SASKATCHEWAN RESEARCH COUNCIL

RANGELAND CLASSIFICATION FOR AGRI-MANITOBA

Limited Report

Prepared for Manitoba Forage and Grassland Association

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Summary

- This report presents the first phase of an ecological classification of rangelands for the agricultural portion of Manitoba.
- The highest level of the classification is the ecoregion. Agri-Manitoba is divided into nine ecoregions representing the trends in climate and major geological features.
- Each ecoregion is divided into ecosites, representing variation in topography, soils, moisture regime, and salinity. The 21 ecosites described for Manitoba can be related to similar ecosites in the neighbouring provinces and states. Guidance is provided for identifying ecosites in the field. Ecosites can be mapped by predictive methods using the available soil maps. Ecosite maps are provided for 14 municipalities distributed across agri-Manitoba, to show general patterns in ecosite distribution.
- A number of different plant communities can occur on a given ecosite, reflecting differences in grazing history, fire, or other disturbances. A complete community classification was beyond the scope of the current phase of the project. However, the available data and literature were analyzed to make initial descriptions of the potential grassland communities for many ecosites.

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1 Introduction

This report presents an ecological classification of Manitoba's grazing lands, following the approach that has been widely adopted in rangelands of the western United States, Alberta, and Saskatchewan. Ecosystem classification is an essential tool for ecosystem management. Classification of ecosystems provides a framework of standardized ecological units, which can be used for a variety of applications:

- **Range management planning:** Planning of a grazing operation requires mapping the various fenced pasture units, areas of native and tame pasture, water sources, and so on. Mapping of range ecosites provides another piece of the puzzle. Areas with different soil properties, topography, and moisture regime often require different management. In some cases fencing is used to separate different ecosites, such as riparian sites requiring special management.
- **Range health assessment:** In the other western provinces, classification of range ecosites has gone hand in hand with development of range health assessment methods. These methods assess whether rangeland has been damaged by overgrazing; how well is it performing functions such as soil and water protection; and whether it is producing as much forage as it is capable of. Range health assessment is based on comparing the current state of the rangeland to the potential state for that ecosite. Therefore, is implicitly based on ecosite classification
- **Recommended stocking rates**: Range ecosites differ in levels of forage production, and therefore in the stocking rates that they can support. Recommended stocking rates are provided for each ecosite. In planning sustainable stocking for a grazing unit, the area of each ecosite is determined, and multiplied by the recommended stocking rate for that ecosite. However, other factors such as the distribution of cover types, differences in preference by grazing animals, and past changes caused by over-grazing must also be considered
- **Describing and mapping wildlife habitats**: Wildlife managers need to identify important habitats for various species, particularly species at risk. Ecosite classification provides information on landscape and vegetation attributes that are used to identify different kinds of habitat.
- **Designing biodiversity monitoring programs**: Surveys for populations of wildlife species or presence of rare species are usually stratified by some kind of land units, in order to distribute sample points across the landscape. Use of an ecosite classification for this purpose provides an ecological basis for stratification, rather than using administrative units that are unrelated to ecological relationships.
- **Environmental impact assessment of proposed developments**: EIAs usually include some form of ecosystem mapping as a way of organizing the information. In other provinces, it has been found that ecosite classifications developed for range management purposes are used by consultants doing EIA work.
- **Providing targets for restoration following disturbance**: Reclamation specialists select species that will be expected to do well on a given area of land, and that will help to return the land to a more natural condition. Ecosite classification provides information on the potential plant community to be expected on each type of land, which can be used in designing seed mixes.

Use of a standardized classification means that grazing managers, wildlife managers, regulators, environmental consultants, and conservation NGOs can all speak the same language and use the same maps. This facilitates communication among the various users, contributing toward a more integrated approach towards land-use issues.

Ecosystem classification systems are hierarchical, in the sense that large units are divided into smaller units, which are divided into even smaller units. The rangeland classification uses the following hierarchy:

- **Ecoregions** – broad units reflecting climate and major landscape features
- **Ecosites** – smaller units within ecoregions reflecting more local factors such as soil texture and moisture regime.
- **Plant Communities** – smaller units within ecosites reflecting differences in the history of management and disturbance.

2 Ecoregions

2.1 Background

The first step in the classification is to divide the province into ecological regions or Ecoregions. Ecoregions are broad zones that are determined by climate and major geological features. The composition and productivity of rangeland will be different in a moist climate compared to a dry climate, even if the soil material is the same. The Ecoregions used in the rangeland classification are shown in Figure 1 and described below[1]. Climatic trends among these Ecoregions are shown in Figure 2, and summarized in Table 1. Climatic parameters include:

- Growing degree days – the sum over all the days in the growing season of the amount by which the mean daily temperature exceeds a base of 5˚ C.
- Annual precipitation – total precipitation (rain plus snow) for the year.
- Climatic Moisture Index – annual precipitation minus annual potential evapotranspiration, an index which is closely related to vegetation patterns in the Prairie Provinces (Hogg 1994).

