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Soil survey of the County of Two Hills No. 21 Alberta

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ALBERTA RESEARCH COUNCIL
Natural Resources Division
Terrain Sciences Department

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Alberta Soil Survey Report No.35

TERRAIN SCIENCES DEPARTMENT, ALBERTA RESEARCH COUNCIL
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Preface

The soil survey of the County of Two Hills No. 21 began in the spring of 1971. This survey was the first in Alberta to be carried out on a county basis. The format of the report, and the type of map presentation utilized, is also a first in the province.

This soil survey was carried out to update a portion of the reconnaissance survey, Wainwright and Vermilion Sheets (Wyatt *et al.*, 1944), which is inadequate for present day needs because of the mapping scale employed. The new survey benefits from more intensive investigation of soils in the field, use of recent, good quality aerial photographs and improved map presentation (photo base).

The soil map consists of 53 individual sheets that are prepared from aerial photographs. The Index to Map Sheets provides a number system to orient the individual map sheets or pages.

The first section of the report outlines cultural and historic features of the county. This is followed by discussions on physical features of the area and their relationship to soils.

The report outlines in detail the system that was employed in soil mapping. The soils were mapped on the basis of soil associations. Each soil association is characterized on the basis of its parent material, taxonomic classification, the topography on which it commonly occurs, surface and internal drainage and the dominant textures. The association names correspond to the series names previously established in older soil survey reports for similar soils. Each soil association is subdivided into soil mapping units which are based on soil subgroups. Each mapping unit is defined on the basis of the proportions of soil present and the extent of erosion, if any.

The final portion of the report outlines soil survey interpretations for agriculture and engineering. The agricultural interpretations are based on the Canadian Soil Capability for Agriculture classification while the engineering interpretations are based on accepted engineering publications and practices.

The report has two appendices. The first includes detailed descriptions of some soils mapped and a summary of their chemical and physical properties. The second provides definitions of terms.

The area

Location and extent

The County of Two Hills No. 21 is located in the east central portion of Alberta (figure 1). This irregularly shaped area lies between 53 and 54 degrees north latitude and between 111 and 112 degrees west longitude. The county consists of parts or all of townships 53 to 58, ranges 6 to 15, west of the fourth meridian. The area is included as part of National Topographic Map Sheets 73-E (NW) and 83-H (NE).

The County of Two Hills No. 21 encompasses about 272 034 hectares (671 690 acres). Agriculture is the primary industry in the county. The main population centers are the town of Two Hills and the villages of Willingdon, Hairy Hill, Myrnam and Derwent.

History and development

In its early history, Canada needed strong, hardworking people to open the vast unbroken, uninhabited lands of the West. In 1896, Clifford Sifton, a young Manitoba lawyer, suggested that the mass immigration of sturdy central Europeans was needed to assist with the opening of the West. Sir Wilfred Laurier, then Prime Minister, accepted Sifton's idea and between 1896 and 1914, many thousands of immigrants came to Canada, some of them settling in the east central part of Alberta, the present County of Two Hills No. 21 (Alberta Association of Municipal Districts and Counties, 1982, pers. comm.).

Many settlers came from the Ukraine, Romania and other parts of Europe. Such names as Myrnam (peace to us), Sober (assembly), Slawa (glory), Krasnahora (beautiful hill), Beauvallon and Brosseau were given to schools, post offices and districts.

The evolution of local government to the present County of Two Hills No. 21 progressed through several stages beginning with the formation of Local Improvement District 27-M-4 in 1904. The present county was established in 1963.

In the early history of the county and the surrounding area, travel was by wagon on trails that were dusty in dry weather and nearly impassable when wet. One major route travelled from Edmonton was the South Victoria Trail, also known as the Winnipeg Trail, located on the south side of the North Saskatchewan River (MacGregor, 1969). This route headed east through Star, passed the north shore of Whitford Lake, turned southeast and passed through Hairy Hill enroute to Two Hills and Morecambe.

The Canadian Northern Railway was completed in 1905 and was located just to the south of the present county boundary. For many years, this railway served the needs of the county inhabitants. In 1928, the Canadian Pacific Railway completed construction of the Lloydminster to Edmonton line that traverses the county. The hamlets of Whitford, Kaleland, Musidora, and villages of Willingdon, Hairy Hill, Two Hills, Myrnam and Derwent sprang up along the railway.

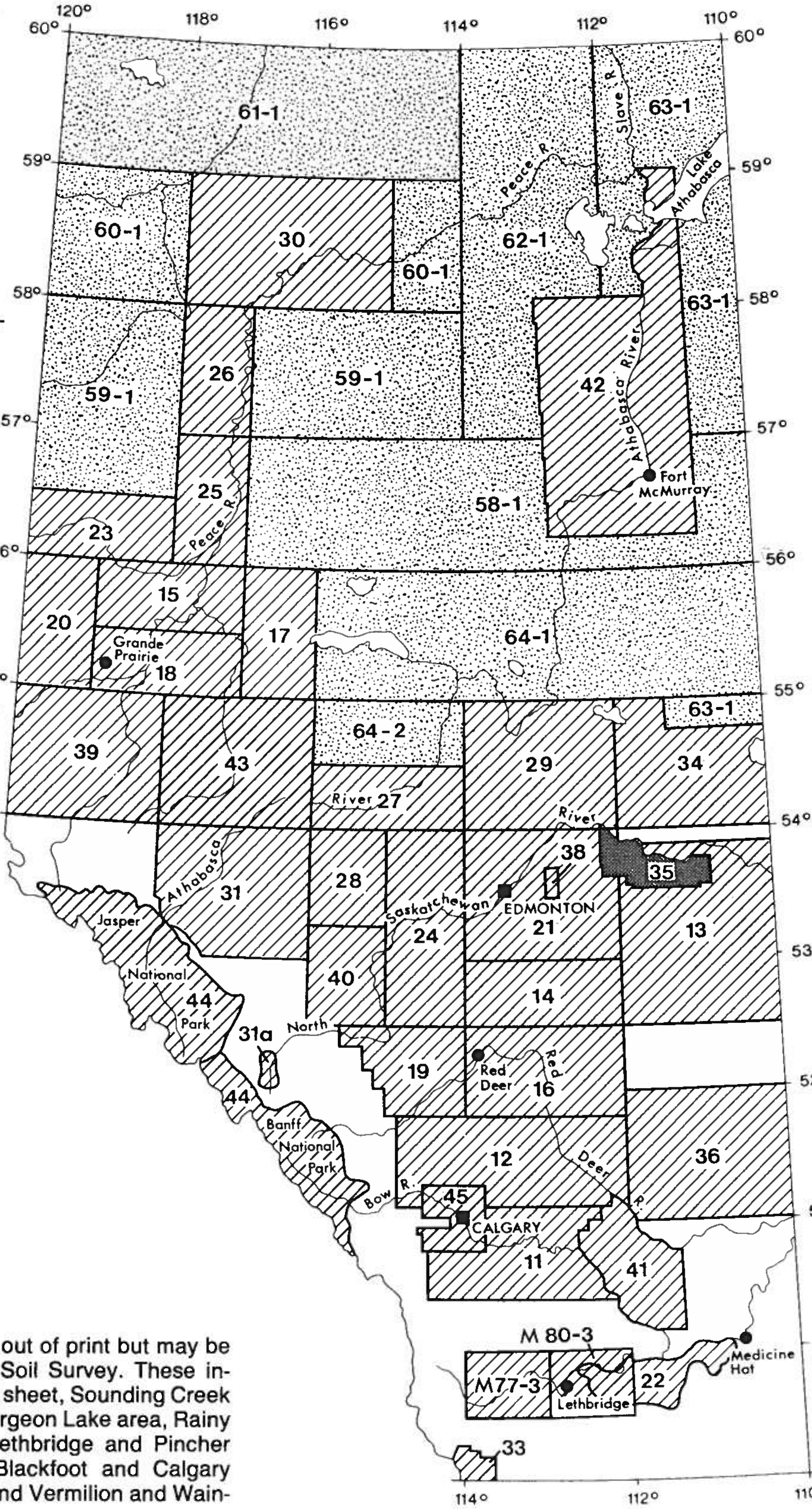
Four bridges span the North Saskatchewan River — the Elk Point, Duvernay, Myrnam and Shandro bridges. Roads and highways are constructed and maintained by the county and by Alberta Transportation.

Alberta Transportation entered into joint ownership of an airport with the town of Two Hills in 1980.

Sandy Lake and Lac Sante have been developed for recreational purposes.

Legend:

11 Blackfoot and Calgary sheets
12 Rosebud and Banff sheets
13 Vermilion and Wainwright sheets
14 Peace Hills sheet
15 Rycroft and Watino sheets
16 Red Deer sheet
17 High Prairie and McLennan sheets
18 Grande Prairie and Sturgeon Lake sheets
19 Rocky Mountain House sheet
20 Beaverlodge and Blueberry Mountain sheets
21 Edmonton sheet
22 St. Mary and Milk River Project
23 Cherry Point and Hines Creek area
24 Buck Lake and Wabamun Lake area
25 Grimshaw and Notikewin area
26 Hotchkiss and Keg River area
27 Whitecourt and Barrhead area
28 Chip Lake area
29 Tawatinaw map sheeet 83I
30 Mount Watt and Fort Vermilion area
31 Hinton-Edson area 83F
31a North Saskatchewan River Valley
33 Waterton Lakes National Park
34 Sand River sheet
35 Two Hills County
36 Oyen sheet
38 Elk Island National Park
39 Wapiti Map area
40 Brazeau Dam
41 Newell County
42 Athabasca Oil Sands area
43 Iosegun Sheet
44 Banff and Jasper National Parks
45 Calgary Urban Perimeter
M77-3 NW Lethbridge
M80-3 NE Lethbridge
58-1 Preliminary
59-1 Preliminary
60-1 Preliminary
61-1 Preliminary
62-1 Preliminary
63-1 Preliminary
64-1 Preliminary
64-2 Preliminary



Note:
Reports published prior to 1942 are out of print but may be obtained on loan from the Alberta Soil Survey. These include: MacLeod sheet, Medicine Hat sheet, Sounding Creek sheet, Peace River, High Prairie, Sturgeon Lake area, Rainy Hills sheet, Sullivan Lake sheet, Lethbridge and Pincher Creek sheets, Milk River sheet, Blackfoot and Calgary sheets, Rosebud and Banff sheets and Vermilion and Wainwright sheets.

Figure 1. Soil surveys in Alberta

Since about 1972, farming operations have quadrupled in size (Alberta Association of Municipal Districts and Counties, 1982, pers. comm.) because of mechanization and the consolidation of smaller farm units. Consolidation has led to a decrease in the county population from 5528 in 1966 to 4720 in 1982. The town of Two Hills is the largest market center with a population in 1982 of 1340 followed by the villages of Derwent (147), Myrnam (411), Hairy Hill (96) and Willingdon (359).

Agriculture is the primary industry in the county with grain and livestock production predominant.

The oil and gas industry also contributes to the economy of the county. The County of Two Hills constructed its own Natural Gas Utility in 1975 for the supply of natural gas to its rural people.

The environment

Physiography and topography

The County of Two Hills No. 21 lies within the Eastern Alberta Plains physiographic division (Bostock, 1970). A further subdivision of this physiographic division into sections and districts is outlined in table 1 (Pettapiece, in prep.). The location of the districts within the County of Two Hills is shown in figure 2. In general, the elevational change across the county is not great and ranges from about 610 to 720 m. The lowest elevation, about 580 m, occurs in the valley of the North Saskatchewan River.

The Whitford Plain district is in the western and central portion of the county between 600 and 700 m elevation. Undulating ground moraine characterizes the greater proportion of this district and the topography is generally level to undulating, but occasionally gently rolling. The slopes seldom exceed 9 percent. In places, the ground moraine is thin and outcrops of saline bedrock are fairly common in the area.

The Whitefish Upland district is found along a section of the North Saskatchewan River in the northwestern section of the county. The elevation ranges from about 590 to 670 m. Undulating ground moraine and coarse to medium-textured glaciofluvial and glaciolacustrine deposits characterize this area. The topography is generally fairly steep, ranging from moderately rolling to hilly.

The Myrnam Upland, the largest physiographic district in the county in areal extent, is in the central and eastern portion of the area at elevations between 620 and 720 m. Hummocky disintegration moraine characterizes much of the area (plate 1), particularly near Plain Lake, Musidora and Myrnam. As well, a fairly extensive area of glaciofluvial material occurs to the northeast of Myrnam, while bedrock-controlled landforms are predominant east of Derwent. In this latter area, the till is thin or absent (plate 2). The topography in the Myrnam Upland is extremely variable. The hummocky moraine is characterized by relatively short steep slopes ranging up to 15 percent. The landforms east of Derwent are commonly characterized by long steep slopes of similar incline. In general, the topography of the glaciofluvial sediments is gently to moderately rolling.

Plate 1. Hummocky disintegration moraine north of Myrnam

Table 1. Physiographic classification of land in the County of Two Hills

Division	Section	District
Eastern Alberta Plains	Tawatinaw Plain	Whitford Plain
	Vermilion Uplands	Whitefish Upland
		Myrnam Upland

Bedrock geology

The Alberta Plains is an area of low relief underlain at shallow depths by a succession of sandstone and shales — mostly nonmarine — and coal beds of Late Cretaceous and Early Tertiary ages (Kathol and McPherson, 1975). The bedrock structure of the plains is simple; the strata dip gently westward at a slope of a few metres per kilometre. Successively younger strata outcrop at the bedrock surface in a westerly direction to the point where they are affected by the structural deformation that formed the Rocky Mountain Foothills.

Throughout the County of Two Hills, the near-surface

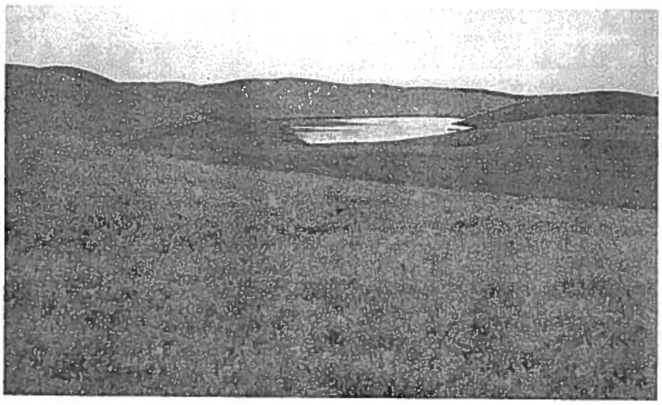


Plate 2. Thin till overlying bedrock in the Derwent area

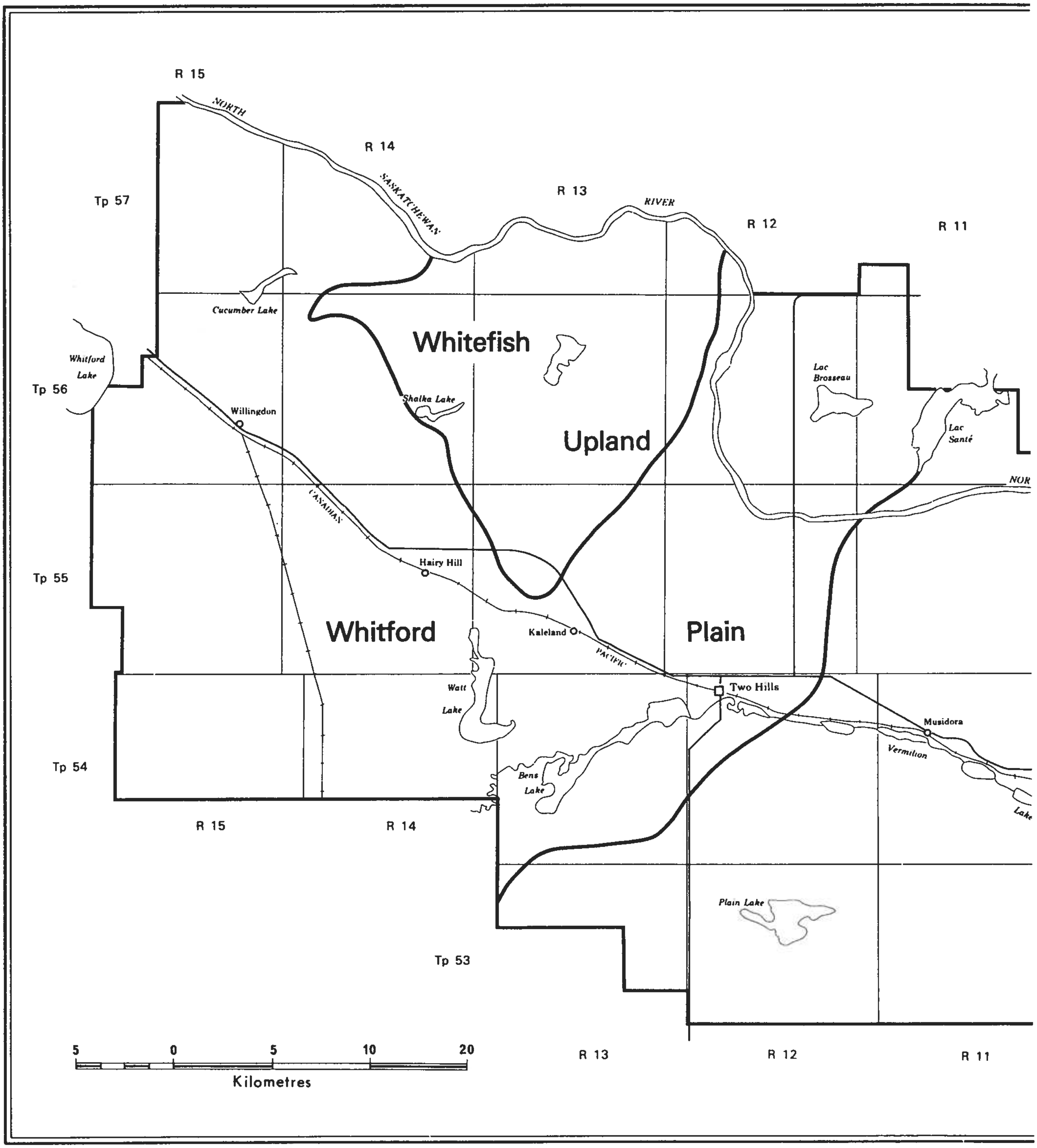
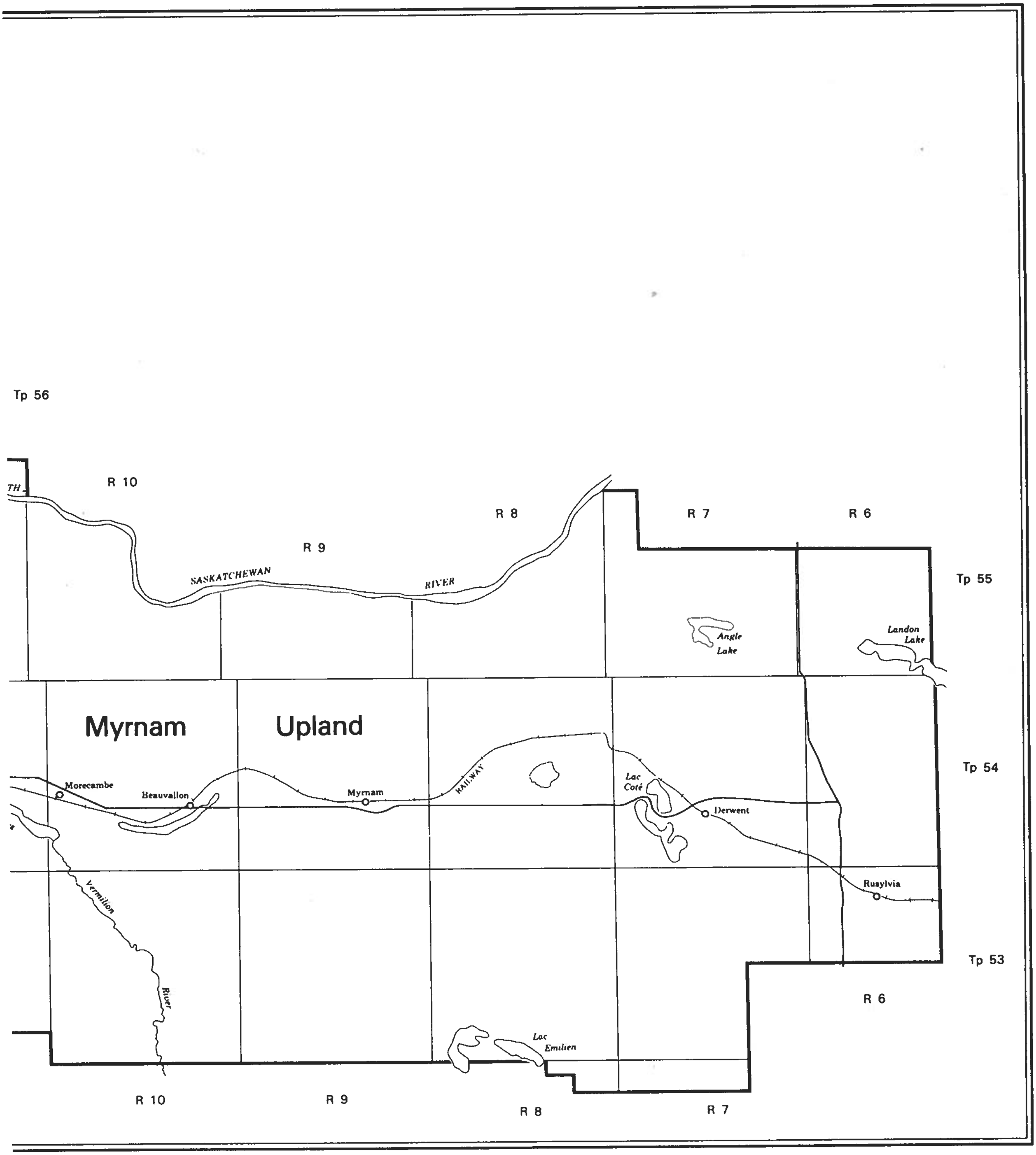


Figure 2. Location of physiographic districts in the County of Two Hills


Tp 56
R 10
R 9
R 8
R 7
R 6
Tp 55
SASKATCHEWAN
RIVER
Angle Lake
Landon Lake
Myrnam
Upland
Tp 54
Morecambe
Beauvallon
Myrnam
RAILWAY
Lac Coté
Derwent
Rusylvia
Vermilion
River
Tp 53
R 6
Lac Emilien
R 10
R 9
R 8
R 7

bedrock is the Belly River Formation of Late Cretaceous age (Green, 1972). This formation is composed of non-marine gray to greenish gray, thick-bedded, feldspathic sandstone, gray clayey siltstone, gray and green mudstone and concretionary ironstone beds.

Surficial geology

The County of Two Hills was covered by ice during the Pleistocene Epoch. Glacial deposits ranging in thickness from less than 1 m to 30 m or more overlie the bedrock surface. The principal surficial deposits are till, glaciofluvial sand and gravel, glaciolacustrine sediments, and undifferentiated recent fluvial materials (figure 3).

Elements of the preglacial landscape are discernible in that present-day uplands coincide with preglacial highs and the low areas often follow preglacial valleys. The near-surface sediments, however, were deposited primarily in glacial and postglacial times.

The glacial deposits in the area are of Wisconsin age (Ellwood, 1961). Investigations in the area indicate the presence of only one till that was deposited by glaciation from the Keewatin area to the northeast.

Ground moraine is the dominant depositional glacial landform in the county. It is present in the western portion of the map area and in scattered localities elsewhere. It forms a level to gently undulating till plain of variable thickness, ranging from less than 1 m to 25 m.

Hummocky dead-ice moraine is present throughout the entire county, but is most prominent in the south central portion near Plain Lake. Studies of this glacial landform in western Canada and Europe indicate that this type of deposit is a product of till deposition from stagnant ice (Bayrock and Hughes, 1962). The main topographic elements associated with these landforms include knobs, kettles and till ridges. Knobs composed mainly of till average 4 to 6 m in height, but may attain heights up to 15 m.

The till associated with the hummocky dead-ice moraine has properties similar to the ground moraine. It is generally fine-loamy, moderately stony and may be locally saline. The soil associations established on till materials are Angus Ridge, Camrose, Norma, Uncas, Falun, Cooking Lake, Demay, Daysland, Hairy Hill and Whitford.

Glaciolacustrine deposits are of limited areal extent in the county. The most prominant deposit is found northwest of the town of Two Hills and has been called Two Hills Glacial Lake (Ellwood, 1961). This sandy deposit contains some pebbles and gravel and is characterized by undulating to slightly hummocky topography. The Redwater soil association is found on this material. Throughout the county small areas of fine-silty glaciolacustrine sediments occur sporadically. The Ponoka, Armena, Kapona, Rimbey and Fawcett soil associations have been mapped in areas of this material. Fine-clayey deposits are the least extensive of the glaciolacustrine sediments in the county. Duagh and Cucumber soil associations are representative of these materials.

The glaciofluvial deposits found in the county of Two Hills are sandy, sandy-skeletal and loamy-skeletal. They are often well stratified and well washed, but generally poorly sorted (Ellwood, 1961). These materials are generally associated with meltwater channels and major streams and may be considered valley train materials. The most extensive areas of glaciofluvial sands and gravels occur adjacent to the Vermilion River Valley and in the Myrnam meltwater channel. An especially large area of sandy material occurs in the Slawa area extending almost to Derwent. The topography associated with glaciofluvial sediments in this area is undulating to hummocky. In the eastern portion of the county some of the sand overlies directly a rolling rock surface. Soil associations established on gravelly materials include Ferintosh, Two Hills, Snipe Hills, and Clouston, those on sandy materials include the Nicot, Leith, Desjarlais and Culp association.

In the eastern portion of the county, bedrock is found at the surface or is mantled by a thin, sporadic cover of glacial materials. The bedrock is generally clayey and nonsaline, but some sandy material also occurs in some portions of the area. The topography of the landscape is bedrock controlled, consisting of fairly steep rolling and hilly slopes. Soil associations established on bedrock material include the Brosseau, Pathfinder, Maughan, Kavanagh and Shandro associations.

Postglacial or recent fluvial deposits are not widespread in the map area and are confined to drainage channels. The soils developed on these sediments are of variable texture ranging from sandy to fine loamy. For the most part, the alluvium occurs as terrace deposits along the drainage channels. Because of extreme variability in texture and drainage characteristics, the soils developed on recent sediments have simply been mapped as an Alluvium complex.

Climate

The climate of an area exerts a strong influence over the distribution of vegetation and soils and to a large degree dictates the prevailing type of land use. Climatic data have not been recorded for any specific locations within the boundary of the county, although data are available for stations just outside the county, at Vegreville and Ranfurly to the south, Elk Point to the northeast and Vermilion to the southeast. The records at these centers should represent climatic conditions within the County of Two Hills.

The climate is continental with fairly long cold winters and warm summers. Precipitation and temperature for the four stations near the county are given in table 2. January is the coldest month with a mean monthly temperature of about −18°C. July is the warmest month averaging about 17°C.

The mean annual precipitation ranges from 400 to 430 mm. June, July and August are the months of highest rainfall totalling 200 to 230 mm. About 60 percent of the total annual precipitation occurs during the growing season from May to August.

Climate has a significant effect on the type and success of agricultural practices. The duration of the grow-

Table 2. Mean monthly temperatures and total precipitation at selected stations adjacent to the County of Two Hills

	Vegreville 635 m		Ranfurly 685 m		Elk Point 585 m		Vermilion 620 m	
	Mean temperature °C	Total precipitation mm	Mean temperature °C	Total precipitation mm	Mean temperature °C	Total precipitation mm	Mean temperature °C	Total precipitation mm
January	-18	15	-11	20	-19	20	-18	20
February	-14	13	-13	18	-14	15	-14	15
March	- 8	13	- 7	18	- 8	18	- 8	18
April	3	20	3	23	2	20	3	20
May	10	30	11	36	9	36	10	31
June	14	66	14	66	14	66	14	66
July	17	81	17	81	17	74	17	71
August	15	79	16	71	15	66	16	69
September	10	43	10	46	9	46	10	38
October	4	15	4	18	4	20	4	18
November	- 6	18	- 6	20	- 7	20	- 6	20
December	-13	15	-13	20	-15	23	-14	20
Mean Annual	1	410	2	440	1	420	1	410
Years Observed	25		30		27		27	

ing season determines the type of crops that can be satifactorily grown and matured. Climatic zones (Bowser, 1967) have been established in the province based on the criteria of frost-free period and number of degree-days above 5.6°C. Table 3 provides data characterizing the growing season, degree-days above 5.6°C, and frost data for five locations near the County of Two Hills. The data are arrived at through use of a formula (Hopkins, 1938) that takes into account the effects of elevation, latitude, and longitude on temperature.

Vegetation

The County of Two Hills is located in the Aspen Grove and Mixedwood Sections of the Boreal Forest Region (Rowe, 1972). The Aspen Grove Section coincides generally with the Black and Dark Gray Chernozemic soil areas while Gray Luvisolic soils predominate in the area designated as the Mixedwood Section.

The Aspen Grove Section or Aspen Parkland (plate 3) as it is referred to by Bird (1961) contains two major plant communities — forest and grassland. These communities are intermingled in a mosaic of irregular isolated patches. The grassland occupies the drier locations and aspen poplar the moist sheltered sites. For the most part, agricultural development has removed or altered the plant communities of the Aspen Grove Section. In undisturbed areas, however, the vegetative cover includes marsh reed grass (*Calamagrostis canadensis*), slender wheatgrass (*Agropyron trachycaulum*), northern wheatgrass (*Agropyron*

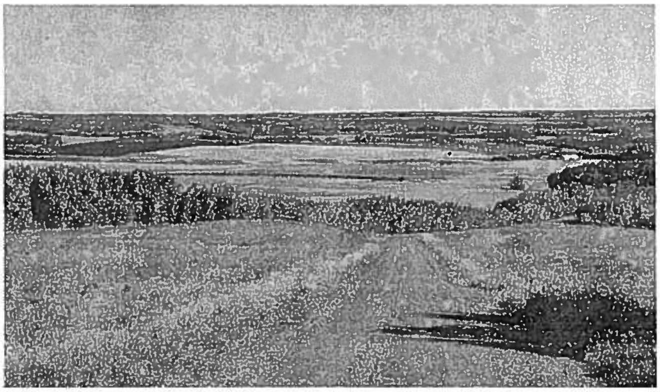


Plate 3. Vegetation of the Aspen Parkland

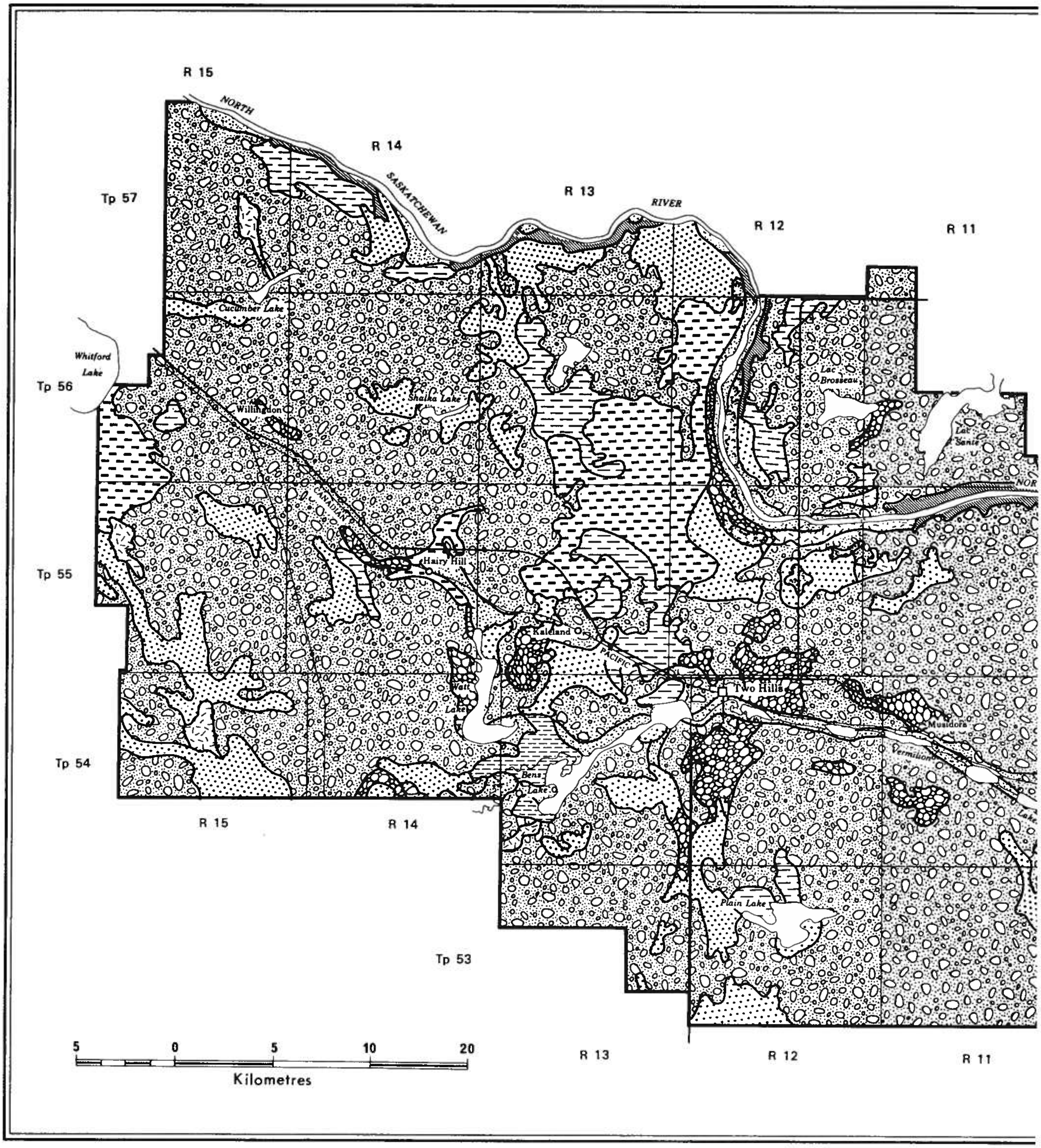


Figure 3. Soil parent materials in the County of Two Hills

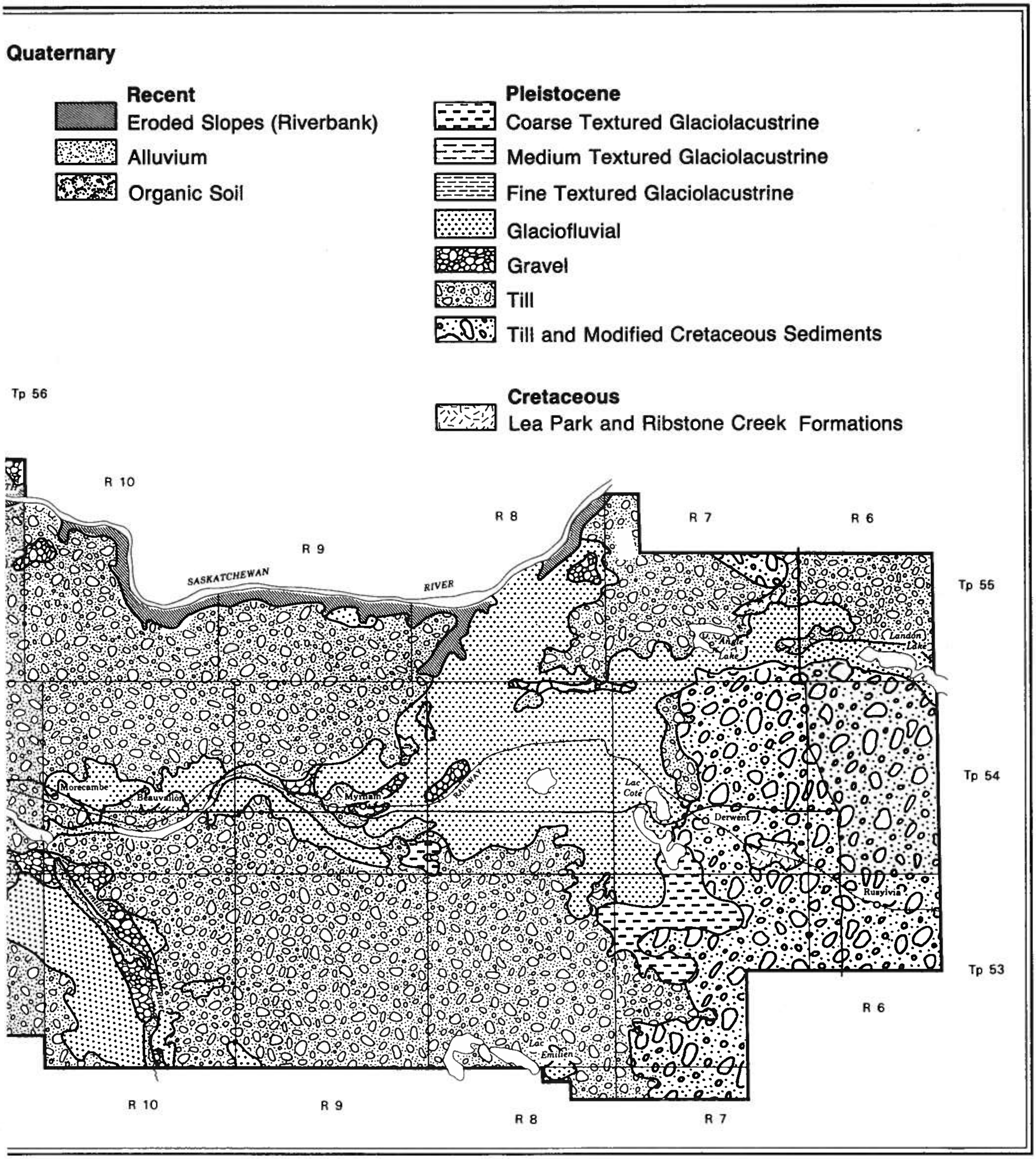

Quaternary
Recent
Eroded Slopes (Riverbank)
Alluvium
Organic Soil
Pleistocene
Coarse Textured Glaciolacustrine
Medium Textured Glaciolacustrine
Fine Textured Glaciolacustrine
Glaciofluvial
Gravel
Till
Till and Modified Cretaceous Sediments
Cretaceous
Lea Park and Ribstone Creek Formations
Tp 56
Tp 55
Tp 54
Tp 53
R 10
R 9
R 8
R 7
R 6
SASKATCHEWAN
RIVER
RAILWAY
Morecambe
Beauvallon
Myrnam
Lac Coté
Derwent
Angle Lake
Landon Lake
Rusylvia
Lac Emilien

Table 3. Durations and dates of growing season, degree-days and frost data at selected stations adjacent to the County of Two Hills

	Vegreville	Willingdon	Ranfurly	Elk Point	Vermilion
Growing season, (5.6°C)					
beginning	April 23	April 24	April 24	April 25	April 24
end	Oct. 11	Oct. 11	Oct. 10	Oct. 10	Oct. 10
duration, days	171	170	169	168	169
degree-days above 5.6°C	2509	2432	2414	2376	2434
Average date of last killing frost (spring)	May 18	May 20	May 20	May 22	May 29
Average date of first killing frost (fall)	Sept. 14	Sept. 13	Sept. 12	Sept. 10	Sept. 13
Average date of last frost (spring)	June 7	June 10	June 9	June 13	June 9
Average date of first frost (fall)	Sept. 1	Aug. 30	Aug. 31	Aug. 28	Aug. 13
Killing frost-free period (-2.2°C), days	119	116	115	111	117
Frost-free period (0°C), days	86	81	81	76	83

Williams/Hopkins Agroclimatic Estimates for 1180 Points on Canadian Great Plains.

dasystachyum), western wheatgrass (*Agropyron smithii*), rough fescue (*Festuca scabrella*), June grass (*Koeleria gracilis*), fringed brome (*Bromus ciliatus*), speargrass (*Stipa comata*), green needlegrass (*Stipa viridula*), and Hooker's oatgrass (*Avena hookeri*).

The undisturbed vegetative cover of the Mixedwood Section is referred to as the Poplar Association by Moss (1955). Aspen poplar (*Populus tremuloides*) is the dominant tree species with lesser amounts of paper birch (*Betula papyrifera*), white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*). The shrub cover includes mountain alder (*Alnus tenuifolia*), pincherry (*Prunus pennsylvanica*), dogwood (*Cornus stolonifera*), saskatoon berry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), willow (*Salix* spp.) and low-bush cranberry (*Viburnum edule*). Other shrubs include wild rose (*Rosa acicularis*), raspberry (*Rubus idaeus and Rubus pubescens*), snowberry (*Symphoricarpos albus*), gooseberry (*Ribes* spp.), buffaloberry (*Shepherdia canadensis*), hazelnut (*Corylus cornuta*) and honeysuckle (*Lonicera involucrata*).

Some of the more common herbs found in the Poplar Association are fireweed (*Epilobium angustifolium*), aster (*Aster ciliolatus*), northern bedstraw (*Galium boreale*), sarsaparilla (*Aralia nudicaulus*), wintergreen (*Pyrola asarifolia*), wild lily-of-the-valley (*Maianthemum canadense*), lungwort (*Mertensia paniculata*), meadow-rue (*Thalictrum venulosum*), strawberry (*Fragaria virginiana*) and horsetail (*Equisetum* spp.).

Feather mosses include *Pyloesia polyantha* and *Mnium cuspidatum*. Marsh reedgrass and slender wheatgrass commonly occur in this association.

Moist areas where organic and gleysolic soils often occur have a characteristic vegetative cover. The density and type of cover varies because of differences in degree of wetness. Black spruce (*Picea mariana*) is the dominant tree species and dwarf birch (*Betula glandulosa*) and willow (*Salix* spp.) are the principal shrubs in these areas. Other commonly occurring plants include Labrador tea (*Ledum groenlandicum*), cloudberry (*Rubus chamaemorus*) and three-leaved Solomon's seal (*Smilacina trifolia*). Sphagnum is the most common bog moss.

Drainage

The County of Two Hills is drained by the North Saskatchewan River, a part of the Hudson Bay drainage system in Canada. The Vermilion River is the major tributary of the North Saskatchewan River in the county. This river originates northwest of Viking and flows through Vegreville to the County of Two Hills. Just east of the town of Two Hills, the Vermilion River widens into a chain of narrow lakes known as the Vermilion Lakes, and from this point the river flows east and northeast to the North Saskatchewan River.

The hummocky moraine portion of the county is characterized by many lakes and sloughs of varying size. The levels of these lakes fluctuate with seasonal precipitation patterns, but they are generally shallow. The larger lakes include Watt and Plain Lakes and Lac Brosseau and Lac Sante.

There is a considerable area of hay meadow associated with poorly drained areas along the Vermilion River and Vermilion Lakes. In years of abnormally high precipitation, flooding occurs in some of these areas and the amount of hay that can be harvested successfully is reduced (plate 4).

Plate 4. Flooding of the Vermilion River at the Town of Two Hills

General soil characteristics

The general soil map (figure 4) illustrates the distribution of the major soils in the county. Chernozemic soils predominate. These soils are generally well to moderately well drained. They are characterized by surface horizons that have been darkened by the accumulation of organic matter from the decomposition of grasses and herbs representative of grassland or of grassland-forest communities. Both Black and Dark Gray Chernozemic soils are found in the area. The Dark Gray Chernozems are characterized by A horizons that exhibit the effect of eluviation that is usually associated with soils developed under forest vegetation. The Chernozemic soils are found in all physiographic districts in the county and are formed on a wide variety of soil parent materials.

Solonetzic soils are an important group of soils in the county. These soils have developed under saline conditions and are characterized by B horizons that are very hard when dry and swell to a sticky mass of low permeability when wet. Most Solonetzic soils are associated with a vegetative cover of grasses and herbs, although some may occur under tree cover. Groundwater discharge is believed to play an important role in the formation of Solonetzic soils.

The Solonetzic soils are found primarily in the Whitford Plain physiographic district in the county, but also occur to a limited extent in the Myrnam Upland district.

Luvisolic soils are developed under a forest cover and are fairly widespread in the County of Two Hills. Luvisolic soils generally have light colored eluvial horizons and B horizons in which silicate clay has accumulated. The Gray Luvisolic soils lack a prominent dark colored A horizon, whereas the Dark Gray Luvisols have the properties specified for Luvisolic soils but have a dark-colored A horizon more than 5 cm thick.

Brunisolic soils are of limited areal extent in the County of Two Hills. These soils are generally developed on fairly coarse-textured sediments under forest cover. They lack the degree or kind of horizon development specified for other soil orders. The B horizons in the Eutric Brunisolic soils of the area, for example, are weakly expressed and do not meet the criteria for Luvisolic soils.

The Luvisolic and Brunisolic soils occur primarily in the Myrnam Upland physiographic district.

Gleysolic soils are not confined to any particular physiographic district, but are found scattered throughout the county. Features of these soils indicate periodic or prolonged saturation with water and reducing conditions. Gleysolic soils occur commonly in shallow depressions and on level lowlands that are saturated with water every spring. In some locations in the county, the Gleysolic soils exhibit a high degree of salts or carbonates or both, depending on the nature of the associated groundwater.

Organic soils are of limited areal extent in the County of Two Hills. These soils are composed largely of organic materials and include most of the soils commonly known as peat, muck or bog soils. The Organic soils in the county are relatively shallow and generally have a mineral layer within the control section. They occur mainly in the Whitefish Upland district.

Regosolic soils are also of limited areal extent in the county. They are found primarily along drainage ways on relatively recent sediments. Such soils are weakly developed and lack genetic horizons. Regosolic soils are generally rapidly to imperfectly drained and may occur under a range of vegetation and climates.

The soils

Soil formation

Soils form through the interaction of five major factors: climate, plant and animal life, parent material, topography and time. The relative influence of each factor generally varies from place to place. Local variations in soils are caused by differences in the kind of parent material and in topography and drainage.

Climate, and particularly the pattern of temperature and precipitation, determines the degree of weathering of mineral material. In addition, climate affects the growth of vegetation and the leaching of weathered material. Frost action contributes to the weathering of stones and boulders.

All living organisms — plants, animals, bacteria and fungi — are important factors in soil formation. Plants are generally responsible for the color of the surface layer and the amount of nutrients and organic matter in the soil. Animals such as earthworms help keep the soil open and porous. Bacteria decompose dead plants, thus releasing nutrients for use by plants.

Parent material determines the mineral and chemical composition of the soil, and to a large extent, the rate at which soil-forming processes occur.

The topography — as expressed by the shape of the land surface, the slope and the depth to the watertable — has a strong influence on soil formation. Soils that

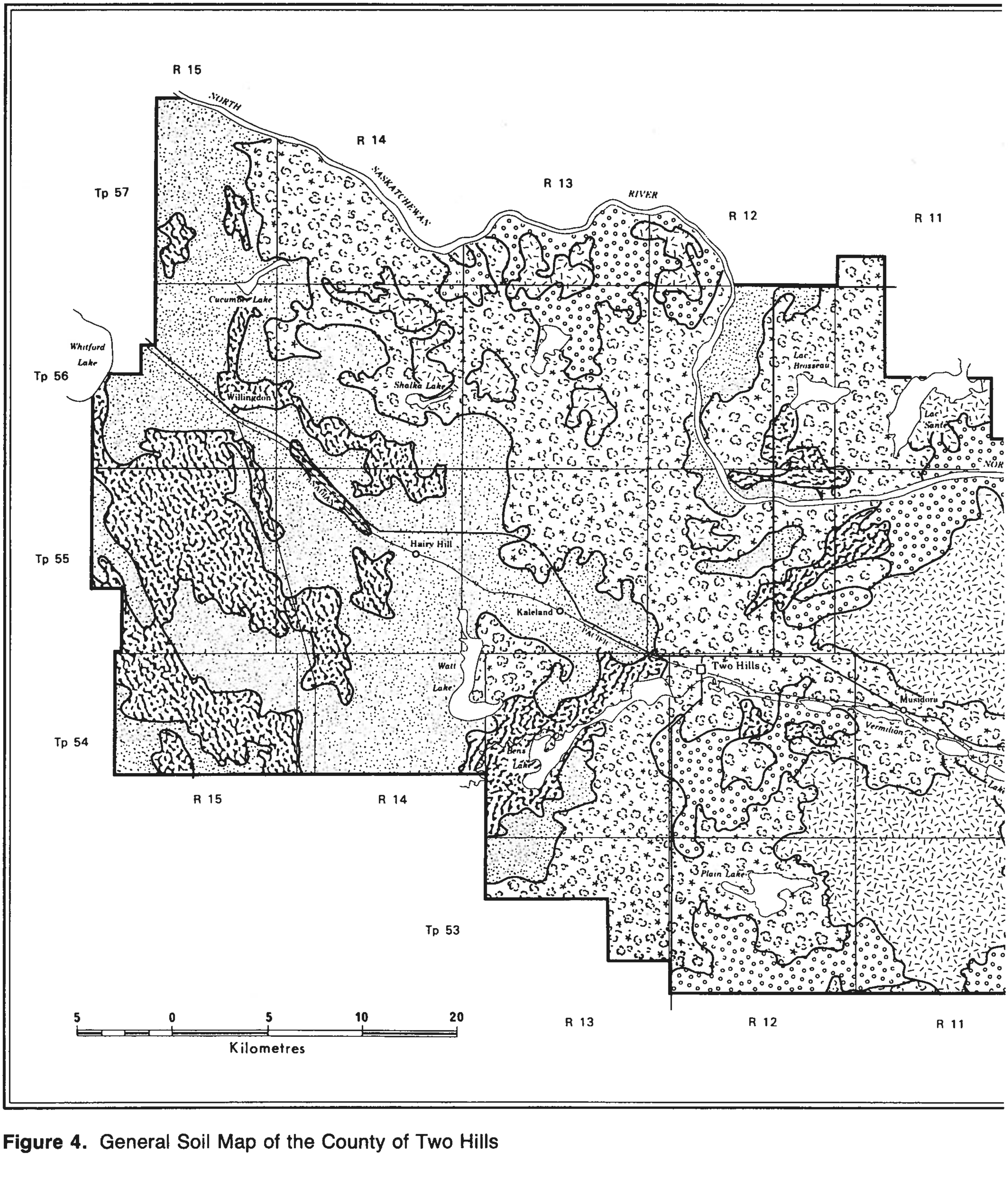
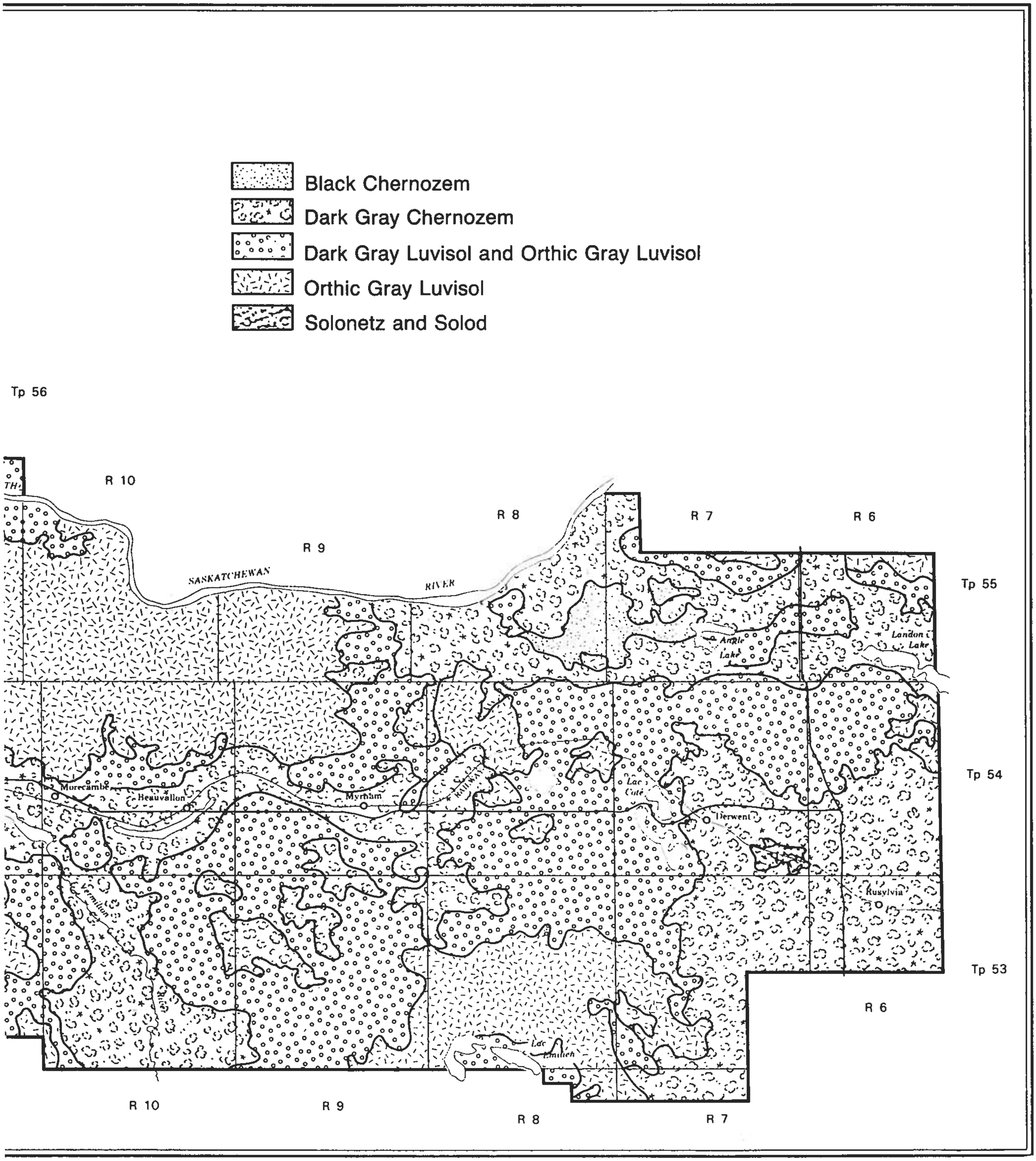
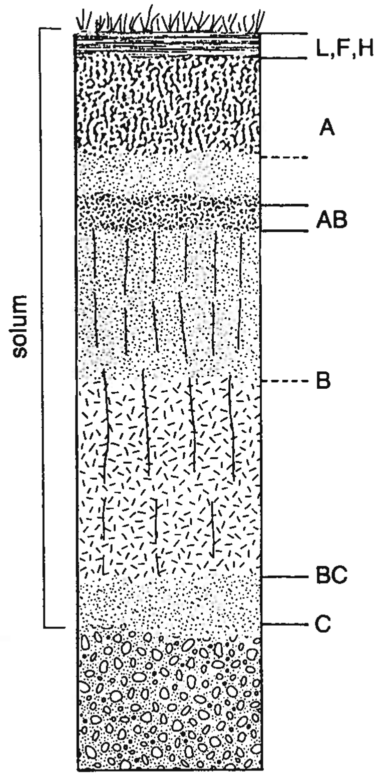


Figure 4. General Soil Map of the County of Two Hills


Black Chernozem
Dark Gray Chernozem
Dark Gray Luvisol and Orthic Gray Luvisol
Orthic Gray Luvisol
Solonetz and Solod
Tp 56
R 10
R 9
R 8
R 7
R 6
Tp 55
SASKATCHEWAN
RIVER
Tp 54
Morecambe
Beauvallon
Myrnam
Derwent
Rusylvia
Tp 53
R 6
R 10
R 9
R 8
R 7



L,F,H — Organic horizon, which may be subdivided into: L (raw organic matter), F (partially decomposed organic matter), and H (decomposed organic matter).

