]; 5T[20]	6NT	4NE
ZGL3	4WN	6WN	2C
ZRB1	6TK	6T	4ET
ZRB4	6TK[60]; 3M[40]	6T	4ET/3ET†
ZSA	4NW	6N	4N/3N†

* Rated class 3 rather than 2 (e.g. 3M vs 2M) in the southeast corner of the map sheet where the moisture deficit is considered to be most severe.
† Two classes indicated (e.g. 3E / 4E) where the miscellaneous unit occurs in both Black and Dark Brown soil zones; the better rating (lower number) occurs in the Black zone.