The Rangeland Ecoregions are distributed across the transition from grassland to boreal forest in southern Manitoba. In the National Ecological Framework, upon which much of this map is based, the warmest and driest parts of Manitoba are placed in the Prairie Ecozone, in which grassland was the predominant natural vegetation prior to settlement. This coincides with the following Rangeland Ecoregions: Aspen Parkland, Assiniboine Delta, Southwest Manitoba Uplands, Aspen/Oak Parkland, and most of the Tall Grass Prairie. The cooler and moister parts of southern Manitoba are placed in forest ecozones, either the Boreal Plain Ecozone (Mid-Boreal Upland and Transition, Interlake Plain) or the Boreal Shield Ecozone (Lake of the Woods). The Rangeland Ecoregions are limited to agri-Manitoba, the part of Manitoba in which there is agricultural settlement. This includes all of the Prairie Ecozone, as well as the bordering parts of the forested Ecozones where agriculture has been extended by land clearing.

[1] Technical details on the development of the Ecoregion map and the climatic analysis are in Appendix A.

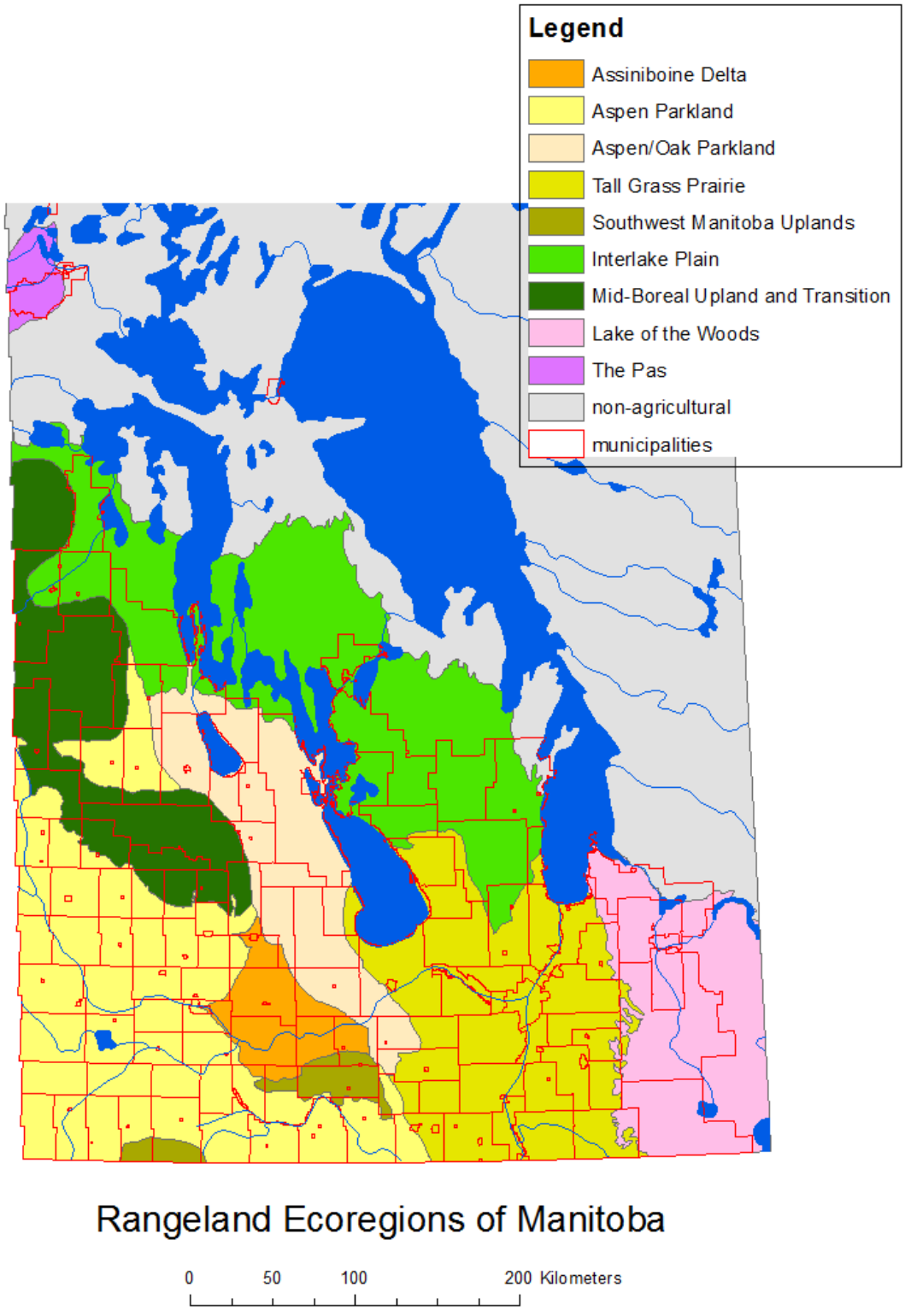

Figure 1 Rangeland Ecoregions of Manitoba.