A — A mineral horizon at or near the surface. It may be a dark coloured horizon in which there is an accumulation of humus (Ah), or a light coloured horizon from which clay, iron, and humus have been leached (Ae).

AB — Transition horizon.

B — Mineral horizons that (1) may have an enrichment of clay (Bt), iron (Bf), or organic matter (Bh); or (2) may be characterized by a columnar structure and a significant amount of exchangeable sodium (Bn); or (3) may be altered to give a change in colour or structure (Bm). Usually lime and salts have been leached out of this horizon. (4) The symbol "j" is used with the above suffixes to denote a failure to meet the specified limits of the suffix.

BC — Transition horizon.

C — Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying (Cg) and the accumulation of calcium or magnesium carbonates (Ck) and soluble salts (Cs).

Figure 5. Diagram of a soil profile showing various horizons

form in areas with convex slopes are generally well-drained, whereas those formed in more gently sloping or level areas often show some evidence of wetness. Soils developed in depressional areas show strong evidence of wetness.

During the formation of soils, time — generally a long time — is required for changes to occur in the parent material. In the County of Two Hills, most soils have developed since the last period of glaciation, estimated at 10 000 years. Soils formed along drainage ways may be subject to overflow and receive new deposits of sediments with each flooding. These soils generally show little soil development, as evidenced by weak structure and small color differences between horizons.

Soil morphology

The results of the soil-forming factors can be distinguished by different layers or soil horizons seen in a soil profile (figure 5). The profile extends from the surface downward to material that is altered little by the soil-forming process. Most soils have three master horizons: the A, B and C horizons.

The surface horizon is designated by Ap or Ah. The suffix p indicates a surface layer that has been plowed at regular intervals. The suffix h indicates a surface layer relatively undisturbed by man. The A horizon is also the layer of maximum leaching, or eluviation of clay and iron. Such a horizon is designated as Ae. The B horizon underlies the A horizon and is commonly called the subsoil. It is the horizon of maximum accumulation of clay (Bt), iron (Bf), or organic matter (Bh). The C horizon which is below the A and B horizons consists of material that is altered little by soil-forming processes.

Soil classification

The system of soil classification used in this project was published in 1970 (Canada Soil Survey Committee, 1970). Where practical, however, the terminology used during the course of the survey has been updated to include that outlined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).

The Canadian system is a hierarchical one in which the classes are based on the generalization of soil properties. The various soil units are classified by their respective Orders, Great Groups and Subgroups. A brief description of the soil Orders, Great Groups and Subgroups found in the County of Two Hills follows.

Chernozemic soils

These are well to imperfectly drained soils developed under grassland or transitional grassland-forest vegetation. They are characterized by a dark colored, organo-mineral (Ah) surface horizon and B and C horizons of high base saturation. In the County of Two Hills, soils of the Black and Dark Gray Great Groups are represented. Soils of the Black Great Group have an Ah horizon that is dark gray to black and usually over 15 cm thick. Soils of the Dark Gray Great Group have an Ah horizon that contains light gray spots or bands and usually a lighter-colored Ahe horizon. The Chernozemic soils in the County of Two Hills include Angus Ridge, Brosseau, Cucumber, Falun, Ferintosh, Norma, Peace Hills, Ponoka, Redwater, Rimbey and Sante soils.

Solonetzic soils
This order of soils consists of well to imperfectly drained soils developed under a variable vegetative cover. They are characterized by Solonetzic B horizons and saline parent material. A guide to the characterization of these soils is provided by chemical criteria, but separations made at the Great Group level are based mainly on the morphological differences evident in the profiles. These morphological features relate mainly to the presence or absence of an AB horizon and on the nature of the B horizon. Soils of the Solonetz and Solodized Solonetz Great Groups are characterized by an abrupt change from the A to the very hard columnar B horizon. Plant roots tend to concentrate along the contact between the friable A horizon and the hard B horizon. The roots that do penetrate usually follow along the cleavage faces and are flattened. Soils of the Solod Great Group have a transitional AB horizon and a B horizon that breaks readily into blocky aggregates.

The Solonetz, Solodized Solonetz and Solod soils occur largely in the western portion of the county, primarily south of Willingdon. The Black Solonetz and Solodized Solonetz soils are represented by the Armena, Camrose, Duagh, Kavanagh and Whitford associations. The Black Solod soils include the Daysland and Kapona associations.

Luvisolic soils
These well to imperfectly drained soils formed under forest or forest-grassland vegetation in moderate to cool climates. All soils in this order have a pronounced eluvial Ae horizon and an illuvial textural Bt horizon in which silicate clay is the main accumulation product.

Gray Luvisols represent the central concept of the Great Group as defined. Where an Ah horizon is present, it is less than 5 cm thick. Dark Gray Luvisols have the general characteristics of the Great Group, but the Ah or Ahe horizon is more than 5 cm thick. The Ah and Ahe horizons contain gray streaks that are most readily seen when the soil is dry.

Two Subgroups of the Luvisolic Order are found in the county — the Orthic Gray Luvisols and Dark Gray Luvisols. The Luvisolic soils are dominant in the central portion of the county generally near Musidora and Myrnam. The Clouston, Cooking Lake, Culp, Fawcett, Leith, Maughan, Pathfinder, Snipe Hills and Uncas soils are representative of this soil order.

Brunisolic soils
Soils of the Brunisolic Order have sufficient development to exclude them from the Regosolic Order, but they lack the degree or kind of horizon development specified for other orders. Brunisolic soils occur predominantly under forest cover with brownish-colored Bm horizons, but the order also includes soils with both Ae and weakly expressed B horizons of accumulation of either clay (Btj) or amorphous Al and Fe compounds (Bfj).

Brunisolic soils are of minor occurrence in the County of Two Hills and are represented by both the Orthic Eutric and Eluviated Eutric Subgroups. Nicot soils are representative of this soil order in the county.

Regosolic soils
Regosols include rapidly to poorly drained soils that lack discernible horizons or have only organic (L-H) or nonchernozemic organo-mineral (Ah) surface horizons. The Orthic and Cumulic Regosols are the only subgroups found in the map area. These soils occur as part of the undifferentiated Alluvium and Riverbank soil complexes.

Gleysolic soils
These soils are poorly drained and have strongly gleyed mineral horizons. They have developed under varying climatic conditions and vegetative cover types in the presence of a high or a fluctuating water table. These soils may have organic surface horizons up to 40 cm thick and are characterized by dull grayish colors throughout the profile. Prominent yellowish or reddish colored mottles may also be present.

Criteria related to classification at the Great Group level are provided by the characteristics of the A horizon. In the county, two Great Groups, the Humic Gleysol and Luvic Gleysol have been recognized. The Humic Gleysol Great Group consists of soils that have an Ah horizon more than 8 cm thick but no eluviated Aeg horizon. The Luvic Gleysol Great Group comprises soils characterized by a prominent Aeg horizon.

Poor drainage is a dominant factor in the development of Gleysolic soils and often there is little difference in profile characteristics over a fairly wide range of parent materials. Gleysolic soils are dominant in a minor portion of the area but frequently occur in association with the better drained upland soils. The Gleysolic soils represented in the map area include the Demay, Desjarlais, Hairy Hill and Shandro soils.

Organic soils
Organic soils are very poorly drained and are characterized by a surface accumulation of peat 40 cm or more in thickness (60 cm if fibric sphagnum moss is dominant). The peat is greater than 17 percent in organic carbon content. Two types of Organic soils were mapped in the County of Two Hills —one in which the peat is developed from sedge, while the other is of moss origin. Those soils developed from sedge are classified mainly as Mesisols and Humisols; the soils developed from moss are mainly Mesisols. Organic soils are represented by the Hilda and Manatokan soil complexes.

Soil survey methods

The purpose of a soil survey is to identify and delineate soil patterns in the landscape and to present the information to the user.

Field work in the County of Two Hills was initiated in 1971 and completed in 1974. The soils were examined and described according to the Proceedings of the Canada Soil Survey Committee (1970). Field mapping was carried out with the aid of panchromatic aerial photographs flown in 1966 and 1967. Upon completion of the field work the data were checked, compiled and published at a map scale of 1:31 680.

The area was traversed mainly by vehicle, and to a lesser extent on foot, where roads were unavailable or where more detailed investigations were required. Soil observations along traverse lines were spaced at 0.2 to 0.4 km intervals. Soil observations at each site included an appraisal of the soil parent material, soil profile, drainage, texture, stone content, depth to carbonates or salts and characteristics of the landform and topography. Soil samples of representative soil profiles were collected for laboratory investigation at selected locations.

Basic definitions

This section is included to explain the various categories and terminology used in the soil legend accompanying the soil map.

Soil association — A soil association is a group of defined and named taxonomic soil units occurring together in an individual or characteristic pattern over a geographic region. This grouping of soils is developed on similar parent materials and under an essentially similar climate.

As used in this survey, the major soil associations are separated according to lithologic differences in soil parent materials and Great Group characteristics. The designations for the associations are derived from local geographical names.

The soil associations are subdivided into mapping units on the basis that various soil profiles of a given soil association occur in close geographic association. The soil association is used to group various collections of soils in order to reflect certain pertinent aspects of the landscape.

Soil complex — Soil complexes are collections of soils whose distribution is not related to soil parent material or whose characteristics are so varied that further differentiation at the scale of mapping employed is not feasible. Such complexes are broader in character than the soil associations. The complexes described in the County of Two Hills are Riverbank (RB), Alluvium (AV), Hilda (HD) and Manatokan (MN) complexes. The Riverbank and Alluvium complexes are usually associated with streams. The Hilda and Manatokan complexes comprise organic soils.

Map unit — Map units are subdivisions of the soil association. Because the map unit identifies the soil association and the relative proportions of soils within the association, it is the most important feature of the soil map. The map unit also describes the landscape, since various soil profiles are largely associated with differences in topographic position and related drainage conditions, and with kinds and frequencies of slope.

Soil combinations — Land areas consisting of collections of soil associations are shown on the soil map as combinations. The soils represented by the first symbol of the combination always occupy more than one-half of the delineated soil area.

Soil map symbols — On the soil map, each individual soil area is enclosed by a boundary line. The soil area within each boundary is identified by a symbol that is arranged in the following sequence:

$$\frac{\text{Soil Association — Map Unit}}{\text{Topographic Class — Stoniness}} \quad \text{for example} \quad \frac{\text{AGS7}}{\text{d2}}$$

This symbol describes an area of Angus Ridge soils, map unit 7, which comprises 50 percent Eluviated Black Chernozemic soils, 20 percent Black Solodized Solonetic soils, and 30 percent Humic Gleysols. The topography is class d (5 to 9 percent slope) and stoniness Class 2 (moderately stony land).

The index map shows the location of the 53 individual soil map sheets presented on a photo mosaic base. This index map will facilitate location of areas of interest to the reader.

Dominant and significant soils — These terms are used in the soil map legend to indicate the relative proportion of various soils making up a map unit. Within an outlined map unit, dominant soils occupy 40 percent or more of the area while significant soils occupy over 10 percent but less than 40 percent of the area.

Soil erosion definition

Nine soil associations in the County of Two Hills contain map units that have the extent of erosion included in their definition. Erosion, as used in this study, refers to the amount of area in which some or all of the surface horizon (Ap) has been lost through erosion. In many locations, the B horizon is exposed or is being cultivated.

No attempt was made to distinguish between the effects of water and wind erosion. In general, water erosion is considered the dominant factor in the erosion of fine-textured soils, whereas wind is dominant in the erosion of coarse-textured or sandy soils. Erosion, especially that caused by water, commonly occurs on steeply sloping topography.

Three subdivisions or classes are used in incorporating erosion as a component of the map units.

1. Approximately 30 percent eroded — this category includes those soil areas of which 30 ± 10 percent of the unit area has the subsoil exposed at the surface. This is the most commonly used category.
2. Greater than 30 percent but less than 70 percent eroded — this category includes those soil areas that have greater than 30 percent but less than 70 percent of the unit area with the subsoil exposed due to erosion. This unit or category is used primarily in defining map units of soils developed on sandy parent materials.
3. Greater than 70 percent eroded — this category refers to areas which have 70 percent or more of the soil surface exposed as subsoil. In these areas, some of the B horizon has been removed as well.

The C horizons or parent materials are relatively near the surface and in some instances are exposed at the surface. Soils that are this severely eroded generally occur on moderately rolling to hilly topography.

A comparison with previous mapping procedures

This section is included in order to explain the categories and terminology employed in the legend and how they relate to those used in previously published soil surveys covering this area, that is the Wainwright-Vermilion Sheets (Wyatt *et al.*, 1944) and Edmonton Sheet (Bowser *et al.*, 1962).

In the Wainwright-Vermilion report, the soils were described by a three-digit number system. The first digit designated the soil zone, the second the parent material and the third profile variation. For example, a soil designated as 4.2.2. referred to a Black soil developed on glacial till with normal profile development.

In the soil survey of the Edmonton Sheet, the soil series concept of describing soils was adopted. The soil series was defined as a soil body such that any profile within the body has a similar number and arrangement of horizons with similar properties. When using the soil series as a mapping unit, it was complexed with other soil series.

In this study, the soils were grouped into soil associations, which are a group of named taxonomic soil units occurring in a characteristic pattern over a geographic area. This grouping of soils is developed on similar parent material and under an essentially similar climate. The soil associations are subdivided into mapping units on the basis that various soil profiles of a given soil association occur in close geographic association. The soil association is used to group various collections of soils in order to reflect pertinent aspects of the landscape.

The changes in classification and mapping procedures are a result of advancement in technology and knowledge of the soils.

Description of soil associations

Angus Ridge soil association (AGS)

The Angus Ridge soil association is comprised of soils that are dominantly Eluviated Black Chernozemic developed on fine loamy till.

These soils are found primarily in the Whitford Plain and Whitefish Upland in the western portion of the county. The till is an olive brown color, slightly to moderately stony, moderately permeable and weakly to moderately calcareous. The topography is dominantly undulating to moderately rolling ground moraine and to a lesser extent hummocky dead ice moraine. Depth to bedrock is variable, ranging from less than 1 m to 30 m or more.

Soil drainage varies from well drained on upper slope positions to poorly drained in lower slope and depressional areas.

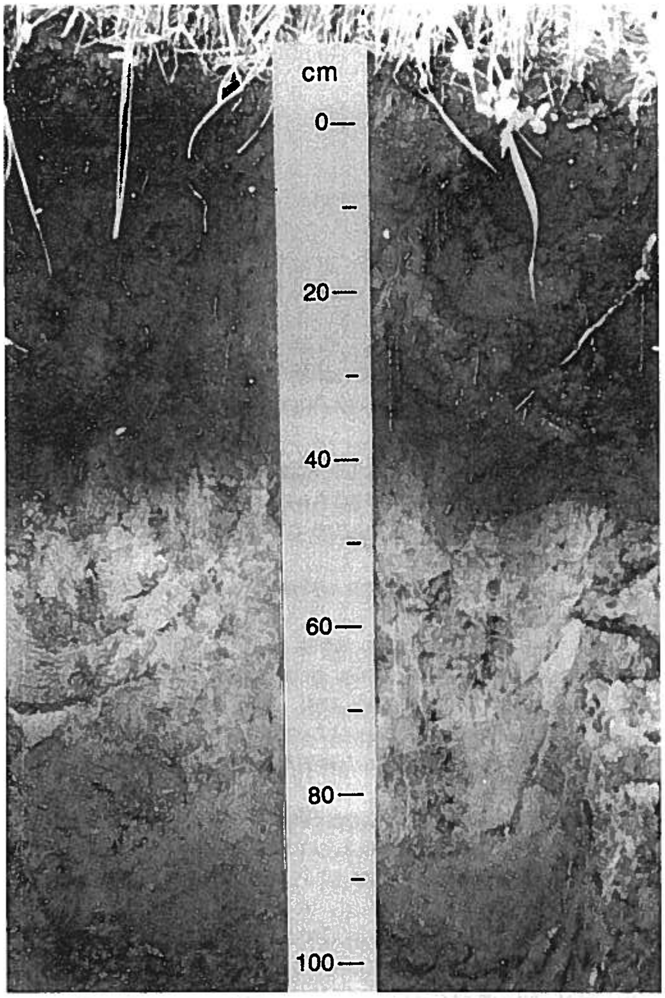


Plate 5. An Eluviated Black soil of the Angus Ridge association

Angus Ridge soils are characterized by strongly developed Chernozemic features. These include an Ah (Ap) horizon, a discontinuous Ae, a Bm or Bt and calcareous Ck horizon (plate 5).

Eight mapping units were established for the Angus Ridge association.

Map combinations — The Angus Ridge soil is often mapped in combination with units of other associations. These include Ponoka and Cucumber associations where a veneer of glaciolacustrine sediments overlie till or Peace Hills and Ferintosh associations where sandy and gravelly glaciofluvial deposits occur above the till.

Use — Soils of the Angus Ridge association are some of the most productive in the County of Two Hills. They are utilized for producing all crops normally grown in the area (plate 6). Care should be taken to control erosion on some of the steeper slopes.

Armena soil association (ARM)

The Armena soil association includes Black Solodized Solonetz soils developed on dark grayish brown to olive brown stone-free fine loamy glaciolacustrine material.

These imperfectly drained soils are found primarily in the southeastern portion of the county on the Myrnam Plain. The topography is uniformly level to gently undulating.

Plate 6. An area of productive Angus Ridge soils

Plate 7. Brosseau soils are well suited to the production of agricultural crops

Armena soils are characterized by thin Ah horizons (0-8 cm), weakly developed Ae and strong columnar Bnt horizons. Lime and salts are commonly found at 25 to 30 cm from the surface.

One mapping unit was established for the Armena soil association.

Use — The Armena soils are seldom cultivated because of undesirable soil characteristics. The relatively thin Ah horizon and the dense impermeable Bnt horizon restrict cultivation; areas of these soils are generally used for unimproved pasture.

Brosseau soil association (BSU)

The Brosseau soil association comprises mainly Orthic Dark Gray Chernozemic soils developed on residual (bedrock) parent material. In some locations, a thin veneer of till overlies the bedrock. This till is characterized by a high content of local bedrock. Outcrops of shale and sandstone are found throughout the area; the landforms are a reflection of the underlying bedrock surface.

The Brosseau soil association is found in the Whitford Plain and Myrnam Upland near Duvernay and Derwent. The topography associated with these moderately well to imperfectly drained soils is gently to strongly rolling.

The fine loamy profile of Brosseau soils exhibits a fairly thick, 10 to 15 cm, Ah (Ap) horizon, a Bt horizon with strong blocky structure, and an olive brown clay loam C horizon. Lime is at about 60 cm from the surface, except where erosion has been active. In such areas lime may be found at 30 cm.

Six mapping units were established for the Brosseau soil association.

Map combinations — The Brosseau map units are mapped in combination with units of other associations in some portions of the area. In particular, they are mapped with units of the Falun association in areas where a thin veneer of till overlies bedrock.

Use — These fine loamy soils are well suited to the production of agricultural crops (plate 7). Some limitation to cultivation is imposed by the relatively steep slopes and susceptibility to water erosion.

Camrose soil association (CMO)

The soils of the Camrose association are mainly Black Solodized Solonetz soils developed on a dense yellowish brown to dark grayish brown till. These soils occur primarily in the Whitford Plain physiographic district and to a minor extent in the western portion of the Myrnam Plain. The topography associated with these moderately well to imperfectly drained soils is generally undulating to gently rolling.

The soils of the Camrose association are fine loamy and exhibit an Ah or Ahe horizon from 13 to 25 cm thick. There is a fairly sharp break beneath the Ah to a dense round-topped columnar Bnt horizon. The Bnt is usually dark brown and organic staining is apparent. Lime and salts are generally present at depths greater than 50 cm from the surface. Because of the dense nature of the B horizon, these soils generally have a fairly low permeability and some mottling may be observed in the lower portion of the A horizon.

Four mapping units were established for the Camrose soil association.

Map combinations — In some locations, the Camrose association is intimately mixed with soils of the gravelly Two Hills soil association. Where this occurs, the two associations have been mapped in combination (CMO1 - TWH1).

Use — Camrose soils are generally suited to the production of grain and forage crops. Where the topsoil (Ah horizon) is especially thin, the dense and somewhat intractable B horizon may present some special tillage problems.

Clouston soil association (CUN)

The Clouston soil association includes Orthic Gray Luvisolic soils developed on gravelly glaciofluvial material. These soils do not occur extensively in the County of Two Hills and are only found in small isolated areas associated with ice contact landforms. The topography is variable, ranging from gently rolling to strongly rolling; these coarse-textured soils are generally rapidly drained.

In the natural state, Clouston soils are characterized by a thin leaf litter at the surface, a weak to moderately developed Ae horizon and a Bm or Bt horizon with some accumulation of clay that often clings to stones. Lime is seldom found within 1.5 m of the surface.

Two mapping units were established for the Clouston soil association.

Map combinations — Clouston soils are mapped in combination with Cooking Lake soils where the gravels are sporadically mixed with till; they are also mapped with Nicot and Culp soils, where the gravels are intimately intermixed with glaciofluvial sand.

Use — Low natural fertility, stoniness and droughtiness are the major factors limiting these soils for agricultural use. They are generally used for unimproved pasture. In some locations, the gravel has been used for construction.

Cooking Lake soil association (COA)

The Cooking Lake soil association is made up of Gray Luvisolic soils developed on fairly dense, dark grayish brown to olive brown till that is slightly to very stony, moderately permeable and weakly to moderately calcareous.

These fine loamy soils are found in a significant portion of the county with the major areas near Musidora on the Myrnam Upland. They are found on ground and hummocky moraine where the topography varies from undulating to strongly rolling. Typically, these soils are moderately well drained in upper and mid-slope positions.

In their native state, Cooking Lake soils are characterized by a thin leaf mat, a distinct Ae horizon and an illuvial clay-enriched Bt horizon. Lime is usually found at depths greater than 1 m.

Six mapping units were used to delineate the soils of the Cooking Lake association.

Map combinations — The Cooking Lake soil association is mapped in combination with the Culp and Clouston soil associations in some portions of the map area. Specifically, where till and fluvial sand are mixed or where a veneer of sand overlies till, the Cooking Lake association is mapped with the Culp association; where till occurs with localized deposits of glaciofluvial gravel, the combination is with the Clouston soil association.

Use — Cooking Lake soils occupy a significant portion of the County of Two Hills. The cultivated areas are used for the production of coarse grain and forages and for improved pasture. The low natural fertility and crusting of the surface (Ae horizon) are the major limitations of these soils for agricultural use. Topography may also be a limiting factor.

Extensive areas of Cooking Lake soils have not been cleared of tree cover. These areas occur in the hummocky moraine terrain, which is characterized by steep slopes and numerous sloughs. These areas are extremely difficult to cultivate and are generally used for native pasture.

The county community pasture is located in an area of Cooking Lake soils. The tree cover is cleared in portions of the reserve to improve grass production and increase the carrying capacity.

Management practices to provide increased production on Cooking Lake soils include the use of nitrogen and phosphorous fertilizers and crop rotations which include legumes.

Cucumber soil association (CCB)

The soils of the Cucumber association are primarily fine clayey Orthic and Eluivated Black Chernozemic soils. The parent material is a pale brown to grayish brown, fine-textured glaciolacustrine deposit. The Cucumber soils are found on gently undulating to undulating topography on the Whitefish Plain.

These fine textured soils are characterized by a fairly thick Ah or Ahe horizon, and a strongly structured B horizon that is slowly permeable. The C horizon is moderately calcareous and lime is usually found within 1 m of the surface.

Two mapping units were established for the Cucumber soil association.

Map combinations — The Cucumber soils occur in combination with Angus Ridge and Norma associations along the margins of glaciolacustrine areas where the sediments are shallow and outcrops of till are common.

Use — Most areas of Cucumber soils in the county are used as cropland. They are suitable for the production of all crops adapted to the area. A relatively high moisture-holding capacity enables the Cucumber soils to sustain crop growth during periods of moisture stress.

Culp soil association (CUP)

The Culp soil association comprises primarily Orthic Gray Luvisolic soils developed on an olive brown to yellowish brown glaciofluvial sandy parent material.

These soils are rapidly drained and are found on undulating to moderately rolling topography on the Whitefish Plain and Myrnam Upland.

The Culp soils are sandy and in their natural state are characterized by a thin Ah horizon (< 5 cm) that overlies a deep Ae horizon (20 to 30 cm). The Bt or Btj horizon is sandy loam to sandy clay loam in texture with a weakly developed structure. There are often distinct irregular fine-textured bands about 1 cm thick in the lower B and in the C horizons. Lime is usually at a depth greater than 1.5 m from the surface.

Two mapping units were used to describe the soils of the Culp association.

Map combinations — In areas of thin glaciofluvial deposition, Culp soils are often mapped in combination with soils of the Cooking Lake association.

Use — Culp soils have a limited production capability for agriculture. Low natural fertility, droughtiness and susceptibility to erosion are the main limiting factors. Some Culp soils are used for forage production and improved pasture.

Daysland soil association (DYD)

The Daysland soil association comprises mainly Black Solod soils developed on yellowish brown to dark grayish brown till. These soils are found in the western portion of the county on the Whitford Plain.

Daysland soils are generally moderately well drained and are associated with undulating to gently rolling ground moraine. A soil profile typical of Daysland soils consists of an Ah and/or Ahe horizon from 20 to 28 cm thick, a distinct eluviated Ae, and a Bnt horizon characterized by well-developed angular blocky structure. Weakly expressed columnar structure is evident in some profiles, but such structure usually breaks readily to angular blocky meso structure.

Five mapping units were established for the Daysland soil association.

Map combinations — Soils of the Daysland association were mapped with the Peace Hills soil association in some portions of the map area.

Use — The Black Solod soils are generally more easily managed and more productive than the Solonetz soils with which they are commonly associated in the landscape. The A horizon is thicker and the B horizon more pervious to water and plant roots. These soils are capable of producing all agricultural crops adapted to this area.

Demay soil association (DMY)

The Demay soil association includes Luvic Gleysols developed on medium to fine-textured till. These poorly drained soils occur throughout the county, but are most prevalent in the Myrnam Upland physiographic area.

Demay soils occupy lower slope and depressional locations in the landscape; the topography associated with these soils is generally level to depressional. Such soils develop in a relatively wet environment influenced by groundwater discharge or excess surface runoff from upland areas. Demay soils have a peaty surface horizon varying from 5 to 25 cm in thickness. This horizon is underlain by gleyed or mottled Aeg and Btg horizons.

One mapping unit was established for soils of the Demay soil association.

Map combinations — Demay soils are found in combination with Uncas and Cooking Lake soil associations in portions of the map area. They are also mapped in combination with Manatokan soils where the depth of peaty material is variable and often exceeds 40 cm.

Use — A limited amount of Demay soil is cultivated in the county. These soils are usually a minor constituent of other soil map units, so the use of the major soil constituent determines the use of the Demay soil.

Areas dominated by Demay soil are used for native pasture. Poor drainage and potential frost hazard limit these soils for agricultural use.

Desjarlais soil association (DSJ)

The Desjarlais soil association includes poorly drained Humic Gleysols developed on glaciofluvial sandy materials. These soils are found primarily in the western portion of the County on the Whitford Plain.

The soil profile of a Desjarlais soil is characterized by a loamy sand Ah or Ap horizon about 15 cm thick that is underlain by an extensively mottled, coarse-textured B horizon. In some locations, these soils are carbonated or saline. The topography on which the Desjarlais soils occur is level to gently undulating (plate 8).

Two mapping units were established for the Desjarlais soil association.

Use — Desjarlais soils are used primarily for the production of forage crops and for pasture. They are characterized by high water table levels and salinity, which limits their usefulness or capability for agricultural production. Because these soils are usually located adjacent to bodies of water, they may be inundated for short periods during the growing season.

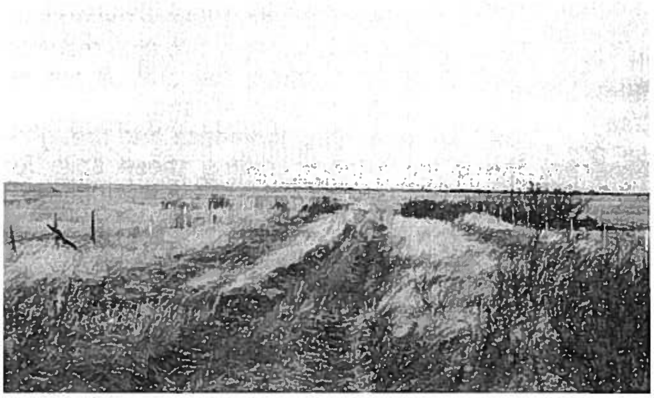


Plate 8. A Desjarlais soil area

Duagh soil association (DUG)

The Duagh soil association comprises mainly fine clayey Black Solonetz soils developed on glaciolacustrine sediments in the Whitford Plain physiographic district. These soils usually occur on fairly level topography adjacent to lakes or sloughs. Because of their location, they are often imperfectly drained.

Duagh soils are typically Solonetzic. The Ah horizon is thin (2 to 10 cm), the Ae is weakly developed and the Bnt is dense, relatively impermeable, and exhibits strong columnar structure. Lime and salts may occur at 25 cm from the surface.

One mapping unit was used to delineate soils of this association.

Use — Because of the undesirable characteristics of the Solonetzic B horizon and the relatively shallow Ah horizon, special care is required in cultivating these soils. They are used primarily for the production of forages and for native pasture in this area.

Falun soil association (FLU)

The Falun soil association comprises mainly Orthic Dark Gray Chernozemic soils developed on dark grayish brown to olive brown till.

These fine loamy soils are among the most extensive in the County of Two Hills and are found in all physiographic districts but most commonly in the Myrnam Upland. The topography is typical of both ground moraine and hummocky dead-ice moraine and varies from undulating to strongly rolling. The Falun soils are well-drained and slightly to very stony.

An Ah or Ahe horizon 10 to 50 cm thick is found at the surface. This horizon is underlain by a thin, weakly developed, often discontinuous Ae and a strong coarse granular to subangular blocky Bt or Btj horizon. Lime is usually at a depth greater than 75 cm from the surface.

Fourteen mapping units were established to describe the soils of the Falun association.

Map combinations — The Falun soil association is mapped in combination with several other soil associations. These combinations generally occur where there is a gradual change from one soil parent material to another. For example, along the margins of glaciolacustrine deposits, the Falun soil association is often mapped in combination with the Rimbey association;

Falun-Redwater and Falun-Two Hills combinations occur where thin glaciofluvial deposits overlie till; where till and bedrock outcrops are intimately mixed, Falun-Brosseau soil associations are commonly mapped.

Use — Falun soils are among those best suited for agriculture in the county (plate 9). They are cultivated on all classes of terrain including the strongly rolling class. It is in these areas of moderately to strongly rolling topography that soil erosion is most pronounced.

Falun soils are capable of producing all agricultural crops adapted to or normally grown in this area. Under good management, maximum returns can be expected from these soils.

Fawcett soil association (FWT)

Soils of the Fawcett association are fine loamy Dark Gray Luvisols developed on dark grayish brown to olive brown glaciolacustrine materials.

Fawcett soils are of limited areal extent in the county and are found primarily in the Myrnam Upland physiographic district. They are generally well drained and occur on undulating to gently rolling topography.

Typically, these soils have an Ah/Ahe horizon thickness of 13 to 25 cm, a distinct eluviated Ae and a weak to moderately well developed Bt horizon. Depth to lime is usually greater than 1 m.

Two mapping units were used to describe the Fawcett soil association.

Map combinations — In some locations, Fawcett soils are mapped in combination with Uncas soils, particularly where the glaciolacustrine sediments are shallow.

Use — The Fawcett soil areas in the county are almost entirely cultivated. They are best suited for the production of coarse grains and forage crops. These soils require the addition of fertilizers and organic matter to ensure maximum returns.

Ferintosh soil association (FNH)

The Ferintosh soil association includes Black Chernozemic soils developed on gravelly glaciofluvial deposits. Generally, these soils occur along glacial meltwater channels, the largest area being in the vicinity of Watt Lake.

These coarse-textured soils are generally rapidly drained and usually occur on gently undulating topography.

The surface texture is loamy sand, the B horizon loamy sand to sandy loam with a variable coarse fragment content, and the C horizon is very gravelly. Lime is usually found as a coating on the underside of stones in the C horizon.

Three mapping units were established to describe the soils of the Ferintosh association.

Map combinations — Soils of the Ferintosh soil association are mapped in combination with several other soil associations in the county. These include the Falun, Camrose and Peace Hills associations. The Ferintosh-Falun and Ferintosh-Camrose combinations occur where thin gravelly Ferintosh soils overlie till, while the Ferintosh-Peace Hills combination is found where deposits of sand and gravel are intimately mixed.

Use — Stoniness and droughtiness are the major factors limiting the use of Ferintosh soils for agriculture. Some cereal crops are grown where the Ah horizon is relatively thick, but generally these soils are utilized for native or improved pasture.

Hairy Hill soil association (HYL)

The Hairy Hill soil association includes poorly drained Humic Gleysol soils developed on till. These soils are found primarily on the Whitford Plain in lower slope positions where the topography ranges from depressional to very gently sloping. Such soils are developed and maintained by groundwater discharge and surface runoff. These soils are often found adjacent to sloughs and may in some locations be saline or carbonated.

The Hairy Hill soils are fine loamy and are typified by an Ah horizon, a mottled and gleyed Bg horizon and calcareous or saline Cks horizon.

Two mapping units were established for the Hairy Hill soil association.

Map combinations — Hairy Hill soils are mapped in combination with Ferintosh soils in locations where gravelly glaciofluvial deposits occur intermixed with till.

Use — Hairy Hill soils are not well suited to the production of agricultural crops. Excessive wetness coupled with high salinity and carbonate content limit these soils to the production of forage crops (plate 10). During years of abnormally high precipitation, some areas of Hairy Hill soils remain inundated for much of the growing season.

Plate 9. An area of productive Falun soils

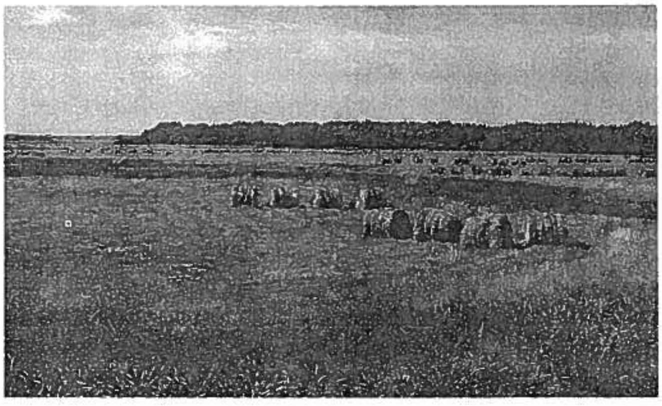


Plate 10. Hairy Hill soils are better suited for production of forage crops than cereal crops

Kapona soil association (KPO)
The Kapona soil association includes Black Solod and Black Solonetz soils developed on fine loamy glaciolacustrine sediments. These soils are found principally on the Whitford Plain. The Kapona soils are characterized by a relatively thick Ah horizon of 20 to 25 cm, Ahe, Ae and AB horizons and a Bnt horizon with a moderately coarse columnar structure that breaks to moderately blocky. The parent material is weakly saline and lime occurs at depths of 50 cm or greater.

One mapping unit was established to describe the soils of the Kapona association.

Use — Kapona soils are generally suited to the production of grain and forage crops.

Kavanagh soil association (KVG)
The Kavanagh soil association comprises mainly Black Solonetz soils developed on weathered bedrock of the Belly River Formation. These fine loamy soils are dark grayish brown to olive brown in color. In some locations they are slightly stony,indicating a thin deposit of glacial materials overlying the bedrock.

The surface Ah or Ap horizon is generally thin, ranging from 5 to 15 cm thick. The Bnt horizon is characterized by strong columnar structure and extremely hard consistence when dry. The parent material is saline and calcareous. The solum of Kavanagh soils has low permeability, often resulting in a mottled or gleyed appearance. In general, the soils are moderately well to imperfectly drained and are found on undulating to gently rolling topography.

Five mapping units were used to delineate areas of Kavanagh soils in the County of Two Hills.

Map combinations — Kavanagh soils are mapped in combination with Camrose and Falun soils in several areas where the till veneer overlying bedrock is relatively shallow.

Use — Although Kavanagh soils have characteristics that make them somewhat undesirable for agricultural production, many Kavanagh soil areas are cultivated. The relatively level topography on which they occur is probably the reason for their use. The productivity of these soils depends on the depth of the A horizon. Coarse grains and forages can be grown on those soils that have relatively thick Ah (Ap) horizons. Kavanagh soils with thin surface horizons are best suited to permanent pasture (plate 11).

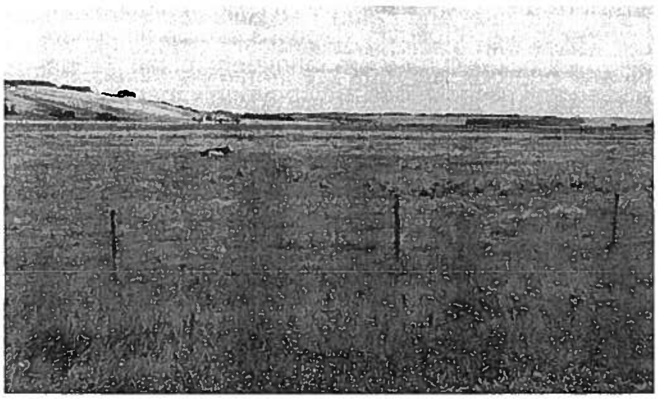


Plate 11. An area of Kavanagh soils best suited to unimproved pasture

Leith soil association (LIH)
The Leith soil association comprises mainly Dark Gray Luvisolic soils developed on glaciofluvial materials. These soils are found mainly on the Myrnam Upland near Myrnam and Derwent.

Leith soils are rapidly drained and occur on topography ranging from undulating to strongly rolling. In the natural state, an Ahe horizon of about 15 cm occurs at the surface and is underlain by a weakly structured sandy loam to loamy sand Btj horizon. The depth to lime is extremely variable in these sandy soils.

Seven mapping units were established to describe soils of the Leith association.

Map combinations — Leith soils are mapped in combination with other soils developed on till, glaciolacustrine and glaciofluvial materials. These include the Uncas, Fawcett and Snipe Hills soil associations.

Use — A considerable portion of the Leith soils in the County of Two Hills is cultivated. Forage and cereal crops account for most of the developed acreage with improved pasture next in importance. Cultivation of these soils, especially in areas of relatively steep terrain, has resulted in severe erosion or loss of the surface organo-mineral horizon. These soils are highly erodible and are best used for the production of forages and improved pasture.

Fertilizers are required to ensure adequate crop production on these soils.

Maughan soil association (MAA)
Gray Luvisolic soils characterize the Maughan soil association. These well-drained soils are found primarily on the Myrnam Upland near Derwent. The parent material is fine loamy weathered bedrock. The topography on which Maughan soils are found is generally strongly rolling to hilly. Such topography is a reflection of the underlying bedrock surface.

In their native state, Maughan soils have a leaf litter about 5 cm thick at the surface overlying a moderately to strongly developed Ae horizon. The Bt horizon is clay loam in texture with moderately well developed structure. Lime is seldom found within the control section of these soils.

One mapping unit was used to describe the soils of the Maughan association.

Map combinations — In areas of shallow till over bedrock, the Maughan soils are mapped in combination with Cooking Lake soils.

Use — Some Maughan soil areas are cultivated for the production of forage crops and, to a lesser extent, coarse grains. Many areas are used for native pasture. The agricultural capability of these soils is limited by their susceptibility to water erosion, somewhat low natural fertility and relatively steep topography.

Nicot soil association (NIT)
The Nicot soil association includes Eluviated and Orthic Eutric Brunisolic soils developed on coarse- textured glaciofluvial materials. These well-drained soils are

characterized by relatively weak horizon expression. In their native state, a leaf litter overlies a thin Ah horizon (less than 5 cm), the Ae is discontinuous and the B horizon shows a color change but insufficient clay accumulation to qualify as a Bt or Btj horizon. Lime is seldom present within the control section. Nicot soils occur on gently to strongly rolling topography.

Two mapping units were used to describe the soils of the Nicot association.

Map combinations — Nicot soils are mapped with Falun soils and with Two Hills soils in portions of the area.

Use — A limited proportion of the Nicot soil areas are cultivated and used for the production of coarse grains and forages. They are generally severely eroded. Many areas that had been cleared and cultivated at one time are now being used for improved pasture. Most Nicot soil areas are under tree cover and are used for native pasture. One Nicot soil area is being utilized as a site for a golf course near Derwent (plate 12).

Norma soil association (NRM)

The Norma soil association is comprised mainly of Solonetzic Black soils developed on fairly dense dark grayish brown to olive brown till. These soils are found primarily on ground moraine on the Whitford Plain. Norma soils generally occur on gently undulating to undulating topography and are well to imperfectly drained.

Soils of the Norma association have Ah or Ahe horizons 15 to 25 cm thick. The B horizon is weakly prismatic to blocky and commonly characterized by organic staining on the ped surfaces. Lime is found in the C horizon at depths of 45 cm or greater. The parent material is often weakly saline.

Three mapping units were used to delineate soils of the Norma association.

Use — Norma soils are capable of growing all agricultural crops adapted to or normally grown in this area.

Pathfinder soil association (PHF)

The Pathfinder soil association includes Dark Gray Luvisols developed on weathered bedrock (residual) parent material. These soils are geographically associated with Brosseau soils on the Myrnam Upland near Derwent. Pathfinder soils are generally coarse loamy compared to the fine loamy Brosseau soils. The landscapes on which Pathfinder soils occur are primarily a reflection of the underlying bedrock surface and the topography is generally strongly rolling to hilly.

The Pathfinder soil profile is characterized by a sandy loam Ahe horizon overlying a moderately well developed Ae. The Bt horizon is sandy loam to sandy clay loam with weakly-developed structure. Lime is seldom found within the control section,

Two mapping units were used to delineate soils of the Pathfinder association.

Map combinations — Soils of the Pathfinder association are mapped in combination with the Uncas association in areas where a shallow till deposit overlies bedrock.

Use — Soils of the Pathfinder association are used for both cereal and forage crop production. However, susceptibility to erosion, somewhat low natural fertility and relatively steep topography limit the capability of these soils.

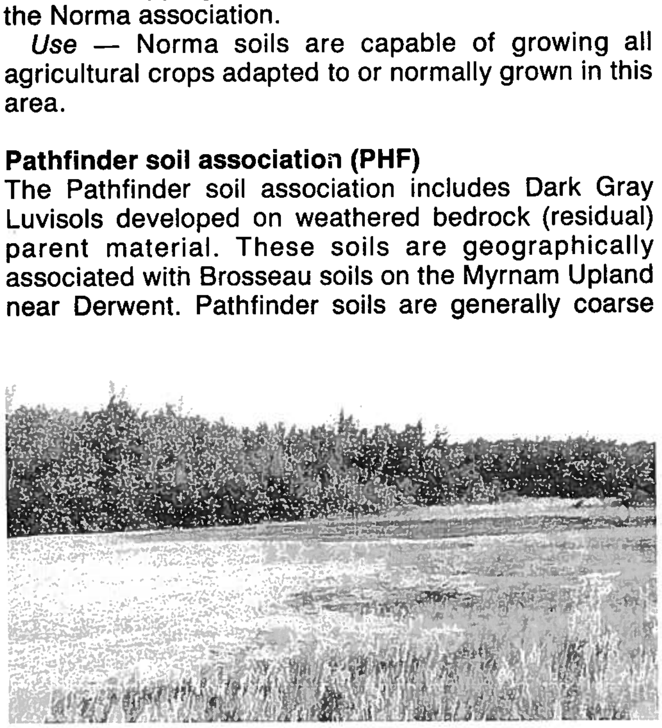


Plate 12. A golf course developed on Nicot soils

Peace Hills soil association (PHS)

The Peace Hills soil association comprises mainly sandy Orthic Black soils developed on glaciofluvial material. The mode of deposition of these materials appears to have been both by sedimentation in glacial lakes and as outwash deposits along post glacial stream channels. The Peace Hills soils are found primarily in the western portion of the county on the Whitford Plain.

Peace Hills soils occur on gently undulating to moderately rolling topography and are generally well drained.

Typically, these soils have a fairly thick sandy Ah horizon and a loose or friable sandy B horizon. Lime occurs in the subsoil but usually at a considerable depth from the surface.

Seven mapping unit were used to define the Peace Hills soil association.

Map combinations — The Peace Hills soil association is mapped in combination with five other soil associations — Angus Ridge, Ponoka, Fertintosh, Norma and Camrose. Such combinations are a result of the intimate mixing of the glaciofluvial parent material of the Peace Hills soils with other parent materials, notably till, glaciolacustrine and gravelly glaciofluvial deposits.

Use — Peace Hills soils are extensively cultivated within the county. The surface texture of these soils varies from sandy loam to loamy sand. The Peace Hills soils are susceptible to wind erosion, especially the more coarse textured members (plate 13). For this reason, a significant number of the Peace Hills soil areas are used for forage production and pasture. The finer textured (sandy loam) member is capable of growing wheat and coarse grains. Nitrogen and phosphorus fertilization is recommended to ensure adequate crop yields.

Ponoka soil association (POK)

The Ponoka soil association includes fine loamy Eluviated Black soils developed on glaciolacustrine materials. Soils of this association are found primarily in

Plate 13. The coarse-textured Peace Hills soils are susceptible to wind erosion

the Whitford Plain physiographic district on undulating to gently rolling topography. Generally, these soils are well drained except in some lower slope positions where some mottling in the solum indicates imperfect drainage.

The Ponoka soils are characterized by a relatively thick Ah horizon of 20 to 30 cm, an Ae horizon and a clay loam Bt or Btj horizon exhibiting a fairly strong subangular blocky structure. Lime is found in the C horizon at depths generally greater than 70 cm.

Four mapping units were established for the Ponoka soil association.

Map combinations — Soils of the Ponoka association were mapped in combination with the Angus Ridge, Peace Hills and Ferintosh associations. Such combinations occur where the glaciolacustrine sediments are intimately mixed with till, coarse glaciofluvial or gravelly glaciofluvial deposits.

Use — Soils of the Ponoka association are some of the most productive in the County of Two Hills. They are capable of producing all crops normally grown in the area. Caution should be exercised in cultivating Ponoka soils on the steeper topography because of a potential water erosion hazard.

Redwater soil association (RDW)

The Redwater soil association includes coarse loamy Orthic Dark Gray Chernozemic soils developed on glaciolacustrine materials. These include the sandy sediments northwest of the town of Two Hills which, according to Ellwood (1961), were deposited in Glacial Lake Two Hills. At the same time, some sandy parent material of the Redwater association was deposited as outwash marginal to postglacial drainage channels. Redwater soils are found primarily on the Whitford Plain and Myrnam Uplands.

Soils of the Redwater association are found on undulating to strongly rolling topography. These well to rapidly drained soils are stone free except where they are associated with gravelly glaciofluvial deposits.

A representative soil profile of the Redwater soils exhibits Ah and Ahe horizons at the surface, which may range up to 40 cm in thickness. The B horizon is sandy loam in texture, weakly structured and friable. The depth to lime is variable and may range from 1 to over 2 m from the surface.

Eleven mapping units were established to describe the soils of the Redwater soil association.

Map combinations — The Redwater soil association is mapped in combination with the Falun, Rimbey and Two Hills soil associations in various parts of the county.

Use — Redwater soils are extensively cultivated for the production of forage and cereal crops. To sustain production, sound management practices are essential, including the addition of plant nutrients and minimizing the wind erosion hazard.

Rimbey soil association (RMY)

The Rimbey association comprises mainly Orthic Dark Gray soils developed on glaciolacustrine materials. These fine silty to fine loamy soils are found primarily in the Whitford Plain and Myrnam Upland physiographic districts. They are well-drained and occur on undulating to strongly rolling topography.

A typical Rimbey soil profile is characterized by Ah and Ahe horizons 15 to 38 cm thick, a silt loam to silty clay loam weakly structured Bt horizon and a calcareous C horizon. The depth to lime is usually about 1 m.

Five mapping units were used to describe the soils of the Rimbey soil association.

Map combinations — The Rimbey soil association is mapped in combination with other soil associations where a complex pattern of soil parent material occurs. The combinations include Rimbey-Falun, Rimbey-Redwater and Rimbey-Two Hills.

Use — Rimbey soils are well-suited to the production of cereal and forage crops. They are, however, susceptible to erosion, which is evident on the more steeply sloping terrain. Caution must be exercised in agricultural practices to prevent water erosion on the more steeply sloping terrain.

Sante soil association (SXQ)

The Sante soil association includes fine loamy Solonetzic Black soils developed on glaciolacustrine sediments. These soils are of limited areal extent in the County of Two Hills and are confined to the Whitford Plain physiographic district. They are generally, moderately well drained and are found on uniform gently undulating to undulating topography.

Sante soils are characterized by an Ah horizon about 20 cm thick, a thin Ae horizon and a Btnj with strong columnar breaking to fine subangular blocky structure. Lime occurs at about 80 cm from the surface.

One mapping unit was used for describing the soils of the Sante soil association.

Use — Sante soils are suited to the production of wheat, coarse grains and forages.

Shandro soil association (SHZ)

The Shandro soil association includes poorly drained, fine clayey soils developed on weathered bedrock. These soils are generally both saline and carbonated and are found geographically associated with Solonetz soils on the Whitford Plain. They occur on depressional to undulating topography and are most frequently mapped in low-lying areas or in the bottom of old drainage channels.

The dominant soil profile in the Shandro association is a saline and carbonated Humic Gleysol. This soil is characterized by a silty clay Ah horizon about 15 cm thick, a mottled and gleyed Bskg horizon and a gleyed, saline and calcareous parent material.

One mapping unit was used to describe the Shandro soil association.

Use — Shandro soils have severe limitations for agricultural production. Because of poor drainage and adverse physical and chemical properties, they are seldom cultivated and are used primarily for native pasture.

Snipe Hills soil association (SNI)
Soils of the Snipe Hills association are mainly skeletal coarse loamy Dark Gray Luvisols developed on glaciofluvial material. These soils are of limited areal extent in the County of Two Hills and are found primarily on the Myrnam Upland. Generally, they are rapidly drained and found on undulating to moderately rolling topography.

The soils of the Snipe Hills association are characterized by weakly developed Ahe horizons 8 to 15 cm thick, an Ae horizon and a coarse sandy and gravelly Bt horizon. Lime is encountered at varying depths, but is often found as a coating on the underside of stones and pebbles.

Two mapping units describe the soils of the Snipe Hills association.

Map combinations — The Snipe Hills soil association is mapped in combination with the Uncas and Leith associations. With Uncas, the gravel is intermixed with till; with Leith, sand and gravel deposits are intimately mixed.

Use — Stoniness, droughtiness and to some extent climate are the major factors limiting the agricultural use of these soils. They are seldom cultivated, except when in association with other more suitable agricultural soils. They are used mainly for native pasture.

An important nonagricultural use is that of providing gravel for construction.

Two Hills soil association (TWH)
The Two Hills soil association comprises skeletal coarse loamy Orthic Dark Gray soils developed on glaciofluvial materials (plate 14). These gravelly deposits are found principally on the Whitford Plain and Myrnam Upland, near the town of Two Hills, and downstream from the town along the Vermilion River.

The well-drained Two Hills soils occur on undulating to moderately rolling topography. These soils are typically characterized by an Ah and Ahe horizon 13 to 25 cm thick, a variably textured coarse Bt and gravelly C horizon.

Three mapping units were established to define the Two Hills soil association.

Map combinations — Where gravelly glaciofluvial deposits occur in close proximity to till, the Two Hills soil association is often mapped in combination with the Falun association. In other areas, the combination of Two Hills and Redwater associations has been recognized where gravelly and sandy deposits are intimately mixed.

Plate 14. An Orthic Dark Gray soil typical of the Two Hills soil association

Use — Stoniness and droughtiness are the major limiting factors for agricultural use.

In areas where the A horizon is relatively thick, these soils are used for grain and forage production. In other areas, the tree cover has not been cleared and the land is used for grazing. A major use of these soil areas is to provide gravel for construction purposes. This is evident in the relatively large pit areas south of the town of Two Hills.

Uncas soil association (UCS)
The Uncas soil association includes fine loamy Dark Gray Luvisolic soils developed on till. Soils of this association are among the most commonly occurring in the county (plate 15) and are found in all physiographic districts, but are most prominent on the Myrnam Upland.

These well to moderately well drained soils are associated with a wide range of topography. They are found on both hummocky dead ice and ground moraine on which the topographic classes range from undulating to strongly rolling and hilly.

In their natural state, Uncas soils are characterized by Ah or Ahe horizons 10 to 25 cm thick, a prominent Ae usually greater than 8 cm and a sandy clay loam to clay loam Bt horizon with moderately to strongly developed subangular blocky structure. Lime is usually found below a depth of 1 m.

Ten mapping units were established to describe the soils of the Uncas soil associaton. Landscapes of two of these map units are illustrated in plates 16 and 17.

Map combinations — The Dark Gray Luvisolic Uncas soil represents an intergrade between the Dark Gray Chernozemic Falun soil and the Gray Luvisolic Cooking Lake soil. In some locations in the map area, these soil associations are mapped in combination.