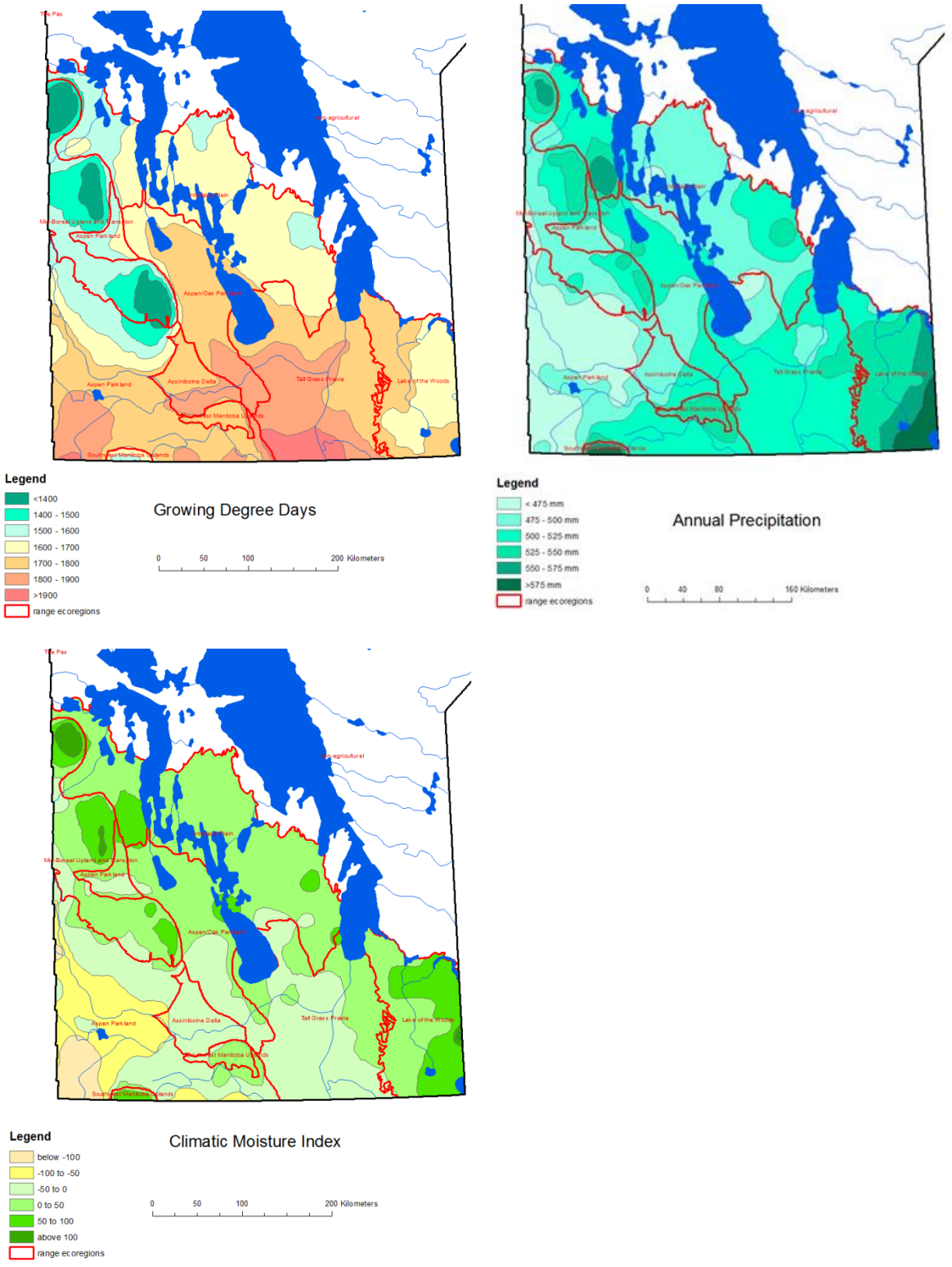

Figure 2 Climatic trends in relation to the Rangeland Ecoregions

Table 1 Average values of climatic variables for the Rangeland Ecoregions of Manitoba.

Ecoregion	Growing Degree Days	Annual Precipitation (mm)	Climatic Moisture Index (mm)
Aspen Parkland	1708	482	-45
Assiniboine Delta	1778	497	-28
Tall Grass Prairie	1807	508	-8
Aspen/Oak Parkland	1741	503	9
Mid-Boreal Upland and Transition	1464	503	29
Interlake Plain	1644	501	30
Southwest Manitoba Uplands	1714	546	31
Lake of the Woods	1702	545	51
non-agricultural	1632	528	70

An important geological feature used in separating ecoregions is the Manitoba Escarpment, which runs through agri-Manitoba from northwest to southeast. The land below (i.e. east of) the escarpment is the former bed of Lake Agassiz, a huge lake formed as the last continental glacier was melting. Most of the Lake Agassiz basin is flat, and drainage is often poor. The land west of the escarpment is about 200 metres higher on average, and is more varied in topography and drainage. Other geological features used include the major Cretaceous bedrock uplands in western Manitoba (Turtle Mountain, Riding Mountain, Duck Mountain, Porcupine Hills), the large delta of the Assiniboine River, and the Precambrian Shield in eastern Manitoba.
Most of the descriptive information on individual ecoregions was taken from the publication "Terrestrial Ecozones, Ecoregion, and Ecodistricts of Manitoba" (Smith et al. 1998).

2.2 Aspen Parkland Ecoregion

The Aspen Parkland occupies most of the prairie land west of the Manitoba Escarpment. It includes the driest climates in Manitoba, with precipitation falling below 475 mm and the moisture index falling below -50 mm in the southwest corner of the Ecoregion (Figure 2, Table 1). However, the Ecoregion encompasses considerable climatic variation, with moisture conditions increasing northward and eastward (Figure 2).

The Aspen Parkland is underlain by Cretaceous shales, which are covered with level to gently undulating glacial deposits, including loamy glacial till and sandy materials deposited by glacial meltwater. The roughest topography is associated with sands that have been modified into dunes by wind action, and with the deeply incised valleys of the Souris, Assiniboine, and Pembina Rivers. Elevations average about 470 metres (1540 feet). Upland soils are predominantly Black Chernozems. The natural vegetation is a mosaic of aspen[2] woodlands (or bur oak on drier sites) with grasslands. Most of the landscape has been converted to cropland and tame forage. The largest areas of natural vegetation used for grazing are associated with sandy soils, for example in the area north and south of St. Lazare.

In the National Ecological Framework, the Aspen Parkland Ecoregion extends from Manitoba across central Saskatchewan and Alberta, reflecting climatic moisture conditions that are

[2] Scientific names of plant species are shown in Appendix B.

transitional between grassland and boreal forest. However, the Aspen Parkland in Manitoba is warmer and higher in precipitation than the areas further west. Growing degree-days within the Aspen Parkland average 1708 in Manitoba compared to 1493 in Saskatchewan, while annual precipitation averages 482 mm in Manitoba compared to 423 mm in Saskatchewan. Apparently the higher precipitation is balanced by higher evaporation, resulting in a similar moisture balance between the provinces. As in other provinces, tree cover tends to decrease from the moister to the drier parts of the Aspen Parkland, and the driest area in the southwest corner of the province is shown on some maps as Mixed Prairie rather than Aspen Parkland. However, even in this area, there are clear examples of the woodland/grassland mosaic that characterizes the Parkland.

2.3 Assiniboine Delta Ecoregion

The Assiniboine Delta is shown separately from the Aspen Parkland, to represent an ecologically distinctive area. It is similar climatically to other areas at the eastern edge of the Aspen Parkland (Figure 2, Table 1), from which it is distinguished by landscape features. Where the early Assiniboine River flowed into glacial Lake Agassiz, it deposited a large sandy delta, much of which was later modified into dunes by wind action. There are also areas of loamy glaciolacustrine deposits. The average elevation of the Assiniboine Delta is about 370 metres (1210 feet).

Most of the dunes are stabilized by vegetation, but there is a 10 km^2 area of active dunes. Upland soils include Regosols on recently active dunes and Black Chernozems on more stable areas. This is now one of the most important areas of natural vegetation in southern Manitoba, and its vegetation is distinct from the rest of the Aspen Parkland. Vegetation on the dunes includes grassland, aspen stands, patches of scrubby bur oak, and distinctive areas with widely spaced white spruce. Much of the Ecoregion is covered by a military base (CFB Shilo) and a provincial park (Spruce Woods).

2.4 Southwest Manitoba Uplands Ecoregion

The Southwest Manitoba Uplands Ecoregion represents the more heavily wooded vegetation associated with higher elevations in the Pembina Hills and Turtle Mountain. The average elevation is about 510 metres (1670 feet), but Turtle Mountain reaches 700 metres (2300 feet). The climate of the Southwest Manitoba Uplands reflects the higher elevations, with lower temperatures, higher precipitation, and higher moisture index compared to the surrounding Aspen Parkland (Figure 2, Table 1). These trends are more pronounced for Turtle Mountain than for the lower Pembina Hills.