Use — Uncas soils are extensively cultivated in the county. They are used for the production of cereal crops in addition to forage crops and pasture. In regard to wheat production, there is a possibility of frost damage

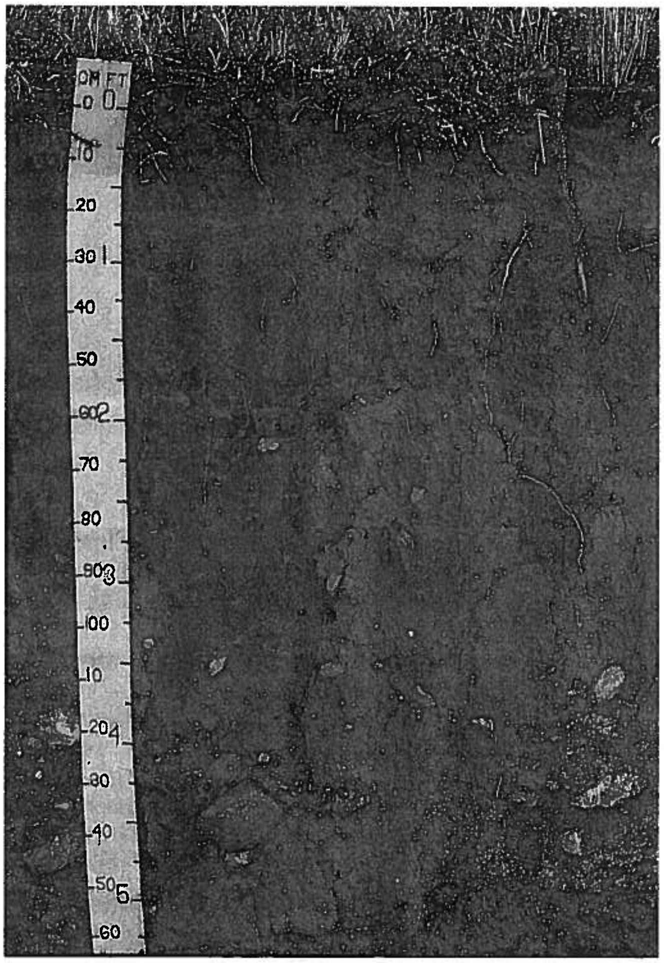


Plate 15. An Uncas soil profile

during some years. Uncas soils are susceptible to water erosion, especially in areas of moderately to strongly rolling terrain. They are quite productive following clearing and breaking, but lose this potential as organic matter levels decline and surface materials are eroded. Continued fertilization with nitrogen and phosphorus is required to correct the lower than optimum level of natural fertility.

Whitford soil association (WHF)

The Whitford soil association is a fine loamy Black

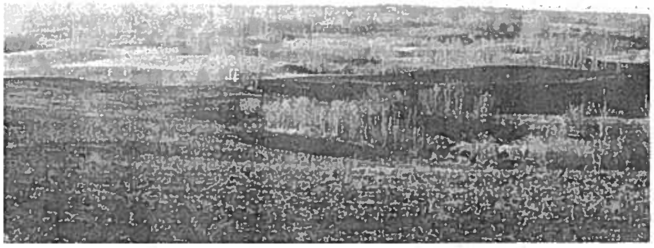


Plate 17. An area representative of the UCS10 map unit

Solonetz soil developed on a dense, saline till. In the Soil Survey report of the Edmonton Sheet 83-H (Bowser *et al.*, 1962), this soil is referred to as a Black Alkali Solonetz.

Whitford soils occur on the Whitford Plain in areas of gently undulating topography. They are usually imperfectly drained. The Ah horizon of Whitford soils is thin and rarely more than 5 to 8 cm thick. The Bnt horizon is clay loam to clay, dark brown and organic stained with strong, very hard columnar structure. Lime and salts are generally encountered at about 30 cm from the surface. These soils are slowly permeable.

Two mapping units were established to recognize the soils of the Whitford association.

Map combinations — Whitford-Kavanagh combinations are used where a till veneer over bedrock is thin. Whitford-Two Hills combinations are recognized along old meltwater channels where gravel deposits occur in association with a thin veneer of till over bedrock.

Use — Because of the relatively undesirable characteristics of the Solonetzic B horizon and the shallow Ah horizon, the Whitford soil is used primarily for permanent pasture (plate 18). This soil is not suited to the conventional tillage practices used for most other soils in the area.

Description of soil complexes

Alluvium complex (AV)

The Alluvium complex consists of a collection of

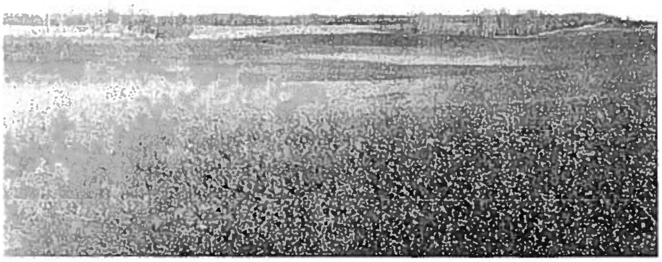


Plate 16. An area representative of the UCS1 map unit

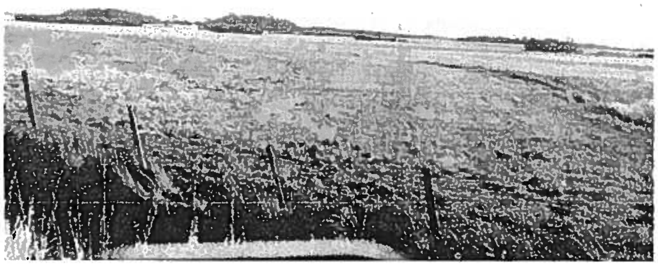


Plate 18. An area representative of the WHF1 map unit

heterogeneous soils developed on recent fluvial material along rivers and abandoned meltwater channels. These soils represent several categories in the taxonomic classification system including Chernozemic, Regosolic, Solonetzic and Gleysolic Orders. These soils are locally variable in texture, lime content, soil reaction (pH), organic matter content and stoniness. The topography on which they occur is generally nearly level to undulating but drainage is variable ranging from moderately well to poorly drained.

Six mapping units were used to delineate the soils of the Alluvium complex.

Use — Soils of the Alluvium complex are used quite extensively for agricultural production. Some areas are used for the production of coarse grains during relatively dry years. Other areas are used for the production of forage crops. The areas that are subject to flooding are used for the harvesting of native grasses and sedges as hay and for pasture land (plate 19). During wet years, these areas are generally inundated. The areas affected most by high water levels include lands adjacent to the Vermilion River.

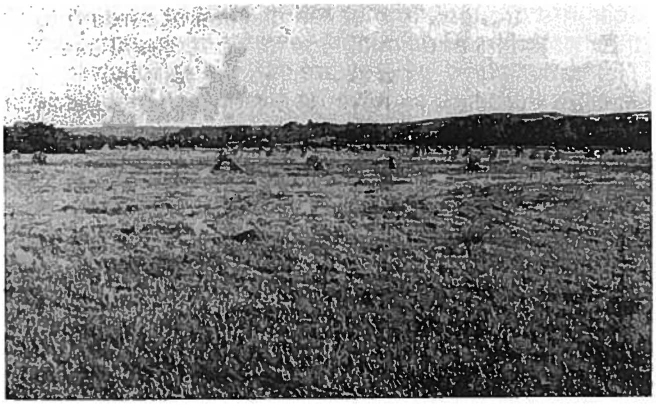


Plate 19. An Alluvium soil area used for hay production

Hilda complex (HD)

The Hilda complex includes Organic soils developed on mesic fen peat. Generally the peat layer is relatively shallow and overlies medium-textured sediments. The soils of the Hilda complex are common along the edges of sloughs and small lakes and in some depressional locations in the landscape.

These soils are developed and maintained under the influence of groundwater discharge and are usually saturated to within a few centimetres of the surface for a significant portion of the growing season. Sedges, coarse grasses and willow usually cover these soils.

One mapping unit was used to describe the soils of the Hilda complex.

Use — Soils of the Hilda complex have limited potential for agricultural use. At best they provide poor quality native pasture.

Manatokan complex (MN)

The Manatokan complex includes organic soils developed on mesic fen or forest peat. Generally, the organic layer is shallow and overlies medium-textured sediments. The most significant occurrence of this soil is found on the Myrnam Upland.

The Manatokan soils, like the soils of the Hilda complex, are developed under the influence of groundwater discharge and are generally saturated to near the surface for a significant portion of the growing season. They differ from the Hilda soils mainly in regard to the botanical origin of the organic layer. A fairly high component of the peat is of moss origin rather than sedge. The vegetative cover includes black spruce, willow, mosses, sedges and coarse grasses.

One mapping unit was established to describe the soils of the Manatokan complex.

Map combinations — Soils of the Manatokan complex are mapped in combination with soils of the Cooking Lake and Demay associations in portions of the map area. Such combinations usually occur where these soils are intimately mixed and the scale of mapping does not permit their separation.

Use — Manatokan soils have little potential for agricultural use. In some areas, they are included with other soils as native pasture.

Riverbank complex (RB)

The Riverbank complex includes Regosolic, Chernozemic and Luvisolic soils developed on colluvial deposits along the steeply sloping banks of rivers, drainage channels and escarpments.

The parent material of these soils is of variable texture and consists primarily of eroded sediments from glacial and recent deposits. Surface drainage varies from good to excessive.

Three mapping units were established to describe the soils of the Riverbank complex.

Use — Most of the Riverbank soils are unsuitable for cultivation. Generally, only the Chernozemic soils that occur on the more gentle slopes are cultivated but these areas account for only a minor portion of the total area of Riverbank soils. The remainder of the soils are used for native pasture or are not used at all. Most of the areas have a dense tree cover.

Soil survey interpretations

Soil capability for agriculture

The soil capability classification for agriculture is an interpretive soil grouping that can be made from soil survey data (Brocke, 1977). This classification system provides a method of evaluating the potential of a soil to produce certain crops.

The capability classification consists of two main categories:

- *capability class* — a grouping of classes having the same relative degree of limitation and hazard;
- *capability subclass* — a grouping of soils with similar kinds of limitations and hazards. Mineral

soils are grouped into seven classes according to their potential and limitations for agricultural use. The *capability classes* are defined as follows:

1. Soils in this class have no significant limitations in use for crops.
2. Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
3. Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.
4. Soils in this class have severe limitations that restrict the range of crops or require special conservation practices.
5. Soils in this class have severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible.
6. Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible.
7. Soils in this class have no capability for arable culture or permanent pasture.

Organic soils are not placed in capability classes and are indicated by the letter *O*.

The *capability subclasses* are based on characteristics that limit the agricultural use of the soil. They are as follows:

C - adverse climate
D - undesirable soil structure and/or low permeability
E - erosion damage
F - low natural fertility
I - inundation (flooding by streams or lakes)
M - moisture (low moisture holding capacity)
N - salinity
P - stoniness
R - shallowness to solid bedrock
S - soil limitations — a combination of two or more subclasses, D, F, M and N
T - adverse topography
W - excess water
X - minor cumulative limitations

Climate, soil properties and topography are the prime considerations in assessing areas for agricultural use.

Factors not considered in developing the rating include distance to market, kind of roads, size of farms, type of ownership, cultural patterns, skill or resources of individual operators and hazard of crop damage by storms.

Because soils having different limitations are not always separable in the field at the scale of mapping used, groupings are made for the agricultural capability classification.

Historically, soil capability for agriculture information has been presented in map form. The scale and the detail of the County of Two Hills soil map, however, make it impossible to include the soil capability ratings on the soil map. The ratings, therefore, are provided in a table in which all soil map units and combinations of map units in the area are listed alphabetically and a rating is applied. All combinations of topography and degree of stoniness are included. The use of a table to provide soil capability for agriculture ratings has the disadvantage that each individual area cannot be judged specifically on its characteristics. Areas designated on the soil map as having the same soil type, topography class and degree of stoniness would be assigned similar capability ratings in the table.

As mentioned previously, climate is a major factor in assessing soil capability for agriculture. Similar soil units occur in both agroclimatic subregions (1 and 2) within the county. The user should therefore determine which agroclimatic subregion is represented by a specific parcel of land. These subregions were established by Bowser (1967) and are illustrated in figure 6.

The following information is provided as an aid in interpreting the soil ratings. The large arabic numerals denote capability classes. Letters placed after class numerals denote the subclasses or limitations. Arabic numerals placed after a class numeral give the approximate proportion of the class out of a total of 10.

Rating	
1	Denotes an area of Class 1 soils with no limitations.
$1^{6}2^{3}_{P}6^{1}_{W}$	Denotes an area of Class 1 with no limitation, Class 2 with a stoniness limitation and Class 6 with excess moisture limitation in the proportions of 6:3:1.
$5^{T7}_{D}6^{3}_{W}$	Denotes an area of Class 5 with adverse topography and undesirable soil structure limitations and Class 6 with excess moisture and salinity in the proportion of 7:3.
$4^{T7}_{E}5^{2}_{P}6^{1}_{W}$	Denotes an area of Class 4 with adverse topography and erosion damage limitations, Class 5 with stoniness limitations and Class 6 with excess water limitations in the proportions of 7:2:1.
$2^{6}_{C}3^{3}_{M}6^{1}_{W}$	Denotes an area of Class 2 with adverse climate limitation, Class 3 with moisture (low moisture holding capacity) limitations and Class 6 with excess moisture limitation in the proportions of 6:3:1.

Agricultural soil capability ratings for the soils of the County of Two Hills are given in table 4.

Engineering properties of soils

Soil chemical and physical properties are important factors in the design, construction and maintenance of roads, pipelines, powerlines, buildings and various other facilities. In this regard, the soil properties of importance to the engineer are grain size distribution, plasticity, compaction, permeability, shrink-swell potential, permeability to water, drainage and salinity. Topography, depth to water table and depth to bedrock are important site factors. Some of these properties were evaluated for several soil associations in the County of Two Hills. Procedures for the analyses are outlined in the ASTM Book of Standards (1979). The data are presented in table 5.

Table 4. Agricultural soil capability ratings

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
AGS1/b1	1	
AGS1/c1,c2	1	
AGS1/d1,d2	3_{T}	
AGS1/d3	$3^{7}_{T}4^{3}_{P}$	
AGS1/e0,e1,e2	4_{T}	
AGS1/e3	$4^{7}_{T}5^{3}_{P}$	
AGS2/b1,b2	$1^{9}6^{1}_{W}$	
AGS2/b3	$1^{6}2^{3}_{P}6^{1}_{W}$	
AGS2/c0,c1,c2	$1^{9}6^{1}_{W}$	
AGS2/c3	$1^{6}2^{3}_{P}6^{1}_{W}$	
AGS2/d1,d2	$3^{9}_{T}6^{1}_{W}$	
AGS2/e1	$4^{9}_{T}6^{1}_{W}$	
AGS2/e3	$4^{6}_{T}5^{3}_{P}6^{1}_{W}$	
AGS2/f1	$5^{9}_{T}6^{1}_{W}$	
AGS3/b1	$1^{7}6^{3}_{W}$	
AGS3/c1	$2^{7}_{T}6^{3}_{W}$	
AGS3/d1,d2	$3^{7}_{T}6^{3}_{W}$	
AGS3/d3	$3^{5}_{T}4^{2}_{P}6^{3}_{W}$	
AGS3/e0	$4^{7}_{T}6^{3}_{W}$	
AGS4/d1,d2	$3^{T9}_{E}6^{1}_{W}$	
AGS4/e2	$4^{T9}_{E}6^{1}_{W}$	
AGS4/e3	$4^{T6}_{P}5^{3}_{E}6^{1}_{W}$	
AGS5/b1	$1^{9}6^{1}_{W}$	
AGS5/c1	$1^{9}6^{1}_{W}$	
AGS5/d1,d2	$3^{9}_{T}6^{1}_{W}$	
AGS6/c1	$2^{7}_{T}6^{3}_{W}$	
AGS7/c1,c2	$2^{7}_{T}6^{3}_{W}$	
AGS7/d1,d2	$3^{7}_{T}6^{3}_{W}$	
AGS7/d3	$3^{5}_{P}5^{2}_{P}6^{3}_{W}$	
AGS8/d1,d2	$3^{9}_{T}6^{1}_{W}$	
AGS1-FNH1/c1	$1^{8}3^{2}_{M}$	
AGS1-FNH1/d2	$3^{8}_{T}4^{2}_{M}$	
AGS1-FNH3/c2	$1^{8}3^{2}_{M}$	
AGS1-FNH3/d1,d2	3^{T}_{M}	
AGS1-PHS4/d1	$3^{7}_{T}4^{3}_{M}$	
AGS1-PHS5/d1	$3^{7}_{T}4^{2}_{M}6^{1}_{W}$	
AGS1-PHS7/e1	$4^{6}_{T}5^{3}_{M}6^{1}_{W}$	
AGS1-POK1/c1	1	
AGS1-POK1/d2	3_{T}	
AGS1-POK4/c0	$1^{9}6^{1}_{W}$	
AGS2-CCB1/d2	$3^{9}_{T}6^{1}_{W}$	
AGS2-CCB2/d1	$3^{9}_{T}6^{1}_{W}$	
AGS2-CCB2/e1	$4^{9}_{T}6^{1}_{W}$	
AGS2-FNH1/c1	$1^{7}3^{2}_{M}6^{1}_{W}$	
AGS2-FNH3/c1,c2	$1^{7}3^{2}_{M}6^{1}_{W}$	
AGS2-PHS1/e1	$4^{7}_{T}5^{2}_{M}6^{1}_{W}$	
AGS2-PHS5/c1	$1^{7}2^{2}_{M}6^{1}_{W}$	
AGS2-POK1/c1	$1^{9}6^{1}_{W}$	
AGS2-POK1/e1	$4^{9}_{T}6^{1}_{W}$	
AGS2-POK3/b0	$1^{9}6^{1}_{W}$	
AGS3-FNH1/c1	$2^{5}_{T}3^{2}_{M}6^{3}_{W}$	
AGS3-FNH3/c2	$2^{5}_{T}3^{2}_{M}6^{3}_{W}$	
AGS3-FNH3/c4	$2^{5}_{T}3^{2}_{P}6^{3}_{W}$	
AGS3-FNH3/d2	$3^{5}_{T}4^{2}_{M}6^{3}_{W}$	
AGS3-PHS5/b1	$1^{4}3^{3}_{M}6^{3}_{W}$	
AGS3-PHS5/c1	$2^{4}_{T}3^{3}_{M}6^{3}_{W}$	
AGS3-PHS5/e2	$4^{4}_{T}5^{3}_{M}6^{3}_{W}$	
AGS7-PHS5/c1	$2^{5}_{T}5^{2}_{M}6^{3}_{W}$	
ARM1/c0	$4^{9}_{D}6^{W1}_{N}$	
AV1/b0	2_{M}	3_{M}
AV1/c0,c1	2_{M}	3_{M}
AV1/d0,d1	3^{M}_{T}	4^{M}_{T}
AV2/b0	3_{M}	3_{M}
AV2/c0	3_{M}	3_{M}
AV2/d0	3_{T}	4_{T}
AV3/b0,b1	4^{N}_{M}	4^{N}_{M}
AV3/c0	4^{N}_{M}	4^{N}_{M}
AV3/d0	4^{N}_{M}	4^{N}_{M}
AV4/b0	3_{M}	3_{M}
AV4/c0	3_{M}	3_{M}
AV5/a0	5^{N}_{W}	5^{N}_{W}
AV5/b0	5^{N}_{W}	5^{N}_{W}
AV6/a0	6^{W}_{N}	6^{W}_{N}
AV6/c0	6^{W}_{N}	6^{W}_{N}

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
BSU1/b1		$2_C^7 3_E^3$
BSU1/c0,c1,c2		$2_C^7 3_E^3$
BSU1/d0,d1,d2		$3_T^7 3_E^3$
BSU1/e1,e2		4_E^T
BSU1/f1,f2		5_T
BSU2/d1		4_E^T
BSU2/e1		4_E^T
BSU2/f1		5_E^T
BSU2/g1		6_T
BSU3/c1,c2		$2_C^7 6_N^{W3}$
BSU3/d3		$3_T^5 4_P^2 6_N^{W3}$
BSU3/e1		$4_T^7 6_N^{W3}$
BSU4/d1		3_T
BSU5/d1		$3_T^7 4_D^3$
BSU5/e1		$4_T^7 5_D^3$
BSU6/c1		$2_C^5 4_D^2 6_W^3$
BSU6/d1		$3_T^5 4_D^2 6_W^3$
BSU1-FLU1/c1		$2_C^7 3_E^3$
BSU1-FLU1/d1		3_T
BSU1-FLU1/e1		4_T
BSU1-FLU1/f2		5_T
BSU1-FLU2/d1		$3_T^9 6_W^1$
BSU1-FLU2/e1		$4_T^9 6_W^1$
BSU1-FLU2/f1,f2		$5_T^9 6_W^1$
BSU1-FLU2/e1		$4_T^9 6_W^1$
BSU2-FLU2/e1		4_E^T
BSU2-FLU2/f1		5_E^T
BSU2-FLU6/f1,f2		5_E^T
BSU3/-FLU1/f1		$5_T^8 6_N^{W2}$
CCB1/b0	1	2_C
CCB1/c0	$1^9 6_W^1$	$2_C^9 6_W^1$
CCB1-AGS2/d2	$3_T^9 6_W^1$	$3_T^9 6_W^1$
CCB2-NRM1/e1	$4_T^9 6_W^1$	$4_T^9 6_W^1$
CCB2-AGS2/c1	$1^9 6_W^1$	$2_C^9 6_W^1$
CMO1/c0,c1,c2	$2_D^9 6_W^1$	
CMO1/c3	$2_D^7 3_P^2 6_W^1$	
CMO1/d1,d2	$3_T^{D9} 6_W^1$	
CMO1/d3	$3_T^{D7} 4_P^2 6_W^1$	
CMO1/e1	$4_D^{T9} 6_W^1$	
CMO1/e3	$4_D^{T7} 5_P^2 6_W^1$	
CMO2/a1	$2_D^8 6_N^{W2}$	
CMO2/b0,b1,b2	$2_D^8 6_N^{W2}$	
CMO2/c1,c2	$3_T^{D8} 6_N^{W2}$	
CMO2/c4	$3_T^{D6} 4_P^2 6_N^{W2}$	
CMO2/d1	$3_T^{D8} 6_N^{W2}$	
CMO2/d3,d4	$3_T^{D6} 4_P^2 6_N^{W2}$	
CMO2/e4	$4_T^{D6} 5_P^2 6_N^{W2}$	
CMO3/b1	$2_D^7 6_W^3$	$3_D^7 6_W^3$
CMO3/c1,c2	$2_D^7 6_W^3$	$3_D^7 6_W^3$
CMO3/c3	$2_D^5 3_P^2 6_W^3$	$3_D^5 4_P^2 6_W^3$
CMO3/d1,d2	$3_T^{D7} 6_W^3$	$3_D^5 4_P^2 6_W^3$
CMO4/c1	$2_D^6 1^2 6_W^2$	
CMO4/d1,d2	$3_T^{D8} 6_W^2$	
CMO4/e2	$4_D^{T8} 6_W^2$	
CMO1-AGS1/c1	$2_D^5 1^4 6_W^1$	
CMO1-FNH3/d3	$3_T^{D6} 3_M^3 6_W^1$	
CMO1-THH2/c3	$2_D^6 3_P^3 6_W^1$	
CMO1-TWH3/d3	$3_T^{D6} 3_P^3 6_W^1$	
CMO1-TWH3/c4	$2_D^6 3_P^3 6_W^1$	
CMO2-KVG2/d1	$3_T^{D7} 6_N^{W3}$	
CMO2-PHS6/b1	$2_D^5 4_M^2 6_W^3$	
COA1/c1,c2		3_D
COA1/d2,e1,e2		4_D^T
COA1/e3		$4_D^{T7} 5_P^3$
COA2/c1,c2		$3_D^9 6_W^1$
COA2/d1,d2		$3_D^9 6_W^1$
COA2/c3		$3_D^7 4_P^2 6_W^1$
COA2/d3		$3_D^7 4_P^2 6_W^1$
COA2/e1,e2		$4_D^{T9} 6_W^1$
COA2/e3		$4_D^{T7} 5_P^2 6_W^1$
COA2/f1,f2		$5_D^{T9} 6_W^1$
COA2/f3		$5_D^{T7} 6_P^2 6_W^1$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
COA3/c1,c2		$3_{D}^{6}6_{W}^{4}$
COA3/c4		$3_{D}^{4}4_{P}^{2}6_{W}^{4}$
COA3/d2		$4_{D}^{6}6_{W}^{4}$
COA3/d3		$4_{D}^{4}5_{P}^{2}6_{W}^{4}$
COA3/e1,e2,e3		$4_{D}^{T6}6_{W}^{4}$
COA3/f1,f2		$5_{D}^{T6}6_{W}^{4}$
COA3/f3		$5_{D}^{T4}6_{P}^{2}6_{W}^{4}$
COA4/c1,c2		$3_{D}^{9}6_{W}^{1}$
COA4/d1,d2		$4_{D}^{T9}6_{W}^{1}$
COA4/d3		$4_{D}^{T7}5_{P}^{2}6_{W}^{1}$
COA4/e1,e2		$4_{D}^{T9}6_{W}^{1}$
COA4/f1,f2		$5_{D}^{T9}6_{W}^{1}$
COA5/c1		$3_{D}^{6}6_{W}^{4}$
COA5/d1,d2		$4_{D}^{6}6_{W}^{4}$
COA5/e1,e2		$4_{D}^{T6}6_{W}^{4}$
COA5/e3		$4_{D}^{T4}5_{P}^{2}6_{W}^{4}$
COA5/f1,f2		$5_{D}^{T6}6_{W}^{4}$
COA1-CUP1/d1		$4_{D}^{T7}4_{M}^{3}$
COA1-CUP1/e2		$4_{D}^{T7}4_{M}^{3}$
COA1-CUP2/c2		$3_{D}^{7}4_{M}^{3}$
COA1-CUP2/e2		$4_{D}^{T6}5_{M}^{3}6_{W}^{1}$
COA2-CUP1/d1,d2		$4_{D}^{T7}4_{M}^{2}6_{W}^{1}$
COA2-CUP1/e1,e2		$4_{D}^{T7}4_{M}^{2}6_{W}^{1}$
COA2-CUP1/e3		$4_{D}^{T6}4_{M}^{3}6_{W}^{1}$
COA2-CUP1/f2		$5_{D}^{T7}5_{M}^{2}6_{W}^{1}$
COA2-CUP1/f3		$5_{D}^{T6}5_{M}^{3}6_{W}^{1}$
COA2-CUP1/g1		6_{T}
COA2-CUP2/c2		$3_{D}^{7}4_{M}^{2}6_{W}^{1}$
COA2-CUP2/d2		$4_{D}^{T7}4_{M}^{2}6_{W}^{1}$
COA2-MAA1/d2		$4_{D}^{T9}6_{W}^{1}$
COA2-MAA1/e1		$4_{D}^{T9}6_{W}^{1}$
COA2-CUN1/c2		$3_{D}^{6}4_{M}^{3}6_{W}^{1}$
COA2-CUN1/d3		$3_{D}^{6}4_{P}^{3}6_{W}^{1}$
COA2-CUN1/e3		$4_{D}^{T6}5_{P}^{3}6_{W}^{1}$
COA2-CUN1/e4		$4_{D}^{T6}5_{P}^{3}6_{W}^{1}$
COA2-CUN1/f3		$5_{D}^{T6}5_{P}^{3}6_{W}^{1}$
COA2-CUN2/c3		$3_{D}^{6}4_{P}^{3}6_{W}^{1}$
COA2-CUN2/d1		$4_{D}^{T6}5_{M}^{3}6_{W}^{1}$
COA2-CUN2/d3		$4_{D}^{T6}5_{P}^{3}6_{W}^{1}$
COA2-NIT1/e3		$4_{D}^{T6}5_{M}^{3}6_{W}^{1}$
COA3-CUN1/c1		$3_{D}^{4}4_{M}^{2}6_{W}^{4}$
COA3-CUN1/d3		$4_{D}^{T4}5_{P}^{2}6_{W}^{4}$
COA3-CUP1/d1,d2		$4_{D}^{T4}5_{M}^{2}6_{W}^{4}$
COA3-CUP1/,e1		$4_{D}^{T4}5_{M}^{2}6_{W}^{4}$
CUN1-CUP1/d5		5_{P}
CUN1-COA2/e4		$5_{P}^{7}4_{D}^{T3}$
CUN1-NIT1/d3		$5_{M}^{7}5_{P}^{3}$
CUN2-COA2/e2		$4_{M}^{7}4_{D}^{T3}$
CUP1/d0,d1		4_{M}
CUP1/e0,e1		4_{M}^{T}
CUP1/f0		5_{T}
CUP1/g0		6_{T}
CUP2/c1		$4_{M}^{9}6_{W}^{1}$
CUP2/d1		$4_{T}^{M9}6_{W}^{1}$
CUP1-COA1/d1,d3		$4_{M}^{7}4_{D}^{T3}$
CUP1-COA1/e1		$4_{M}^{7}4_{D}^{T3}$
CUP1-COA1/e3		$4_{M}^{7}4_{D}^{T3}$
CUP1-COA1/f1,f2		5_{T}
CUP1-COA1/f3		5_{D}^{T}
CUP1-COA2/d1		$4_{M}^{6}4_{D}^{T3}6_{W}^{1}$
CUP1-COA2/e1		$4_{M}^{6}4_{D}^{T3}6_{W}^{1}$
CUP1-COA2/f1		$5_{T}^{9}6_{W}^{1}$
DMY1/b1,c1		6_{W}
CUP2-COA2/d2		$4_{M}^{6}4_{D}^{T3}6_{W}^{1}$
CUP2-COA3/e1		$4_{M}^{5}4_{D}^{T3}6_{W}^{2}$
DSJ1/b0	3_{W}	
DSJ1/c0	3_{W}	
DSJ2/a0	5_{N}^{W}	
DSJ2/b0	5_{N}^{W}	
DUG1/a0	$3_{D}^{7}6_{N}^{W3}$	
DUG1/b0,b1	$3_{D}^{7}6_{N}^{W3}$	
DUG1/c0	$3_{D}^{7}6_{N}^{W3}$	
DYD1/c1,c2	$2_{D}^{5}3_{D}^{4}6_{W}^{1}$	
DYD1/d1,d2	$3_{D}^{T9}6_{W}^{1}$	
DYD1/e1	$4_{T}^{9}6_{W}^{1}$	
DYD2/b1	$2_{D}^{5}3_{D}^{2}6_{W}^{3}$	

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
DYD2/c1,c2	$2^{5}_{D}3^{2}_{D}6^{3}_{W}$	
DYD2/d1,d2	$3^{T7}_{D}6^{3}_{W}$	
DYD3/c2	$2^{5}_{D}1^{2}6^{3}_{W}$	
DYD3/d1	$3^{T7}_{D}6^{3}_{W}$	
DYD4/c2	$2^{7}_{D}1^{2}6^{1}_{W}$	
DYD4/d2	$3^{T7}_{D}1^{2}6^{1}_{W}$	
DYD4/e2	$4^{9}_{T}6^{1}_{W}$	
DYD5/c1,c2	$2^{5}_{D}1^{3}6^{2}_{W}$	
DYD5/d2	$3^{T8}_{D}6^{2}_{W}$	
DYD5/d3	$3^{T8}_{D}6^{2}_{W}$	
DYD5/e3	$4^{T8}_{D}6^{2}_{W}$	
DYD2-PHS3/b1	$2^{5}_{D}3^{2}_{M}6^{3}_{W}$	
DYD2-POK1/d1	$3^{T5}_{D}2^{2}_{T}6^{3}_{W}$	
FLU1/b1,b2		$2^{9}_{C}6^{1}_{W}$
FLU1/b4		$3^{9}_{P}6^{1}_{W}$
FLU1/c1,c2		$2^{9}_{C}6^{1}_{W}$
FLU1/c3		$3^{9}_{P}6^{1}_{W}$
FLU1/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU1/d3,d4		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU1/e1,e2		$4^{9}_{T}6^{1}_{W}$
FLU1/f2		$5^{9}_{T}6^{1}_{W}$
FLU1/g1		6_{T}
FLU2/c1,c2		$2^{6}_{C}3^{3}_{E}6^{1}_{W}$
FLU2/c3		$2^{6}_{C}3^{3}_{P}6^{1}_{W}$
FLU2/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU2/d3		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU2/e1,e2		$4^{9}_{T}6^{1}_{W}$
FLU2/e3		$4^{6}_{T}5^{3}_{P}6^{1}_{W}$
FLU2/f1,f2		5_{T}
FLU3/c1,c2		$2^{7}_{C}3^{3}_{E}$
FLU3/d1,d2		3_{T}
FLU3/d3		$3^{7}_{T}4^{3}_{P}$
FLU3/e1,e2		4_{T}
FLU3/e3		$4^{7}_{T}5^{3}_{P}$
FLU3/f1,f2		5_{T}
FLU3/g2		6_{T}
FLU4/c1,c2		$2^{5}_{C}3^{2}_{E}6^{3}_{W}$
FLU4/c3		$2^{5}_{C}3^{2}_{P}6^{3}_{W}$
FLU4/d1,d2		$3^{7}_{T}6^{3}_{W}$
FLU4/d3		$3^{5}_{T}4^{2}_{P}6^{3}_{W}$
FLU4/e1,e2		$4^{7}_{T}6^{3}_{W}$
FLU4/e3		$4^{5}_{T}5^{2}_{P}6^{3}_{W}$
FLU4/f1		$5^{7}_{T}6^{3}_{W}$
FLU5/b1,b2		$2^{7}_{C}6^{3}_{W}$
FLU5/b3		$2^{5}_{C}3^{2}_{P}6^{3}_{W}$
FLU5/c1,c2		$2^{7}_{C}6^{3}_{W}$
FLU5/c3		$2^{5}_{C}3^{2}_{P}6^{3}_{W}$
FLU5/d1,d2		$3^{7}_{T}6^{3}_{W}$
FLU5/d3		$3^{5}_{T}4^{2}_{P}6^{3}_{W}$
FLU5/e2		$4^{7}_{T}6^{3}_{W}$
FLU5/f2		$5^{7}_{T}6^{3}_{W}$
FLU6/e1,e2		$4^{T9}_{E}6^{1}_{W}$
FLU6/e3		$4^{T7}_{E}5^{2}_{P}6^{1}_{W}$
FLU6/f1,f2		5^{T}_{E}
FLU7/e1		$4^{T7}_{E}6^{3}_{W}$
FLU8/c1		$2^{7}_{C}6^{3}_{W}$
FLU8/d1,d2		$3^{7}_{T}6^{3}_{W}$
FLU8/f2		$5^{7}_{T}6^{3}_{W}$
FLU9/c1		$2^{6}_{C}3^{3}_{E}6^{1}_{W}$
FLU9/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU9/d3		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU9/e1,e2		$4^{9}_{T}6^{1}_{W}$
FLU9/e3		$4^{7}_{T}5^{2}_{P}6^{1}_{W}$
FLU9/f1,f2		5_{T}
FLU9/f3		5^{T}_{P}
FLU10/d1,		$3^{6}_{T}4^{3}_{E}6^{1}_{W}$
FLU10/e0		$4^{T9}_{E}6^{1}_{W}$
FLU10/f1		5_{T}
FLU11/b2		$2^{6}_{C}3^{3}_{D}6^{1}_{W}$
FLU11/c1		$2^{6}_{C}3^{3}_{D}6^{1}_{W}$
FLU11/d1,d2		$3^{6}_{T}4^{3}_{D}6^{1}_{W}$
FLU11/f1,f2		$5^{T9}_{D}6^{1}_{W}$
FLU12/d1		$4^{T9}_{E}6^{1}_{W}$
FLU13/c2		$2^{5}_{C}3^{2}_{E}6^{3}_{W}$
FLU13/d1,d2		$3^{7}_{T}6^{3}_{W}$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
FLU13/e1,e2		$4^{7}_{T}6^{3}_{W}$
FLU14/c1,c2		$2^{9}_{C}6^{1}_{W}$
FLU14/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU14/d3		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU14/e1,e2		$4^{9}_{T}6^{1}_{W}$
FLU14/f2		$5^{9}_{T}6^{1}_{W}$
FLU1-AV1/c1		$2^{7}_{C}3^{3}_{M}$
FLU1-BSU1/c1		$2^{9}_{C}6^{1}_{W}$
FLU1-BSU1/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU1-CMO3/c1		$2^{6}_{C}3^{3}_{D}6^{1}_{W}$
FLU1-RDW1/c1,c2		$2^{7}_{C}3^{3}_{M}$
FLU1-RDW1/c3		$2^{7}_{C}3^{3}_{M}$
FLU1-RDW1/d1,d2		$3^{7}_{T}3^{3}_{M}$
FLU1-RDW1/f1		5_{T}
FLU1-RDW3/c3		$2^{7}_{C}3^{3}_{M}$
FLU1-RDW7/c1		2_{C}
FLU1-RDW7/d1,d2		3_{T}
FLU1-RDW7/e1		4_{T}
FLU1-RMY1/b1		2_{C}
FLU1-RMY1/c1,c2		2_{C}
FLU1-RMY1/d1,d2		3_{T}
FLU1-RMY2/d1		3_{T}
FLU1-TWH1/b2		$2^{7}_{C}3^{3}_{M}$
FLU1-TWH1/c1,c2		$2^{7}_{C}3^{3}_{M}$
FLU1-TWH1/c3,c4		$2^{7}_{C}3^{3}_{P}$
FLU1-TWH1/d1,d2		$3^{7}_{T}4^{3}_{M}$
FLU1-TWH1/d3		$3^{7}_{T}4^{3}_{P}$
FLU1-TWH1/e2		4^{T}_{M}
FLU1-TWH1/e3		4^{T}_{P}
FLU1-TWH1/f4		5^{T}_{P}
FLU1-TWH2/c2		$2^{7}_{C}3^{3}_{M}$
FLU1-TWH2/c3		$2^{7}_{C}3^{3}_{P}$
FLU1-TWH2/d2		$3^{7}_{T}4^{3}_{M}$
FLU1-TWH3/c1,c2		$2^{6}_{C}3^{3}_{M}6^{1}_{W}$
FLU1-TWH3/d1,d2		$3^{9}_{T}6^{1}_{W}$
FLU1-TWH3/d3		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU1-TWH3/e2		$4^{9}_{T}6^{1}_{W}$
FLU1-TWH3/e3		$4^{T9}_{P}6^{1}_{W}$
FLU1-TWH3/f4		5^{T}_{P}
FLU2-AV1/c1		$2^{6}_{C}3^{3}_{M}6^{1}_{W}$
FLU2-AV1/e1,e2		$4^{6}_{T}5^{3}_{M}6^{1}_{W}$
FLU2-BSU1/d1,d2		$3^{6}_{T}4^{3}_{E}6^{1}_{W}$
FLU2-BSU1/e1,e2		$4^{9}_{T}6^{1}_{W}$
FLU2-BSU1/f1		$5^{9}_{T}6^{1}_{W}$
FLU2-KVG1/e1		$4^{6}_{T}5^{3}_{D}6^{1}_{W}$
FLU2-RDW1/d1		$3^{6}_{I}4^{3}_{M}6^{1}_{W}$
FLU2-RDW1/e2		$4^{T9}_{M}6^{1}_{W}$
FLU2-RDW1/e3		$4^{T9}_{P}6^{1}_{W}$
FLU2-RDW1/f2		$5^{9}_{T}6^{1}_{W}$
FLU2-RDW3/c1		$2^{6}_{C}3^{3}_{M}6^{1}_{W}$
FLU2-RDW3/d3		$3^{7}_{T}4^{2}_{P}6^{1}_{W}$
FLU2-RDW3/e2		$4^{T9}_{M}6^{1}_{W}$
FLU2-RDW4/d1,d2		$3^{6}_{T}4^{E3}_{M}6^{1}_{W}$
FLU2-RDW4/e1		$4^{7}_{T}5^{2}_{M}6^{1}_{W}$
FLU2-RDW7/c1,c2		$2^{6}_{C}3^{3}_{M}6^{1}_{W}$
FLU2-RDW7/d2		$3^{6}_{T}4^{3}_{M}6^{1}_{W}$
FLU2-RDW7/e1,e2		$4^{6}_{T}5^{3}_{M}6^{1}_{W}$
FLU2-RDW7/e3		$4^{6}_{T}5^{3}_{M}6^{1}_{W}$
FLU2-RDW8/b2		$2^{6}_{C}3^{3}_{M}6^{1}_{W}$
FLU2-RMY2/d2		$3^{9}_{T}6^{1}_{W}$
FLU2-RMY3/d1		$3^{9}_{T}6^{1}_{W}$
FLU2-RMY5/c1		$2^{9}_{C}6^{1}_{W}$
FLU2-RMY5/d1		$3^{9}_{T}6^{1}_{W}$
FLU2-RMY5/e2		$4^{9}_{T}6^{1}_{W}$
FLU2-TWH1/f3		$5^{T9}_{P}6^{1}_{W}$
FLU2-TWH2/d3		$3^{6}_{T}4^{3}_{P}6^{1}_{W}$
FLU2-TWH3/d2		$3^{9}_{T}6^{1}_{W}$
FLU2-TWH3/e2		$4^{9}_{T}6^{1}_{W}$
FLU2-TWH3/e3		$4^{6}_{T}5^{3}_{P}6^{1}_{W}$
FLU3-RDW1/d2		$3^{7}_{T}4^{3}_{M}$
FLU3-RDW1/e2		4^{T}_{M}
FLU3-RDW1/f2		5_{T}
FLU3-RDW3/d1		$3^{7}_{T}4^{3}_{M}$
FLU3-RDW4/f1		5_{T}
FLU3-TWH1/e2		4_{T}
FLU3-TWH1/e3		$4^{7}_{T}5^{3}_{P}$
FLU4-BSU1/d1		$3^{5}_{T}4^{3}_{E}6^{2}_{W}$
FLU4-BSU1/e1,e2		$4^{T8}_{E}6^{2}_{W}$
FLU4-RDW1/d1		$3^{5}_{T}4^{3}_{M}6^{2}_{W}$
FLU4-RDW1/e1		$4^{5}_{T}5^{3}_{M}6^{2}_{W}$
FLU4-RMY2/d2		$3^{8}_{T}6^{2}_{W}$
FLU4-TWH1/b2		$2^{5}_{C}3^{3}_{M}6^{2}_{W}$
FLU4-TWH1/e1		$4^{5}_{T}5^{3}_{M}6^{2}_{W}$
FLU4-TWH3/c2		$2^{8}_{C}6^{2}_{W}$
FLU4-TWH3/d4		$3^{5}_{T}4^{3}_{P}6^{2}_{W}$
FLU4-TWH3/e2		$4^{8}_{T}6^{2}_{W}$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
FLU4-TWH3/f3		5^{T}_{P}
FLU5-BSU1/d1		$3^{6}_{T}4^{2}_{E}6^{2}_{W}$
FLU5-BSU2/d1		$3^{6}_{T}4^{2}_{E}6^{2}_{W}$
FLU5-MN1/c1		$2^{6}_{C}6^{2\,2}_{WO}$
FLU5-RDW1/b2		$2^{5}_{C}3^{3}_{M}6^{2}_{W}$
FLU5-RDW1/d1,d2		$3^{5}_{T}4^{3}_{M}6^{2}_{W}$
FLU5-RDW1/e2		$4^{5}_{T}5^{3}_{M}6^{2}_{W}$
FLU5-RDW1/f1		$5^{8}_{T}6^{2}_{W}$
FLU5-RDW3/c2		$2^{5}_{C}3^{3}_{M}6^{2}_{W}$
FLU5-RDW3/e2		$4^{5}_{T}5^{3}_{M}6^{2}_{W}$
FLU5-RMY1/c1		$2^{8}_{C}6^{2}_{W}$
FLU5-TWH1/c4		$2^{5}_{C}3^{3}_{P}6^{2}_{W}$
FLU5-TWH2/d3		$3^{5}_{T}4^{3}_{P}6^{2}_{W}$
FLU6-BSU1/f1		$5^{T\,9}_{E}6^{1}_{W}$
FLU6-BSU2/e1		$5^{T\,9}_{E}6^{1}_{W}$
FLU6-LIH1/f1		$5^{T\,9}_{E}6^{1}_{W}$
FLU6-RDW8/d2		$3^{7}_{T}4^{3}_{E}$
FLU6-RDW8/e1		4^{T}_{E}
FLU6-RDW8/f2		5^{T}_{E}
FLU9-BSU4/e1		$4^{6}_{T}5^{3}_{E}6^{1}_{W}$
FLU9-BSU4/f1		5_{T}
FLU9-RDW1/e3		$4^{7}_{T}5^{2}_{E}6^{1}_{W}$
FNH1/b3		3_{M}
FNH1/b4		4_{P}
FNH1/c1		3_{M}
FNH1/d0,d2		3^{M}_{T}
FNH1/e3		4^{T}_{M}
FNH1/f3		5^{T}_{P}
FNH2/c2,c3		$3^{8}_{M}6^{2}_{W}$
FNH2/d2		$3^{M\,8}_{T}6^{2}_{W}$
FNH3/c2		3^{M}
FNH3/d1		3^{M}_{T}
FNH1-PHS1/c3		3_{M}
FNH1-RDW5/d2		$3^{M\,9}_{T}6^{1}_{W}$
FNH2-CMO3/d3		$4^{M\,5}_{T}3^{2}_{D}6^{3}_{W}$
FNH2-PSH1/b4		$3^{M\,9}_{P}6^{1}_{W}$
FNH2-PHS1/d1		$3^{M\,9}_{T}6^{1}_{W}$
FNH3-AGS1/b2		$3^{6}_{M}1^{4}$
FNH3-AGS2/b3		$3^{6}_{P}1^{4}$
FNH3-AGS2/c2		$3^{6}_{M}1^{4}$
FNH3-AGS2/d2		3^{M}_{T}
FNH3-AGS2/d3		$3^{7}_{M}4^{T\,3}_{P}$
FWT1/c0		3_{D}
FWT2/c0		$3^{9}_{D}6^{1}_{W}$
FWT2/d0		$4^{T\,9}_{D}6^{1}_{W}$
FWT2/f1		5_{T}
FWT1-UCS1/d0,d1		3^{D}_{T}
FWT1-UCS1/e1		4^{T}_{D}
FWT1-LIH2/e0		$4^{T\,7}_{D}5^{3}_{M}$
HD/a0	0	0
HD/b0	0	0
HYL1/a0,a1	$5^{7}_{N}6^{W\,3}_{N}$	
HYL1/b0,b1,b2,b3	$5^{7}_{N}6^{W\,3}_{N}$	
HYL1/c1,c2,c3	$5^{7}_{N}6^{W\,3}_{N}$	
HYL1/d2	$5^{7}_{N}6^{W\,3}_{N}$	
HYL2/b0,b1,b2	$6^{W\,6}_{N}5^{D\,4}_{W}$	$6^{W\,6}_{N}5^{D\,4}_{W}$
HYL2/c1,c2	$6^{W\,6}_{N}5^{D\,4}_{W}$	$6^{W\,6}_{N}5^{D\,4}_{W}$
HYL2/e2	$6^{W\,6}_{N}5^{D\,4}_{W}$	$6^{W\,6}_{N}5^{D\,4}_{W}$
HYL2-FNH3/b2,c2	$6^{W\,7}_{N}3^{3}_{M}$	
KPO1/c0,d0	$4^{9}_{D}6^{W\,1}_{N}$	
KVG1/d1	4_{D}	4_{D}
KVG1/d3	$4^{7}_{D}5^{3}_{P}$	$4^{7}_{D}5^{3}_{P}$
KVG1/e1,e2	4^{T}_{D}	4^{T}_{D}
KVG1/f3	5^{T}_{D}	5^{T}_{D}
KVG2/a0	$4^{7}_{D}6^{W\,3}_{N}$	$4^{7}_{D}6^{W\,3}_{N}$
KVG2/b0,b1,b2	$4^{7}_{D}6^{W\,3}_{N}$	$4^{7}_{D}6^{W\,3}_{N}$
KVG2/b3	$4^{5}_{D}5^{2}_{P}6^{W\,3}_{N}$	$4^{5}_{D}5^{2}_{P}6^{W\,3}_{N}$
KVG2/c0,c1	$4^{7}_{D}6^{W\,3}_{N}$	$4^{7}_{D}6^{W\,3}_{N}$
KVG2/c3	$4^{5}_{D}5^{2}_{P}6^{W\,3}_{N}$	$4^{5}_{D}5^{2}_{P}6^{W\,3}_{N}$
KVG2/d1	$5^{T\,7}_{D}6^{W\,3}_{N}$	$5^{T\,7}_{D}6^{W\,3}_{N}$
KVG2/d4	$5^{T\,5}_{D}6^{2}_{P}6^{W\,3}_{N}$	$5^{T\,5}_{D}6^{2}_{P}6^{W\,3}_{N}$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
KVG3/b0	$3^{6}_{D}4^{2}_{M}6^{2}_{W}$	$3^{6}_{D}4^{2}_{M}6^{2}_{W}$
KVG3/b3,c3	$3^{6}_{D}4^{2}_{P}6^{2}_{W}$	$3^{6}_{D}4^{2}_{P}6^{2}_{W}$
KVG4/d1	$4^{7}_{D}3^{3}_{T}$	$4^{7}_{D}3^{3}_{T}$
KVG4/f1	5_{T}	5_{T}
KVG5/d1	$4^{4}_{D}3^{3}_{T}6^{3}_{W}$	$4^{4}_{D}3^{3}_{T}6^{3}_{W}$
KVG1-CMO1/e3	$4^{8}_{D}5^{2}_{P}$	
KVG1-CMO1/f3	5^{T}_{P}	5^{T}_{P}
KVG2-CMO1/c1	$4^{7}_{D}6^{3}_{W}$	$4^{7}_{D}6^{3}_{W}$
KVG2-CMO1/d1	$4^{7}_{D}6^{3}_{W}$	$4^{7}_{D}6^{3}_{W}$
LIH1/c0,c1,c3		$4^{9}_{M}6^{1}_{W}$
LIH1/e0,e1,e2		$4^{T9}_{M}6^{1}_{W}$
LIH1/f1,f2		$5^{T9}_{M}6^{1}_{W}$
LIH2/c0,c2		$4^{5}_{M}5^{4}_{E}6^{1}_{W}$
LIH2/d0,d1,d2		$4^{M9}_{E}6^{1}_{W}$
LIH2/e0,e1,e2,e3		$4^{T5}_{M}5^{4}_{E}6^{1}_{W}$
LIH2/f0,f1		$5^{T9}_{M}6^{1}_{W}$
LIH3/d0,d1		$4^{M9}_{E}6^{1}_{W}$
LIH3/e0,e1		$5^{M9}_{E}6^{1}_{W}$
LIH3/f0,f1		$6^{T9}_{M}6^{1}_{W}$
LIH4/d0		$4^{9}_{M}6^{1}_{W}$
LIH4/c0,c1		$4^{M9}_{E}6^{1}_{W}$
LIH5/d2		$4^{T5}_{M}5^{4}_{E}6^{1}_{W}$
LIH5/f1		6^{T}_{M}
LIH6/d0		$5^{M9}_{E}6^{1}_{W}$
LIH7/c0		$4^{6}_{M}6^{4}_{W}$
LIH7/d0		$4^{T6}_{M}6^{4}_{W}$
LIH1-FWT1/e0		$4^{6}_{T}4^{T3}_{D}6^{1}_{W}$
LIH1-FWT2/d0		$4^{6}_{M}3^{3}_{D}6^{1}_{W}$
LIH1-FWT2/e0		$4^{T6}_{M}4^{T3}_{D}6^{1}_{W}$
LIH1-FWT2/f0		$5^{9}_{T}6^{1}_{W}$
LIH1-SNI1/c2		$4^{9}_{M}6^{1}_{W}$
LIH1-SNI1/c3		$4^{7}_{M}5^{2}_{P}6^{1}_{W}$
LIH1-SNI1/e3		$4^{7}_{M}5^{2}_{P}6^{1}_{W}$