The uplands are composed of Cretaceous and Tertiary shales, but the land surface is made up of hummocky morainal deposits as well as glacio-fluvial deposits. Upland soils are predominantly Dark Gray and Black Chernozems, but there are local areas of forest soils (Gray Luvisols). The natural vegetation is predominantly aspen forest, but grasslands were more extensive in the past, as indicated by the presence of Chernozemic soils. Much of the Pembina Hills portion of the ecoregion has been converted to farmland, but Turtle Mountain is still mostly forested.

2.5 Aspen/Oak Parkland Ecoregion

The Aspen/Oak Parkland includes the northern portion of the prairie land in the Lake Agassiz basin. The average elevation is about 280 metres (920 feet). The Aspen/Oak Parkland is similar

in precipitation to the Tall Grass Prairie, but growing seasons are cooler, resulting in a somewhat higher moisture index (Figure 2, Table 1).

The Aspen/Oak Parkland is underlain by flat-lying Paleozoic limestone. Most of the land surface consists of glacial till with low-relief ridge-and-swale topography. Upland soils are dominantly Black Chernozems. The natural vegetation consists of a mosaic of aspen and bur oak groves with patches of grassland. However most of the ecoregion has been converted to cropland.

2.6 Tall Grass Prairie Ecoregion

The Tall Grass Prairie includes the southern portion of the prairie land in the Lake Agassiz basin. The average elevation is about 250 metres (820 feet). The area as mapped here forms the southeast corner of the Prairie Ecozone, but extends eastward into part of the Boreal Plain Ecozone in the Steinbach area and up to Lake Winnipeg. The Tall Grass Prairie is the warmest part of Manitoba (Figure 2, Table 1). Precipitation is moderate compared to forest regions, but is high compared to other prairie regions (Figure 2, Table 1). The combination of warm summers with relatively high precipitation favours the tall warm-season grasses that characterize the region.

The Tall Grass Prairie is underlain by flat-lying Paleozoic limestone. Most of the land surface is a level plain of thick silts and clays deposited by glacial Lake Agassiz. Upland soils are predominantly Humic Vertisols and Black Chernozems, but Gleysols are also widespread in poorly drained areas. The natural vegetation consists of tall grass prairie dominated by big bluestem on uplands, and wet meadows and marshes on the extensive poorly drained areas. In the core of the Tall Grass Prairie (roughly along the Red River south of Winnipeg, and west from there to the escarpment), trees are restricted to fringes along stream channels, dominated by Manitoba maple, green ash, white elm, basswood, and cottonwood. In the peripheral areas to the north and east, groves of trembling aspen and bur oak become more common. Most of the land has been drained and converted to cropland.

2.7 Mid-Boreal Upland and Transition Ecoregion

This ecoregion includes the forested uplands of Riding Mountain, Duck Mountain, and the Porcupine Hills, lying immediately west of the Manitoba Escarpment. The ecoregion as mapped here also includes the fringe of Boreal Transition on the lower slopes of these uplands. The average elevation over this area is about 590 metres (1940 feet), only 120 metres higher than the average for the Aspen Parkland, but parts of the uplands reach elevations over 700 metres (2300 feet). The uplands are surrounded by parkland, but the higher elevations result in a cooler, moister climate that supports boreal forest. Temperatures are much lower, and precipitation and moisture higher, compared to the adjacent parkland, and even compared to the lower-elevation forest of the Interlake Plain (Figure 2, Table 1).

These hills are part of the broad swath of mid-boreal upland extending across Saskatchewan and Alberta. They are bedrock hills composed of Cretaceous shale, covered by loamy to clayey glacial till deposits. Upland soils are mainly Gray Luvisols, with Eutric Brunisols on coarse-textured materials. Dark Gray Chernozemic soils are also found, particularly in the transitional areas around the fringe. The natural vegetation is predominantly mixedwood forest of trembling aspen, balsam poplar, white and black spruce, and balsam fir, with jack pine stands on coarse soils. Most of the land is reserved in national and provincial parks and provincial forest reserves. There are limited areas of cropland, hayland and pasture, mainly in the transitional areas.

2.8 Interlake Plain Ecoregion

The Interlake Plain includes the forest land in the Lake Agassiz basin, in the area between Lake Winnipeg and Lakes Manitoba and Winnipegosis, and just west of Lake Winnipegosis. The average elevation is about 260 metres (850 feet). The Interlake Plain is cooler than the prairie regions to the south (Figure 2, Table 1). Precipitation is similar to other parts of the Lake Agasssiz basin, but lower levels of evaporation result in a higher moisture index that supports forest vegetation (Figure 2, Table 1).