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
LIH1-UCS1/c1		$4^{6}_{M}3^{3}_{D}6^{1}_{W}$
LIH1-UCS1/d1,d2		$4^{6}_{M}3^{3}_{D}6^{1}_{W}$
LIH1-UCS1/e1		$4^{T6}_{M}4^{3}_{D}6^{1}_{W}$
LIH1-UCS1/f3		$5^{T9}_{M}6^{1}_{W}$
LIH1-UCS2/d1		$4^{6}_{M}3^{3}_{D}6^{1}_{W}$
LIH1-UCS2/d3		$4^{6}_{M}4^{3}_{P}6^{1}_{W}$
LIH1-UCS2/e1		$4^{T6}_{M}4^{T3}_{D}6^{1}_{W}$
LIH2-FLU1/b3		$4^{M6}_{E}3^{3}_{P}6^{1}_{W}$
LIH2-SNI1/e2		$4^{M9}_{E}6^{1}_{W}$
LIH2-SNI1/e3		$4^{M7}_{E}5^{2}_{P}6^{1}_{W}$
LIH2-SNI2/e1		$4^{M9}_{E}6^{1}_{W}$
LIH2-UCS1/d1,d2		$4^{M6}_{E}3^{3}_{D}6^{1}_{W}$
LIH2-UCS1/e1,e2		$4^{T6}_{6}4^{T3}_{D}6^{1}_{W}$
LIH2-UCS1/f1		$5^{9}_{T}6^{1}_{W}$
LIH3-UCS1/e1,e2		$5^{M6}_{E}4^{T3}_{D}6^{1}_{W}$
LIH3-UCS1/f2		$5^{T6}_{M}5^{T3}_{D}6^{1}_{W}$
LIH4-UCS1/e1		$4^{T6}_{M}4^{T3}_{D}6^{1}_{W}$
LIH5-UCS2/e1		$5^{M6}_{E}4^{T3}_{D}6^{1}_{W}$
MAA1/f1		$5^{T9}_{D}6^{1}_{W}$
MAA1-COA1/f1		$5^{T9}_{D}6^{1}_{W}$
MN1/a0,b0,b1,c0,c1		0
MN1-DMY1/b0,b1		$0^{7}6^{3}_{W}$
MN1-COA1/d0		$0^{7}4^{3}_{D}$
NIT1/c0,c1,c2,c3		5_{M}
NIT1/d0,d1,d2		5_{M}
NIT1/e0		5^{T}_{M}
NIT1/f0,f1		6^{T}_{M}
NIT2/c0		$5^{7}_{M}2^{2}_{C}6^{1}_{W}$
NIT2/d0,d1		$5^{7}_{M}3^{2}_{T}6^{1}_{W}$
NIT2/e0,e1		$5^{7}_{M}4^{2}_{T}6^{1}_{W}$
NIT2/f0		6^{T}_{M}
NIT1-UCS2/e1		$5^{6}_{M}4^{T3}_{D}6^{1}_{W}$
NIT1-TWH1/e1		$5^{6}_{M}4^{T3}_{D}6^{1}_{W}$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
NRM1/b1,b2	$1^{9}6^{1}_{W}$	$2^{9}_{C}6^{1}_{W}$
NRM1/c1,c2	$1^{9}6^{1}_{W}$	$2^{9}_{C}6^{1}_{W}$
NRM1/d1,d2	$3^{9}_{T}6^{1}_{W}$	$4^{9}_{T}6^{1}_{W}$
NRM1/d3	$3^{6}_{T}4^{3}_{P}6^{1}_{W}$	$4^{6}_{T}5^{3}_{P}6^{1}_{W}$
NRM1/e1,e2	$4^{9}_{T}6^{1}_{W}$	$5^{9}_{T}6^{1}_{W}$
NRM2/b3	$1^{5}2^{2}_{P}6^{3}_{W}$	$2^{5}_{C}3^{2}_{P}6^{3}_{W}$
NRM2/c1	$2^{7}_{T}6^{3}_{W}$	$2^{7}_{C}6^{3}_{W}$
NRM3/c1	$2^{5}_{T}3^{2}_{D}6^{3}_{W}$	$2^{5}_{C}3^{2}_{D}6^{3}_{W}$
NRM3/d1	$3^{5}_{T}4^{2}_{D}6^{3}_{W}$	$3^{5}_{T}4^{2}_{D}6^{3}_{W}$
NRM1-FNH1/c2	$1^{7}2^{2}_{M}6^{1}_{W}$	
NRM1-PHS1/d1	$1^{7}2^{2}_{M}6^{1}_{W}$	
NRM1-PHS7/d1	$1^{5}2^{2}_{M}6^{3}_{W}$	
PHF1/d1		$3^{9}_{T}6^{1}_{W}$
PHF1/e0,e1		$4^{9}_{T}6^{1}_{W}$
PHF1/e3		$4^{T\,9}_{P}6^{1}_{W}$
PHF1/f1		$5^{9}_{T}6^{1}_{W}$
PHF1-UCS1/e1		$5^{9}_{T}6^{1}_{W}$
PHS1/b0,b2	2_{M}	
PHS1/c0,c1	2_{M}	
PHS1/d0,d1	3^{M}_{T}	
PHS1/e0,e1	4^{T}_{M}	
PHS2/c0,c1	2_{M}	
PHS2/d0,d1,d2	3^{M}_{E}	
PHS2/e2	4^{T}_{M}	
PHS2/f1	5_{T}	
PHS3/b0,b1	$2^{7}_{M}6^{3}_{W}$	
PHS3/c0,c1	$2^{7}_{M}6^{3}_{W}$	
PHS3/d1	$3^{M\,7}_{T}6^{3}_{W}$	
PHS4/c0,c1	2_{M}	
PHS4/d1	3^{M}_{T}	
PHS4/e1	4^{T}_{M}	
PHS5/b0	$2^{9}_{M}6^{1}_{W}$	
PHS5/c0,c1	$2^{9}_{M}6^{1}_{W}$	
PHS5/d0,d1	$3^{M\,9}_{T}6^{1}_{W}$	
PHS6/c0,c1	$3^{8}_{M}6^{2}_{W}$	
PHS7/a0	$2^{7}_{M}6^{3}_{W}$	
PHS7/b0	$2^{7}_{M}6^{3}_{W}$	
PHS7/c0	$2^{7}_{M}6^{3}_{W}$	
PHS7/d0	$3^{M\,7}_{T}6^{3}_{W}$	
PHS1-AGS1/e1	4^{T}_{M}	
PHS1-AGS1/c1	$2^{6}_{M}1^{4}$	
PHS1-FNH1/c0	3_{M}	
PHS1-FNH1/d2	3^{M}_{T}	
PHS1-POK1/b0	$2^{7}_{M}1^{3}$	
PHS2-AGS1/c1	$2^{7}_{M}1^{3}$	
PHS2-AGS1/d2	3^{M}_{T}	
PHS2-AGS2/c1	$2^{7}_{M}1^{3}$	
PHS2-FNH1/b1	3_{M}	
PHS3-POK1/d0	3^{M}_{T}	
PHS3-POK2/b1	$2^{6}_{M}1^{3}6^{1}_{W}$	
PHS3-AGS2/c1	$2^{5}_{M}1^{2}6^{3}_{W}$	
PHS4-CMO4/b1	$2^{6}_{M}2^{3}_{D}6^{1}_{W}$	
PHS4-CMO4/c1,c2,c3	$2^{6}_{M}2^{3}_{D}6^{1}_{W}$	
PHS4-NRM1/c0	$2^{7}_{M}1^{3}$	
PHS4-NRM1/d0,d2,d3	3^{T}_{M}	
PHS5-AGS1/b1	$2^{5}_{M}1^{4}6^{1}_{W}$	
PHS5-NRM1/c0,c1	$2^{5}_{M}1^{4}6^{1}_{W}$	
PHS5-FNH1/c0,c2	3_{M}	
POK1/b0	1	
POK1/c0	1	
POK1/d0	3_{T}	
POK1/e0	4_{T}	
POK2/b0	$1^{9}6^{1}_{W}$	
POK2/c0,c1	$1^{9}6^{1}_{W}$	
POK2/d0	$3^{9}_{T}6^{1}_{W}$	
POK2/e0	$4^{9}_{T}6^{1}_{W}$	
POK2/f0	$5^{9}_{T}6^{1}_{W}$	
POK3/b0	1	
POK3/c0	1	
POK3/e0	4_{T}	
POK4/c0,c1	$1^{8}6^{2}_{W}$	
POK4/d1	$3^{8}_{T}6^{2}_{W}$	

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
POK1-FNH1/d1	$3_T^7 4_M^3$	
POK1-FNH3/e1	$4_T^7 5_M^3$	
POK1-PHS1/c0,c1	$1^7 2_M^3$	
POK1-PHS1/d0,d1	$3_T^7 4_M^3$	
POK2-AGS1/e1	$4_T^9 6_W^1$	
POK2-AGS3/c1	$1^5 2_T^3 6_W^2$	
POK3-AGS1/c0	1	
POK4-AGS1/c1	2_T	
RB1/e2	4_T	4_T
RB1/e4	$4_T^7 5_P^3$	$4_T^7 5_P^3$
RB1/f0,f2	5_T	5_T
RB1/f3	5_P^T	5_P^T
RB1/g3	6_T	6_T
RB2/e2	4_T	4_T
RB2/f1,f2	5_T	5_T
RB2/f3	5_P^T	5_P^T
RB2/g2,g3	6_T	6_T
RB3/f2	5_T	5_T
RB3/g3	6_T	6_T
RDW1/b0		3_M
RDW1/c0,c1,c2		3_M
RDW1/d0,d2		3_M
RDW1/f0,f1		5_T
RDW1/g0		6_T
RDW2/d1		4_E^M
RDW2/e1,e2		5_E^M
RDW2/f2		5_M^T
RDW3/b1		$3_M^9 6_W^1$
RDW3/c0,c1,c2		$3_M^9 6_W^1$
RDW3/d1,d2		$3_M^9 6_W^1$
RDW4/c0,c1		3_M
RDW4/d0,d1,d2		3_M
RDW4/e0,e1,e2		4_M^T
RDW4/f0		5_T
RDW5/b0,b2		$3_M^7 6_W^3$
RDW5/c0,c1		$3_M^7 6_W^3$
RDW5/d1		$3_M^7 6_W^3$
RDW5/e1		$4_M^{T\,7} 6_W^3$
RDW6/b0,b1		$3_M^7 6_W^3$
RDW6/c0,c1		$3_M^7 6_W^3$
RDW6/d0,d1,d2		$3_M^7 6_W^3$
RDW6/e0		$4_M^{T\,7} 6_W^3$
RDW7/c0,c1		3_M
RDW7/d0,d1		3_M
RDW7/e1		4_M^T
RDW7/f1		5_T
RDW8/c0,c1,c2		3_M
RDW8/d0,d1,d2		3_M
RDW8/e0,e1		4_M^T
RDW8/e3		$4_M^{T\,7} 5_P^3$
RDW8/f2		5_T
RDW9/c0		$3_M^7 6_W^3$
RDW9d1		$3_M^7 6_W^3$
RDW9/e0		$4_M^{T\,7} 6_W^3$
RDW10/d0		$3_M^5 4_M^{E\,3} 6_W^2$
RDW10/e0		$4_M^{T\,8} 6_W^2$
RDW10/f1		$5_T^8 6_W^2$
RDW11/d0,d1		$3_M^7 4_M^{E\,3}$
RDW11/e0		4_M^T
RDW11/f0,f1		5_T
RDW11/g0		6_T
RDW1-FLU1/f1		5_T
RDW1-FLU4/d1		$3_M^6 3_T^3 6_W^1$
RDW1-FLU4/e1		$4_M^{T\,9} 6_W^1$
RDW1-RMY1/b0		$3_M^7 2_C^3$
RDW1-RMY1/c0		$3_M^7 2_C^3$
RDW1-RMY1/d0,d1		$3_M^7 3_T^2$
RDW1-TWH1/c3		$3_M^7 4_P^3$
RDW1-TWH1/d3		$3_M^7 4_P^{T\,3}$
RDW2-FLU1/e2		$4_E^{M\,7} 4_T^3$
RDW2-FLU3/f0		5_E^T
RDW2-RMY1/e0		$4_E^{M\,7} 4_T^3$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
RDW3-FLU1/c1,c2		$3_M^6 2_C^3 6_W^1$
RDW3-FLU1/d1		$3_M^6 3_T^3 6_W^1$
RDW3-FLU1/e1,e2		$4_M^{T6} 4_T^3 6_W^1$
RDW3-FLU2/d0,d1,d2		$3_M^6 3_T^3 6_W^1$
RDW3-FLU2/e2		$4_M^{T9} 6_W^1$
RDW3-RMY1/b0		$3_M^6 2_C^3 6_W^1$
RDW3-RMY1/d0		$3_M^6 3_T^3 6_W^1$
RDW3-TWH1/b1		$3_M^9 6_W^1$
RDW3-TWH1/c1,c2		$3_M^9 6_W^1$
RDW3-TWH1/c3		$3_M^6 4_P^3 6_W^1$
RDW3-TWH1/d3		$3_M^6 4_P^3 6_W^1$
RDW3-TWH1/e1		$4_M^{T9} 6_W^1$
RDW3-TWH1/f4		5_P^T
RDW4-FLU1/d1,d2		$3_M^6 3_T^3 6_W^1$
RDW4-FLU1/e1		$4_M^{T6} 4_T^3 6_W^1$
RDW4-FLU1/f1		$5_T^9 6_W^1$
RDW4-FLU2/d1		$3_M^6 3_T^3 6_W^1$
RDW4-FLU2/e1		$4_M^{T6} 4_T^3 6_W^1$
RDW4-FLU3/d1		$3_M^6 3_T^3 6_W^1$
RDW4-FLU3/e1		$4_M^{T6} 4_T^3 6_W^1$
RDW4-TWH1/c2		$3_M^9 6_W^1$
RDW4-TWH1/c3		$3_M^7 4_P^2 6_W^1$
RDW4-TWH1/d2		$3_M^9 6_W^1$
RDW4-TWH1/d3		$3_M^7 4_P^2 6_W^1$
RDW4-TWH1/e3,e4		$4_M^{T7} 5_P^2 6_W^1$
RDW4-TWH1/f1		5_T
RDW5-FLU1/c1,c2		$3_M^5 2_T^3 6_W^2$
RDW5-FLU1/d1,d2,d3		$3_M^5 3_T^3 6_W^2$
RDW5-RMY1/f1		$5_T^8 6_W^2$
RDW5-TWH1/c3		$3_M^5 4_P^3 6_W^2$
RDW5-TWH1/f2		$5_T^8 6_W^2$
RDW6-RMY1/f1		$5_T^8 6_W^2$
RDW6-RMY2/d0		$3_M^5 3_T^3 6_W^2$
RDW7-FLU2/e1		$4_M^{T7} 4_T^3$
RDW7-TWH1/f4		5_P^T
RDW7-TWH3/d3		$3_M^7 4_P^{T3}$
RDW7-TWH3/f2		5_T
RDW9-TWH1/e3		$4_M^{T5} 5_P^3 6_W^2$
RMY1/c0		2_C
RMY1/d0		3_T
RMY1/e0		4_T
RMY1/f0		5_T
RMY2/d0		3_T
RMY2/e0		4_E^T
RMY2/f0		5_T
RMY3/c0		$2_C^8 6_W^2$
RMY3/d0,d1		$3_T^8 6_W^2$
RMY3/e0		$4_E^{T8} 6_W^2$
RMY3/f0		$5_T^8 6_W^2$
RMY4/d1		$3_T^9 6_W^1$
RMY4/e0		$4_T^9 6_W^1$
RMY5/c0,c1		$2_C^9 6_W^1$
RMY5/d1		$3_T^9 6_W^1$
RMY5/e1		$4_T^9 6_W^1$
RMY1-FLU1/c1		2_C
RMY1-FLU1/d0		3_T
RMY1-FLU6/e0		4_E^T
RMY1-RDW1/c0		$2_C^7 3_M^3$
RMY1-RDW3/d0		$3_T^7 3_M^3$
RMY1-RDW3/e0		4_T
RMY1-TWH3/c1		$2_C^7 3_M^3$
RMY2-FLU1/d1		3_T
RMY2-FLU2/e2		4_T
RMY2-RDW1/d0		3_T
RMY2-RDW1/e1		4_T
RMY2-RDW4/f1		5_T
RMY2-RDW6/d0		$3_T^6 4_M^3 6_W^1$
RMY2-RDW6/e0		$4_T^8 6_W^2$
RMY2-UCS2/f1		5_T
RMY3-FLU1/e1		$4_T^9 6_W^1$
RMY3-NRM1/e2		$4_T^9 6_W^1$
RMY3-RDW6/e0		$4_T^8 6_W^2$
RMY3-RDW8/f0		5_T
RMY3-TWH1/d1		$3_T^9 6_W^1$
RMY4-RDW1/f0		$5_T^9 6_W^1$
RMY5-FLU1/e1		$4_T^9 6_W^1$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
SHZ1/a0,a1,a2,a3	6_N^W	6_N^W
SHZ1/b0,b1,b2,b3	6_N^W	6_N^W
SHZ1/c0,c1	6_N^W	6_N^W
SNI1/c3		$4_P^9 6_W^1$
SNI1/d1		$4_M^9 6_W^1$
SNI1/e5		$5_P^{T9} 6_W^1$
SNI2/c3		$4_P^9 6_W^1$
SNI2/d3		$4_P^9 6_W^1$
SXQ1/b0	$1^9 6_W^1$	
SXQ1/c0	$2_T^9 6_W^1$	
SXQ1-NRM1/e1	$4_T^9 6_W^1$	
TWH1/b3		3_P
TWH1/c1		3_M
TWH1/c4		$3_M^6 4_P^4$
TWH1/d3,d4		$3_T^6 4_P^4$
TWH1/e2		4_M^T
TWH1/f1,f2		5_T
TWH2/c1,c2		$3_M^9 6_W^1$
TWH2/c3,c4		$3_M^6 4_P^3 6_W^1$
TWH2/d1,d2		$4_T^{M9} 6_W^1$
TWH2/d3		$4_T^{M6} 4_P^3 6_W^1$
TWH2/d4,d5		$4_P^{M9} 6_W^1$
TWH3/d4		$4_P^9 6_W^1$
TWH1-FLU1/b3		$3_P^7 2_C^3$
TWH1-FLU1/c2		$3_M^7 2_C^3$
TWH1-FLU1/c3		$3_P^7 2_C^3$
TWH1-FLU1/d3		$4_P^{M7} 3_T^3$
TWH1-FLU5/f4		5_P^T
TWH1-RDW1/d4		4_M^P
TWH2-FLU1/b1		$3_M^6 2_C^3 6_W^1$
TWH2-FLU1/b3		$3_M^6 3_P^3 6_W^1$
TWH2-FLU1/c3		$3_M^6 3_P^3 6_W^1$
TWH2-FLU1/d3,d4		$4_P^{M6} 3_T^3 6_W^1$
TWH2-FLU1/e3		$4_P^{T6} 4_T^3 6_W^1$
TWH2-FLU3/c3		$3_M^6 3_P^3 6_W^1$
TWH2-RDW3/d2		$4_T^{M9} 6_W^1$
TWH2-RDW4/d3		$4_P^{M9} 6_W^1$
TWH2-RDW7/d3		$4_P^{M9} 6_W^1$
UCS1/b2		$2_C^9 6_W^1$
UCS1/b3		$2_C^6 3_P^3 6_W^1$
UCS1/c1,c2		$2_C^9 6_W^1$
UCS1/d1,d2		$3_T^9 6_W^1$
UCS1/e1,e2		$4_T^9 6_W^1$
UCS1/e3		$4_T^6 5_P^3 6_W^1$
UCS1/f2		$5_T^9 6_W^1$
UCS2/c1,c2		$2_C^6 3_E^3 6_W^1$
UCS2/d2		$3_T^6 3_E^3 6_W^1$
UCS2/d3		$3_T^7 4_P^2 6_W^1$
UCS2/e1,e2		$4_T^9 6_W^1$
UCS2/e3		$4_T^7 5_P^2 6_W^1$
UCS2/f1,f2		5_T
UCS3/d1		$3_T^7 6_W^3$
UCS4/d2		$3_T^5 4_E^2 6_W^3$
UCS4/e2		$4_T^7 6_W^3$
UCS4/e3		$4_T^5 5_P^2 6_W^3$
UCS5/b3		$3_D^9 6_W^1$
UCS5/b4		$4_P^6 3_D^3 6_W^1$
UCS5/c1,c2		$2_C^6 3_D^3 6_W^1$
UCS5/c3		$2_C^6 3_P^3 6_W^1$
UCS5/d1,d2		$3_T^6 4_D^3 6_W^1$
UCS5/d3		$3_T^6 4_P^{T3} 6_W^1$
UCS5/e1,e2		$4_T^9 6_W^1$
UCS5/e3		$4_T^7 5_P^2 6_W^1$
UCS5/f1,f2		$5_T^9 6_W^1$
UCS5/f3		$5_P^{T9} 6_W^1$
UCS6/c1,c2		$2_C^9 6_W^1$
UCS6/c3		$2_C^6 3_P^3 6_W^1$
UCS6/d1,d2		$3_T^9 6_W^1$
UCS6/e1,e2		$4_T^9 6_W^1$
UCS6/e3		$4_T^7 5_P^2 6_W^1$
UCS6/f1,f2		$5^T 6_W^1$
UCS6/f3		$5_P^{T9} 6_W^1$
UCS7/c1,c2		$2_C^7 6_W^3$
UCS7/d1,d2		$3_T^7 6_W^3$
UCS7/e1		$4_T^7 6_W^3$
UCS7/f2		$5_T^7 6_W^3$
UCS8/d1		$3_T^7 6_W^3$

Table 4. (continued)

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
UCS8/e1,e2		$4_T^7 6_W^3$
UCS8/f1		$5_T^7 6_W^3$
UCS9/c1,c2		$2_C^6 3_E^3 6_W^1$
UCS9/d1,d2,d3		$3_T^6 4_E^3 6_W^1$
UCS9/e1,e2		$4_T^6 5_E^3 6_W^1$
UCS9/f1,f2		5_T
UCS10/c1,c2		$2_C^5 3_D^2 6_W^3$
UCS10/d1,d2		$3_T^5 4_D^2 6_W^3$
UCS10/d3		$3_T^5 4_P^2 6_W^3$
UCS10/e1,e2		$4_T^7 6_W^3$
UCS10/f2		$5_T^7 6_W^3$
UCS10/f3		$5_P^{T7} 6_W^3$
UCS1-CUN1/e3		$4_P^{T6} 5_M^3 6_W^1$
UCS1-FWT1/d2		$3_T^9 6_W^1$
UCS1-FWT1/e2		$4_T^9 6_W^1$
UCS1-LIH1/c1		$2_C^6 3_M^3 6_W^1$
UCS1-LIH1/d1,d2		$3_T^9 6_W^1$
UCS1-LIH1/e1		$4_T^9 6_W^1$
UCS1-LIH2/d2		$3_T^6 4_M^3 6_W^1$
UCS1-FWT1/d1,d2		$3_T^9 6_W^1$
UCS1-LIH1/e1		$4_T^9 6_W^1$
UCS1-LIH2/d2		$3_T^6 4_M^3 6_W^1$
UCS1-LIH4/d1,d2		$3_T^6 4_M^3 6_W^1$
UCS1-LIH4/d3		$3_T^6 4_P^{M3} 6_W^1$
UCS1-LIH4/e3		$4_T^6 4_P^{M3} 6_W^1$
UCS1-PHF1/e1		$4_T^9 6_W^1$
UCS1-PHF1/g1		6_T
UCS1-RDW4/e1		$4_T^9 6_W^1$
UCS1-SNI1/c2		$2_C^6 4_M^3 6_W^1$
UCS1-SNI1/d3,d4		$3_T^6 4_P^3 6_W^1$
UCS1-SNI1/e4		$4_P^{T6} 5_M^3 6_W^1$
UCS1-SNI1/b4		$4_P^9 6_W^1$
UCS1-SNI2/c1		$2_C^6 4_M^3 6_W^1$
UCS1-SNI2/c4		$4_P^9 6_W^1$
UCS1-SNI2/d2		$3_T^6 4_M^3 6_W^1$
UCS1-SNI2/d3		$3_P^{T6} 4_M^3 6_W^1$
UCS1-TWH2/d2		$3_T^6 4_M^3 6_W^1$
UCS1-TWH2/e3		$4_P^{T6} 5_M^3 6_W^1$
UCS2-LIH1/c2		$2_C^6 3_M^3 6_W^1$
UCS2-LIH1/d1		$3_T^9 6_W^1$
UCS2-LIH1/e1		$4_T^9 6_W^1$
UCS2-LIH2/c2		$2_C^6 4_E^{M3} 6_W^1$

Map Unit or Complex	ARDA Rating Climate 1	ARDA Rating Climate 2
UCS2-LIH2/d1		$3_T^6 4_E^{M3} 6_W^1$
UCS2-LIH2/e2		$4_T^6 5_E^{M3} 6_W^1$
UCS2-LIH2/f2		$5_M^{T9} 6_W^1$
UCS2-LIH4/e2		$4_T^6 4_M^3 6_W^2$
UCS2-PHF1/e1		$4_T^9 6_W^1$
UCS2-SNI1/d3		$3_T^6 4_P^{M3} 6_W^1$
UCS2-SNI2/c3		$2_C^6 4_P^{M3} 6_W^1$
UCS2-SNI2/d3		$3_T^6 4_P^{M3} 6_W^1$
UCS2-TWH1/d2		$3_T^9 6_W^1$
UCS3-LIH2/d1		$3_T^5 4_M^2 6_W^3$
UCS3-LIH7/c2		$3_T^5 4_M^2 6_W^3$
UCS3-LIH7/d1		$4_T^5 4_M^2 6_W^3$
UCS3-SNI1/d3		$3_T^5 4_P^2 6_W^3$
UCS5-LIH1/d1		$3_T^6 4_M^3 6_W^1$
UCS5-LIH1/e2		$4_T^6 5_M^3 5_W^1$
UCS5-PHF1/d1,d2		$3_T^9 6_W^1$
UCS5-PHF1/e2		$4_T^9 6_W^1$
UCS6-LIH2/d1		$3_T^6 4_M^3 6_W^1$
UCS6-LIH4/d1		$3_T^6 4_M^3 6_W^1$
UCS6-PHF2/f1		$5_T^9 6_W^1$
WHF1/b1,b2	$4_D^7 6_N^{W3}$	$4_D^7 6_N^{W3}$
WHF1/c0,c1,c2	$4_D^7 6_N^{W3}$	$4_D^7 6_N^{W3}$
WHF1/c3	$4_D^5 5_P^2 6_N^{W3}$	$4_D^5 5_P^2 6_N^{W3}$
WHF1-KVG2/b4	$4_D^4 5_P^3 6_N^{W3}$	$4_D^5 5_P^2 6_N^{W3}$
WHF1-KVG2/c1	$4_D^7 6_N^{W3}$	$4_D^7 6_N^{W3}$

Samples for engineering tests were taken from the B or C horizons at depths up to about 1 m. Results of tests for Atterberg Limits and particle size composition were used to classify the soil materials according to the American Association of State Highway Officials (AASHO) and Unified Soil Classification Systems. The methodology and classification systems are described in a publication of the Portland Cement Association (1962).

Glacial till is the most widespread soil parent material in the County of Two Hills. This material is generally classified as CL in the Unified System A6 to A4 in the AASHO system, and loam to clay loam in the textural classification of the United States Department of Agriculture. Such soils include the Angus Ridge, Daysland, Uncas, Norma, Whitford, Falun and Cooking Lake associations.

The soils developed from glaciolacustrine sediments are generally medium textured and like those developed on till are classified as CL in the Unified System and A6 to A4 in the AASHO system. These include the Armena; Sante, Kapona and Rimbey association. The soils of the Redwater association are nonplastic as are all the soils developed on glaciofluvial and fluvial sediments. These latter soils include the Peace Hills, Leith, Culp, Clouston and Nicot associations and the Alluvium complex.

Since glacial till is composed prmarily of local bedrock, the classification of the soils developed on bedrock is generally similar to that of till, that is Cl in the Unified System and A7 to A4 in the AASHO system. Kavanagh, Brosseau, Pathfinder and Maughan soils are developed on bedrock material in the County of Two Hills.

In certain areas of the country, sulfate attack on concrete may be a problem. This is most likely to occur in areas of Solonetzic soils that are known to be relatively high in water soluble salts, notably sodium sulfate. In areas where the sulfate ion content exceeds 0.10 percent (United States Bureau of Reclamation, 1966), serious consideration should be given to the use of Type V or alkali resistant cement in facility construction.

Very general ratings of soil suitability for specific uses can be obtained by use of the soil maps and reference to guidelines as presented in *Guidebook for Use with Soil Survey Reports of Alberta Provincial Parks* (Greenlee, 1981). Although this guidebook is oriented to interpretations for recreational uses, the guidelines are applicable to other situations. Additional information can be found in a guide for engineering by the United States Department of Agriculture (1972).

Soil management

Some principles of soil management can be applied to all soils suitable for farm crops in the county. Specific management practices to be used should be modified, as knowledge of soil problems and crop production increases.

Most soils in the County of Two Hills will respond to applications of fertilizer. The amounts needed depend on the content of plant nutrients, which is determined by laboratory analyses of soil samples, on the needs of the crop to be grown and on the level of yield desired. For assistance in arranging for and interpreting soil tests, farmers and others should consult the local district agriculturist.

Nitrogen is released by organic matter, but most of this nitrogen is in a complex organic form and is unusable by plants. Nitrogen fertilizer must be applied to supplement the nitrogen made available to the plants by the soil. Similarly, the soils in the County of Two Hills vary in their ability to supply phosphorus to plants and, therefore, the addition of a proper amount of phosphate in the form of commercial fertilizer is essential for optimum crop yields.

Soil tilth affects germination of seeds, ease of tillage and infiltration of water into the soil. Maintaining the soil organic matter content promotes good soil tilth and improves soil fertility. Returning plant residue to the soil, using sod crops, cover crops and green manure crops are practices that help to maintain a high organic matter content. Tillage gradually reduces organic matter content and breaks down soil structure. Therefore, it should be kept to a minimum for seedbed preparation and weed control. Research into the benefits of "minimum tillage" is now underway in several locations (Lindwall, 1977).

Erosion is a major cause for concern wherever agriculture is practiced intensively. All soils are subject to erosion. A surface layer that is exposed after cultivation, especially on sloping landscapes, is susceptible to varying degrees of erosion. To minimize erosion, cropping systems should include minimum tillage, return of crop residues to the soil, and use of cover crops and green manure crops. Other practices that reduce erosion are contour cultivation, grassed waterways and planting of windbreaks. On the more steeply sloping land, consideration should be given to a permanent grass cover in order to provide a protective surface cover. A high level of pasture management is needed on some coarse-textured soils to provide sufficient ground cover to protect the soil from erosion. Such management should provide for fertilization and control of grazing. The practice of summerfallowing is always a concern because of the susceptibility of bare land to erosion. Recently, research has been undertaken to investigate the benefits of snow management (Stepphun, 1980; Nicholaichuk, 1983) to soil moisture conservation. Maintaining optimum soil moisture levels through

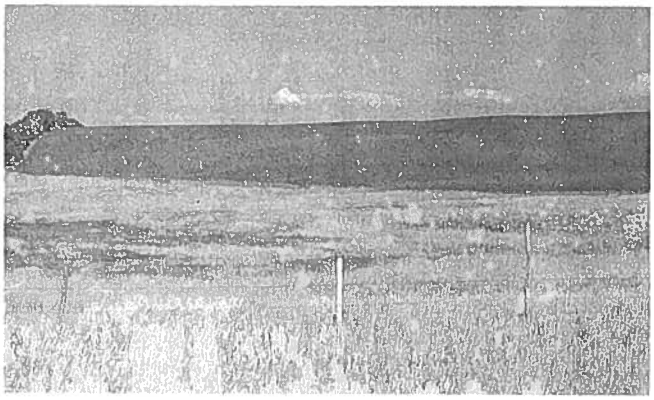


Plate 20. The lighter colored areas on the knolls indicate erosion of the Ap horizon

Plate 21. Areas easily erodible are kept in grass cover

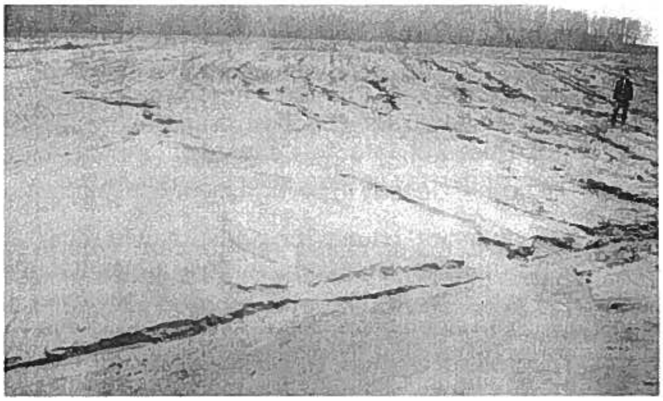


Plate 22. Severe soil erosion can occur in gently sloping areas

Plate 24. Strong winds can move soil particles over great distances

Plate 23. The soil lost from this field has accumulated to an extent that the fence post is almost buried

Plate 25. Coarse-textured soils in summerfallow are susceptible to wind erosion

snow management may lead to a reduction in the amount of summerfallow in western Canada. Examples of the effects of water erosion in the County of Two Hills are shown in plates 20, 21, 22 and 23.

Wind erosion occurs most commonly on sandy soils, especially those exposed by summerfallow. These relatively noncohesive soils are generally low in organic matter and clay content and are, therefore, susceptible to wind erosion. In some areas wind erosion may result in the burial of soils and crops under blown or redeposited materials. Plates 24 and 25 show examples of wind erosion in the County of Two Hills.

Solonetzic soils pose serious management problems because of poor physical properties and the near surface presence of soluble salts. Drainage, tillage and fertilization as well as crop adaptation are important in maximizing crop production. The reader is referred to an excellent publication entitled *Solonetzic Soils Technology and Management* available from the Department of Extension, The University of Alberta, Edmonton.

Table 5. Engineering test data for some of the soil associations in the County of Two Hills

Soil Association	Sample Depth from Surface (cm)	% Passing Sieve #40	% Passing Sieve #200	% Smaller Than 0.05 mm	% Smaller Than .005 mm	% Smaller Than .002 mm	% Smaller Than .001 mm	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Index	Optimum Moisture (%)	Maximum Dry Density lb/cu ft	Classification Unified	Classification AASHO	Classification USDA
Alluvium	61-90	100	27	27	13	12	11		NP*					SL
Angus Ridge	91-120	92	60	56	31	27	18	32	14	17	107	CL	A-6(7)	L-CL
	121-150	91	62	58	33	26	19	29	11	17	107	CL	A-6(5)	L
Armena	31-60	99	42	44	35	32	31	31	14	16	112	CL	A-6(3)	SL
Brosseau	61-90	100	99	98	82	60	48	70	34			CL	A-7-5(20)	L-CL
	61-90	99	97	96	79	66	55	69	34			CL	A-7-5(20)	L-CL
Clouston	30-60	20	3	8	6	5	4		NP					S
Cooking Lake	91-120	92	62	58	34	25	19	28	12	14	114	CL	A-6(6)	CL
Culp	91-120	95	10	16	12	11	11		NP					S
Daysland	91-120	100	91	84	35	25	18	35	14	21	101	CL	A-6(10)	SiL
	121-150	100	97	85	32	19	5	38	14	25	95	CL	A-6(9)	SiL
Falun	91-120	91	65	58	39	31	29	34	17	16	112	CL	A-6(8)	CL
Kapona	61-120	100	33	35	26	24	22	26	7	18	106	SM(d)	A-4(8)	SL-SCL
Kavanagh	121-150	99	80	69	39	31	22	68	41	28	91	CH	A-7-6(20)	CL
	60-90	99	87	81	56	49	36	57	29	29	90	CH	A-7-6(13)	C
	60-90	100	96	93	72	48	52	67	36	30	86	CH	A-7-5(20)	SiC
Leith	61-90	99	24	29	12	12	11		NP					LS-SL
Maughan	31-60	93	45	49	34	29	24	31	12	18	106	CL	A-6(3)	SCL
Nicot	91-120	61	4	9	8	7	7		NP					S
Norma	91-120	89	57	54	26	20	16	28	11	15	111	CL	A-6(4)	L
	121-150	92	58	53	24	18	14	27	10	15	111	CL	A-4(5)	L
Pathfinder	61-90	98	53	55	28	23	22	27	10	16	111	CL	A-4(8)	SL
Peace Hills	91-120	100	9	4	1	0	0		NP					S
	121-150	99	11	7	3	1	0		NP					S
Redwater	91-120	85	16	18	14	11	9		NP					LS
Rimbey	121-150	96	79	68	38	31	27	31	14	16	111	CL	A-6(10)	CL
Sante	91-120	99	68	62	37	31	29	31	15	15	113	CL	A-6(10)	SCL
Uncas	91-120	93	76	70	29	24	22	27	10	16	111	CL	A-4(8)	L
	91-120	87	54	51	33	27	25	28	12	14	113	CL	A-6(5)	CL
Whitford	121-150	89	59	53	27	20	16	30	18	11	121	CL	A-6(8)	L
	151-180	90	62	53	27	21	15	31	13	17	107	CL	A-6(6)	L

NP — non plastic

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Appendix A.

Soil morphological descriptions and analytical data of representative soil profiles

Soil association: Alluvium
Map unit: AV2
Classification: Rego Black (carbonated)
Profile location: SW35-55-12-W4
Topography: Gently undulating
Drainage: Moderately well drained
Parent material: Fluvial

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-15	black (10YR 2/1m*)	loam	moderate, fine granular	friable	abundant	clear wavy
Ahk	15-41	black (10YR 2/1m)	clay loam	moderate, fine granular	friable	abundant	clear wavy
Ck	41 +	grayish brown to dark grayish brown (2.5Y 5/2-4/2m)	silty clay loam	weak, fine platy & weak, fine granular		few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-15	7.6	0.66	7.12	11	—	—	—	—	—	—	28	46	26	15	L
Ahk	15-41	8.1	0.36	4.22	12	—	—	—	—	—	2.4	22	50	28	18	CL
Ck	41 +	8.7	—	—	—	—	—	—	—	—	17.6	11	58	31	16	SiCL

*m – moist color

Appendix A. (continued)

Soil association: **Angus Ridge**
Map unit: **AGS1**
Classification: **Eluviated Black**
Profile location: **SW17-56-14-W4**
Topography: **Gently rolling**
Drainage: **Well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-23	black (10YR 2.5/1m*)	sandy loam	moderate, coarse prismatic	very friable	abundant fine & medium	clear wavy
Ahe	23-30	dark gray (10YR 4/1m)	sandy loam	coarse platy	friable	plentiful very fine	clear wavy
Btj	30-55	brown (10YR 5/3m)	loam to sandy clay loam	moderate, weak prismatic to moderate, medium subangular blocky	firm	few fine	clear wavy
Cca	55-88	pale brown (10YR 6/3m)	loam to sandy loam	moderate, medium granular	firm	few	clear wavy
Ck	88+	grayish brown (10YR 5/2m)	sandy loam			few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-23	6.8	0.30	—	—	0.1	0.8	15.7	2.9	24.2	—	66	22	12	7	SL
Ahe	23-30	6.3	0.23	—	—	0.0	0.2	10.6	2.2	17.2	—	68	20	12	7	SL
Btj	30-55	6.4	0.07	—	—	0.2	0.3	9.4	3.5	15.5	—	52	27	21	14	L-SCL
Cca	55-88	8.1	—	—	—	—	—	—	—	—	—	52	30	18	13	L-SL
Ck	88+	8.2	—	—	—	—	—	—	—	—	—	57	27	16	9	SL

*m – moist color

Appendix A. (continued)

Soil association: **Armena**
Map unit: **ARM1**
Classification: **Black Solodized Solonetz**
Profile location: **NE20-53-7-W4**
Topography: **Undulating**
Drainage: **Imperfectly drained**
Parent material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-10	very dark gray (10YR 3/1m*)	sandy loam	weak, fine granular	friable	abundant	abrupt smooth
Ae	10-13	olive brown (2.5Y 4/4m)	very fine sandy loam	weak, platy	friable	abundant	gradual wavy
Bnt	13-30	very dark gray to very dark grayish brown (10YR 3/1-3/2m)	sandy clay loam	strong, coarse columnar to coarse blocky	firm	few	clear wavy
Cksag	30+	olive brown (2.5Y 4/4m)	sandy loam	prominent mottles	friable to firm		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-10	6.9	0.57	5.43	10	1.8	0.9	14.4	4.7	22.7	—	59	23	18	9	SL
Ae	10-13	6.9	0.20	1.77	9	3.2	0.2	2.5	2.0	9.1	—	73	16	11	2	SL
Bnt	13-30	8.1	0.19	1.76	8	—	—	—	—	—	1.5	58	16	26	18	SCL
Cksag	30+	8.7	—	—	—	—	—	—	—	—	8.8	74	7	19	12	SL

*m – moist color

Appendix A. (continued)

Soil association: **Brosseau**
Map unit: **BSU2**
Classification: **Orthic Dark Gray Chernozem**
Profile location: **SE10-54-6-W4**
Topography: **Strongly rolling**
Drainage: **Imperfectly drained**
Parent material: **Bedrock**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-13	very dark gray (10YR 3/1m*)	silty clay	weak, fine granular	friable	abundant	diffuse wavy
Bt	13-30	very dark grayish brown (2.5Y 3/2m)	heavy clay	strong, coarse angular blocky	firm	plentiful fine	diffuse wavy
BC	30-53	very dark grayish brown (2.5Y 3/2m)	loam	weak, fine subangular blocky	firm	few	diffuse wavy
Ck	53+	olive brown (2.5Y 4/4m)	clay loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-13	6.6	.59	6.16	10	0.0	0.66	16.9	11.3	36.6	—	11	47	42	24	SiC
Bt	13-30	6.7	.15	2.09	14	1.5	1.6	21.1	17.2	41.4	—	2	27	71	41	HC
BC	30-53	7.0	—	—	—	1.7	1.3	21.6	16.7	39.7	0.5	34	41	25	13	L
Ck	53+	7.2	—	—	—	—	—	—	—	—	3.9	30	35	35	23	CL

*m – moist color

Appendix A. (continued)

Soil association: **Camrose**
Map unit: **CMO3**
Classification: **Black Solodized Solonetz**
Profile location: **NW21-55-15-W4**
Topography: **Undulating**
Drainage: **Moderately well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-15	black (10YR 2/1m*)	loam to sandy loam	moderate, medium granular	friable	plentiful	clear wavy
Ae	15-25	very dark gray (10YR 5/1m)	loam to sandy loam	moderate, fine platy	firm	abundant	abrupt wavy
Bnt	25-48	very dark grayish brown (10YR 3/2m)	loam to sandy clay loam	strong, coarse columnar to strong, medium subangular blocky	very firm	few	clear wavy
Csa	48-69	yellowish brown (10YR 5/4m)	loam	moderate, medium sub-angular blocky	friable	few	gradual wavy
Cca	69+	grayish brown (2.5Y 5/2m)	loam	moderate medium sub-angular blocky	firm		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-15	5.9	0.37	4.73	13	0.7	0.3	3.0	1.4	20.5	—	51	36	13	9	L-SL
Ae	15-25	6.9	0.17	1.79	11	8.6	0.1	2.7	3.3	14.5	—	52	37	11	6	L-SL
Bnt	25-48	7.7	0.08	0.91	11	—	—	—	—	—	—	46	28	26	20	L-SCL
Csa	48-69	7.6	—	—	—	—	—	—	—	—	0.3	44	31	25	18	L
Cca	69+	7.8	—	—	—	—	—	—	—	—	2.8	46	32	22	14	L

*m – moist color

Appendix A. (continued)

Soil association: **Clouston**
Map unit: **CUN1**
Classification: **Orthic Gray Luvisol**
Profile location: **NW17-54-12-W4**
Topography: **Gently rolling**
Drainage: **Rapidly drained**
Parent material: **Glaciofluvial gravels**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
L-H	0-5	very dark gray (10YR 3/1m*)	semi-decomposed leaf litter				
Ae1	5-13	light brownish gray (10YR 6/2m)	gravelly, sandy loam	weak, medium platy	loose	abundant	clear wavy
Ae2	13-30	grayish brown (10YR 5/2m)	gravelly, loamy sand	single grain	loose	few	clear wavy
Bt	30-61	yellowish brown (10YR 5/6m)	gravelly, loamy sand	single grain	loose	few	gradual irregular
Ck	6l +	olive brown (2.5Y 4/4m)	gravelly, loamy sand				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
L-H	0-5	7.4	—	—	—	0.0	1.1	82.5	7.8	—	—	—	—	—	—	—
Ae1	5-13	6.8	0.11	1.36	12	0.0	0.5	7.5	0.5	10.1	—	56	34	10	4	SL
Ae2	13-30	6.5	0.01	0.22	11	0.0	0.2	3.1	0.1	3.4	—	85	11	4	3	LS
Bt	30-61	6.6	0.02	0.22	11	0.0	0.2	4.1	0.5	5.0	—	85	6	9	5	LS
Ck	6l +	7.0	—	—	—	0.0	0.1	7.0	0.8	3.5	2.21	83	11	6	4	LS

*m – moist color

Appendix A. (continued)

Soil association: **Cooking Lake**
Map unit: **COA3**
Classification: **Orthic Gray Luvisol**
Profile location: **SE12-53-9-W4**
Topography: **Strongly rolling**
Drainage: **Moderately well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
L-H	0-5	black (10YR 2/1m*)				abundant	abrupt wavy
Ae	5-17	light brownish gray (10YR 6/2m)	loam	strong, fine platy	firm	plentiful	clear wavy
AB	17-31	olive brown (10YR 4/4m)	clay loam	strong, fine subangular blocky	firm	few	gradual irregular
Bt	31-60	olive brown (10YR 4/4m)	clay loam	strong, medium sub-angular blocky	very firm	few	gradual wavy
BC	60-85	dark grayish brown (10YR 4/2m)	clay loam	strong, large prismatic to large blocky	very firm	few	clear wavy
Ck	85 +	dark grayish brown (2.5Y 4/2m)	clay loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
L-H	0-5	6.5														
Ae	5-17	6.6	0.22	2.39	11	0.16	0.37	8.4	3.1	10.0	—	38	45	17	6	L
AB	17-31	6.4	0.07	0.74	11	0.05	0.21	3.4	2.4	19.5	—	21	50	29	20	CL
Bt	31-60	6.1	0.04	0.55	14	0.07	0.22	6.2	5.5	17.5	—	37	32	31	18	CL
BC	60-85	7.2	—	—	—	0.09	0.21	6.4	5.2	15.5	—	40	30	30	17	CL
Ck	85 +	8.1	—	—	—	—	—	—	—	—	5.29	42	30	28	15	CL

*m – moist color

Appendix A. (continued)

Soil association: **Cucumber**
Map unit: **CCB2**
Classification: **Eluviated Black Chernozem**
Profile location: **NW34-54-8-W4**
Topography: **Undulating**
Drainage: **Moderately well drained**
Parent material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-23	black (10YR 2/1m*)	sandy loam	weak, fine granular	friable	abundant	clear wavy
Ae	23-28	light brownish gray (10YR 6/2m)	fine sandy loam	weak, fine platy	friable	few	abrupt smooth
Bt	28-43	brown to dark brown (10YR4/3-3/3m)	clay loam	strong, medium columnar to fine subangular blocky	very firm	few	clear wavy
BC	43-79	dark grayish brown (2.5Y 4/2m)	sandy loam	weak, fine sub-angular blocky	firm	clear irregular	
Ck	79+	grayish brown (2.5Y 5/2m)	sandy clay loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-23	6.4	0.25	2.89	12	0.8	0.4	9.2	4.2	19.5	—	60	23	17	10	SL
Ae	23-28	7.2	0.10	1.04	10	1.2	0.3	5.0	3.3	9.5	0.3	62	26	12	6	SL
Bnjt	28-43	7.7	0.09	0.93	10	—	—	—	—	—	0.4	41	28	31	21	CL
BC	43-79	7.8	—	—	—	—	—	—	—	—	0.7	61	20	19	11	SL
Ck	79+	8.2	—	—	—	—	—	—	—	—	5.7	50	27	23	12	SCL

*m – moist color

Appendix A. (continued)

Soil association: **Culp**
Map unit: **CUP1**
Classification: **Orthic Gray Luvisol**
Profile location: **SW25-53-11-W4**
Topography: **Gently rolling**
Drainage: **Well drained**
Parent material: **Glaciofluvial**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-5	gray to dark gray (10YR5/1-4/1m*)	loamy sand to sand	weak, fine platy	loose	abundant	clear smooth
Ae	5-36	light brownish gray to grayish brown (10YR6/2-5/2d**)	very fine sand	single grain	loose	plentiful	clear wavy
Bt	36-66	dark yellowish brown (10YR 4/4m)	sandy loam	weak, fine granular	friable	few	gradual irregular
BC	66+	yellowish to dark yellowish brown (10YR5/4-4/4m)	loamy sand	single grain	loose		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-5	7.1	0.07	0.81	12	0.1	0.1	2.7	0.6	6.2	—	87	8	5	2	LS-S
Ae	5-36	6.8	0.01	0.10	10	0.1	0.1	0.9	0.5	2.8	—	92	3	5	3	S
Bt	36-66	6.7	0.04	0.32	8	0.1	0.2	3.0	2.3	9.0	—	81	6	13	10	SL
BC	66+	7.2	—	—	—	0.0	0.2	2.3	1.9	7.4	—	86	3	11	7	LS

*m – moist color
**d – dry color

Appendix A. (continued)

Soil association: Daysland
Map unit: DYD 2
Classification: Black Solod
Profile location: SW16-54-15-W4
Topography: Undulating
Drainage: Moderately well drained
Parent material: Glacial till

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-23	black (10YR 2.5/1m*)	sandy loam	weak, medium granular	friable	plentiful	abrupt wavy
Ahe	23-30	very dark grayish brown (10YR 3/2m)	sandy loam	weak, fine platy	friable	many	abrupt wavy
AB	30-35	yellowish brown (10YR 5/4m)	sandy clay loam	moderate, fine blocky	firm	plentiful	abrupt wavy
Bnt	35-55	dark yellowish brown (10YR 4/4m)	sandy clay loam	moderate, coarse columnar to strong, medium blocky	firm	plentiful	abrupt wavy
Ccasa	55-80	grayish brown (2.5Y 5/2m)	loam	weak, fine and medium subangular blocky		few	clear wavy
Ck	80+	grayish brown (2.5Y 5/2m)	loam	weak, fine subangular blocky	friable	few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-23	5.8	0.34	3.36	10	0.1	0.9	7.5	4.0	21.7	—	61	26	13	7	SL
Ahe	23-30	6.7	0.32	2.92	9	0.3	0.4	4.5	3.4	12.9	—	63	25	12	6	SL
AB	30-35	6.8	—	—	—	0.5	0.3	5.3	4.2	13.3	—	58	22	20	10	SCL
Bnt	35-55	7.7	—	—	—	—	—	—	—	—	0.21	56	21	23	16	SCL
Ccasa	55-80	7.9	—	—	—	—	—	—	—	—	6.7	43	31	26	16	L
Ck	80+	7.7	—	—	—	—	—	—	—	—	6.0	43	32	25	14	L

*m – moist color

Appendix A. (continued)

Soil association: **Demay**
Map unit: **DMY1**
Classification: **Orthic Luvic Gleysol**
Profile location: **SW4-57-12-W4**
Topography: **Gently undulating**
Drainage: **Poorly drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
L-H	0-8		partially decomposed leaf litter				clear wavy
Aegj	8-20	light brownish gray (10YR 6/2m*)	silt loam	weak, fine platy	very friable	abundant	clear wavy
Btg	20-46	grayish brown (10YR 5/2m)	clay loam	moderate, fine subangular blocky	firm	plentiful	clear wavy
BCg	46-70	light olive brown (2.5Y 5/4m)	clay loam	weak, fine sub-angular blocky	firm		clear smooth
Cg	70+	olive brown (2.5Y 4/4m)	loam to clay loam	massive	firm		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
L-H	0-8	7.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aegj	8-20	6.3	0.07	0.75	10	0.0	0.7	11.2	1.8	15.7	—	27	53	20	9	SiL
Btg	20-46	6.0	0.05	0.60	12	0.1	0.6	10.8	3.6	21.3	—	40	31	29	18	CL
BCg	46-70	5.9	0.04	0.38	10	0.0	0.8	9.4	2.1	15.8	—	35	34	31	20	CL
Cg	70+	6.8	—	—	—	—	—	—	—	—	—	42	31	27	16	L-CL

*m – moist color

Appendix A. (continued)

Soil association: **Duagh**
Map unit: **DUG1**
Classification: **Black Solonetz**
Profile location: **NW30-54-12-W4**
Topography: **Level**
Drainage: **Imperfectly drained**
Parent material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-10	very dark gray (10YR 3/1m*)	sandy clay loam	weak, fine platy	friable	few	abrupt smooth
Bnt	10-31	very dark gray to very dark grayish brown (10YR 3/1-3/2m)	silty clay loam	strong, coarse columnar	very firm	very few	clear wavy
Ck	31-54	very dark gray to dark olive gray (5Y 3/1-3/2m)	silty clay	massive	very firm		clear irregular
Csk	54+	very dark grayish brown (2.5Y 3/2m)	loam	massive			

Analysis of representative profile

Horizon	Depth	pH	N	Organic	C/N	Exchangeable Cations (me/100g)				Total CEC	$CaCO_3$	Particle Size				Texture
	(cm)	(H_2O)	(%)	C(%)		Na	K	Ca	Mg	(me/100g)	Equiv.(%)	%S	%Si	%C	%FC	
Ahe	0-10	7.3	0.64	6.59	10	—	—	—	—	—	—	55	23	22	13	SCL
Bnt	10-31	7.8	—	—	—	—	—	—	—	—	3.0	19	44	37	21	SiCL
Ck	31-54	8.8	—	—	—	—	—	—	—	—	19.7	14	43	43	26	SiC
Csk	54+	8.9	—	—	—	—	—	—	—	—	11.3	44	34	22	14	L

*m – moist color

Appendix A. (continued)

Soil association: **Falun**
Map unit: **FLU1**
Classification: **Orthic Dark Gray Chernozem**
Profile location: **SE23-54-11-W4**
Topography: **Gently rolling**
Drainage: **Moderately well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-13	very dark gray (10YR 3/1m*)	loam	moderate, fine granular	very friable	plentiful	abrupt smooth
Ahe	13-20	dark gray (10YR 4/1d**)	loam	weak, fine granular to weak, platy	friable	plentiful	clear irregular
Ae	20-25	gray (10YR 5/1d)	loam	moderate, fine platy	friable	few	gradual irregular
AB	25-36	dark grayish brown (10YR 4/2d)	clay loam	strong, fine sub-angular blocky	hard	few	gradual irregular
Bt	36-56	dark grayish brown (10YR 4/2m)	clay loam	moderate, fine prismatic to medium sub-angular blocky	firm	plentiful	clear wavy
BC	56-76	dark grayish brown (2.5Y 4/2m)	loam	moderate, medium sub-angular blocky	firm	few	clear wavy
Ck	76+	dark grayish brown (2.5Y 4/2m)	loam to clay loam			few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-13	6.8	0.52	6.03	12	0.0	1.0	19.0	5.3	37.5	—	48	30	22	14	L
Ahe	13-20	6.9	0.20	2.55	13	0.1	0.5	10.2	4.3	22.1	—	49	30	21	12	L
Ae	20-25	6.6	0.09	0.85	9	0.0	0.2	4.5	2.4	12.4	—	46	28	26	9	L
AB	25-36	6.8	0.08	0.75	9	0.1	0.3	6.6	5.8	18.5	—	42	27	31	20	CL
Bt	36-56	6.5	0.05	0.35	7	0.2	0.3	5.5	6.2	17.5	—	37	31	32	20	CL
BC	56-76	7.7	—	—	—	—	—	—	—	—	—	38	36	26	16	L
Ck	76+	8.1	—	—	—	—	—	—	—	—	7.2	43	30	27	16	L-CL

*m – moist color
**d – dry color

Appendix A. (continued)

Soil association: **Fawcett**
Map unit: **FWT1**
Classification: **Dark Gray Luvisol**
Profile location: **SW20-53-7-W4**
Topography: **Gently rolling**
Drainage: **Moderately well drained**
Parent material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-8	dark gray (10YR 4/1d*)	loam	moderate, fine granular	soft	abundant	clear wavy
Ahe	8-20	dark grayish brown (10YR 4/2d)	fine sandy loam	weak, coarse platy	soft	abundant	clear wavy
Ae	20-33	pale brown (10YR 6/3d)	very fine sandy loam	moderate, fine platy	soft	abundant	gradual irregular
Bt1	33-53	yellowish brown (10YR 5/4d)	sandy clay loam	coarse blocky to fine subangular blocky	slightly hard	few	gradual wavy
Bt2	53-71	yellowish brown (10YR 5/4d)	sandy clay loam	fine subangular blocky	hard	few	gradual wavy
BC	71-122	olive brown (2.5Y 4/4m**)	sandy clay loam	weak, medium blocky	firm	very few	clear wavy
Ck	122+	dark grayish brown (2.5Y 4/2m)	loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-8	6.8	0.32	3.50	11	0.1	0.3	13.3	5.8	27.5	—	43	34	23	16	L
Ahe	8-20	6.5	0.17	2.07	12	0.1	0.3	12.5	3.8	16.7	—	55	36	9	1	SL
Ae	20-33	6.2	0.08	0.71	8	0.1	0.2	6.3	2.1	9.4	—	65	22	13	7	SL
Bt1	33-53	5.8	0.05	0.46	9	1.2	0.4	9.4	5.5	16.1	—	65	13	22	16	SCL
Bt2	53-71	6.3	0.04	0.40	10	0.6	0.4	10.2	5.5	15.5	—	67	12	21	14	SCL
BC	71-122	6.9	—	—	—	0.9	0.4	11.3	6.8	17.4	—	66	11	23	13	SCL
Ck	122+	7.2	—	—	—	1.2	0.3	12.5	5.6	13.0	2.2	36	41	23	12	L

*d – dry color
**m – moist color

Appendix A. (continued)

Soil association: **Ferintosh**
Map Unit: **FNH1**
Classification: **Orthic Black Chernozem**
Profile location: **SE14-56-15-W4**
Topography: **Moderately rolling**
Drainage: **Well to rapidly drained**
Parent material: **Glaciofluvial gravel and sand**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-18	black (10YR 2/1d*)	sandy loam	weak, fine granular	soft	abundant	abrupt smooth
Btj	18-33	dark brown (10YR 3/3d)	gravelly sandy loam	weak, coarse sub-angular blocky	soft	plentiful	clear irregular
BC	33-51	dark yellowish brown to dark brown (10YR4/4-4/3d)	gravelly loamy sand	single grain	loose	few	clear wavy
Ck	51 +	brown (10YR 5/3d)	gravelly loamy sand				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-18	7.2	0.47	5.12	11	0.0	0.9	19.4	4.2	25.5	—	59	28	13	8	SL
Btj	18-33	7.0	0.25	2.69	11	0.2	0.2	13.4	3.0	16.7	—	62	23	15	7	SL
BC	33-51	7.2	—	—	—	0.1	0.1	9.1	1.7	9.2	0.4	83	12	5	3	LS
Ck	51 +	7.3	—	—	—	—	—	—	—	—	2.4	84	12	4	3	LS

*d – dry color

Appendix A. (continued)

Soil association: Hairy Hill
Map unit: HYL1
Classification: Humic Gleysol
Profile location: SE32-55-14-W4
Topography: Gently undulating
Drainage: Poorly drained
Parent material: Glacial till

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahks	0-18	black (7.5YR 2/0m*)	sandy loam	moderate, medium granular	firm	common	clear smooth
Bskg	18-46	very dark grayish brown (2.5Y 3/2m)	loam to clay loam	weak, fine granular	friable to firm	few	gradual wavy
Ccasg	46-69	dark gray (2.5Y 4/0m)	sandy loam		friable	few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahks	0-18	7.9	0.29	2.88	10	—	—	—	—	—	6.3	65	23	12	5	SL
Bskg	18-46	8.5	—	—	—	—	—	—	—	—	6.8	39	34	27	14	L-CL
Ccasg	46-69	8.6	—	—	—	—	—	—	—	—	15.3	61	24	15	8	SL

*m – moist color

Appendix A. (continued)

Soil association: **Kapona**
Map unit: **KPO1**
Classification: **Black Solod**
Profile location: **NE19-53-7-W4**
Topography: **Undulating**
Drainage: **Imperfectly drained**
Parent Material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-15	very dark gray (10YR 3/1m*)	sandy loam to sandy clay loam	weak, fine granular to single grain	friable	abundant	gradual
Ahe	15-28	very dark grayish brown (10YR 3/2m)	fine sandy loam	weak, fine granular to weak, coarse platy	friable	plentiful	clear wavy
Ae	28-33	brown (10YR 5/3m)	very fine sandy loam	weak platy	friable	plentiful	gradual irregular
AB	33-38	yellowish brown (10YR 5/4m)	sandy clay loam	moderate, fine blocky	firm	few	gradual irregular
Bnt	38-64	dark yellowish brown (10YR 4/4m) organic staining (10YR 3/1m)	sandy clay loam	moderate columnar to strong, coarse blocky	very firm	few	clear smooth
Ck	64+	olive brown (2.5Y 4/4m)	sandy loam to sandy clay loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-15	6.3	0.54	5.74	11	0.1	0.8	15.6	7.9	29.3	—	53	27	20	9	SL-SCL
Ahe	15-28	5.8	0.25	2.87	11	0.1	0.6	5.1	4.1	17.0	—	55	27	18	9	SL
Ae	28-33	6.7	0.10	1.05	11	0.1	0.3	2.3	3.1	8.3	—	65	25	10	3	SL
AB	33-38	6.1	0.08	0.79	10	0.2	0.5	3.3	8.0	13.6	—	63	4	33	16	SCL
Bnt	38-64	6.4	0.08	0.73	9	0.2	0.6	4.4	11.5	16.7	—	65	7	28	17	SCL
Ck	64+	8.0	—	—	—	—	—	—	—	—	1.1	71	9	20	13	SL-SCL

*m – moist color

Appendix A. (continued)

Soil association: **Kavanagh**
Map unit: **KVG1**
Classification: **Black Solodized Solonetz**
Profile location: **NE34-52-7-W4**
Topography: **Gently rolling**
Drainage: **Imperfectly drained**
Parent Material: **Bedrock**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-15	dark gray (10YR 4/1d*)	silty clay loam	single grain	soft	abundant	clear wavy
Ae	15-23	gray (10YR 6/1d)	silt loam	moderate, fine platy	soft	abundant	clear irregular
Bnt1	23-41	dark grayish brown (10YR 4/2d)	silty clay loam	strong, medium columnar	very hard	few	clear wavy
Bnt2	41-61	dark brown (10YR 3/3m**)	clay	weak, medium columnar	hard		clear wavy
Csk	61+	olive brown (10YR 4/4m)	clay				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-15	6.3	0.73	8.3	11	1.6	0.6	16.9	7.3	39.4	—	19	51	30	14	SiCL
Ae	15-23	6.3	0.16	1.74	11	2.2	0.3	4.1	3.6	36.7	—	18	66	16	5	SiL
Bnt1	23-41	7.5	0.15	1.65	11	10.8	0.7	7.3	11.5	25.0	0.3	13	47	40	30	SiCL
Bnt2	41-61	7.9	0.07	0.97	13	—	—	—	—	—	0.3	15	35	50	34	C
Csk	61+	7.9	—	—	—	—	—	—	—	—	1.3	17	32	51	28	C

*d – dry color
**m – moist color

Appendix A. (continued)

Soil association: Leith
Map unit: LIH1
Classification: Dark Gray Luvisol
Profile location: SW8-54-7-W4
Topography: Moderately rolling
Drainage: Rapidly drained
Parent material: Glaciofluvial

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-18	dark to very dark gray (10YR 4/1 - 3/1d*)	loamy sand	weak, fine granular	loose	plentiful	clear wavy
Ae	18-30	pale brown to brown (10YR 6/3 - 5/3d)	sandy loam	weak, medium platy	loose	abundant	clear wavy
Btj	30-51	yellowish brown (10YR 5/4d)	loamy sand	weak, fine subangular blocky to single grain	friable	few	gradual wavy
BC1	51-86	yellowish brown (2.5Y 5/6m**)	sand	single grain	loose		
BC2	86+	yellowish brown (2.5Y 5/6m)	sand	single grain	loose		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-18	6.5	0.26	2.98	11	0.1	0.2	10.5	1.8	13.7	—	86	10	4	3	LS
Ae	18-30	6.1	0.11	1.15	12	0.0	0.24	5.5	1.2	9.1	—	80	9	11	5	SL
Btj	30-51	5.9	0.05	0.51	10	0.1	0.23	5.5	1.6	8.8	—	86	3	11	6	LS
BC1	51-86	7.4	—	—	—	0.1	0.17	3.1	0.7	4.5	0.2	92	2	6	3	S
BC2	86+	7.2	—	—	—	0.0	0.17	2.8	0.6	3.8	0.3	94	0	6	2	S

*d – dry color
**m – moist color

Appendix A. (continued)

Soil association: Maughan
Map unit: MAA1
Classification: Orthic Gray Luvisol
Profile location: SW4-53-7-W4
Topography: Moderately rolling
Drainage: Moderately well drained
Parent material: Bedrock

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
L-H	0-3		semi-decomposed leaf litter				
Ae	3-10	brown (7.5YR 4/2m*)	loam	moderate, fine platy	friable	abundant	gradual wavy
Bt	10-25	yellowish brown (10YR 5/4m)	clay loam	moderate, medium subangular blocky	firm	few coarse	gradual wavy
BC	25-45	yellowish brown (10YR 5/6m)	sandy clay loam	weak, fine subangular blocky	firm	few	gradual wavy
C	45+	light olive to olive brown (2.5Y 5/4-4/4m)	sandy clay loam		firm	few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
L-H	0-3	7.0	—	—	—	0.0	1.6	39.7	3.6	42.8	—	—	—	—	—	—
Ae	3-10	7.0	0.10	1.06	11	0.1	0.6	14.8	2.7	17.4	—	40	34	26	13	L
Bt	10-25	6.8	0.04	0.53	13	0.1	0.6	17.5	5.6	22.3	—	29	34	37	23	CL
BC	25-45	6.8	—	—	—	0.1	0.4	14.8	4.5	19.7	—	51	21	28	15	SCL
C	45+	6.5	—	—	—	0.1	0.4	13.3	3.1	16.7	—	54	19	27	15	SCL

*m – moist color

Appendix A. (continued)

Soil association: **Nicot**
Map unit: **NIT1**
Classification: **Orthic Eutric Brunisol**
Profile location: **NW20-55-12-W4**
Topography: **Gently rolling**
Drainage: **Rapidly drained**
Parent material: **Glaciofluvial**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ap	0-13	very dark grayish brown (10YR 3/2m*)	sand	single grain	friable	plentiful	clear smooth
Bm1	13-30	yellowish brown (10YR 5/4m)	sand	single grain	loose	few	clear wavy
Bm2	30-86	yellowish brown (10YR 5/4m)	sand	single grain	loose	few	gradual wavy
BC	86+	yellowish brown (10YR 5/4m)	sand	single grain	loose		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ap	0-13	7.1	0.05	0.12	2	0.1	0.1	1.7	0.3	4.3	—	94	6	0	0	S
Bm1	13-30	6.8	0.01	0.10	10	0.1	0.0	0.6	0.1	1.5	—	97	3	0	0	S
Bm2	30-86	6.9	0.01	0.09	9	0.0	0.0	0.6	0.2	1.5	—	97	3	0	0	S
BC	86+	7.0	—	—	—	1.2	0.1	0.8	0.2	2.3	—	97	3	0	0	S

*m – moist color

Appendix A. (continued)

Soil association: **Norma**
Map unit: **NRM1**
Classification: **Solonetzic Black Chernozem**
Profile location: **NW35-54-14-W4**
Topography: **Undulating**
Drainage: **Moderately well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-18	very dark gray to black (10YR 3/1-2/1d*)	sandy loam	weak, fine granular	soft	abundant	abrupt smooth
Ae	18-23	brown (10YR 4/3d)	loam	weak, medium platy	slightly hard	abundant	clear irregular
Bnjt	23-43	dark yellowish brown (10YR 4/4d)	loam	moderate, coarse prismatic to medium blocky	hard		clear wavy
BC	43-74	yellowish brown (10YR 5/4d)	loam	strong, medium blocky	hard		clear wavy
Ck	74+	light yellowish to light olive brown (2.5Y 6/4-5/4d)	sandy loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0-18	6.8	0.32	4.04	13	0.1	0.3	14.8	4.7	22.2	—	61	29	10	10	SL
Ae	18-23	6.8	0.16	1.66	10	0.0	0.3	9.7	4.5	15.8	—	47	38	15	11	L
Bnjt	23-43	6.4	0.11	1.42	13	0.2	0.3	9.8	6.2	16.7	—	47	32	21	14	L
BC	43-74	6.7	—	—	—	0.3	0.4	10.3	7.9	16.7	—	43	34	23	15	L
Ck	74+	7.4	—	—	—	—	—	—	—	—	7.5	54	30	16	11	SL

*d – dry color

Appendix A. (continued)

Soil association: **Pathfinder**
Map unit: **PHF1**
Classification: **Dark Gray Luvisol**
Profile location: **NE26-54-7-W4**
Topography: **Moderately rolling**
Drainage: **Moderately well drained**
Parent material: **Bedrock**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahe	0-15	dark gray (10YR 4/1d*)	sandy loam	weak, fine granular	soft	plentiful	clear wavy
Ae	15-30	pale brown (10YR 6/3d)	fine sandy loam	strong, medium platy	soft	abundant	clear wavy
Bt	30-58	light olive brown (2.5Y 5/4m**)	sandy loam	weak, fine subangular blocky	firm	few	gradual wavy
BC1	58-89	light olive brown (2.5Y 5/6m)	sandy loam	weak, fine subangular blocky	firm	few	gradual wavy
BC2	89-109	light olive brown (2.5Y 5/4m)	sandy loam	single grain	loose	few	gradual irregular
C	109+	light olive brown (2.5Y 5/4m)	sandy loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ahe	0 - 15	7.0	0.20	1.72	9	0.1	2.1	18.5	4.5	24.1	0.2	59	25	16	10	SL
Ae	15 - 30	7.0	0.11	1.29	12	0.0	1.6	15.0	3.2	21.4	0.2	58	27	15	10	SL
Bt	30 - 58	6.8	0.04	0.35	9	0.1	0.8	13.4	5.5	20.6	—	62	23	15	12	SL
BC1	58 - 89	6.3	—	—	—	0.1	0.8	13.9	6.2	21.5	—	60	24	16	10	SL
BC2	89 -109	6.7	—	—	—	0.1	0.7	13.6	5.3	19.8	—	63	24	13	9	SL
C	109 +	6.3	—	—	—	0.2	0.4	12.8	7.0	19.0	—	63	25	12	7	SL

*d – dry color
**m – moist color

Appendix A. (continued)

Soil association: **Peace Hills**
Map unit: **PHS1**
Classification: **Orthic Black Chernozem**
Profile location: **SW10-55-15-W4**
Topography: **Gently undulating**
Drainage: **Well drained**
Parent material: **Glaciofluvial**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Drift	42-0	very dark gray (10YR 3/1m*)	sand	weak, medium granular	friable	common	abrupt smooth
Ah	0-25	very dark gray (10YR 3/1m)	loamy sand	moderate, medium granular	friable	common	clear wavy
AB1	25-35	dark brown (7.5YR 3/2m)	loamy sand	weak, medium granular	friable	few	gradual wavy
AB2	35-52	brown to dark brown (7.5YR 4/2m)	loamy sand to sand	weak, medium granular	friable	few vertical	clear wavy
Bm	52-88	yellowish brown (10YR 5/4m)	sand	single grain	loose	few	clear wavy
C	88+	brown (10YR 5/3m)	sand	single grain	loose	few	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Drift	42-0	6.7	0.16	2.40	15	0.0	0.2	5.2	0.7	10.0	—	89	7	4	1	S
Ah	0-25	6.5	0.13	2.15	17	0.0	0.3	4.4	0.7	9.2	—	85	9	6	1	LS
AB1	25-35	6.6	0.05	0.90	18	0.1	0.4	2.0	0.6	5.8	—	85	10	5	3	LS
AB2	35-52	6.8	0.02	0.75	38	0.0	0.3	1.4	0.4	4.7	—	87	8	5	2	LS-S
Bm	52-88	6.8	0.02	0.40	20	0.2	0.3	2.2	0.5	5.7	—	90	5	5	2	S
C	88+	6.7	—	—	—	0.0	0.2	2.0	0.5	5.7	—	88	6	6	2	S

*m – moist color

Appendix A. (continued)

Soil association: Ponoka
Map unit: POK4
Classification: Eluviated Black Chernozem
Profile location: NW20-56-15-W4
Topography: Undulating
Drainage: Moderately well drained
Parent material: Glaciolacustrine

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-36	black (10YR 2/1m*)	loam	weak, fine granular	very friable	common	clear wavy
Ahe	36-43	very dark grayish brown (10YR 3/2m)	sandy loam	weak, fine platy	friable	few	clear wavy
Bt	43-69	yellowish brown (10YR 5/4m)	clay loam	moderate, coarse prismatic to weak, granular	friable	few	clear smooth
BC	69-84	brown (10YR 5/3m)	clay loam	moderate, fine granular	firm	few	clear smooth
Cca	84+	grayish brown (10YR 5/2m)	clay to clay loam	massive			

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-36	7.2	0.44	4.93	11	0.3	0.5	24.4	10.8	34.3	—	46	34	20	13	L
Ahe	36-43	7.9	0.07	0.70	10	—	—	—	—	—	0.38	56	28	16	10	SL
Bt	43-69	7.7	0.06	0.69	10	—	—	—	—	—	0.35	43	20	37	12	CL
BC	69-84	7.5	0.04	0.55	14	—	—	—	—	—	0.64	42	20	38	22	CL
Cca	84+	7.7	—	—	—	—	—	—	—	—	19.9	36	24	40	20	C-CL

*m – moist color

Appendix A. (continued)

Soil association: **Redwater**
Map unit: **RDW4**
Classification: **Orthic Dark Gray Chernozem**
Profile location: **NE14-55-8-W4**
Topography: **Gently rolling**
Drainage: **Well drained**
Parent material: **Glaciolacustrine**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-23	black (10YR 2/1m*)	sandy loam	weak, fine granular	friable	plentiful	abrupt smooth
Ahe	23-38	dark brown (10YR 3/2d**)	sandy loam	weak, fine granular	soft	plentiful	abrupt smooth
Bt	38-58	yellowish brown (10YR 5/4m)	sandy loam	weak, fine subangular blocky	firm	few	clear wavy
BC1	58-89	light olive brown (2.5Y 5/4m)	sand	single grain	loose	few	gradual irregular
BC2	89-109	light olive brown (2.5Y 5/6m)	sand	single grain	loose	few	gradual irregular
Ck	109+	olive brown (2.5Y 4/4m)	loamy sand				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0 - 23	6.8	0.30	3.46	12	0.0	0.3	15.0	1.7	17.6	—	75	13	12	6	SL
Ahe	23 - 38	6.9	0.11	1.15	10	0.1	0.3	8.6	1.4	10.7	—	65	20	15	7	SL
Bt	38 - 58	7.2	0.05	0.42	8	0.0	0.3	7.7	1.5	9.5	0.2	64	25	11	9	SL
BC1	58 - 89	7.5	—	—	—	0.0	0.3	4.8	0.8	5.4	0.2	91	7	2	1	S
BC2	89 -109	7.1	—	—	—	0.0	0.1	6.6	0.3	3.5	0.8	93	6	1	0	S
Ck	109+	7.4	—	—	—	—	—	—	—	—	3.4	85	10	5	5	LS

*m – moist color
**d – dry color

Appendix A. (continued)

Soil association: Rimbey
Map Unit: RMY1
Classification: Orthic Dark Gray Chernozem
Profile location: NW3-56-12-W4
Topography: Gently rolling
Drainage: Moderately well drained
Parent material: Glaciolacustrine

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-25	black (10YR 2/1m*)	silt loam to silty clay loam	moderate, fine granular	friable	many	clear wavy
Ahe	25-33	very dark grayish brown (10YR 3/2m)	silt loam	weak, medium platy	friable	many	clear wavy
Bt	33-51	yellowish to dark yellowish brown (10YR 4/4-5/4m)	silt loam to silty clay loam	weak, fine subangular blocky	friable	plentiful	gradual irregular
BC	51-91	dark yellowish brown (10YR 4/4m)	silt loam	weak, fine subangular blocky	friable	few	clear wavy
Cca	91+	grayish brown (2.5Y 5/2m)	silt loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-25	6.8	0.25	3.55	14	0.1	0.3	13.0	5.4	27.3	—	17	55	28	18	SiL-SiCL
Ahe	25-33	7.0	0.14	1.52	11	0.1	0.2	8.3	4.5	16.2	—	19	60	21	12	SiL
Bt	33-51	7.0	0.06	0.55	9	0.0	0.3	7.7	5.8	17.8	—	16	57	27	17	SiL-SiCL
BC	51-91	8.0	—	—	—	—	—	—	—	—	—	27	51	22	13	SiL
Cca	91+	8.1	—	—	—	—	—	—	—	—	5.2	28	50	22	12	SiL

*m – moist color

Appendix A. (continued)

Soil association: **Shandro**
Map unit: **SHZ1**
Classification: **Humic Gleysol**
Profile location: **SW26-53-17-W4**
Topography: **Gently undulating**
Drainage: **Poorly drained**
Parent material: **Bedrock**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ahks	0-18	black (2.5Y 2/0m*)	silty clay	strong, fine granular	firm	few	abrupt smooth
Bskg	18-36	dark grayish brown (2.5Y 4/2m)	clay	weak, fine granular	firm	few	gradual irregular
Ccasg	36+	dark grayish brown to olive brown (2.5Y 4/2-4/4m)	clay	massive			

Analysis of representative profile

Horizon	Depth	pH	N	Organic	C/N	Exchangeable Cations (me/100g)				Total CEC	$CaCO_3$	Particle Size				
	(cm)	(H_2O)	(%)	C(%)		Na	K	Ca	Mg	(me/100g)	Equiv.(%)	%S	%Si	%C	%FC	Texture
Ahks	0-18	8.0	0.50	—	—	—	—	—	—	—	0.7	9	44	47	30	SiC
Bskg	18-36	7.9	—	—	—	—	—	—	—	—	4.1	6	35	59	40	C
Ccasg	36+	7.7	—	—	—	—	—	—	—	—	6.6	7	33	60	36	C

*m – moist color

Appendix A. (continued)

Soil association: Snipe Hills
Map unit: SNl1
Classification: Dark Gray Luvisol
Profile location: NW31-53-10-W4
Topography: Undulating
Drainage: Rapidly drained
Parent material: Glaciofluvial gravel

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ap	0-10	dark to very dark gray (10YR 4/1-3/1d*)	sandy loam	weak, fine granular	soft	abundant	abrupt smooth
Ae	10-18	brown (10YR 5/3m**)	fine sandy loam	moderate, fine platy	friable	abundant	clear wavy
Btj	18-33	brown to dark brown (10YR 4/3m)	gravelly, coarse sandy loam	single grain	loose	abundant	clear irregular
Ck	33+	brown to dark brown (10YR 4/3m)	gravelly, coarse loamy sand	single grain	loose		

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ap	0-10	6.2	0.43	4.32	10	0.0	0.1	12.5	2.2	26.7	—	57	28	15	10	SL
Ae	10-18	6.5	0.14	1.60	11	0.1	0.1	5.3	1.4	13.3	—	63	25	12	9	SL
Btj	18-33	6.5	0.09	1.20	13	0.1	0.1	5.9	1.8	13.1	—	72	16	12	9	SL
Ck	33+	8.0	—	—	—	—	—	—	—	—	3.7	86	6	8	4	LS

*d – dry color
**m – moist color

Appendix A. (continued)

Soil association: Two Hills
Map unit: TWH1
Classification: Orthic Dark Gray Chernozem
Profile location: NW32-53-10-W4
Topography: Gently rolling
Drainage: Moderately well drained
Parent material: Glaciofluvial gravel

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-13	black (10YR 2/1m*)	loam	weak, fine granular	friable	abundant	abrupt smooth
Ahe	13-20	very dark gray (10YR 3/1m)	loam	moderate, fine platy	friable	abundant	clear wavy
Btj	20-40	very dark grayish to dark brown (10YR 3/3m)	gravelly, sandy loam	weak, fine subangular blocky	friable	abundant	gradual irregular
BC	40+	dark brown (10YR 3/3m)	gravelly, loamy sand	single grain	loose	few to abundant	

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-13	5.9	0.76	7.95	10	0.1	0.4	18.5	4.1	40.0	—	44	37	19	9	L
Ahe	13-20	6.1	0.43	4.60	11	0.2	0.2	10.1	3.1	25.9	—	49	32	19	12	L
Btj	20-40	6.6	0.13	1.35	10	0.1	0.2	5.2	2.9	13.7	—	54	32	14	9	SL
BC	40+	7.7	—	—	—	—	—	—	—	—	—	82	9	9	5	LS

*m – moist color

Appendix A. (continued)

Soil association: **Uncas**
Map unit: **UCS1**
Classification: **Dark Gray Luvisol**
Profile location: **NW20-55-7-W4**
Topography: **Undulating**
Drainage: **Moderately well drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-5	black (10YR 2/1m*)	loam	moderate, fine granular	friable	abundant	clear smooth
Ahe	5-18	very dark gray (10YR 3/1m)	loam	moderate, medium platy	friable	abundant	gradual wavy
Ae	18-31	pale brown (10YR 6/3m)	loam	moderate to strong, medium platy	friable	plentiful	gradual wavy
Bt1	31-51	yellowish brown (10YR 5/4m)	clay loam	moderate, medium sub-angular blocky	very firm	abundant	clear irregular
Bt2	51-69	light olive brown (2.5Y 5/4m)	sandy clay loam	strong, medium sub-angular blocky	very firm	few	gradual irregular
BC	69-87	light olive brown to olive brown (2.5Y 5/4-4/4m)	sandy clay loam	moderate, coarse sub-angular blocky	firm		clear wavy
Ck	87+	dark grayish brown (2.5Y 4/2m)	sandy clay loam				

Analysis of representative profile

Horizon	Depth (cm)	pH (H_2O)	N (%)	Organic C(%)	C/N	Exchangeable Cations (me/100g) Na	K	Ca	Mg	Total CEC (me/100g)	$CaCO_3$ Equiv.(%)	Particle Size %S	%Si	%C	%FC	Texture
Ah	0-5	7.3	0.65	8.17	13	0.0	0.1	23.2	6.1	26.5	—	44	35	21	11	L
Ahe	5-18	7.0	0.31	3.24	10	0.0	0.6	16.6	5.0	21.5	—	45	32	23	11	L
Ae	18-31	6.2	0.08	0.93	12	0.0	0.3	6.4	3.0	10.3	—	34	45	21	9	L
Bt1	31-51	6.5	0.05	0.55	11	0.1	0.4	9.5	5.9	15.0	—	45	25	30	18	CL
Bt2	51-69	6.7	0.04	0.48	12	0.1	0.3	8.6	5.8	13.7	—	49	23	28	16	SCL
BC	69-87	6.9	—	—	—	0.1	0.4	8.6	5.9	12.6	—	50	23	27	15	SCL
Ck	87+	7.8	—	—	—	—	—	—	—	—	6.2	51	23	26	12	SCL

*m - moist color

Appendix A. (continued)

Soil association: **Whitford**
Map unit: **WHF1**
Classification: **Black Solonetz**
Profile location: **SE16-54-9-W4**
Topography: **Undulating**
Drainage: **Imperfectly drained**
Parent material: **Glacial till**

Description of representative profile

Horizon	Depth (cm)	Color	Texture	Structure	Consistence	Roots	Boundary
Ah	0-8	very dark gray (10YR 3/1m*)	sandy loam	single grain	friable	plentiful	abrupt smooth
Bnt	8-23	dark brown (10YR 3/3m)	sandy clay loam	strong, medium columnar	very firm	few	clear wavy
BCsakg	23-50	olive brown (2.5Y 4/4m)	sandy clay loam	moderate, fine sub-angular blocky	firm		clear irregular
Csakg	50+	olive brown (2.5Y 4/4m)	clay loam				

Analysis of representative profile

Horizon	Depth	pH	N	Organic	C/N	Exchangeable Cations (me/100g)				Total CEC	$CaCO_3$	Particle Size				Texture
	(cm)	(H_2O)	(%)	C(%)		Na	K	Ca	Mg	(me/100g)	Equiv.(%)	%S	%Si	%C	%FC	
Ah	0-8	7.5	0.46	4.46	10	4.41	0.62	13.0	4.2	20.1	0.2	58	30	12	9	SL
Bnt	8-23	8.3	0.18	1.60	9	—	—	—	—	—	0.4	54	25	21	17	SCL
BCsakg	23-50	8.9	—	—	—	—	—	—	—	—	9.1	52	23	25	13	SCL
Csakg	50+	9.1	—	—	—	—	—	—	—	—	8.4	36	35	29	13	CL

*m – moist color

Appendix B
Definition of terms

Summary of Canadian System of Soil Classification (1978)

The following are definitions of some terms commonly used to describe features of significance within the map area.

Soil texture
Soil separates (particle sizes) on which textural classes are based:

Separates	Diameter in mm
Very coarse sand (V.C.S.)	2.0 - 1.0
Coarse sand (C.S.)	1.0 - 0.5
Medium sand (M.S.) sand (S.)	0.5 - 0.25
Fine sand (F.S.)	0.25 - 0.10
Very fine sand (V.F.S.)	0.10 - 0.05
Silt (Si.)	0.05 - 0.002
Clay (C.)	less than 0.002
Fine clay (F.C.)	less than 0.0002

Proportions of soils separates in various soil textural classes

From Toogood, J.A. (1958): A simplified textural classification diagram. Canadian Journal of Soil Science, vol. 38, pp. 54-55.

Sands are further divided according to the prevalence of differently sized sand fractions. Medium and coarse sands may contain over 25 percent coarse sand but not over 50 percent fine sands. Fine and very fine sands must contain over 50 percent of the respective fine sand fractions.

The soil textural classes are grouped according to the National Soil Survey Committee of Canada as follows:

- *coarse-textured* - sands, loamy sands
- *moderately coarse-textured* - sandy loam, fine sandy loam
- *medium-textured* - very fine sandy loam, loam, silt loam, silt
- *moderately fine-textured* - sandy clay loam, clay loam, silty clay loam
- *fine-textured* - sandy clay, silty clay, clay (40 to 60 percent)
- *very fine-textured* - heavy clay (more than 60 percent clay)

Soil structure and consistence
Soil structure refers to the aggregation of the primary soil particles into compound particles, or clusters of primary particles, which are separated from adjoining aggregates by surfaces of weakness. The aggregates differ in grade of development (degree of distinctness) and this distinctness is classed as weak, moderate or strong. The aggregates vary in size and are classed as very fine, fine, medium, coarse or very coarse. They also vary in kind, that is, in the character of their faces and edges. The kinds mentioned in this report are: single grain — loose, incoherent mass of individual particles as in sands; blocky — faces rectangular and flattened, vertices sharply angular; subangular blocky — faces subrectangular, vertices mostly oblique, or subrounded; columnar — vertical edges near top of columns are not sharp (columns may be flat-topped, round-topped, or irregular); granular — spheroidal, characterized by rounded vertices; platy — horizontal planes more or less developed.

Soil consistence comprises the attributes of soil materials that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation and rupture. Consistence reflects the strength and nature of the forces of attraction within a soil mass. The terms used in describing soils in this report are: loose — noncoherent; friable (specifies friable when moist) — a soil material which crushes easily under gently to moderate pressure between thumb and forefinger, and coheres when pressed together; firm (specifies firm when moist) — soil material which crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable; hard (specifies hard when dry) — moderately resistant to pressure, can be broken in the hands without difficulty but rarely breakable between thumb and forefinger; compact — term denotes a combination of firm consistence and a close packing or arrangement of particles; plastic (specifies plastic when wet) — soil material can be formed into wires by rolling between the thumb and forefinger and moderate pressure is required for deformation of the soil mass.

Soil moisture classes
Soil moisture classes are defined according to:
1. actual moisture content in excess of field moisture capacity, and
2. the extent of the period during which such excess water is present in the plant root zone.

The classes are:
- *rapidly drained* - soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions;
- *well drained* - soil moisture content does not normally exceed field capacity in any horizon, except possibly the C, for a significant part of the year;
- *moderately well drained* - soil moisture in excess of field capacity remains for a small but significant period of the year;
- *imperfectly drained* - soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year;
  poorly drained - soil moisture in excess of field capacity remains in all horizons for a large part of the year;
- *very poorly drained* - free water remains at or within 30 cm of the surface most of the year;

Special reference to surface drainage may be designated in terms of runoff and described as high, medium, low or ponded. Similarly, specific reference to the characteristics of horizons within the profile may be designated in terms of permeability or percolation and described as rapid, moderate, slow, very slow and none.

Calcareous classes

The Canada Soil Survey Committee (1974) has set the following nomenclature and limits for calcareous grades:

- *weakly calcareous:* 1 to 5 percent calcium carbonate equivalent
- *moderately calcareous:* 6 to 15 percent calcium carbonate equivalent
- *strongly calcareous:* 16 to 25 percent calcium carbonate equivalent
- *very strongly calcareous:* 26 to 40 percent calcium carbonate equivalent
- *extremely calcareous:* greater than 40 percent calcium carbonate equivalent

Reaction classes

The reaction classes and terminology adopted by the Canada Soil Survey Committee (1978) are:

Class	pH (H_2O)
extremely acid	less than 4.5
very strongly acid	4.6 to 5.0
strongly acid	5.1 to 5.5
medium acid	5.6 to 6.0
slightly acid	6.1 to 6.5
neutral	6.6 to 7.3
mildly alkaline	7.4 to 7.8
moderately alkaline	7.9 to 8.4
strongly alkaline	8.5 to 9.0
very strongly alkaline	greater than 9.0

Stoniness

The classes of stoniness are:

- *Stones 1 (slightly stony land)* - some stones, offering slight to no hindrance to cultivation;
- *Stones 2 (moderately stony land)* - enough stones to interfere somewhat with cultivation;
- *Stones 3 (very stony land)* - enough stones to constitute a serious handicap to cultivation and some clearing is required;
- *Stones 4 (exceedingly stony land)* - enough stones to prevent cultivation until considerable clearing is done (50 to 90 percent stones by volume);
- *Stones 5 (excessively stony land)* - the land is a boulder or stone pavement, too stony to permit any cultivation (greater than 90 percent stones by volume).

Horizon boundaries

The lower boundary of each horizon is described by indicating its distinctness and form as suggested in the USDA Soil Survey Manual (United States Department of Agriculture, 1951). The classes of distinctness are:

- *abrupt:* less than 2.5 cm wide
- *clear:* 2.5 to 6 cm wide
- *gradual:* 6 to 12.5 cm wide
- *diffuse:* more than 12.5 cm wide

The categories for form are:

- *smooth:* nearly a plane
- *wavy:* pockets are wider than deep
- *irregular:* pockets are deeper than wide
- *broken:* parts of the horizon are unconnected with other parts

Roots

The terminology for describing roots is that adopted by the Canada Soil Survey Committee (1978). In this system both the abundance and diameter of roots are described. The classes of abundance are:
(number per unit area [$inch^2$] of surface)

- *very few:* less than 1
- *few:* 1 to 3
- *plentiful:* 4 to 14
- *abundant:* more than 14

The diameter categories are:

- *micro:* less than 0.075 mm
- *very fine:* 0.075 to 1 mm
- *fine:* 1 to 2 mm
- *medium:* 2 to 5 mm
- *coarse:* more than 5 mm

Glossary

This is included to define terms commonly used in this report it is not a comprehensive soil glossary.

acid soil — A soil having a pH of less than 7.0.

aeolian deposit — Wind deposit, includes both loess and dune sand.

aggregate — A group of soil particles cohering so as to behave mechanically as a unit.

alkaline soil — A soil having a pH greater than 7.0.

alluvium — A general term for all deposits of modern rivers and streams.

available nutrient — That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants ("available" should not be confused with "exchangeable").

bedrock — The solid rock underlying soils and the regolith or exposed at the surface.

bog — Permanently wet land with low bearing strength.

bulk density, soil — The mass of dry soil per unit bulk volume.

calcareous soil — Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold 0.1N hydrochloric acid.

capability class (soil) — The class indicates the general suitability of the soils for agricultural use. It is a grouping of subclasses that have the same relative degree of limitation or hazard. The limitation or hazard becomes progressively greater from Class 1 to Class 7.

capability subclass (soil) — This is a grouping of soils with similar kinds of limitations and hazards. It provides information on the kind of conservation problem or limitation. The class and subclass together provide the user with information about the degree and kind of limitation for broad land-use planning and for the assessment of conservation needs.

category — Any one of the ranks of the system of soil classification in which soils are grouped on the basis of their characteristics.

cation exchange — The interchange between a cation in solution and another cation on the surface of any surface-active material such as clay colloids or organic colloids.

cation exchange capacity — The sum total of exchangeable cations that a soil can absorb. Sometimes called "total exchange capacity," "base exchange capacity," or "cation adsorption capacity." Expressed in milliequivalents per 100 grams of soil.

classification, soil — The systematic arrangement of soils into categories and classes on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

clay — As a particle-size term; size fraction <0.002 mm equivalent diameter.

clayey — Containing large amounts of clay or having properties similar to those of clay.

coarse fragments — Rock or mineral particles >2.0 mm in diameter.

coarse-texture — The texture exhibited by sands, loamy sands, and sandy loams except very fine sandy loam. A soil containing large quantities of these textural classes.

consistency — (i) The resistance of a material to deformation or rupture; (ii) the degree of cohesion or adhesion of the soil mass.

crust — A surface layer on cultivated soils, ranging in thickness from a few millimetres to perhaps as much as an inch, that is much more compact, hard and brittle when dry than the material immediately beneath it.

degradation — The changing of a soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated, light-colored Ae horizon.

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

eluvial horizon — A soil horizon that has been formed by the process of eluviation. See illuvial horizon.

erosion — The wearing away of the land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep.

fertility, soil — The status of a soil with respect to the amount and availability to plants of elements necessary for plant growth.

fertilizer — Any organic or inorganic material of natural or synthetic origin added to a soil to supply certain elements essential to the growth of plants.

fertilizer requirements — The quantity of certain plant nutrient elements needed, in addition to the amount supplied by the soil, to increase plant growth to a designated optimum.

fine texture — Consisting of or containing large quantities of the fine fractions, particularly of silt and clay.

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

fluvial deposits — All sediments, past and present, deposited by flowing water, including glaciofluvial deposits. Wave-worked deposits and deposits resulting from sheet erosion and mass wasting are not included.

friable — A consistency term pertaining to the ease of crumbling of soils.

frost action — Freezing and thawing of moisture in materials and the resultant effects on these materials and on structures of which they are a part or with which they are in contact.

glacial drift — Embraces all rock material transported by glacier ice, glacial meltwater and rafted by icebergs. This term includes till, stratified drift and scattered rock fragments.

glaciofluvial deposits — Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

glaciolacustrine deposit — Material deposited in lake water and later exposed either by lowering the water level or by uplift of the land. These sediments range in texture from sands to clays.

gravelly — Containing appreciable or significant amounts of gravel.

green manure — Plant material incorporated with the soil while green, for improving the soil.

ground moraine — Generally an unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till, though stratified drift is present in places. The till is thought to have accumulated largely by lodgment beneath the ice but partly also by being let down from the upper surface of the ice through the ablation process. Ground moraine is most commonly in the form of undulating plains with gently sloping swells, sags and enclosed depressions.

groundwater — That portion of the total precipitation that at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

illuvial horizon — A soil layer or horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

illuviation — The process of deposition of soil material removed from one horizon to another in the soil; usually from an upper to a lower horizon in the soil profile. Illuviated substances include silicate clay, iron and aluminum hydrous oxides and/or organic matter.

immature soil — A soil with indistinct or only slightly developed horizons.

infiltration — The downward entry of water into the soil.

landscape — All the natural features such as fields, hills, forests and water, which distinguish one part of the earth's surface from another part. Usually that portion of land or territory the eye can comprehend in a single view, including all its natural characteristics.

leaching — The removal of materials in solution from the soil.

liquid limit — (upper plastic limit) — (i) The water content corresponding to an arbitrary limit between the liquid and plastic states of consistency of a soil. (ii) The water content at which a pat of soil, cut by a groove of standard dimensions, will flow together for a distance of 12 mm under the impact of 25 blows in a standard liquid limit apparatus.

marsh — Periodically wet or continually flooded areas with the surface not deeply submerged. Covered dominantly with sedges, cattails, rushes or other hydrophytic plants. Subclass includes freshwater and salt water marshes.

mature soil — A soil with well-developed soil horizons produced by the natural processes of soil formation.

medium-texture — Intermediate between fine textured and coarse textured (soils). (It includes the following textural classes: very fine sandy loam, loam, silt loam, and silt.).

mineral soil — A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter. It contains $<30\%$ organic matter except for an organic surface layer that may be up to 30 cm thick, if consolidated, or 45 cm if unconsolidated.

mottles — Spots or blotches of different color or shades of color interspersed with the dominant color resulting from reducing conditions.

Munsell color system — A color designation system that specifies the relative degree of the three simple variables of color: hue, value and chroma. For example: 10YR 6/4 is a color (of soil) with a hue - 10YR, value 6, and chroma 4. These notations can be translated into several different systems of color names as desired.

neutral soil — A soil in which the surface layer, at least to normal plow depth, is neither acid nor alkaline in reaction.

organic soil — A soil that has developed dominantly from organic deposits. The majority of organic soils are saturated for most of the year, unless artificially drained, but some of them are not usually saturated for more than a few days. They contain 17% or more organic carbon and:

1. if the surface layer consists of fibric organic material and the bulk density is less than 0.1 [with or without a mesic or humic Op less than 15 cm (6 inches) thick], the organic material must extend to a depth of at least 60 cm (24 inches);
2. if the surface layer consists of organic material with a bulk density of 0.1 or more, the organic material must extend to a depth of at least 40 cm (16 inches);
3. if a lithic contact occurs at a depth shallower than stated in 1 or 2 above, the organic material must extend to a depth of at least 60 cm (4 inches).

outwash — Sediments "washed out" by flowing water beyond the glacier and laid down in thin foreset beds as stratified drift. Particle size may range from boulders to silt.

parent material — The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

particle size — The effective diameter of a particle measured by sedimentation, sieving or micrometric methods.

particle size distribution — The amounts of the various soil separates in a soil sample, usually expressed as weight percentages.

peat — Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed, organic matter.

ped — A unit of soil structure such as a prism, block, or granule formed by natural processes (in contrast to a clod, which is formed artificially).

pedology — Those aspects of soil science involving the constitution, distribution, genesis and classification of soils.

percolation, soil water — The downward movement of water through soil. Especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

pH, soil — The negative logarithm of the hydrogen ion activity of a soil. The degree of acidity or alkalinity of a soil as determined by means of a glass, quinhydrone or other suitable electrode or indicator at a specified moisture content or soil-water ratio, and expressed in terms of the pH scale.

phase, soil — A subdivision of a soil type or other unit of classification having characteristics that affect the use and management of the soil but which do not vary sufficiently to differentiate it as a separate type. A variation in a property or characteristic such as degree of slope, degree of erosion, or content of stones.

physical properties (of soils) — Those characteristics, processes, or reactions of a soil caused by physical forces and which can be described by, or expressed in, physical terms or equations. Sometimes confused with and difficult to separate from chemical properties; hence, the terms "physical-chemical" or "physiochemical" not used in this report).

plastic limit — (i) The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil. (ii) Water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm in diameter.

platy — Consisting of soil aggregates that are developed predominately along the horizontal axes; laminated; flaky.

pore space — Total space not occupied by soil particles in a bulk volume of soil.

productivity, soil — The capacity of a soil, in its normal environment, for producing a specified plant or sequence of plants under a specified system of management. The "specified" limitations are necessary since no soil can produce all crops with equal success nor can a single system of management produce the same effect on all soils. Productivity emphasizes the capacity of soil to produce crops and should be expressed in terms of yields.

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

reaction, soil — The degree of acidity or alkalinity of a soil, usually expressed as a pH value.

saline soil — A nonalkali soil containing soluble salts in such quantities as to interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 mmhos/cm, the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

sand — A soil particle between 0.05 and 2.0 mm in diameter.

silt — A soil particle between 0.05 and 0.002 mm in diameter.

soil — (i) The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. (ii) The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro and microorganisms and topography, all acting over a period of time and producing a product (soil) that differs from the material from which it is derived in many physical, chemical, biological and morphological properties, and characteristics.

soil conservation — (i) Protection of the soil against physical loss by erosion or against chemical deterioration; that is, excessive loss of fertility by either natural or artificial means. (ii) A combination of all management and land-use methods that safeguard the soil against depletion or deterioration by natural or man-induced factors.

soil genesis — The mode of origin of the soil with special reference to the processes or soil forming factors responsible for the development of the solum, or true soil, from the unconsolidated parent material.

soil management — The sum total of all tillage operations, cropping practices, fertilizer, lime and other treatments conducted on or applied to a soil for the production of plants.

soil map — A map showing the distribution of soil mapping units in relation to the prominent physical and cultural features of the earth's surface.

soil moisture — Water contained in the soil.

soil morphology — (i) The physical constitution, particularly the structural properties, of a soil profile as exhibited by the kinds, thickness and arrangement of the horizons in the profile, and by the textures, structure, consistency and porosity of each horizon. (ii) The structural characteristics of the soil or any of its parts.

soil organic matter — The organic fraction of the soil; includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. Usually determined on soils that have been sieved to pass a 2.0 mm sieve.

soil separates — Mineral particles, <2.0 mm in equivalent diameter, ranging between specified size limits.

soil structure — The combination or arrangement of primary soil particles into secondary particles, units or peds. These secondary units may be, but usually are not, arranged in the profile in such a manner as to give a distinctive characteristic pattern. The secondary units are characterized and classified on the basis of size, shape and degree of distinctness into classes, types and grades, respectively.

soil survey — The systematic examination, description, classification and mapping of soils in an area. Soil surveys are classified according to the kind and intensity of field examination.

soil texture — The relative proportions of the various soil separates in a soil. The textural classes may be modified by the addition of suitable adjectives when coarse fragments are present in substantial amounts, for example, "stony silt loam," or "silt loam, stony phase."

solum (plural sola) — The upper horizons of a soil in which the parent material has been modified and within which most plant roots are confined. It consists usually of A and B horizons.

stones — Rock fragments >25 cm in diameter if rounded and 38 cm along the greater axis if flat.

stony — Containing sufficient stones to interfere with or to prevent tillage.

surface soil — The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils and ranging in depth from 8 or 10 cm to 20 or 25 cm. Frequently designated as the "plow layer," the "Ap layer," or the "Ap horizon."

till — (i) Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel and boulders intermingled in any proportion. (ii) To plow and prepare for seeding; to seed or cultivate the soil.

tilth — The physical condition of soil as related to its ease of tillage, fitness as a seedbed and its impedance to seedling emergence and root penetration.

very coarse texture — Consisting of sands and loamy sands.

very fine texture — Consisting of very fine clay particles (more than 60% clay).

waterlogged — Saturated with water.

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

Map Legend

Association	Map Unit	Dominant Soils	(%)	Significant Soils	(%)	Eroded Phase (%)	Parent Material	Comments
Alluvium	AV1	Rego Black	60	Orthic Regosol	40		Fluvial	
	AV2	Rego Black (carbonated)	100					
	AV3	Orthic Regosol (saline)	60	Rego Black (carbonated)	40			
	AV4	Cumulic Regosol	60	Rego Black	40			
	AV5	Gleyed Solonetzic Black	70	Humic Gleysol (saline)	30			
	AV6	Rego Gleysol (carbonated, peaty)	60	Humic Gleysol (carbonated)	40			
Angus Ridge	AGS1	Eluviated Black	70	Orthic Black	30		Glacial Till	
	AGS2	Eluviated Black	60	Orthic Black	30			
				Humic Gleysol	10			
	AGS3	Eluviated Black	50	Orthic Black	20			
				Humic Gleysol	30			
	AGS4	Eluviated Black	60	Orthic Black	30	30		
				Humic Gleysol	10			
	AGS5	Eluviated Black	60	Solonetzic Black	30			
				Humic Gleysol	10			
	AGS7	Eluviated Black	50	Black Solodized Solonetz	20			
				Humic Gleysol	30			
	AGS8	Eluviated Black	60	Black Solod	30			
				Humic Gleysol	10			
Armena	ARM1	Black Solodized Solonetz	90	Humic Gleysol (saline)	10		Glaciolacustrine	
Brosseau	BSU1	Orthic Dark Gray	100			30	Bedrock	
	BSU2	Orthic Dark Gray	100			30		
	BSU3	Orthic Dark Gray	40	Rego Black (carbonated)	40			
				Humic Gleysol (saline)	20			
	BSU4	Orthic Dark Gray	60	Dark Gray Luvisol	30	30		
				Humic Gleysol	10			
	BSU5	Orthic Dark Gray	70	Black Solonetz	30	30		
	BSU6	Orthic Dark Gray	50	Black Solonetz	20	30		
				Humic Gleysol	30			
Camrose	CMO1	Black Solodized Solonetz	90	Humic Gleysol (saline, carbonated)	10		Glacial Till	
	CMO2	Black Solodized Solonetz	50	Gleyed Black Solodized Solonetz	30			
				Humic Gleysol (saline, carbonated)	20			
	CMO3	Black Solodized Solonetz	50	Black Solod	20			
				Humic Gleysol	30			
	CMO4	Black Solodized Solonetz	40	Eluviated Black	40			
				Humic Gleysol	20			
Clouston	CUN1	Orthic Gray Luvisol	90	Luvic Gleysol	10		Glaciofluvial	
	CUN2	Orthic Gray Luvisol	90	Luvic Gleysol	10		Gravel	shallow (<50 cm over till)

Map Legend (continued)

Association	Map Unit	Dominant Soils	(%)	Significant Soils	(%)	Eroded Phase (%)	Parent Material	Comments
Cooking Lake	COA1	Orthic Gray Luvisol	100				Glacial Till	
	COA2	Orthic Gray Luvisol	70	Gleyed Gray Luvisol	30			
	COA3	Orthic Gray Luvisol	60	Luvic Gleysol and Slough	40			
	COA4	Orthic Gray Luvisol	60	Dark Gray Luvisol	40			
	COA5	Orthic Gray Luvisol	40	Dark Gray Luvisol	40			
				Luvic Gleysol and Slough	20			
Cucumber	CCB1	Orthic Black	60	Eluviated Black	40		Glaciolacustrine	
	CCB2	Eluviated Black	60	Orthic Black	30			shallow (<50 cm over till)
				Humic Gleysol	10			
Culp	CUP1	Orthic Gray Luvisol	100				Glaciofluvial	shallow (<50 cm over till)
	CUP2	Orthic Gray Luvisol	90	Luvic Gleysol	10			
Daysland	DYD1	Black Solod	60	Black Solodized Solonetz	30		Glacial Till	
				Humic Gleysol	10			
	DYD2	Black Solod	50	Black Solodized Solonetz	20			
				Humic Gleysol	30			
	DYD3	Black Solod	40	Solonetzic Black	30			
				Humic Gleysol	30			
	DYD4	Black Solod	50	Black Solodized Solonetz	20			
				Eluviated Black	30			
	DYD5	Black Solod	50	Eluviated Black	30			
				Humic Gleysol	20			
Demay	DMY1	Luvic Gleysol (peaty)	60	Luvic Gleysol	40		Glacial Till	
Desjarlais	DSJ1	Humic Gleysol (carbonated)	60	Humic Gleysol	40		Glaciofluvial	
	DSJ2	Humic Gleysol (saline)	100					
Duagh	DUG1	Black Solonetz	70	Humic Gleysol (saline)	30		Glaciolacustrine	
Falun	FLU1	Orthic Dark Gray	90	Humic Gleysol	10		Glacial Till	
	FLU2	Orthic Dark Gray	90	Humic Gleysol	10	30		
	FLU3	Orthic Dark Gray	100			30		
	FLU4	Orthic Dark Gray	70	Humic Gleysol	30	30		
	FLU5	Orthic Dark Gray	70	Humic Gleysol	30			
	FLU6	Orthic Dark Gray	90	Humic Gleysol	10	70		
	FLU7	Orthic Dark Gray	70	Humic Gleysol	30	70		
	FLU8	Orthic Dark Gray	50	Dark Gray Luvisol	20			
				Humic Gleysol	30			
	FLU9	Orthic Dark Gray	60	Dark Gray Luvisol	30	70		
				Humic Gleysol	10			

Map Legend (continued)

Association	Map Unit	Dominant Soils	(%)	Significant Soils	(%)	Eroded Phase (%)	Parent Material	Comments
Falun	FLU10	Orthic Dark Gray	60	Dark Gray Luvisol	30	70	Glacial Till	
				Humic Gleysol	10			
	FLU11	Orthic Dark Gray	70	Gleyed Gray Luvisol	20			
				Humic Gleysol	10			
	FLU13	Orthic Dark Gray	50	Dark Gray Luvisol	20	30		
				Humic Gleysol	30			
	FLU14	Orthic Dark Gray	60	Dark Gray Luvisol	30			
				Humic Gleysol	10			
Fawcett	FWT1	Dark Gray Luvisol	100				Glaciolacustrine	
	FWT2	Dark Gray Luvisol	90	Luvic Gleysol	10			shallow (<50 cm over till)
Ferintosh	FNH1	Orthic Black	70	Eluviated Black	30		Glaciofluvial	
	FNH2	Orthic Black	60	Eluviated Black	20		Gravel	
				Humic Gleysol	20			
	FHN3	Orthic Black	100					shallow (<50 cm over till)
Hairy Hill	HYL1	Humic Gleysol (saline)	60	Humic Gleysol	40		Glacial Till	
	HYL2	Humic Gleysol (saline)	60	Gleyed Black Solonetz	40			
Hilda	HD1	Terric Mesisol	60	Terric Mesic Humisol	40		Organic	
Kapona	KPO1	Black Solod	70	Black Solodized Solonetz	20		Glaciolacustrine	
				Humic Gleysol	10			
Kavanagh	KVG1	Black Solodized Solonetz	100				Bedrock	
	KVG2	Black Solodized Solonetz	70	Humic Gleysol (saline)	30			
	KVG3	Black Solodized Solonetz	80	Humic Gleysol (saline)	20			20-50 cm sand overlying bedrock
	KVG4	Black Solodized Solonetz	70	Orthic Dark Gray	30			
	KVG5	Black Solodized Solonetz	50	Orthic Dark Gray	20			
				Humic Gleysol	30			
Leith	LIH1	Dark Gray Luvisol	90	Luvic Gleysol	10		Glaciofluvial	
	LIH2	Dark Gray Luvisol	90	Luvic Gleysol	10	50		
	LIH3	Dark Gray Luvisol	90	Luvic Gleysol	10	70		
	LIH4	Dark Gray Luvisol	90	Luvic Gleysol	10			shallow (<50 cm over till)
	LIH5	Dark Gray Luvisol	90	Luvic Gleysol	10	50		shallow (<50 cm over till)
	LIH6	Dark Gray Luvisol	90	Luvic Gleysol	10	70		shallow (<50 cm over till)
	LIH7	Dark Gray Luvisol	60	Luvic Gleysol	40			shallow (<50 cm over till)
Manatokan	MN1	Terric Mesisol	60	Terric Fibric Mesisol	20		Organic	
				Typic Mesisol	20			
Maughan	MAA1	Orthic Gray Luvisol	70	Dark Gray Luvisol	20		Bedrock	
				Luvic Gleysol	10			

Map Legend (continued)