This ecoregion is underlain by flat-lying Palaeozoic limestone, and there are areas where the limestone is exposed or only thinly covered. The land surface varies from level plains to low-relief ridge-and-swale topography. Upland soils are predominantly Dark Gray Chernozems, and tend to be highly to extremely calcareous because the glacial till is derived from the underlying limestone. The natural vegetation is predominantly aspen forest on uplands, with willows and sedges in poorly drained depressions. Areas of cropland, hayland and pasture are mixed with the predominant woodland. The Interlake Plain is a transitional area (similar to the Boreal Transition), in which the natural vegetation is mostly forest, but in which grasslands were formerly more widespread as shown by the presence of Chernozemic soils.

2.9 Lake of the Woods Ecoregion

This ecoregion includes the portion of the Boreal Shield that extends into southern Manitoba, lying just east of the Tall Grass Prairie Ecoregion. The average elevation is 310 metres (1020 feet). The Lake of the Woods Ecoregion is cooler than the Tall Grass Prairie to the west, while precipitation is higher (Figure 2, Table 1). The result is a significantly higher moisture index, supporting forest vegetation (Figure 2, Table 1). This predominantly forested ecoregion is somewhat warmer and higher in precipitation than the other forested ecoregions (Figure 2, Table 1), and is considered part of the transition zone extending across the Great Lakes region between boreal forest to the north and temperate forest to the south.

The Lake of the Woods Ecoregion is underlain by the hard, acidic bedrock of the Precambrian Shield, which is exposed in places. However, most of the land surface consists of glacial deposits and wide expanses of peatland. The upland soils are predominantly forest types (Brunisols and Luvisols), but there are Dark Gray Chernozems in the western part of the ecoregion. The natural vegetation on uplands is mainly forest, including boreal species (trembling aspen, white birch, jack pine, white spruce) and species of the boreal/temperate transition zone (eastern white cedar, black ash, white elm, red pine, eastern white pine). Peatlands and other poorly drained areas are dominated by black spruce and tamarack. Agriculture is mainly associated with clayey glaciolacustrine soils that have been artificially drained.

2.10 The Pas Ecoregion

This ecoregion includes a small area of the Saskatchewan River Delta extending into Manitoba in the area of The Pas. Most of the landscape consists of alluvial deposits and peatlands. In this forest climate, upland soils are Brunisols and Luvisols. The natural vegetation consists of black spruce and tamarack on peatlands, willows, swamp birch, and balsam poplar on imperfectly to poorly drained areas, and balsam poplar, trembling aspen, white elm, Manitoba maple, green ash, white birch, white spruce and balsam fir on the slightly elevated river levees. Agriculture is limited to small areas on alluvial soils.

3 Ecosites

3.1 Background

The ecoregions described above are defined by climate and major geological features. Within an ecoregion, rangeland is divided into ecological sites or **ecosites**, which are defined by more local factors. The Society for Range Management defines an ecological site as: "A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management".

Within a local area such as a ranch or a community pasture, it can be assumed that the climate is more or less uniform. Therefore, the variation in growing conditions is mainly related to physical site factors, such as topography, soil texture, and soil moisture regime. For example, a pasture may include loam-textured soils on rolling moraine, sand-textured soils on lacustrine plain, and poorly drained depressions with meadow vegetation. The loamy upland, the sand plain, and the wet meadows are different ecosites: they have different physical site factors and they support different plant communities with different levels of forage production.

Ecosite classification is closely related to soil survey. In some ways, it can be thought of as a simplification of soil survey data into a smaller number of types that represent the main trends in rangeland vegetation. Soil survey data for agri-Manitoba include more than 600 soil series. It is obviously impractical to characterize all of these in terms of rangeland plant communities and forage production. Ecosite classification represents a smaller number of broader types which can be characterized in this way.

It should be noted that different plant communities can occur on a given ecosite, depending on fire history, grazing impact, exotic invasion, and other factors. This variation is dealt with at the next level of the classification.

3.2 The Rangeland Ecosite classification

The classification of Rangeland Ecosites is described in Table 2. It was derived from similar classifications in the neighbouring provinces and states (see third column in Table 2). Concepts were modified by analyzing the range of variation in Manitoba soil survey data, and by discussing site characteristics with experienced Manitoba ecologists. Based on these discussions, it is felt that the ecosites shown here represent the major types of land supporting rangelands in Manitoba.

3.3 Mapping Rangeland Ecosites

Maps of Rangeland Ecosites have been developed for selected municipalities in agri-Manitoba. These maps are derived from the soil map and database for the municipality. Each soil polygon shown on these maps has a large number of attributes associated with it in the accompanying database. Methods were developed to predict the Rangeland Ecosite from these attributes (see details in Appendix C). Land cover maps were used to mask out the areas converted to cropland, so that Rangeland Ecosites are shown only for areas of grassland, woodland, and wetland.

An example of a Rangeland Ecosite map is shown in Figure 3 . Maps for 14 municipalities in different parts of agri-Manitoba are shown in Appendix C.

While these maps provide a good overview of the distribution of ecosites across a municipality, they are limited by the scale of the original soil maps and by the predictive process. This means that they may not give exactly the right answer for every location. In assessing an individual area, reading the map should only be the first step, and should be followed by field observations (see detailed discussion in Section 3.4).

Table 2 Classification of Rangeland Ecosites

ECOSITE	DESCRIPTION	EQUIVALENTS IN NEIGHBOURING JURISDICTIONS
UPLANDS (Rapidly, Well or Imperfectly Drained):		
Precambrian Bedrock	Areas with exposed granite or other acidic bedrock	Not classified
Shallow to Limestone	Includes areas with exposed limestone or other calcareous bedrock, and shallow soils over limestone.	Not classified
Eroded Slopes	Steep valley slopes, with high natural rates of water erosion resulting in thin soil profiles.	Thin in Sask., Thin Loamy, Thin Sandy, etc. in N. Dakota
Dunes	Sand deposits shaped into hills and ridges by wind movement.	Dunes in Sask., Choppy Sands in N. Dakota
Sand	Rapidly to well drained upland sites on soil materials with sand or gravelly texture, but not shaped into dunes.	Sand in Sask., Sands in N. Dakota; also may include Gravelly in Sask, Shallow Gravel in N. Dakota
Sandy Loam	Well drained upland sites on soil materials with sandy loam textures.	Sandy Loam in Sask., Sandy in N. Dakota
Moist Sand	Imperfectly drained sites on soil materials with sand, gravelly, or sandy loam texture.	Dry Meadow in Sask., Subirrigated Sands in N. Dakota
Loam	Well drained upland sites on materials with loam, silt loam, or clay loam texture.	Loam in Sask., Loamy in N. Dakota
Calcareous Loam	Loam sites on highly to extremely calcareous glacial tills	Not classified
Moist Loam	Imperfectly drained sites on materials with loam, silt loam, or clay loam textures.	Dry Meadow in Sask., Subirrigated in N. Dakota
Clay	Well to imperfectly drained upland sites on materials with clay or heavy clay texture.	Clay in Sask., Clayey in N. Dakota

Table 2 (continued)

ECOSITE	DESCRIPTION	EQUIVALENTS IN NEIGHBOURING JURISDICTIONS
Alluvium	Well to imperfectly drained sites formed by recent alluvial deposition along floodplains of streams.	Overflow in Sask., Loamy Overflow, Sandy Overflow, etc. in N. Dakota
Moist Saline	Imperfectly drained sites that are moderately to strongly saline.	Saline Dry Meadow in Sask., Saline Subirrigated in N. Dakota.
WETLANDS (Poorly or Very Poorly Drained)		
Wet Meadow	Wet low-lying sites that are normally flooded for 3-4 weeks in spring, on poorly drained Gleysollic soils.	Wet Meadow in Sask., Wet Meadow in N. Dakota
Saline Wet Meadow	Wet Meadow sites that are moderately to strongly saline.	Saline Wet Meadow in Sask., Saline Lowland in N. Dakota
Shallow Marsh	Wetlands that are normally flooded until July or early August, on very poorly drained Gleysolic soils.	Shallow Marsh in Sask., Shallow Marsh in N. Dakota
Saline Shallow Marsh	Shallow Marsh sites that are moderately to strongly saline.	Saline Shallow Marsh in Sask.
Deep Marsh	Wetlands that are normally flooded throughout the growing season.	Deep Marsh in Sask.
Saline Deep Marsh	Deep Marsh sites that are moderately to strongly saline.	Saline Deep Marsh in Sask.
Fen Peat	Wetlands in which undecomposed plant material accumulates as peat (Organic soils), with nutrient-rich groundwater.	Not classified
Forest Peat	Wetlands in which undecomposed plant material accumulates as peat (Organic soils), with nutrient-poor groundwater.	Not classified
Altered	This modifier can be applied to any of the above sites if the soil profile has been altered as a result of cultivation or other disturbance. Altered soils may have different potential vegetation than unaltered soils, or may take longer to recover to the potential state. Altered sites can be described in the field, but there is no way to map them from available soil survey data.	
Nonproductive	Water, Urban, Bare Soil – excluded from the ecosite classification	