Association	Map Unit	Dominant Soils	(%)	Significant Soils	(%)	Eroded Phase (%)	Parent Material	Comments
Nicot	NIT1	Eluviated Eutric Brunisol	70	Orthic Eutric Brunisol	30		Glaciofluvial	
	NIT2	Eluviated Eutric Brunisol	70	Orthic Dark Gray	20			
				Luvic Gleysol	10			
Norma	NRM1	Solonetzic Black	70	Eluviated Black	20		Glacial Till	
				Humic Gleysol	10			
	NRM2	Solonetzic Black	50	Eluviated Black	20			
				Humic Gleysol	30			
	NRM3	Solonetzic Black	50	Black Solonetz	20			
				Humic Gleysol	30			
Path-finder	PHF1	Dark Gray Luvisol	70	Orthic Gray Luvisol	20	30	Bedrock	
				Luvic Gleysol	10			
	PHF2	Dark Gray Luvisol	70	Orthic Dark Gray	20	30		
				Luvic Gleysol	10			
Peace Hills	PHS1	Orthic Black	100				Glaciofluvial and Glaciolacustrine	
	PHS2	Orthic Black	100			30		
	PHS3	Orthic Black	70	Humic Gleysol	30			
	PHS4	Orthic Black	100					shallow (<50 cm over till)
	PHS5	Gleyed Orthic Black	80	Humic Gleysol	20			shallow (<50 cm over till)
	PHS6	Gleyed Solonetzic Black	70	Humic Gleysol (carbonated)	30			shallow (<50 cm over till)
	PHS7	Eluviated Black	50	Solonetzic Black	20			
				Humic Gleysol	30			
Ponoka	POK1	Eluviated Black	100				Glaciolacustrine	
	POK2	Eluviated Black	60	Orthic Black	30			
				Humic Gleysol	10			
	POK3	Eluviated Black	70	Orthic Black	30			shallow (<50 cm over till)
	POK4	Eluviated Black	50	Orthic Black	30			shallow (<50 cm over till)
				Humic Gleysol	20			
Redwater	RDW1	Orthic Dark Gray	100				Glaciolacustrine	
	RDW2	Orthic Dark Gray	100			70		
	RDW3	Orthic Dark Gray	90	Humic Gleysol	10			
	RDW4	Orthic Dark Gray	90	Humic Gleysol	10	30		
	RDW5	Orthic Dark Gray	70	Humic Gleysol	30			
	RDW6	Orthic Dark Gray	70	Humic Gleysol	30	30		
	RDW7	Orthic Dark Gray	100					shallow (<50 cm over till)
	RDW8	Orthic Dark Gray	100			30		shallow (<50 cm over till)
	RDW9	Orthic Dark Gray	70	Humic Gleysol	30	30		shallow (<50 cm over till)
	RDW10	Orthic Dark Gray	50	Eluviated Eutric Brunisol	30	30		
				Humic Gleysol	20			
	RDW11	Orthic Dark Gray	70	Eluviated Eutric Brunisol	30			
Rimbey	RMY1	Orthic Dark Gray	100				Glaciolacustrine	
	RMY2	Orthic Dark Gray	100			30		
	RMY3	Orthic Dark Gray	80	Humic Gleysol	20	30		
	RMY4	Orthic Dark Gray	90	Humic Gleysol	10			shallow (<50 cm over till)
	RMY5	Orthic Dark Gray	90	Humic Gleysol	10	30		shallow (<50 cm over till)

Map Legend (continued)

Association	Map Unit	Dominant Soils	(%)	Significant Soils	(%)	Eroded Phase (%)	Parent Material	Comments
River-bank	RB1	Rego Black	60	Orthic Regosol	40		Undifferentiated Colluvium	
	RB2	Cumulic Regosol	60	Dark Gray Luvisol	40			
	RB3	Orthic Regosol	100					
Sante	SXQ1	Solonetzic Black	90	Humic Gleysol	10		Glaciolacustrine	
Shandro	SHZ1	Humic Gleysol (saline)	70	Gleyed Black Solonetz	30		Bedrock	
Snipe Hills	SNI1	Dark Gray Luvisol	90	Luvic Gleysol	10		Glaciofluvial Gravel	
	SNI2	Dark Gray Luvisol	90	Luvic Gleysol	10			shallow (<50 cm over till)
Two Hills	TWH1	Orthic Dark Gray	100				Glaciofluvial Gravel	
	TWH2	Orthic Dark Gray	90	Humic Gleysol	10			
	TWH3	Orthic Dark Gray	90	Humic Gleysol	10			shallow (<50 cm over till)
Uncas	UCS1	Dark Gray Luvisol	90	Luvic Gleysol	10		Glacial Till	
	UCS2	Dark Gray Luvisol	90	Luvic Gleysol	10	30		
	UCS3	Dark Gray Luvisol	70	Luvic Gleysol	30			
	UCS4	Dark Gray Luvisol	70	Luvic Gleysol	30	30		
	UCS5	Dark Gray Luvisol	60	Orthic Gray Luvisol Luvic Gleysol	30 10			
	UCS6	Dark Gray Luvisol	60	Orthic Dark Gray Luvic Gleysol	30 10			
	UCS7	Dark Gray Luvisol	50	Orthic Dark Gray Luvic Gleysol and Slough	20 30			
	UCS8	Dark Gray Luvisol	50	Orthic Dark Gray Orthic Gray Luvisol Luvic Gleysol and Slough	10 10 30	30		
	UCS9	Dark Gray Luvisol	60	Orthic Dark Gray Luvic Gleysol	30 10	30		
	UCS10	Dark Gray Luvisol	50	Orthic Gray Luvisol Luvic Gleysol and Slough	20 30	30		
Whitford	WHF1	Black Solonetz	70	Humic Gleysol (saline)	30		Glacial Till	
	WHF2	Black Solonetz	60	Black Solod Humic Gleysol (saline)	20 20			

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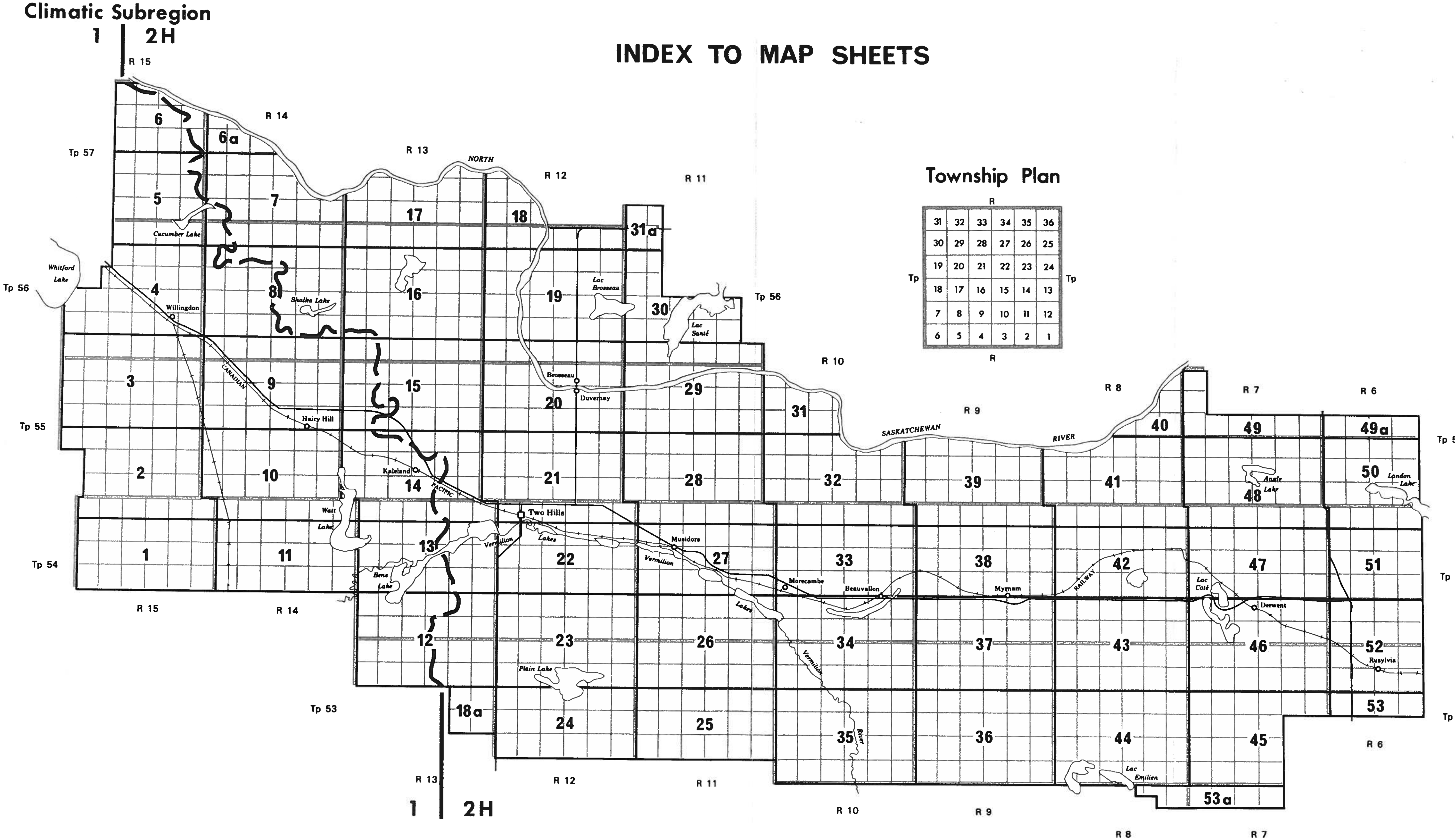


Sheet 1

R 15

(Joins sheet 2)

Tp 54

Tp 54

(Joins sheet 11)

R 15

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 2

R 15

(Joins sheet 3)

Tp 55
Tp 54

Tp 55
Tp 54

(Joins sheet 10)

(Joins sheet 1)

R 15

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 3

R 15

(Joins sheet 4)

Tp 56
Tp 55

(Joins sheet 9)

(Joins sheet 2)

R 15

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

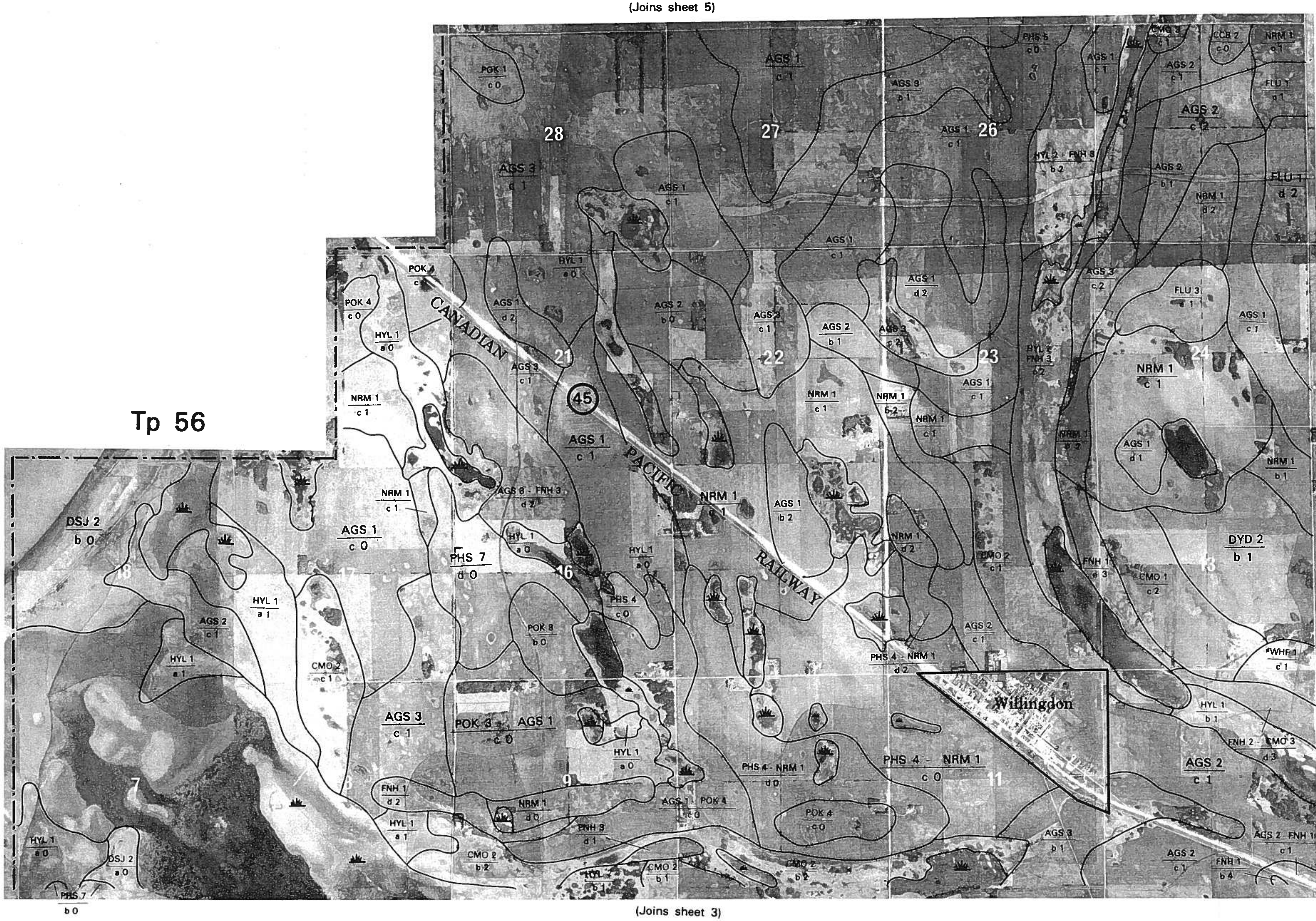
1 1/2 0 1 2 Kilometres

Sheet 4

R 15

(Joins sheet 5)

Tp 56



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Tp 56

(Joins sheet 3)

R 15

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 5

R 15

(Joins sheet 6)

Tp 57 / Tp 56

Tp 57 / Tp 56

(Joins sheet 4)

R 15

APPROXIMATE SCALE 1:31,680

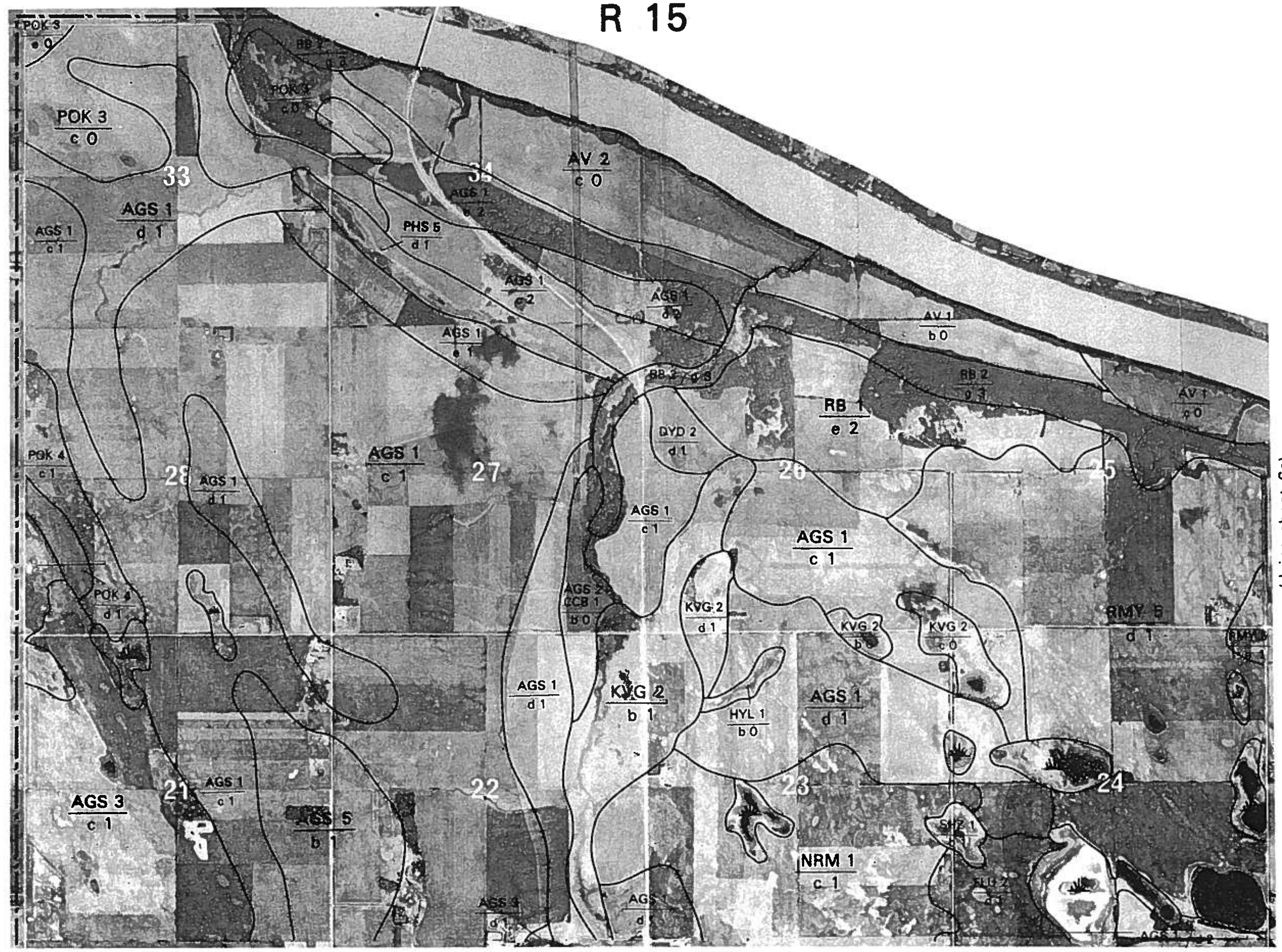
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 6

R 15

Tp 57



(Joins sheet 6a)

Tp 57

(Joins sheet 5)

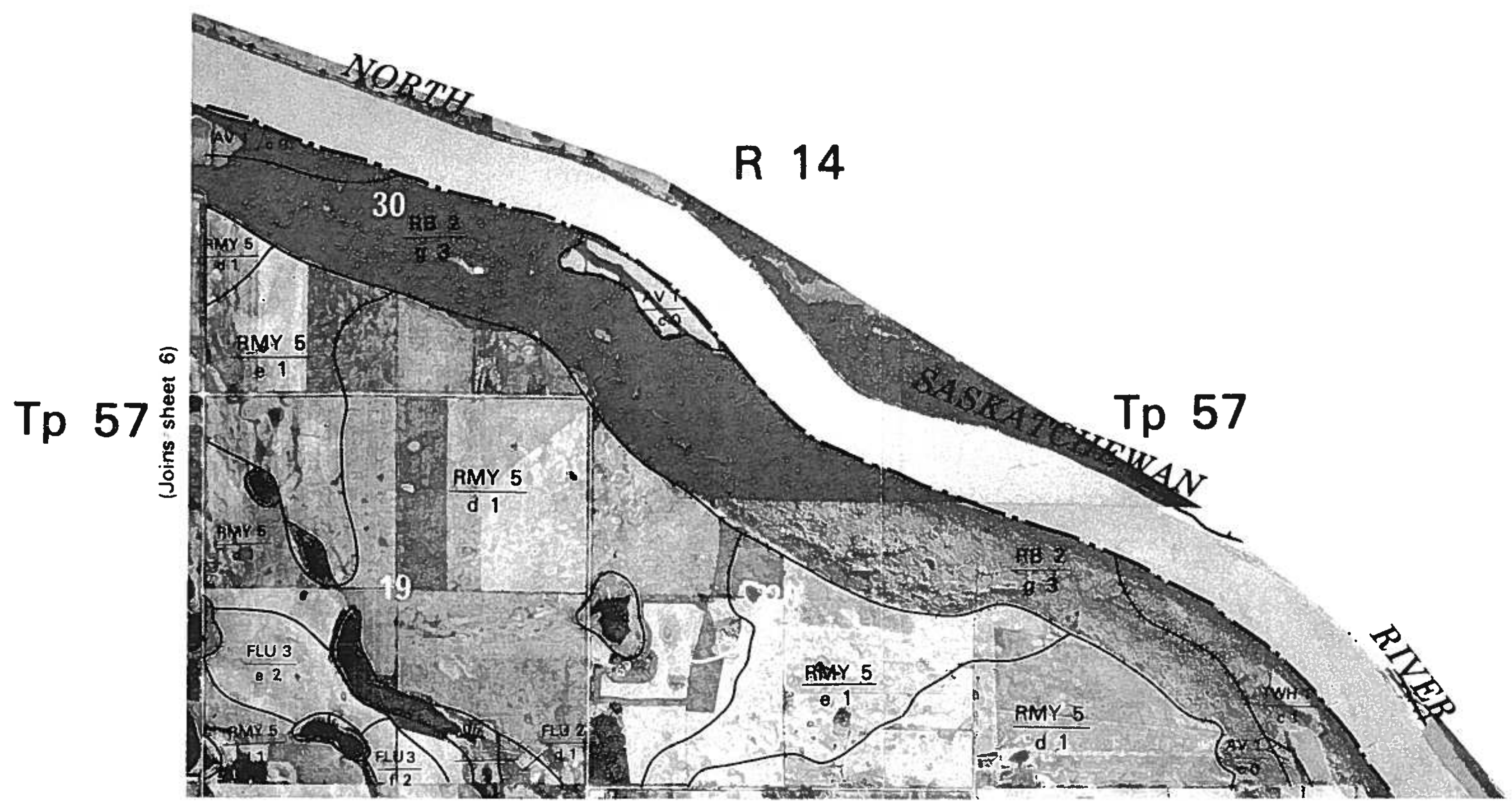
R 15

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 6 a



(Joins sheet 7)

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 7

R 14
(Joins sheet 6a)

(Joins sheet 5)

(Joins sheet 17)

Tp 57
Tp 56

NRM 1
c 1

AGS 3
c 1

(Joins sheet 8)

R 14

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 8

R 14

(Joins sheet 7)

Tp 56 (Joins sheet 4)

(Joins sheet 16) Tp 56

(Joins sheet 9)

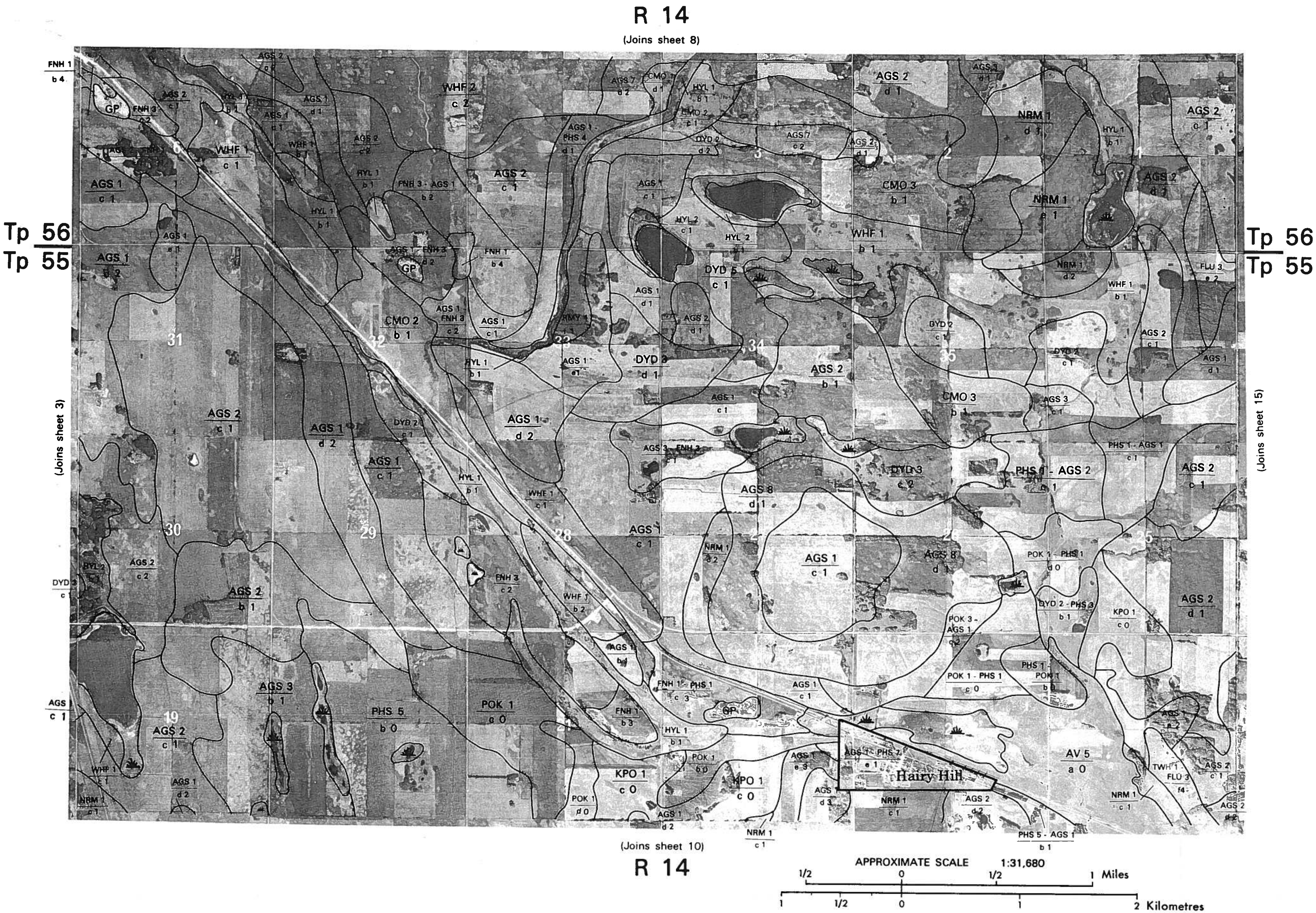
R 14

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 9


R 14
(Joins sheet 8)
Tp 56
Tp 55
Tp 56
Tp 55
(Joins sheet 3)
(Joins sheet 15)
(Joins sheet 10)
R 14
Hairy Hill
AGS 1 c 1
AGS 2 c 1
AGS 2 d 1
AGS 2 b 1
AGS 1 d 2
AGS 2 c 2
AGS 3 b 1
AGS 8 d 1
WHF 1 c 1
WHF 1 b 1
WHF 2 c 2
NRM 1 d 1
NRM 1 e 1
CMO 2 b 1
CMO 3 b 1
DYD 3 d 1
DYD 3 c 2
DYD 5 c 1
FNH 1 b 4
FNH 3 c 2
HYL 1 b 1
PHS 1 - AGS 2 c 1
PHS 5 b 0
POK 1 c 0
POK 1 - PHS 1 c 0
KPO 1 c 0
AV 5 a 0
PHS 5 - AGS 1 b 1
GP
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres

Sheet 10

R 14

(Joins sheet 9)

(Joins sheet 2)

Tp 55
Tp 54

(Joins sheet 14)

Tp 55
Tp 54

(Joins sheet 11)

R 14

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

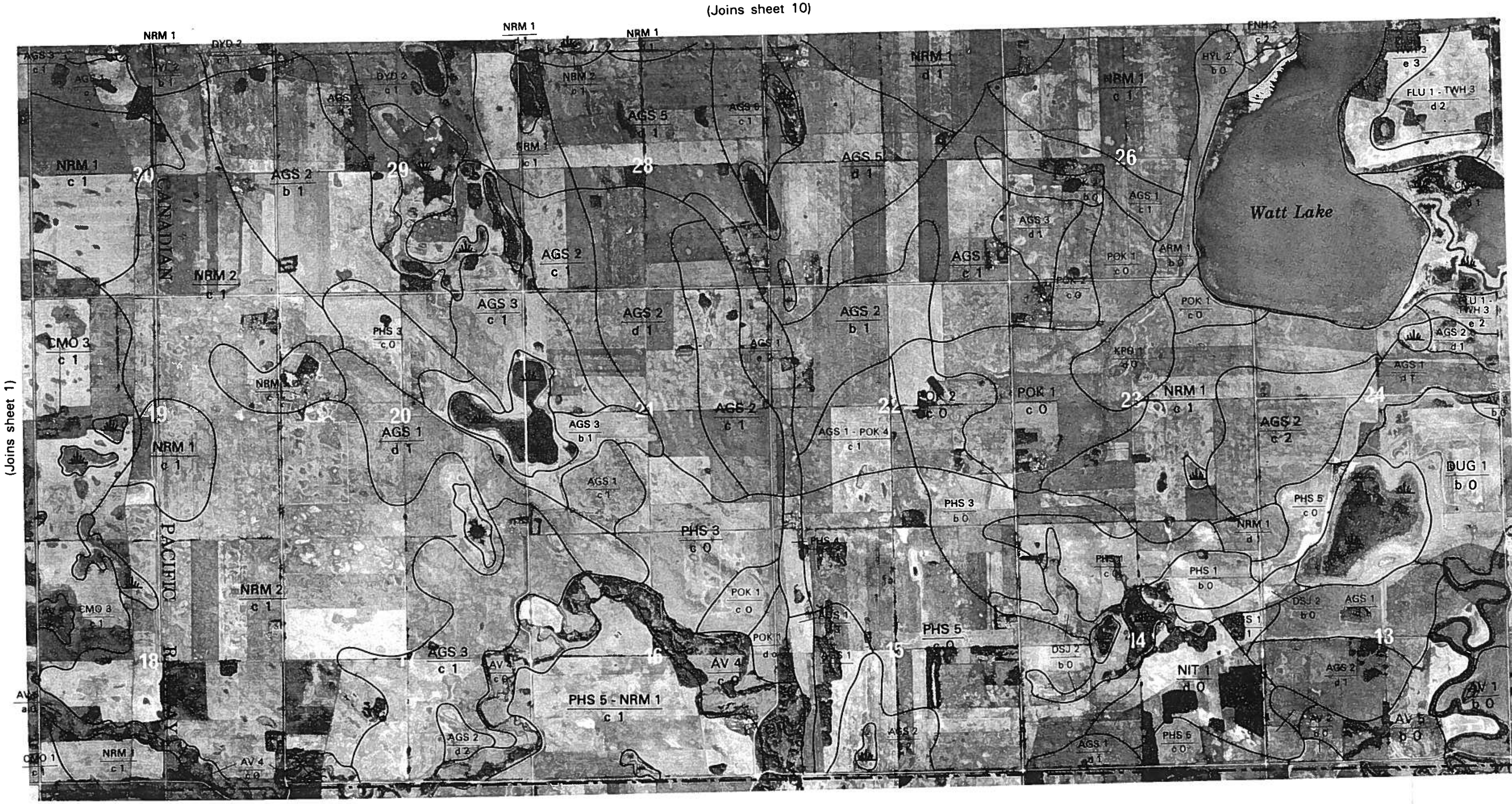
1 1/2 0 1 2 Kilometres

Sheet **11**

R 14

(Joins sheet 10)

Tp 54 (Joins sheet 1)



Tp 54 (Joins sheet 13)

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **12**

R 13

(Joins sheet 13)

Tp 54
Tp 53

(Joins sheet 23)

Tp 54
Tp 53

R 13

(Joins sheet 18a)

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **13**

R 13
(Joins sheet 14)

Tp 54 (Joins sheet 11)

Tp 54 (Joins sheet 22)

(Joins sheet 12)
R 13

APPROXIMATE SCALE 1:31,680

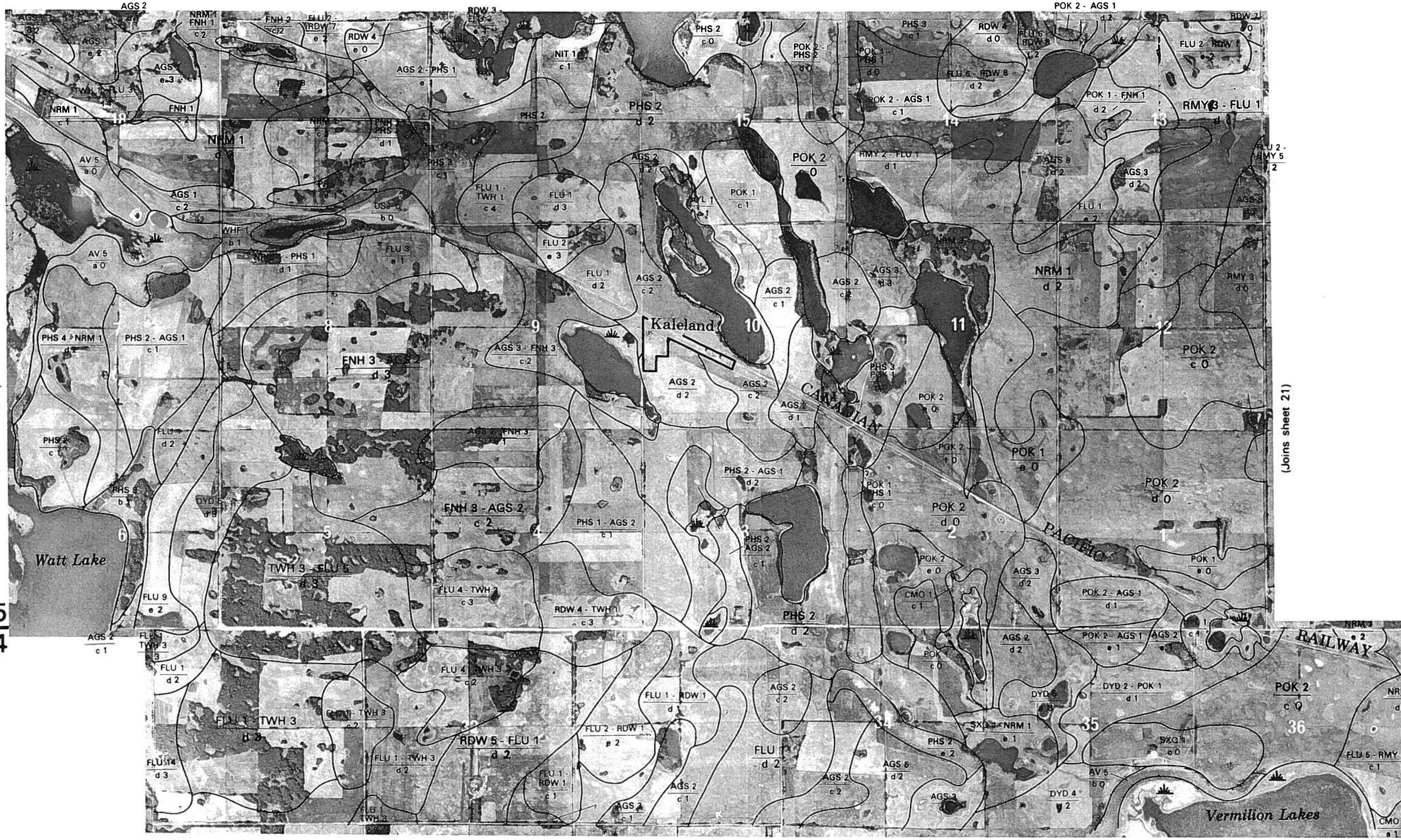
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **14**

R 13
(Joins sheet 15)

(Joins sheet 10)



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Tp 55
Tp 54

Tp 55
Tp 54

(Joins sheet 13)

R 13

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 15

R 13

(Joins sheet 16)

Tp 56 / Tp 55

(Joins sheet 9)

(Joins sheet 20)

Tp 56 / Tp 55

(Joins sheet 14)

R 13

APPROXIMATE SCALE 1:31,680

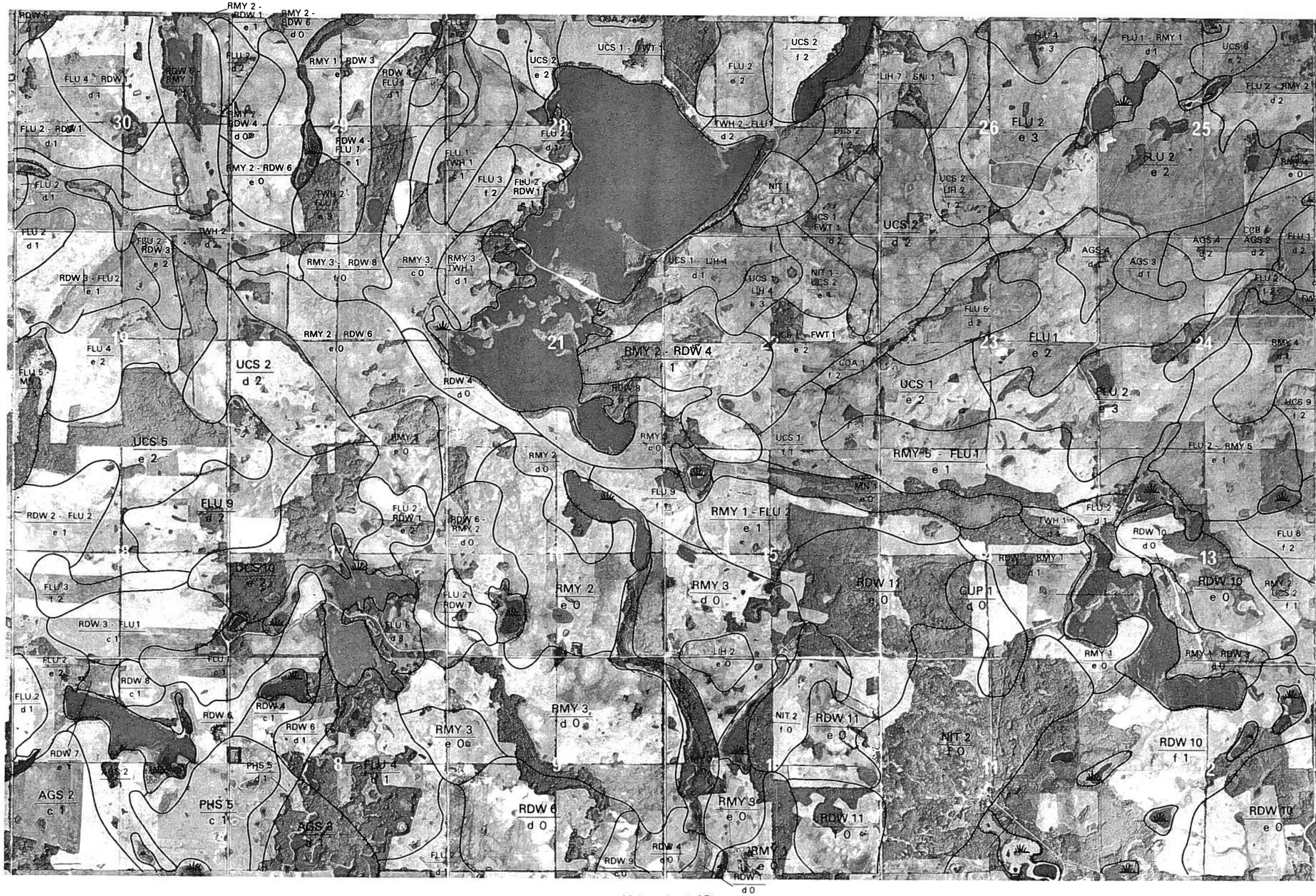
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 16

R 13
(Joins sheet 17)

Tp 56 (Joins sheet 8)



Joins sheet 19) Tp 56

(Joins sheet 15)
R 13

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **17**

R 13

Tp 57
Tp 56

(Joins sheet 7)

(Joins sheet 18)

Tp 57
Tp 56

FLU 4 - RDW 1
d 1

FLU 2 - RMY 2
d 2

(Joins sheet 16)

R 13

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

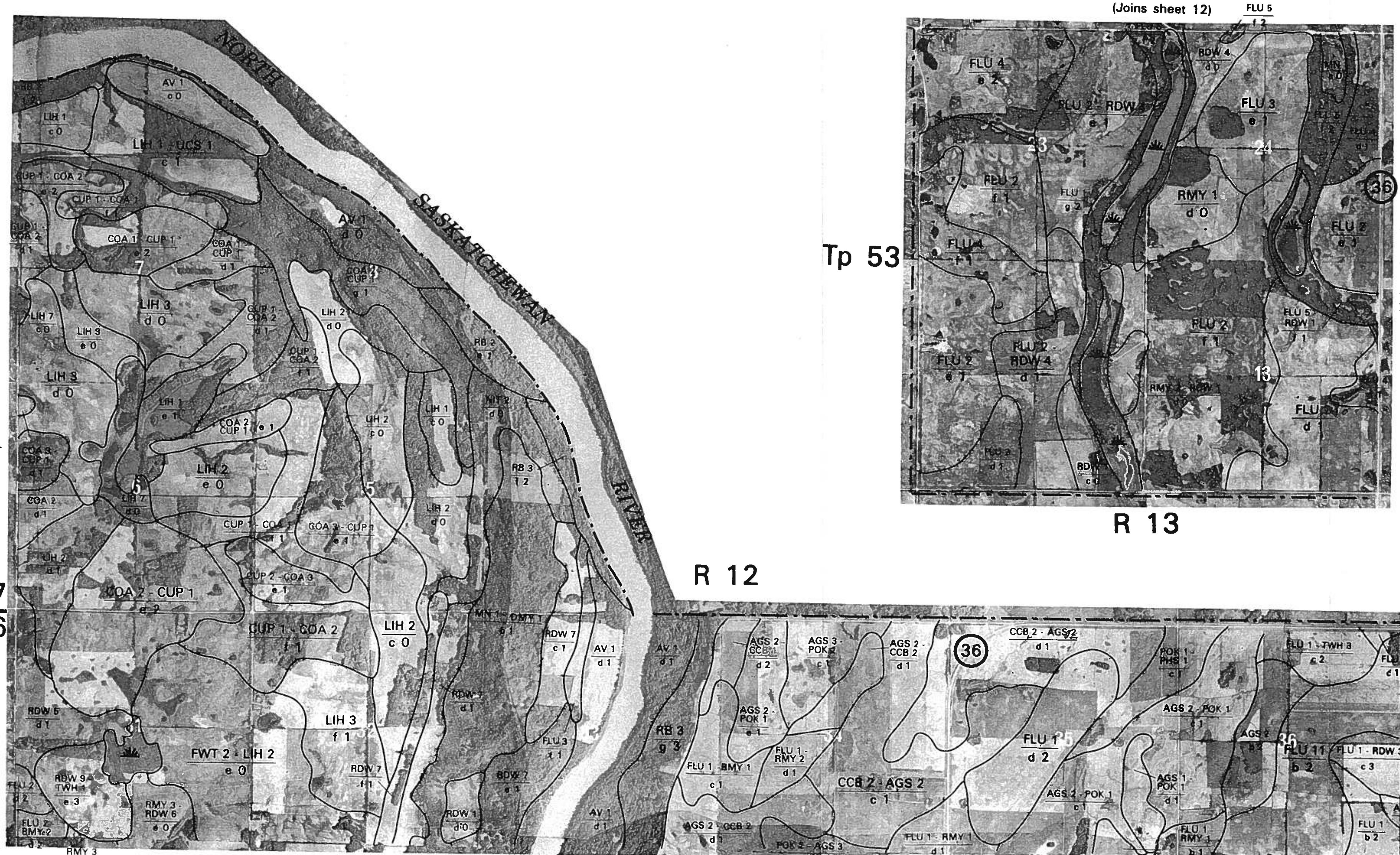
Sheet 18

Sheet 18 a

R 13
(Joins sheet 12)

Tp 53 (Joins sheet 24) Tp 53

R 13



R 12

Tp 57 / Tp 56 (Joins sheet 17)

Tp 57 / Tp 56 (Joins sheet 31a)

(Joins sheet 19)
R 12

APPROXIMATE SCALE 1:31,680

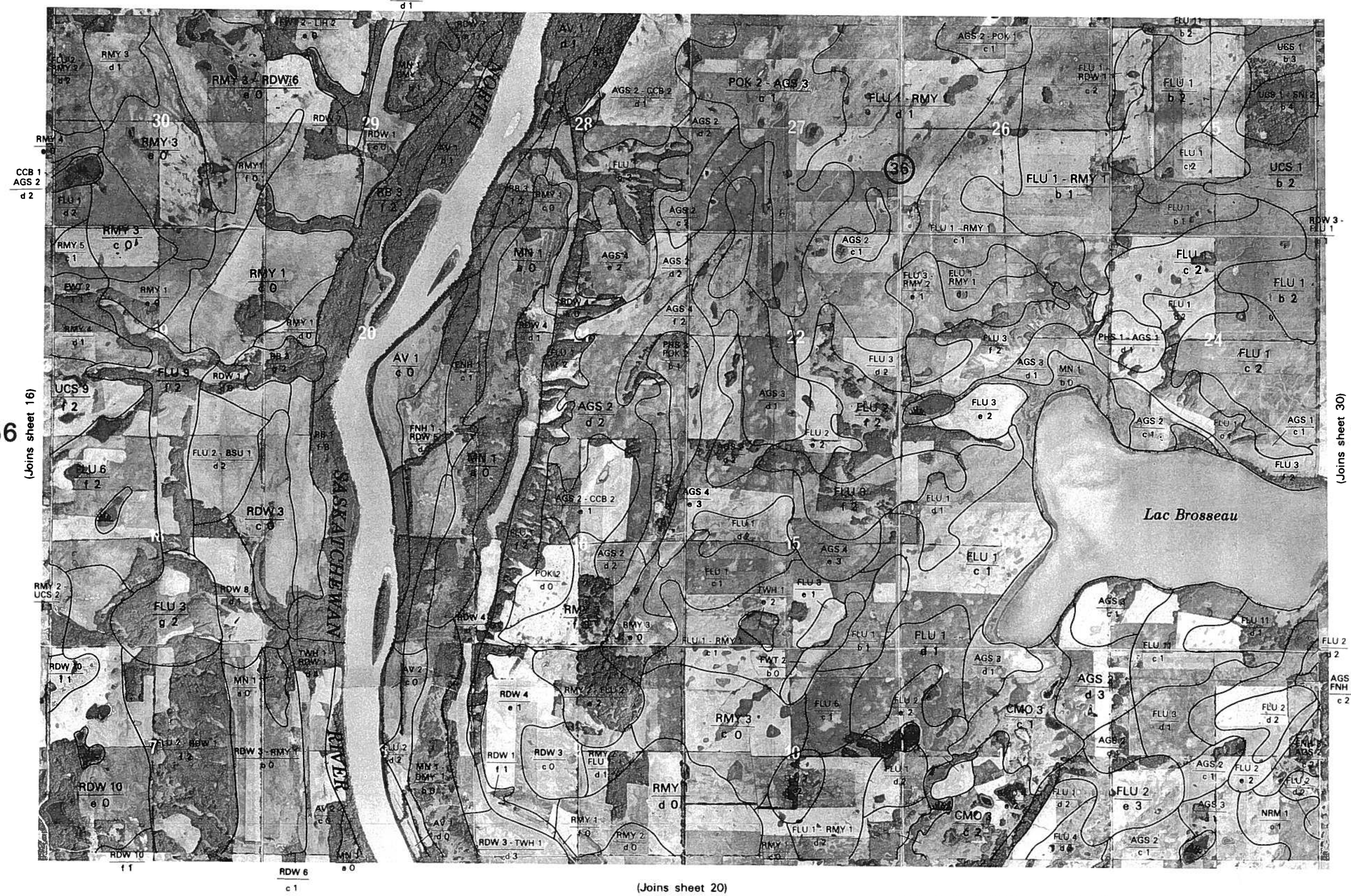
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **19**

R 12

(Joins sheet 18)



Tp 56 (Joins sheet 16)

Tp 56 (Joins sheet 30)

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R 12

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

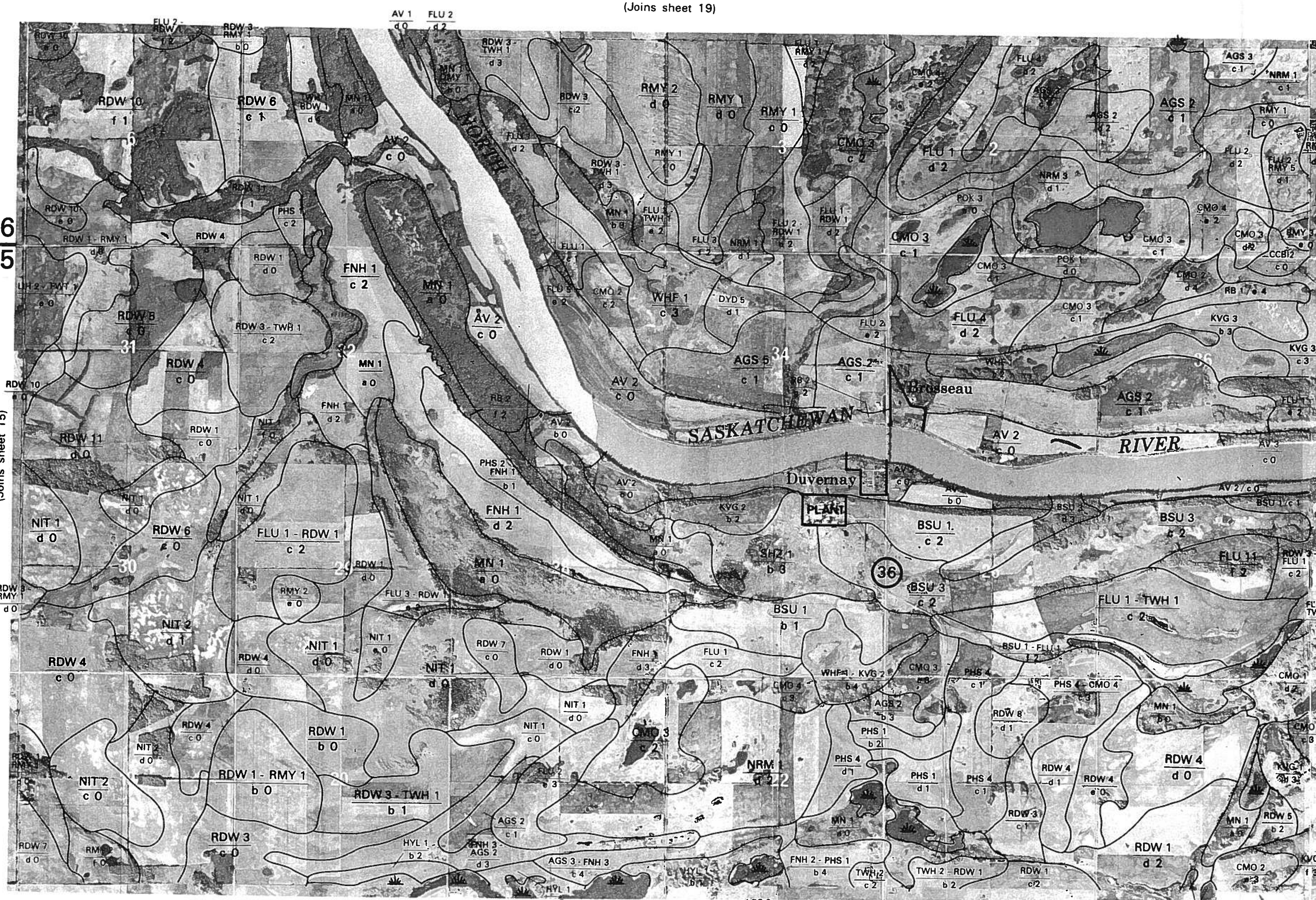
Sheet 20

R 12

(Joins sheet 19)

Tp 56 / Tp 55

(Joins sheet 15)



(Joins sheet 29)

Tp 56 / Tp 55

(Joins sheet 21)

R 12

APPROXIMATE SCALE 1:31,680

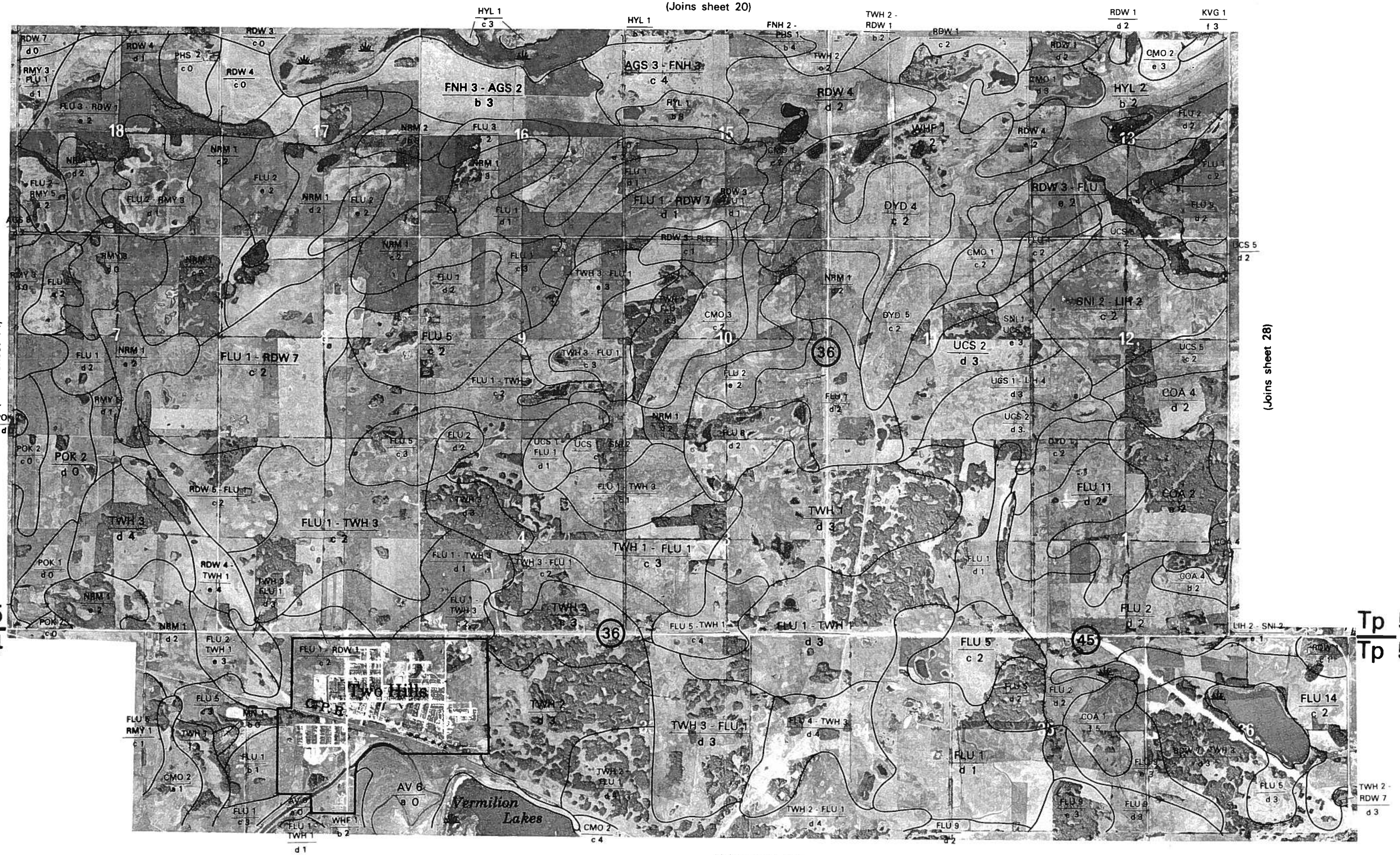
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 21

R 12

(Joins sheet 20)



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R 12

APPROXIMATE SCALE 1:31,680

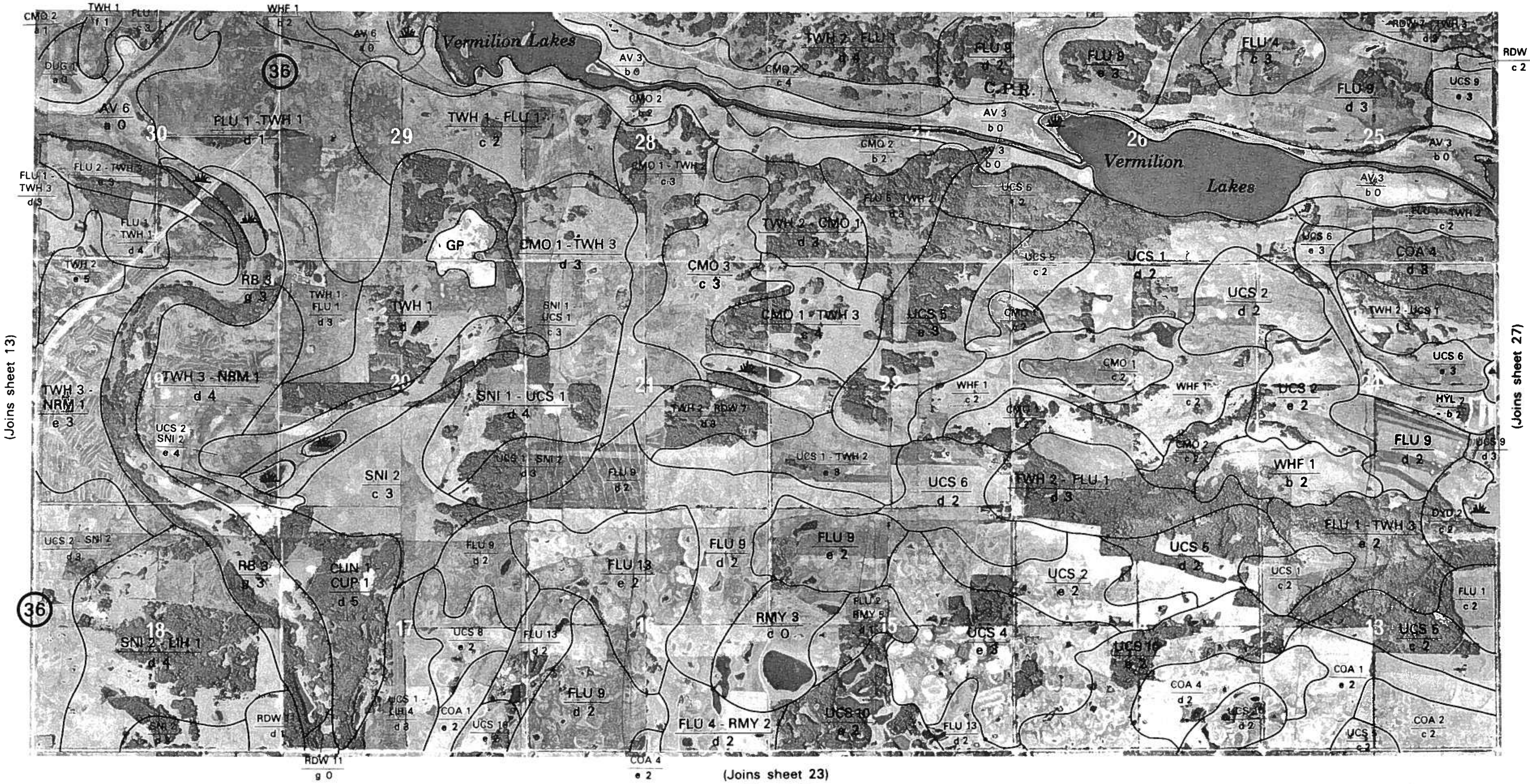
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **22**

R 12
(Joins sheet 21)

Tp 54 (Joins sheet 13)



Tp 54 (Joins sheet 27)

(Joins sheet 23)
R 12

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 23

R 12

(Joins sheet 22)

(Joins sheet 26)

Tp 54 / Tp 53

Tp 54 / Tp 53

(Joins sheet 12)

(Joins sheet 24)

R 12

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

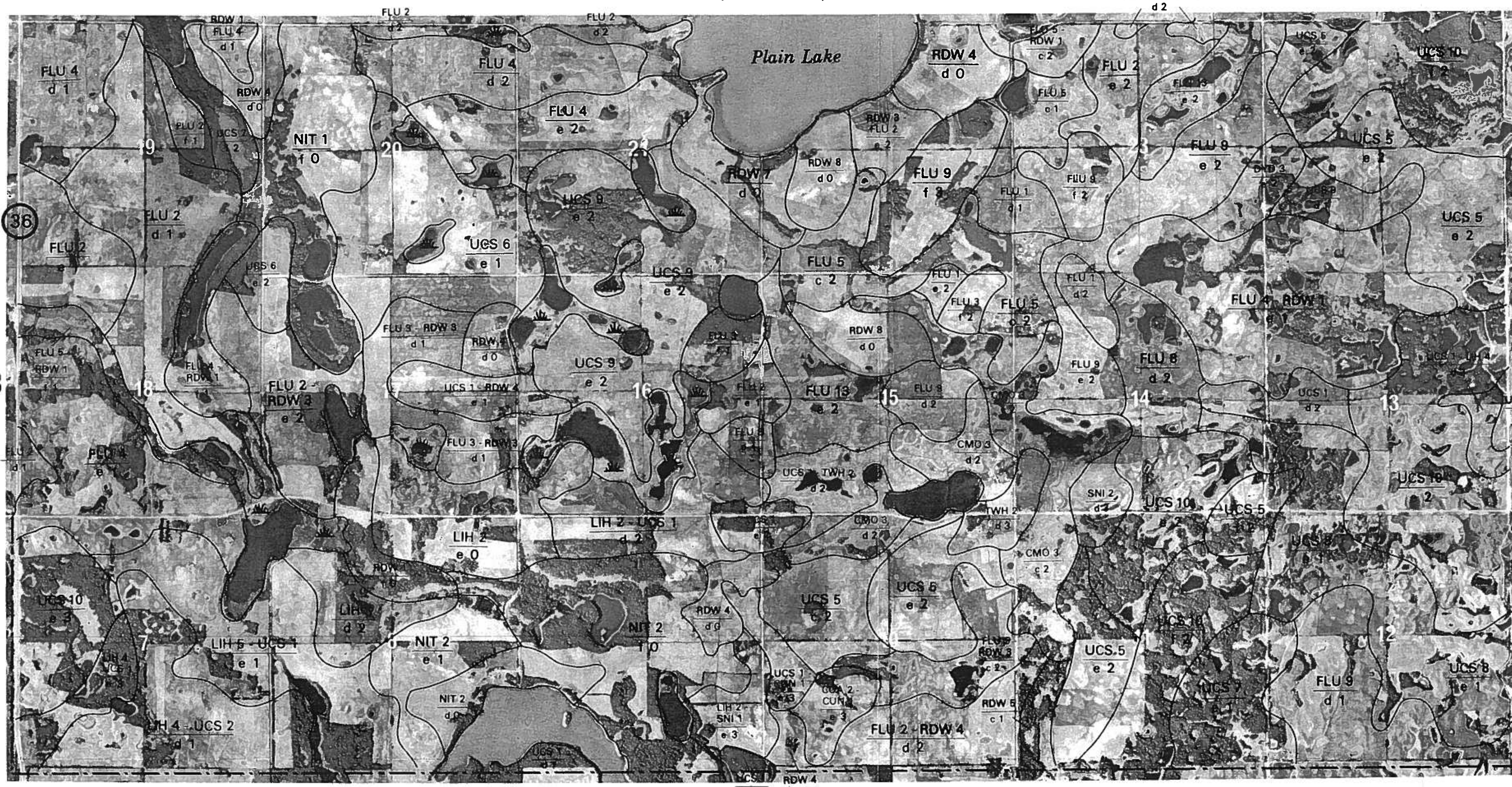
Sheet **24**

R 12

(Joins sheet 23)

(Joins sheet 18a)

Tp 53



Tp 53

(Joins sheet 25)

R 12

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

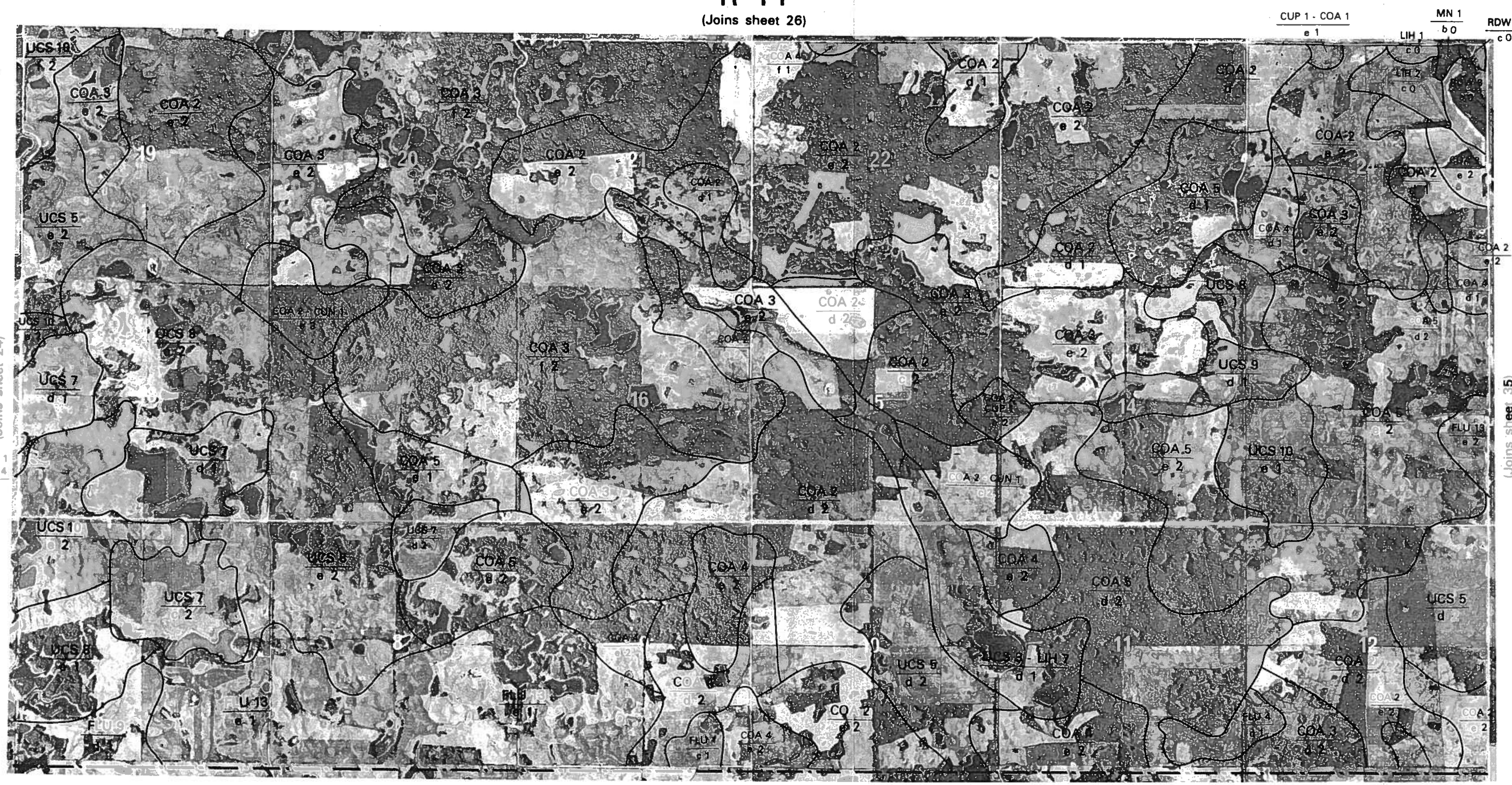
1 1/2 0 1 2 Kilometres

Sheet **25**

R 11

(Joins sheet 26)

Tp 53 (Joins sheet 24)



Tp 53 (Joins sheet 35)

R 11

APPROXIMATE SCALE 1:31,680

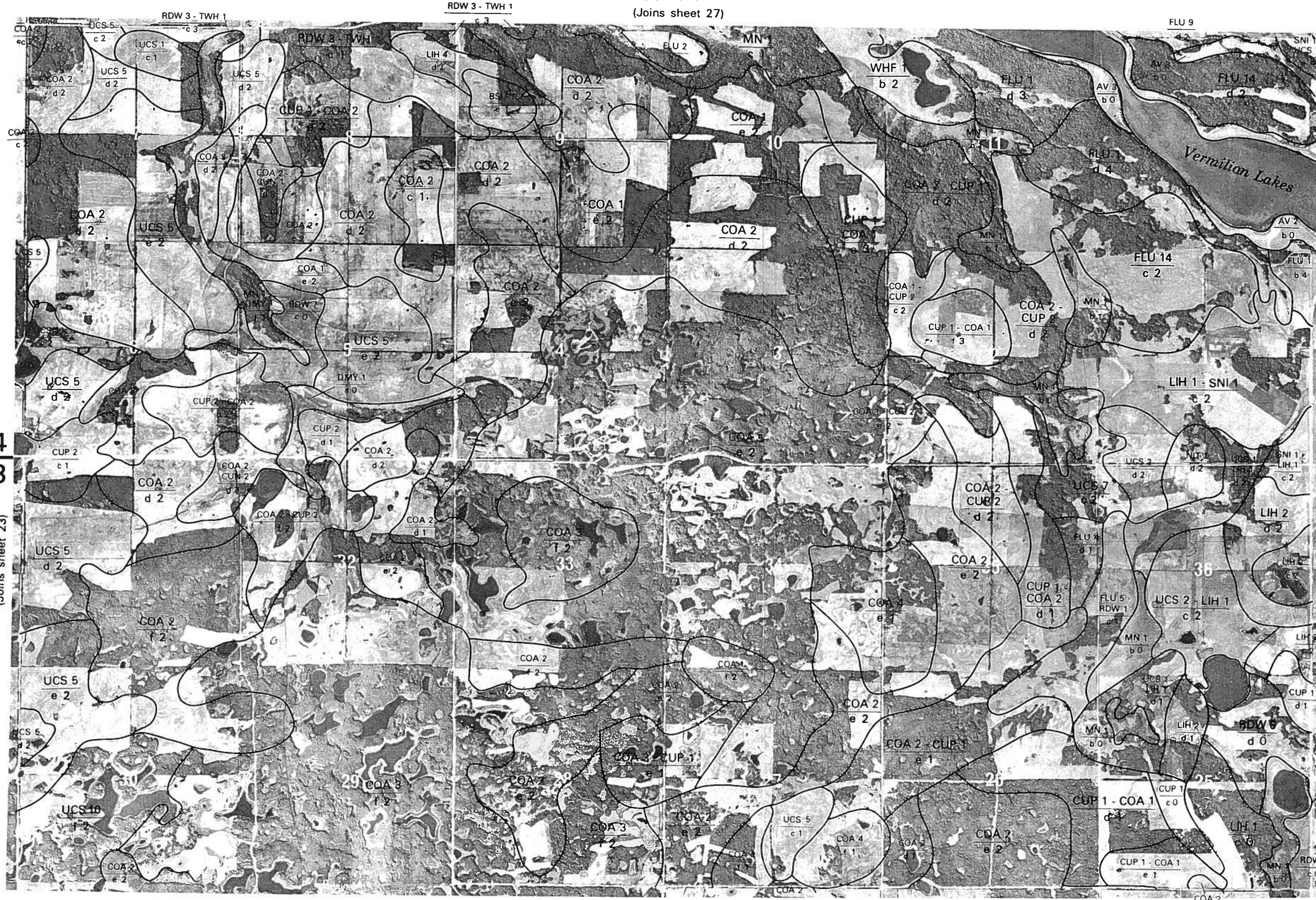
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **26**

R 11

(Joins sheet 27)



Tp 54

Tp 53

(Joins sheet 23)

(Joins sheet 34)

(Joins sheet 25)

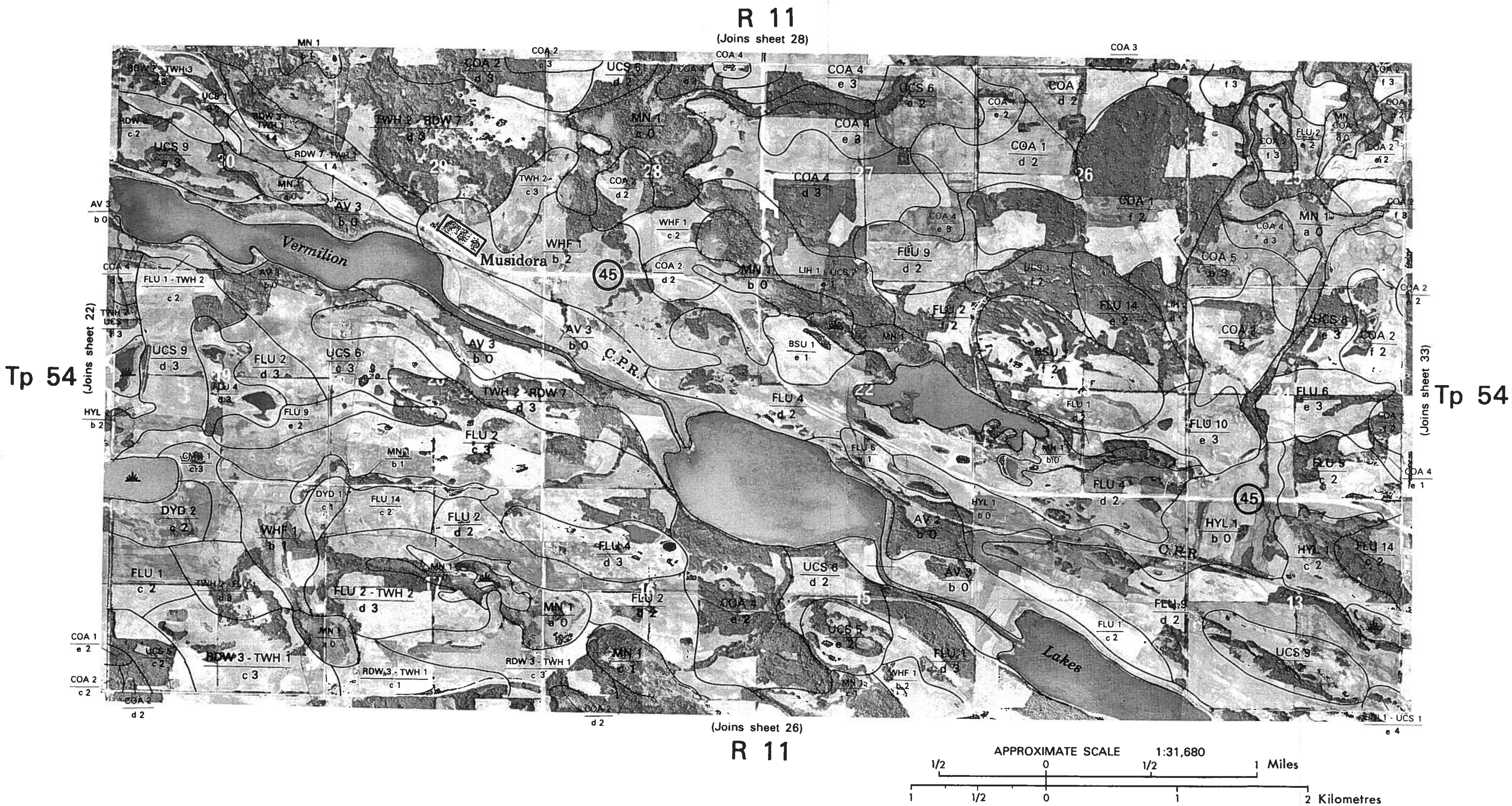
R 11

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **27**


R 11
(Joins sheet 28)
Tp 54
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Tp 54
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Vermilion
Musidora
C.P.R.
Lakes
(Joins sheet 26)
R 11
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres

Sheet 28

R 11

(Joins sheet 29)

Tp 55 / Tp 54

(Joins sheet 27)

R 11

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 29

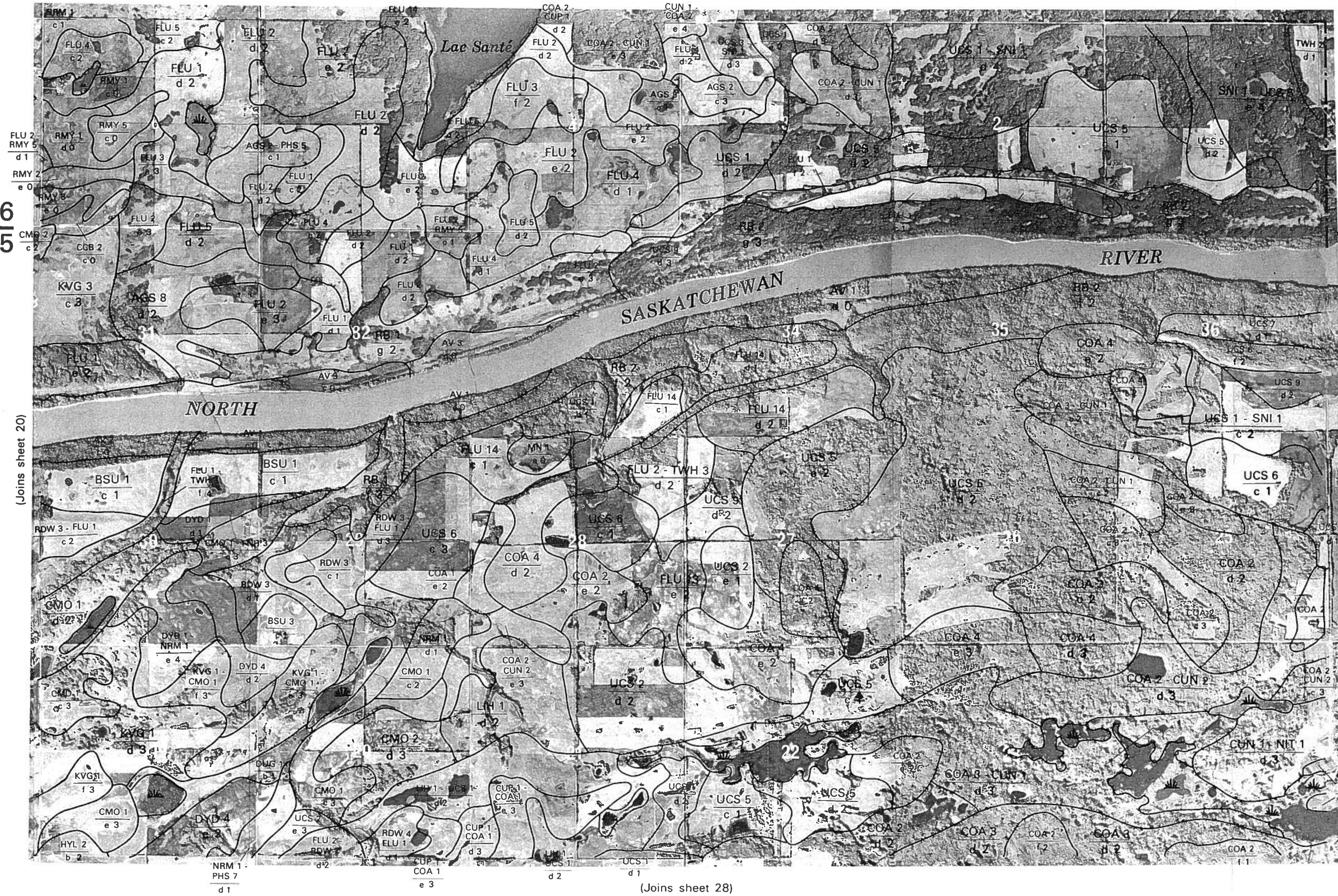
R 11

(Joins sheet 30)

Tp 56

Tp 55

(Joins sheet 20)



(Joins sheet 31)

(Joins sheet 28)

R 11

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

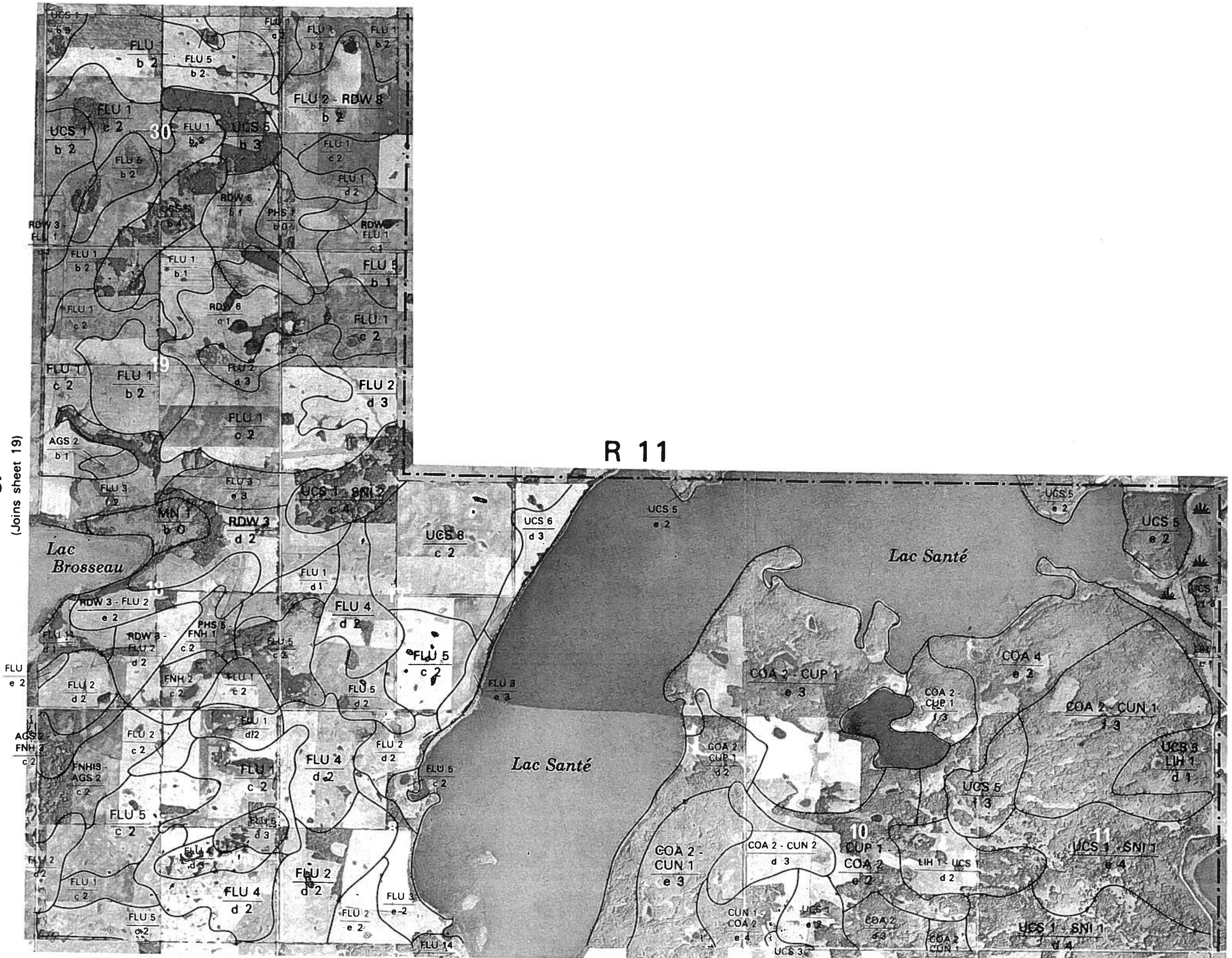
Sheet 30

(Joins sheet 31a)

Tp 56

(Joins sheet 19)

R 11



Tp 56

(Joins sheet 29)

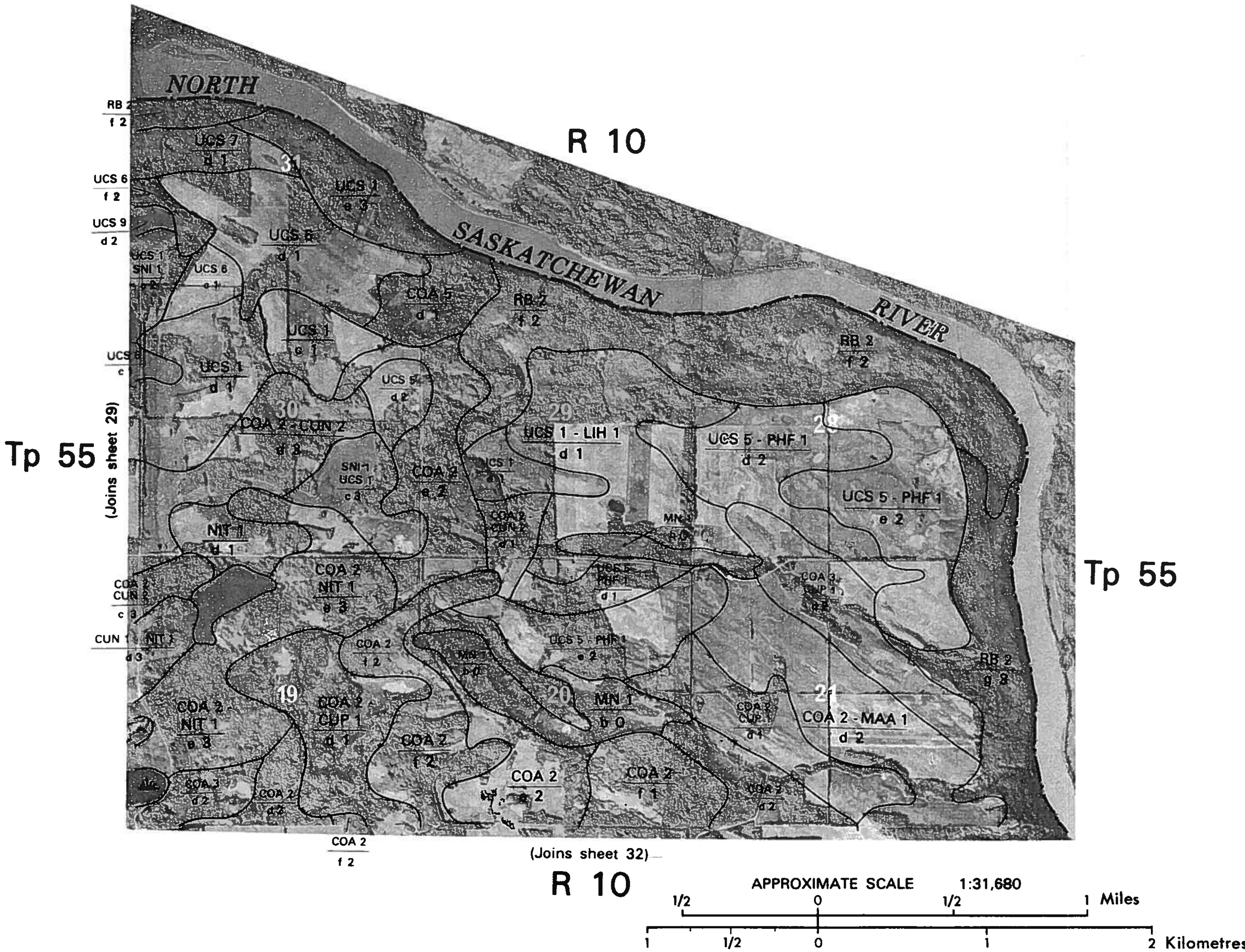
R 11

APPROXIMATE SCALE 1:31,680

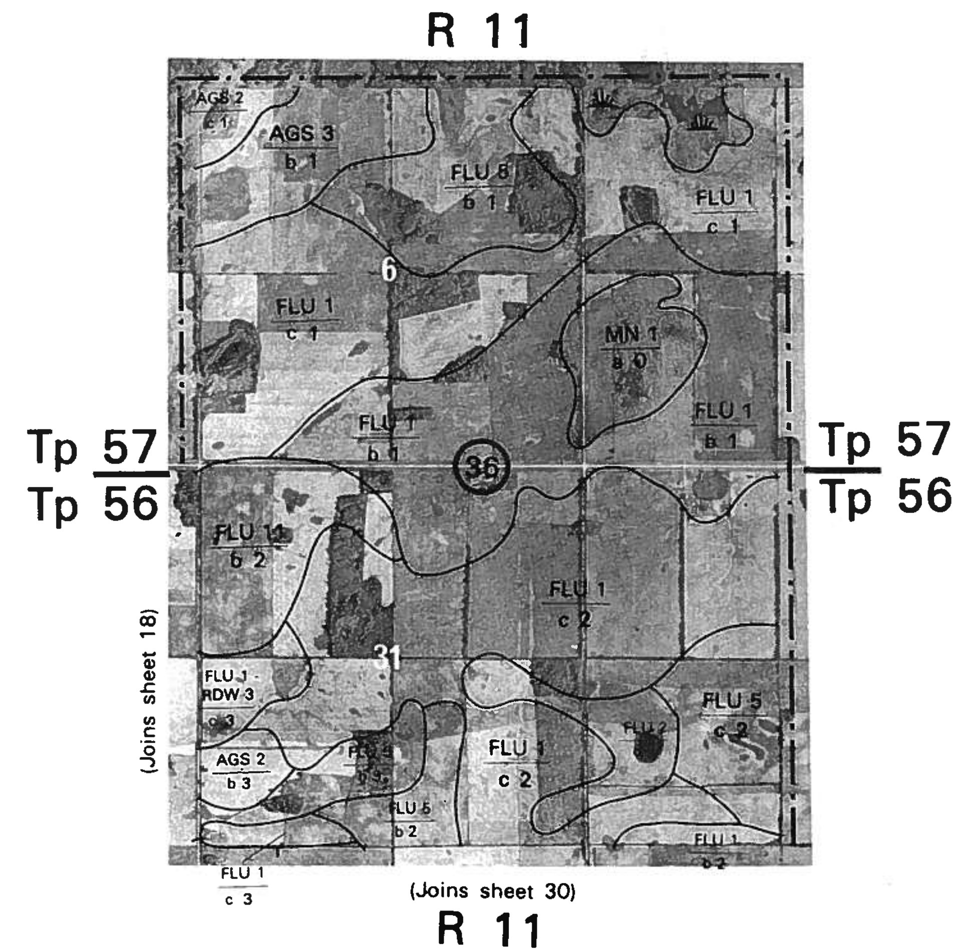
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **31**



Sheet **31**a

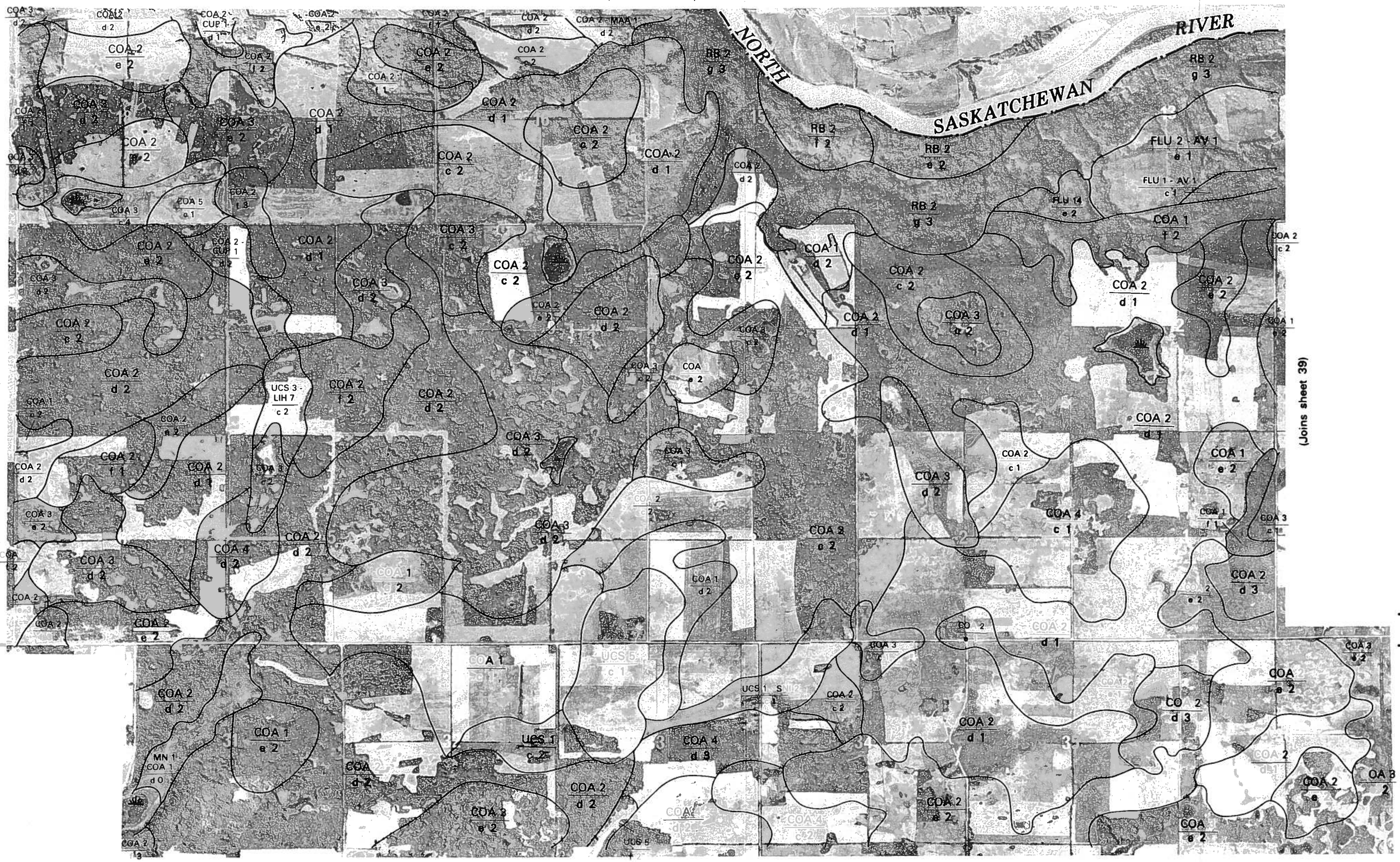


Sheet **32**

R 10

(Joins sheet 31)

(Joins sheet 28)



(Joins sheet 39)

Tp 55
Tp 54

Tp 55
Tp 54

(Joins sheet 33)

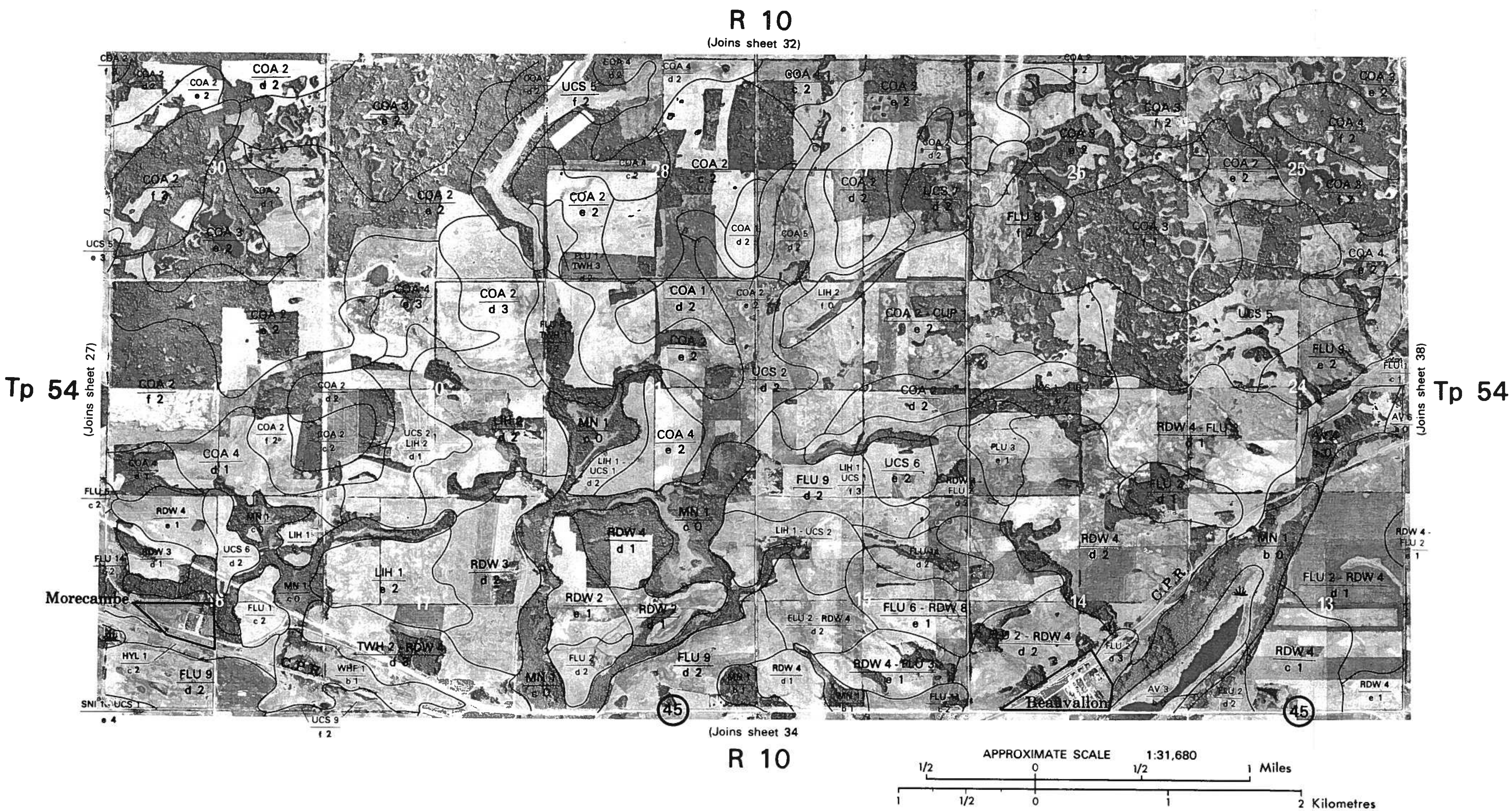
R 10

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 33


R 10
(Joins sheet 32)
Tp 54
(Joins sheet 27)
Tp 54
(Joins sheet 38)
Morecambe
Beauvallon
C.P.R.
45
45
(Joins sheet 34)
R 10
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres

Sheet **34**

R 10

(Joins sheet 33)

(Joins sheet 26)

Tp 54 / Tp 53

(Joins sheet 37)

Tp 54 / Tp 53

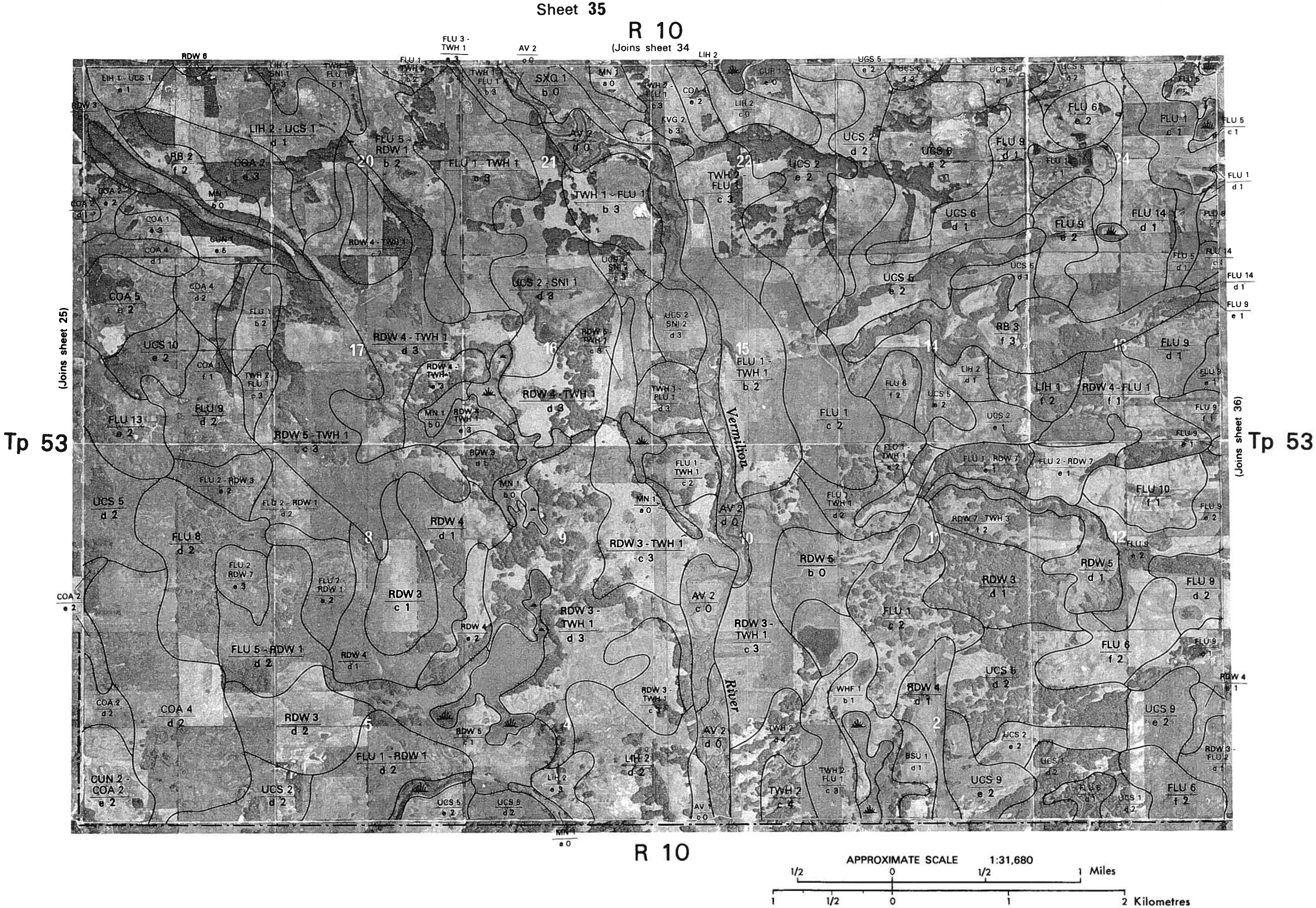
(Joins sheet 35)

R 10

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres


Sheet 35
R 10
(Joins sheet 34)
(Joins sheet 25)
(Joins sheet 36)
Tp 53
Tp 53
R 10
Vermilion
River
LIH 2 - UCS 1
d 1
RB 2
f 2
COA 2
e 3
FLU 5 - RDW 1
b 2
FLU 1 - TWH 1
b 3
SXQ 1
b 0
AV 2
d 0
TWH 1 - FLU 1
b 3
TWH 2 - FLU 1
c 3
UCS 2
d 2
UCS 2
e 2
UCS 6
e 2
FLU 6
e 2
FLU 1
c 1
FLU 9
d 1
UCS 6
d 1
FLU 9
e 2
FLU 14
d 1
UCS 5
e 2
COA 5
e 2
UCS 2 - SNI 1
d 3
UCS 10
e 2
RDW 4 - TWH 1
d 3
RDW 4 - TWH 1
d 3
FLU 1 - TWH 1
b 2
RB 3
f 3
FLU 9
d 1
FLU 13
e 2
FLU 9
d 2
RDW 5 - TWH 1
c 3
FLU 1
c 2
LIH 1
f 2
RDW 4 - FLU 1
f 1
UCS 5
d 2
FLU 8
d 2
RDW 4
d 1
RDW 3 - TWH 1
c 3
AV 2
d 0
RDW 5
b 0
FLU 10
f 1
RDW 5
d 1
RDW 3
d 1
FLU 9
d 2
RDW 3
c 1
AV 2
c 0
RDW 3 - TWH 1
d 3
RDW 3 - TWH 1
c 3
FLU 1
c 2
FLU 5 - RDW 1
d 2
FLU 6
f 2
UCS 5
d 2
RDW 4
d 1
UCS 9
e 2
COA 4
d 2
RDW 3
d 2
FLU 1 - RDW 1
d 2
AV 2
d 0
LIH 2
d 2
UCS 9
e 2
CUN 2 - COA 2
e 2
UCS 2
d 2
TWH 2
c 4
FLU 6
f 2
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres

Sheet 36

R 9

(Joins sheet 37)

Tp 53 (Joins sheet 35)

R 9

Tp 53 (Joins sheet 44)

APPROXIMATE SCALE 1:31,680

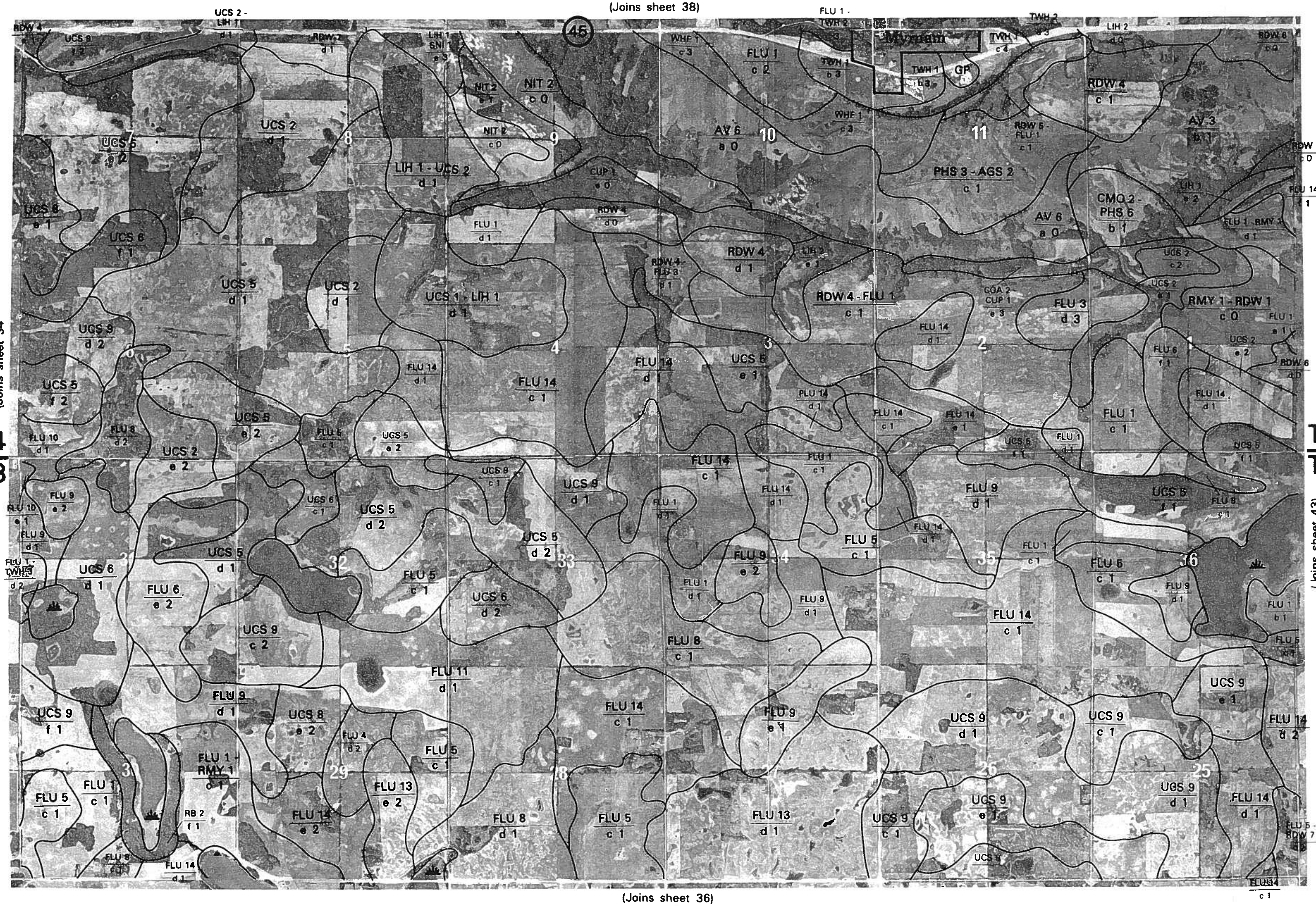
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 37

R 9

(Joins sheet 38)



(Joins sheet 36)

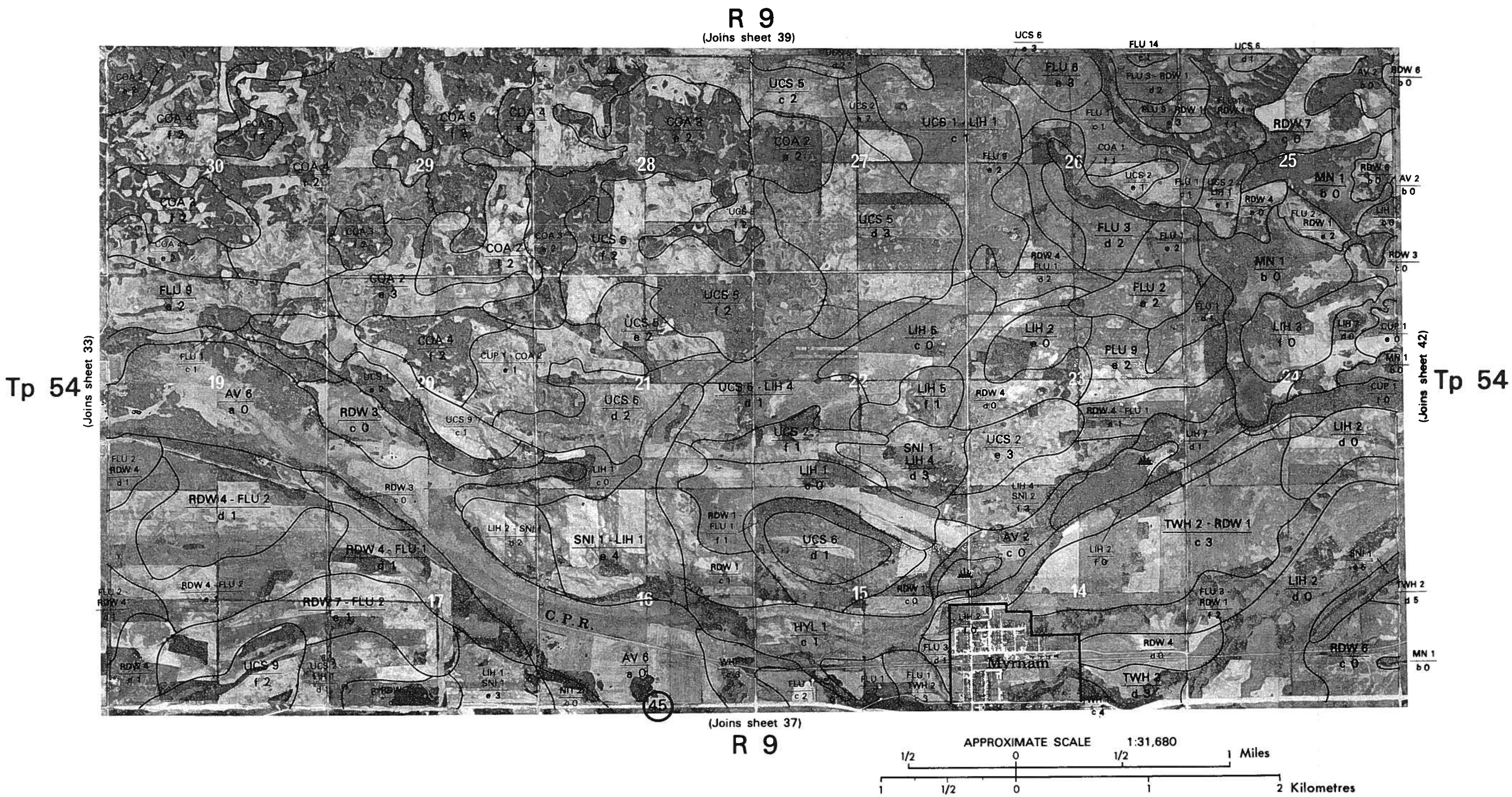
R 9

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **38**



R 9
(Joins sheet 39)
Tp 54
(Joins sheet 33)
Tp 54
(Joins sheet 42)
(Joins sheet 37)
R 9
C.P.R.
Myrnam
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres
30
29
28
27
26
25
19
20
21
22
23
24
18
17
16
15
14
45
COA 4
COA 5
COA 3
COA 2
UCS 5
UCS 6
UCS 1 - LIH 1
FLU 6
RDW 7
MN 1
FLU 3
FLU 2
FLU 9
LIH 2
LIH 5
LIH 6
AV 6
RDW 3
UCS 6 - LIH 4
UCS 2
SNI 1 - LIH 4
LIH 1
RDW 4 - FLU 2
RDW 4 - FLU 1
SNI 1 - LIH 1
UCS 6
AV 2
TWH 2 - RDW 1
RDW 7 - FLU 2
UCS 9
HYL 1
RDW 4
TWH 2
RDW 6

Sheet 39

R 9

(Joins sheet 32)

Tp 55
Tp 54

Tp 55
Tp 54

(Joins sheet 41)

(Joins sheet 38)

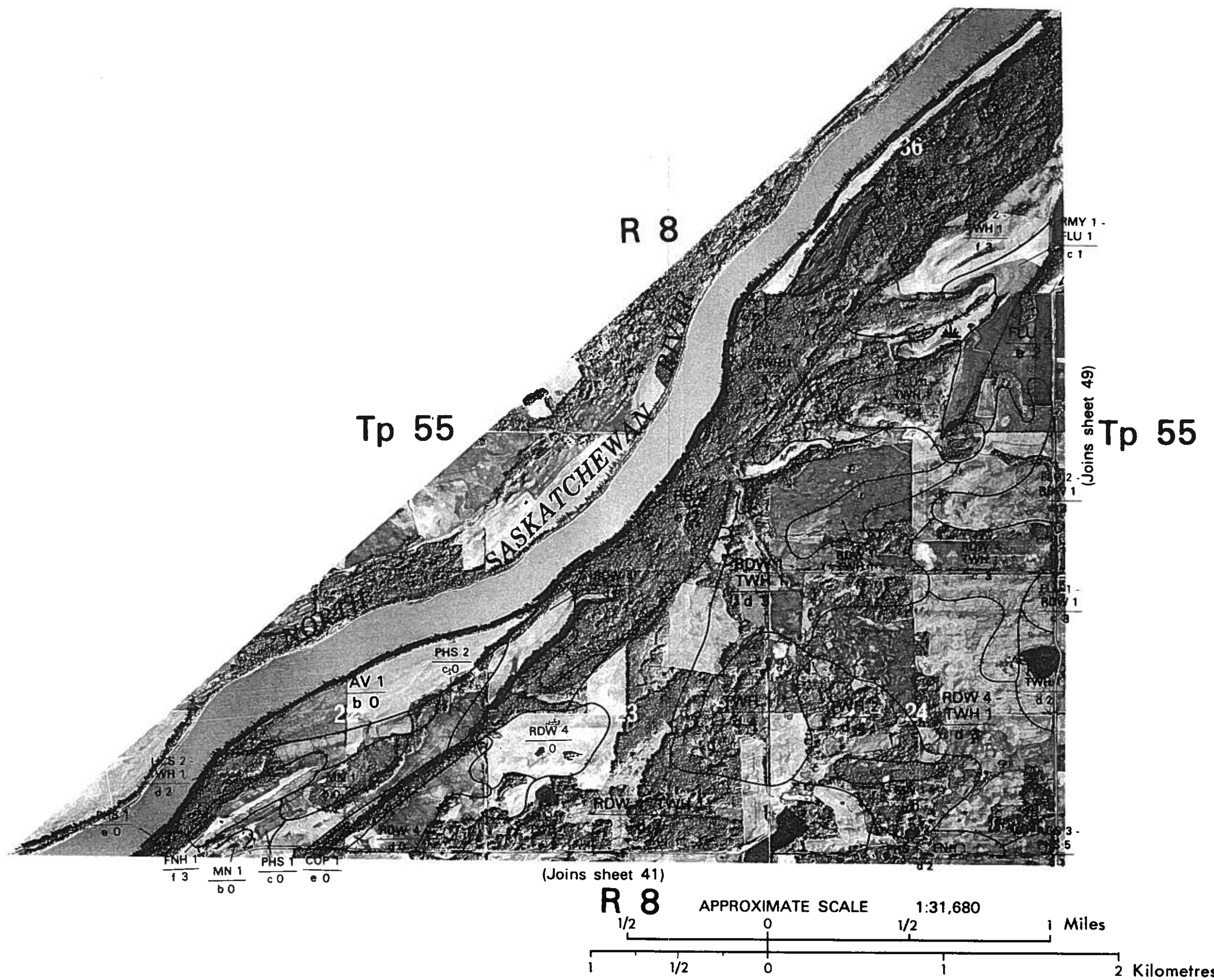
R 9

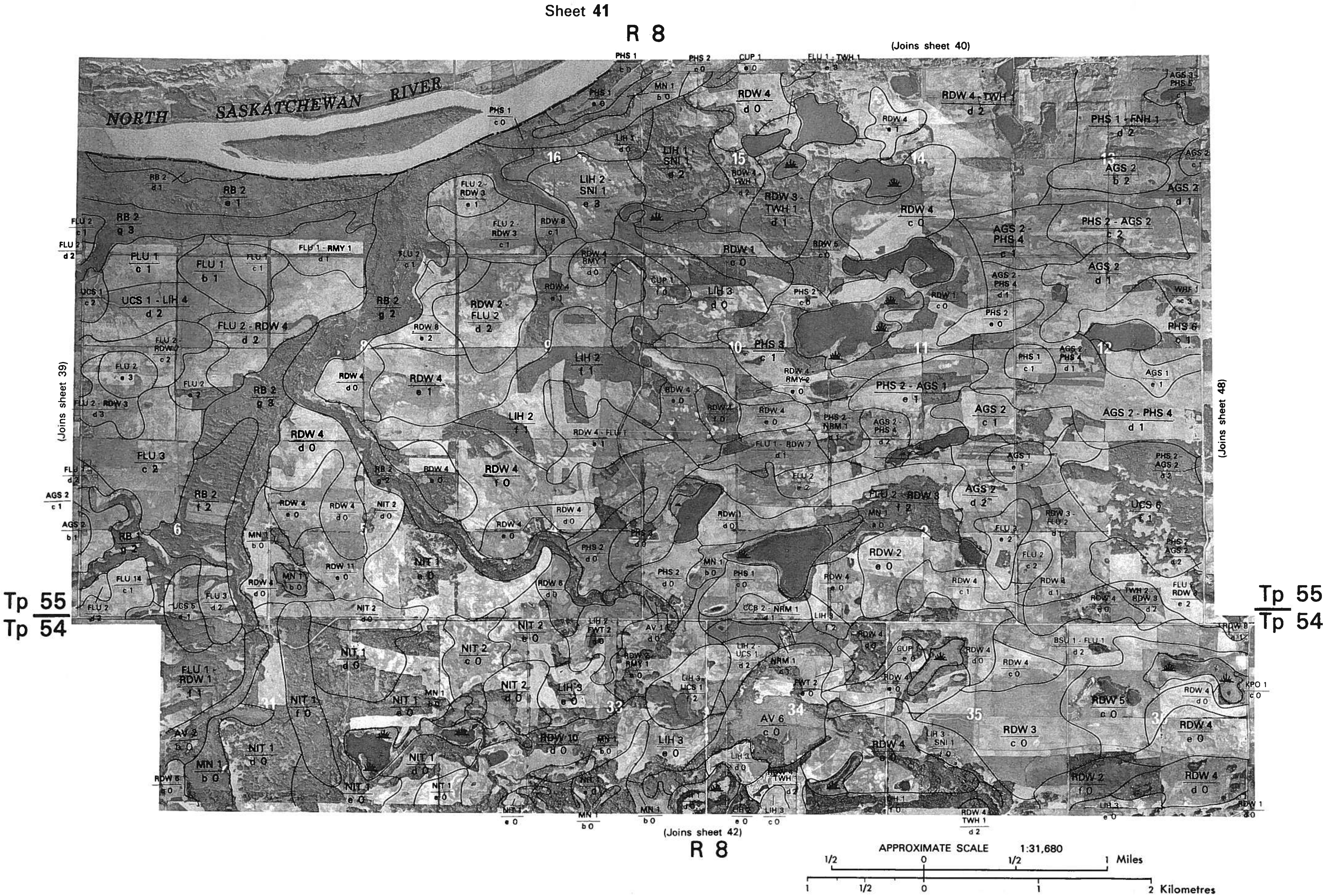
APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

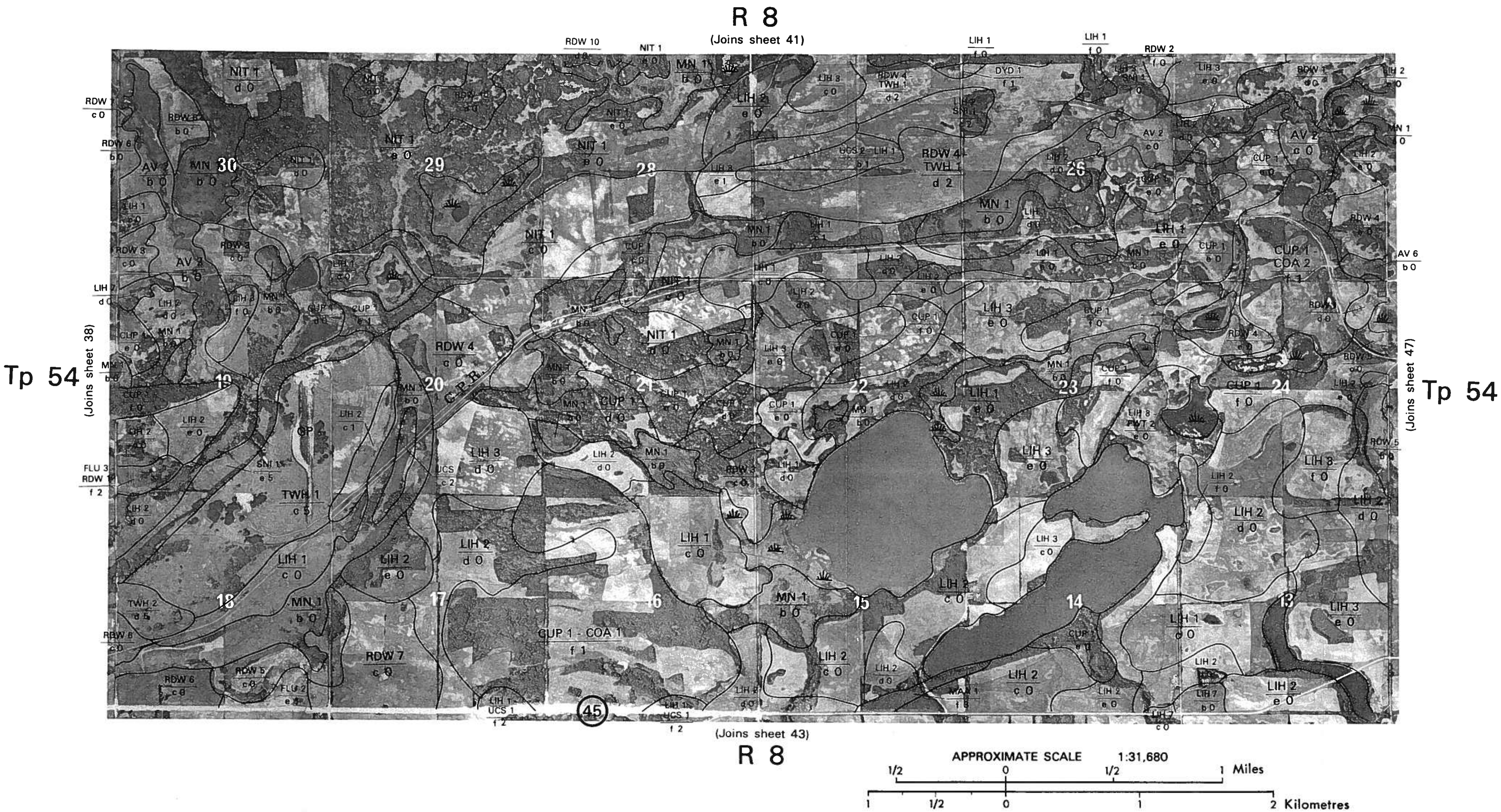
Sheet **40**


R 8
NORTH
SASKATCHEWAN
RIVER
Tp 55
Tp 55
(Joins sheet 49)
36
24
RMY 1 -
FLU 1
c 1
RDW
TWH 1
d 1
AV 1
b 0
PHS 2
c 0
RDW 4
RDW 4 -
TWH 1
FNH 1
f 3
MN 1
b 0
PHS 1
c 0
CUP 1
e 0
(Joins sheet 41)
R 8
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres



Sheet 41
R 8
(Joins sheet 40)
(Joins sheet 39)
(Joins sheet 48)
(Joins sheet 42)
NORTH SASKATCHEWAN RIVER
Tp 55
Tp 54
RB 2 e 1
RB 2 g 3
FLU 1 c 1
FLU 1 b 1
UCS 1 - LIH 4 d 2
FLU 2 - RDW 4 d 2
RB 2 g 2
RDW 2 - FLU 2 d 2
LIH 2 - SNI 1 e 3
LIH 1 - SNI 1 e 2
RDW 4 d 0
RDW 3 - TWH 1 d 1
RDW 4 c 0
RDW 1 e 0
LIH 3 d 0
RDW 4 - TWH 1 d 2
PHS 1 - FNH 1 d 2
AGS 2 b 2
AGS 2 d 1
PHS 2 - AGS 2 c 2
AGS 2 - PHS 4 c 1
AGS 2 d 1
PHS 3 c 1
LIH 2 f 1
RDW 4 e 1
RB 2 g 3
PHS 2 - AGS 1 e 1
AGS 2 c 1
AGS 2 - PHS 4 d 1
RDW 4 d 0
LIH 2 f 1
FLU 3 c 2
RDW 4 f 0
RB 2 f 2
AGS 2 d 2
UCS 6 f 1
FLU 2 - RDW 8 f 2
RDW 2 e 0
NIT 1 e 0
NIT 1 d 0
NIT 2 c 0
NIT 2 d 0
NIT 2 e 0
FLU 1 - RDW 1 f 1
NIT 1 f 0
NIT 1 d 0
LIH 3 e 0
AV 6 c 0
RDW 3 c 0
RDW 5 c 0
RDW 4 e 0
LIH 3 e 0
RDW 10
MN 1 b 0
RDW 4 e 0
RDW 2 f 0
RDW 4 d 0
16
15
14
13
8
9
10
11
12
6
31
32
33
34
35
36
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres
R 8

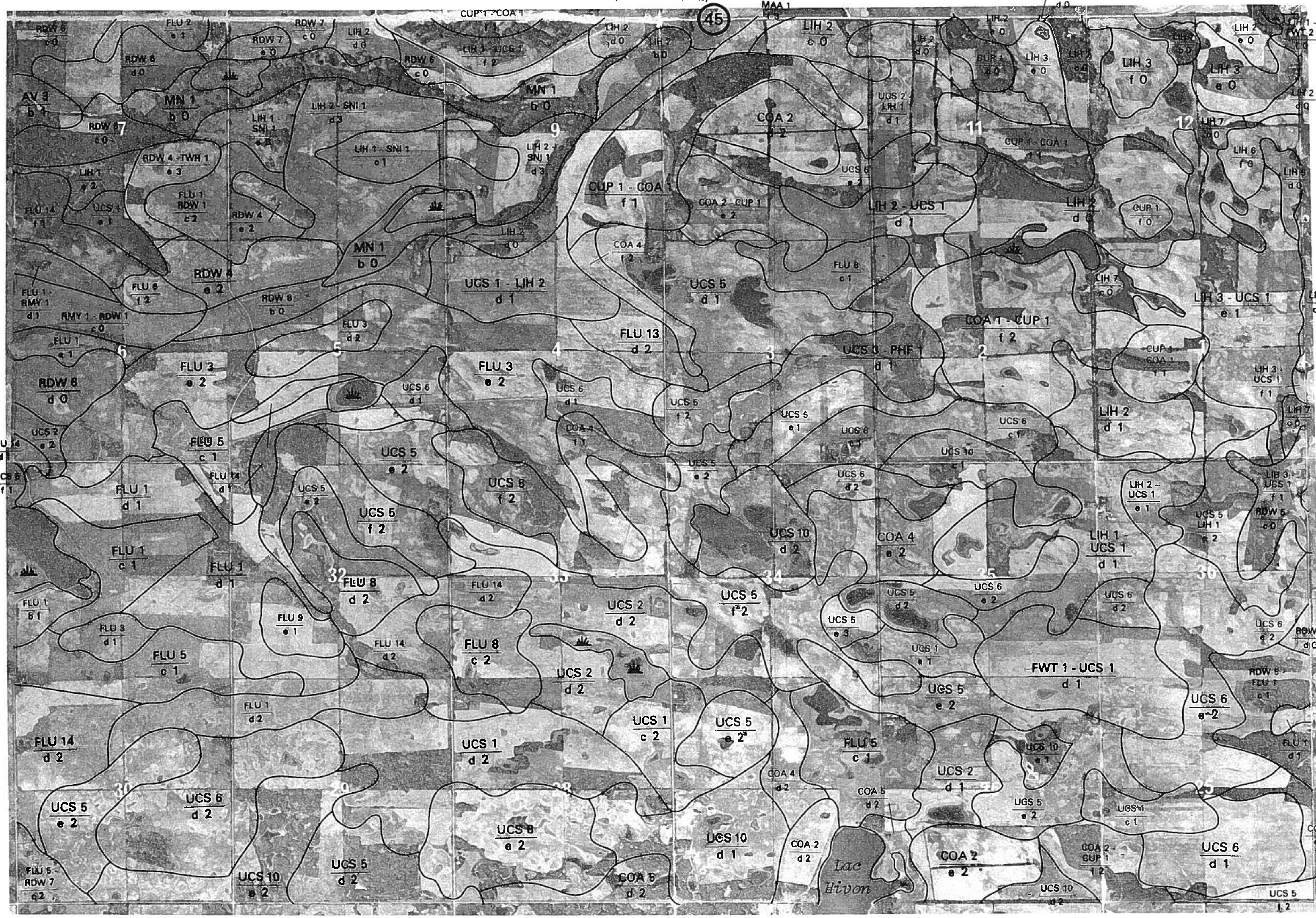
Sheet 42


R 8
(Joins sheet 41)
Tp 54
(Joins sheet 38)
Tp 54
(Joins sheet 47)
(Joins sheet 43)
R 8
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres
NIT 1
d 0
MN 1
b 0
LIH 2
e 0
RDW 4
TWH 1
d 2
AV 2
c 0
NIT 1
e 0
NIT 1
c 0
AV 2
b 0
RDW 4
c 0
NIT 1
d 0
LIH 3
e 0
CUP 1
f 0
CUP 1 - COA 2
f 1
LIH 3
d 0
TWH 1
c 5
LIH 1
c 0
LIH 2
e 0
LIH 2
d 0
LIH 1
c 0
MN 1
b 0
CUP 1 - COA 1
f 1
RDW 7
c 0
LIH 2
c 0
LIH 2
e 0
LIH 3
e 0
LIH 1
e 0
LIH 2
d 0
LIH 3
f 0
LIH 2
d 0
C.P.R.
45

Sheet 43

R 8

(Joins sheet 42)



(Joins sheet 37)

Tp 54 / Tp 53

Tp 54 / Tp 53

(Joins sheet 46)

(Joins sheet 44)

R 8

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **44**

R 8

(Joins sheet 43)

Tp 53 (Joins sheet 36)

Tp 53 (Joins sheet 45)

(Joins sheet 53a)

R 8

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

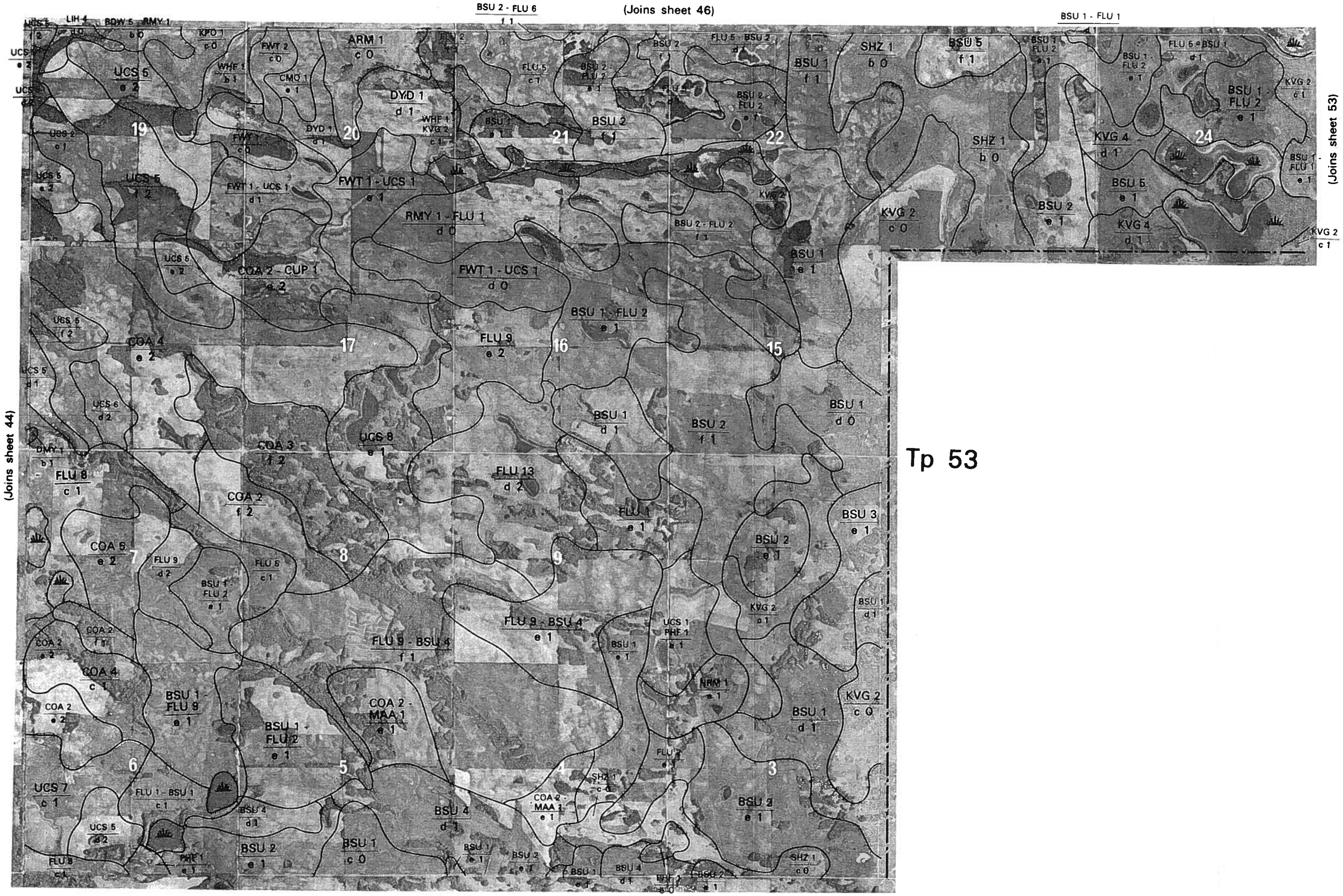
1 1/2 0 1 2 Kilometres

Sheet 45

R 7

(Joins sheet 46)

Tp 53 (Joins sheet 44)



Tp 53 (Joins sheet 53)

(Joins sheet 53a)

R 7

APPROXIMATE SCALE 1:31,680

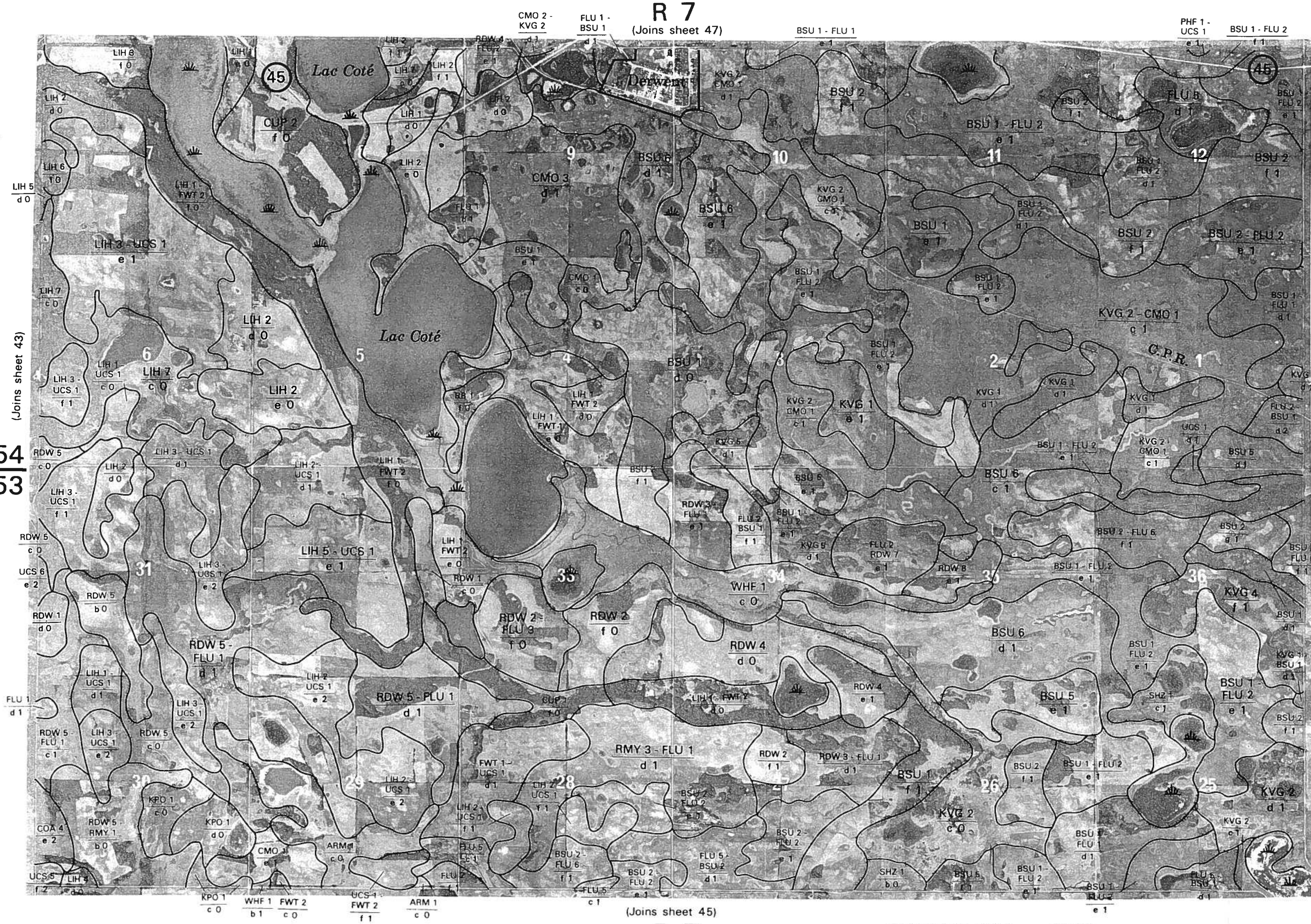
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **46**

R 7

(Joins sheet 47)



(Joins sheet 43)

Tp 54 / Tp 53

Tp 54 / Tp 53

(Joins sheet 52)

(Joins sheet 45)

R 7

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

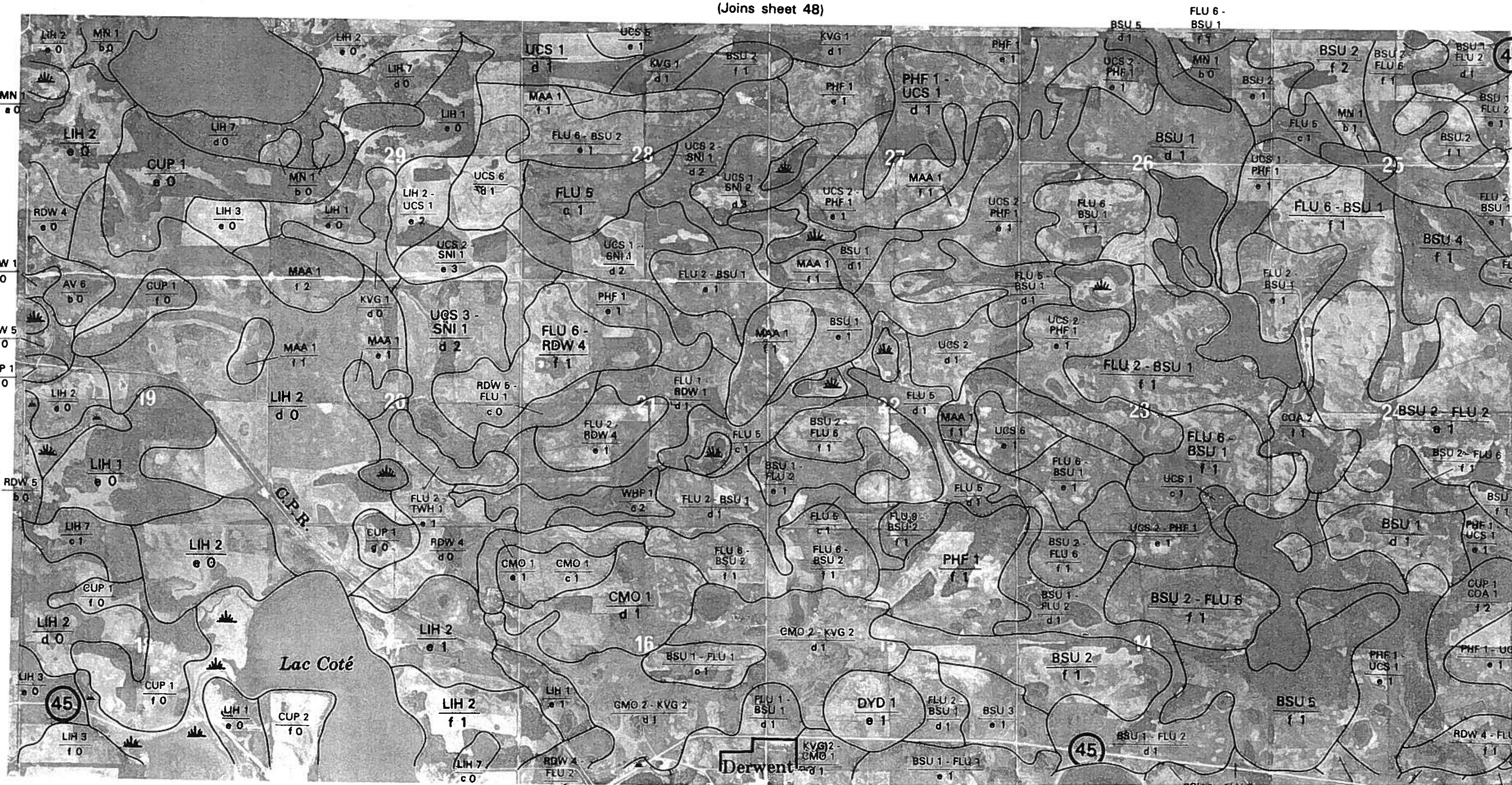
Sheet **47**

R 7

(Joins sheet 48)

Tp 54

(Joins sheet 42)



Tp 54

(Joins sheet 51)

(Joins sheet 46)

R 7

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet 48

R 7

(Joins sheet 49)

(Joins sheet 41)

Tp 55
Tp 54

(Joins sheet 50)

Tp 55
Tp 54

(Joins sheet 47)

R 7

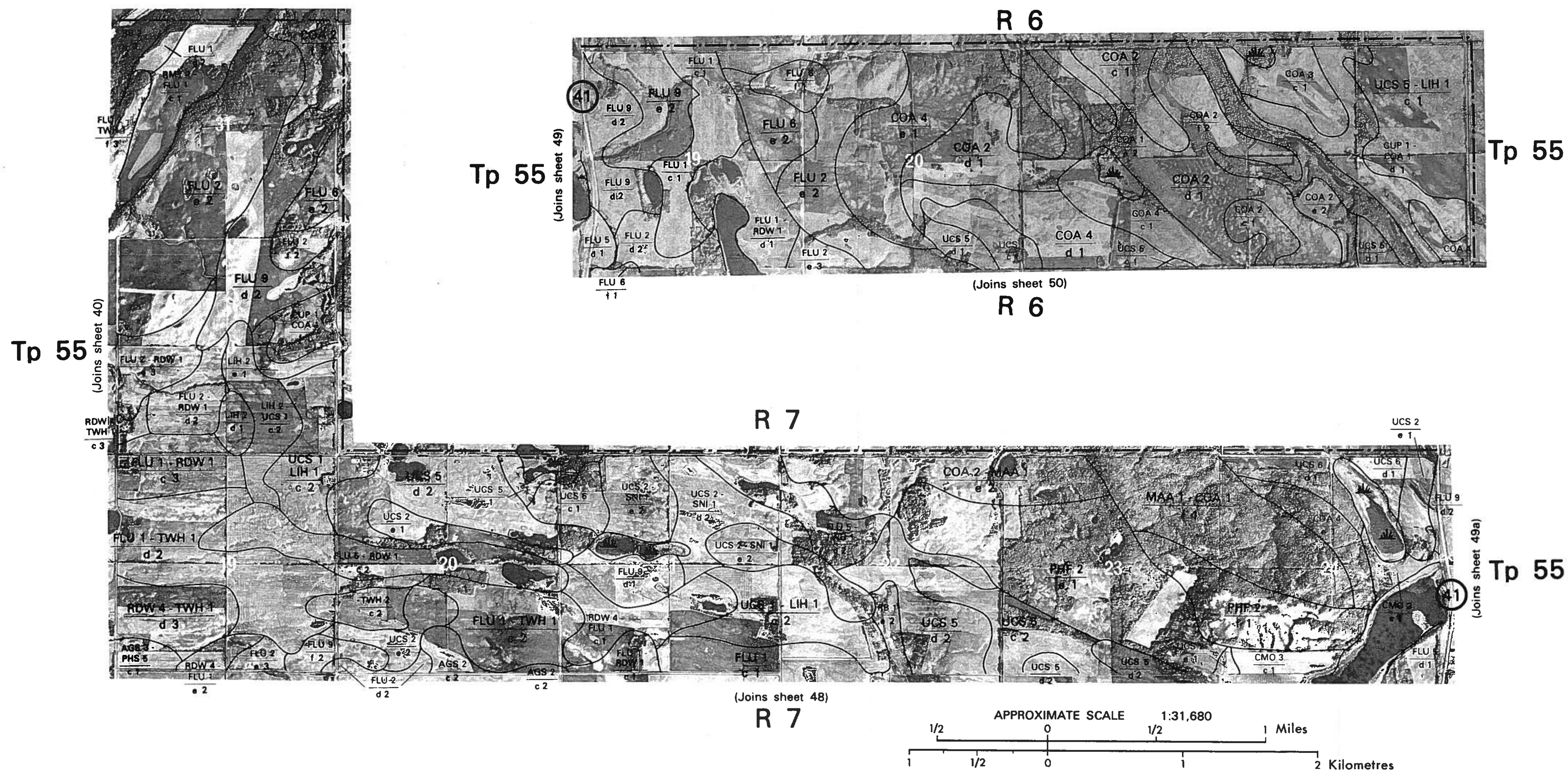
APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **49**

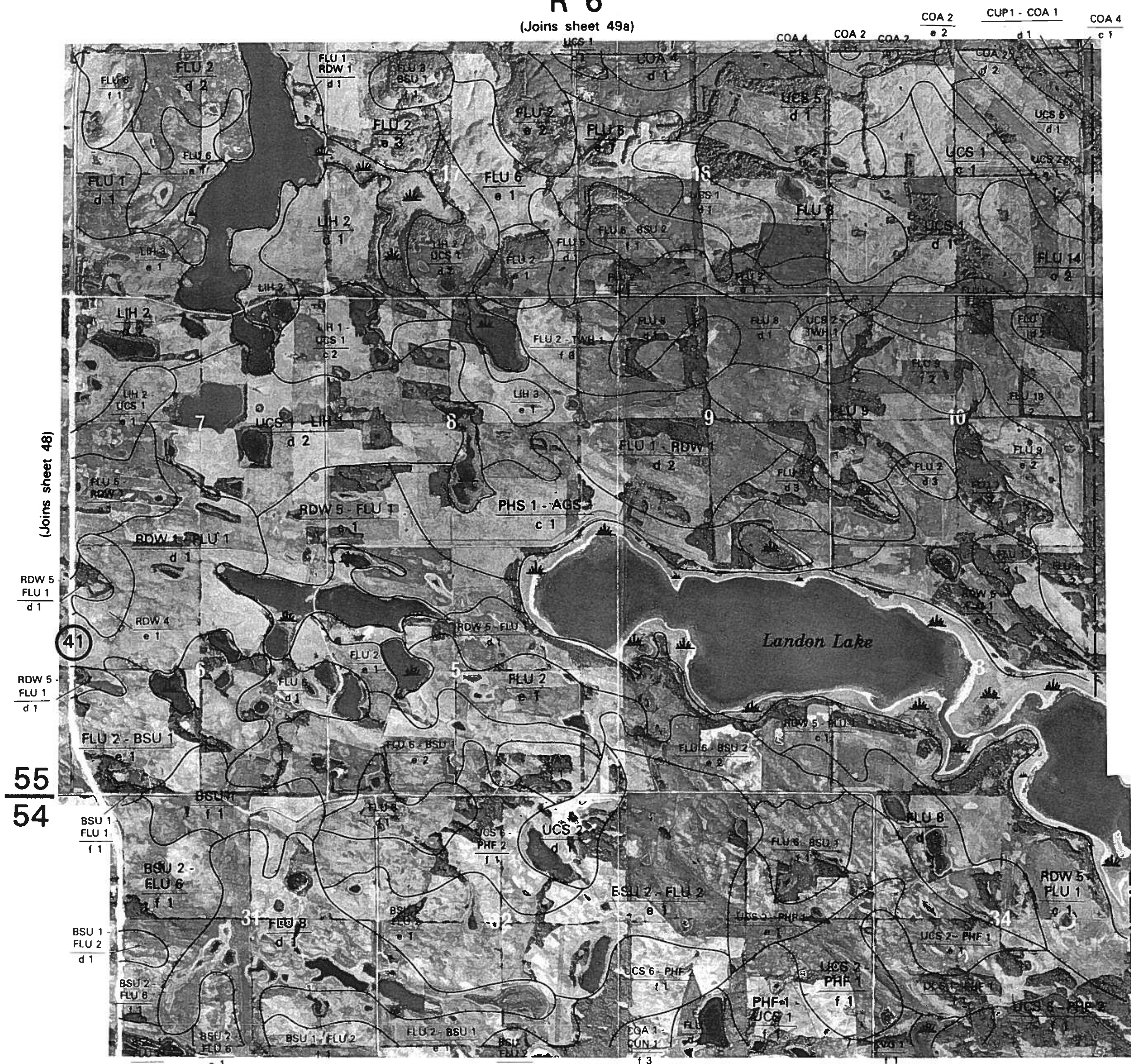
Sheet **49a**



Sheet 50

R 6

(Joins sheet 49a)



Tp 55 / Tp 54

Tp 55 / Tp 54

(Joins sheet 51)

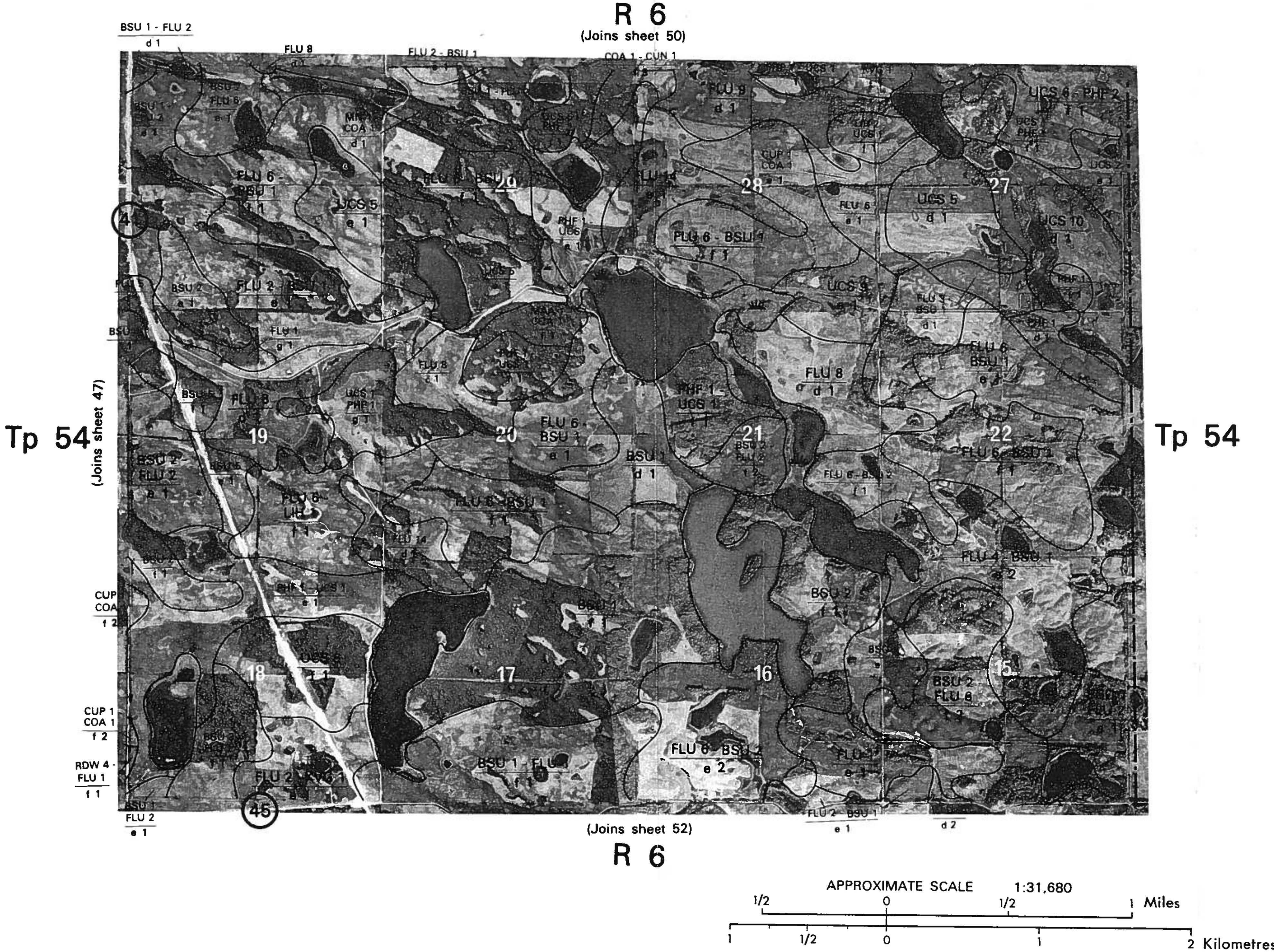
R 6

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

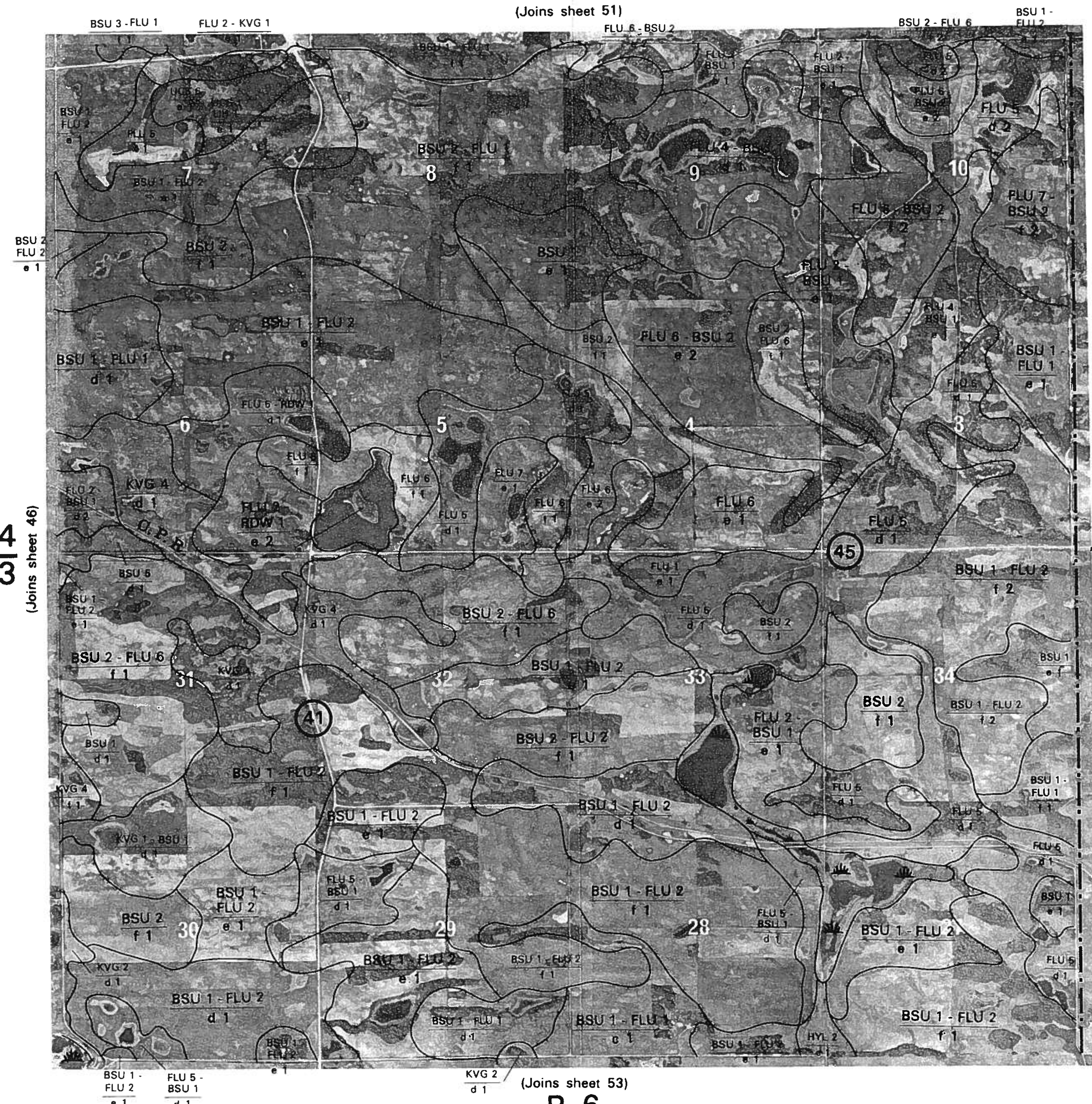
Sheet 51


R 6
(Joins sheet 50)
(Joins sheet 52)
R 6
Tp 54
(Joins sheet 47)
Tp 54
BSU 1 - FLU 2
d 1
FLU 8
FLU 2 - BSU 1
COA 1 - CUN 1
FLU 9
d 1
UCS 6 - PHF 2
FLU 6 - BSU 1
UCS 5
e 1
UCS 5
d 1
UCS 10
FLU 6 - BSU 1
f 1
FLU 2 - BSU 1
UCS 9
FLU 8
d 1
FLU 6
BSU 1
PHF 1
UCS 1
FLU 6
BSU 1
e 1
BSU 1
d 1
FLU 6 - BSU 1
BSU 2
FLU 2
e 1
FLU 6 - BSU 1
FLU 4 - BSU 1
BSU 2
UCS 8
BSU 2
FLU 8
FLU 6 - BSU 1
e 2
BSU 1 - FLU 1
FLU 2 - KYC 1
CUP 1
COA 1
f 2
RDW 4 -
FLU 1
f 1
BSU 1
FLU 2
e 1
FLU 2 - BSU 1
e 1
d 2
29
28
27
19
20
21
22
18
17
16
15
41
45
APPROXIMATE SCALE 1:31,680
1/2 0 1/2 1 Miles
1 1/2 0 1 2 Kilometres

Sheet **52**

R 6

(Joins sheet 51)



Tp 54 / Tp 53

Tp 54 / Tp 53

(Joins sheet 53)

R 6

APPROXIMATE SCALE 1:31,680

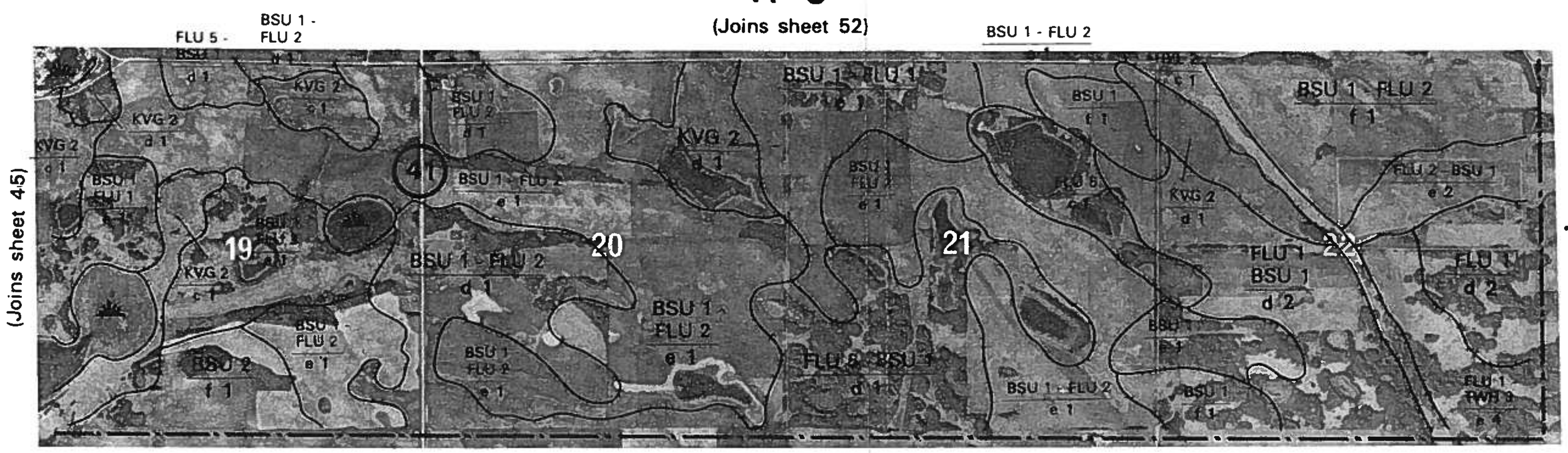
1/2 0 1/2 1 Miles

1 1/2 0 1 2 Kilometres

Sheet **53**

R 6
(Joins sheet 52)

Tp 53 (Joins sheet 45)



Tp 53

R 6

APPROXIMATE SCALE 1:31,680

1/2 0 1/2 1 Miles

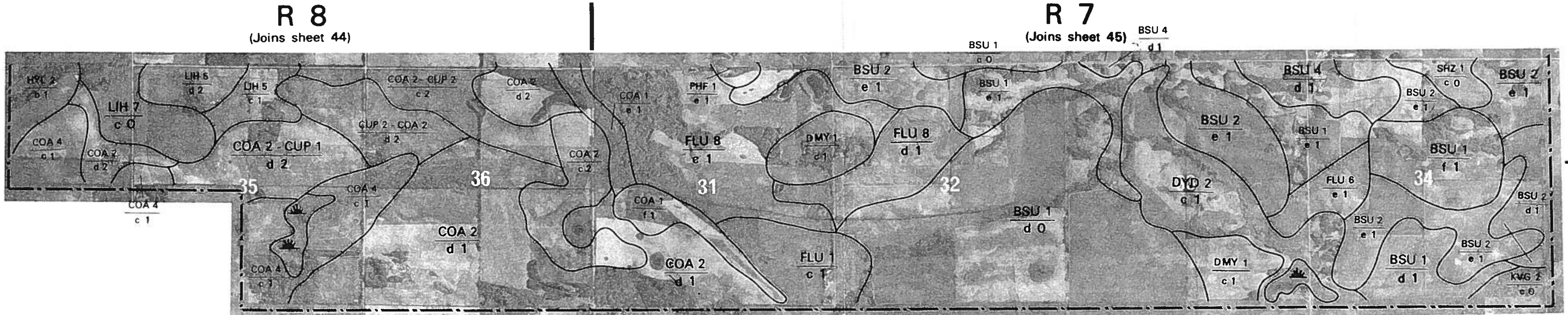
1 1/2 0 1 2 Kilometres

Sheet **53a**

R 8
(Joins sheet 44)

R 7
(Joins sheet 45)

Tp 52



COA 4
c 1

Tp 52

R 8

R 7