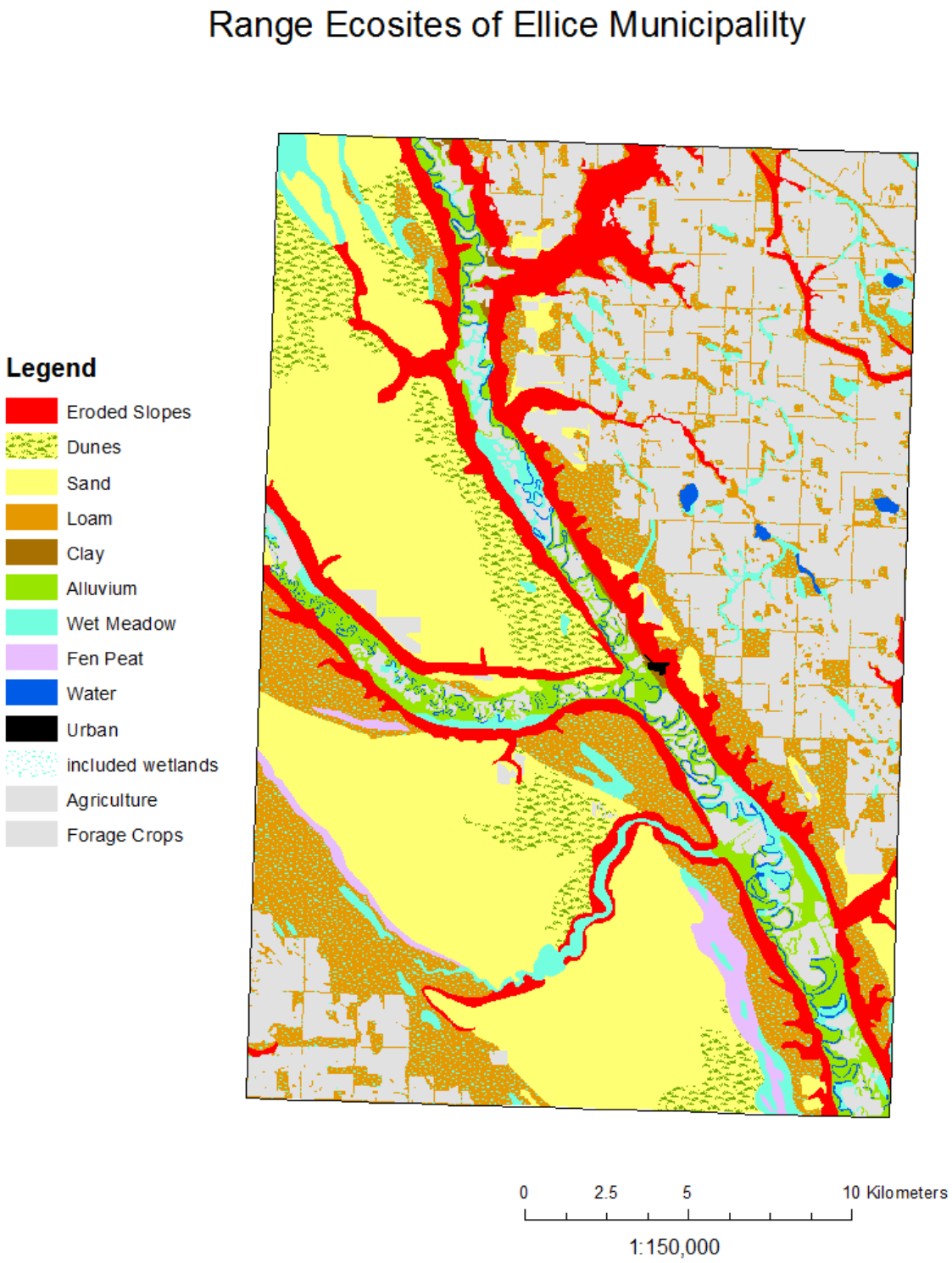

Figure 3 Example of a Rangeland Ecosite map.

3.4 Identifying Rangeland Ecosites

Identification of ecosites is a process that depends on the knowledge and experience of the observer. The following list of steps illustrates the full process using all available information:

- Check the ecosite map (if available) or the soil map and soil survey report for the area.
- Assess the land surface.
- Dig a soil pit and look at the soil profile.
- Determine the texture of the soil.
- Assess the vegetation.
- Apply the above information in the key for identifying Rangeland Ecosites (Table 4).
- Check your answer against the ecosite descriptions in Section 6, to make sure that it is appropriate.

More experienced observers will develop shortcuts, and may not always follow every step. However, everyone will benefit from doing more complete assessments (e.g. digging a soil pit) from time to time to improve their identifications.

The first step in identifying Rangeland Ecosites is to look at the soil map and the accompanying soil survey report for the area. The soils of southern Manitoba have been mapped by the Land Resource Unit of Agriculture and Agri-Food Canada. Soil Survey Reports can be found at http://sis.agr.gc.ca/cansis/publications/surveys/mb/index.html. For each mapped soil, the report will tell you attributes such as:

- Type of soil parent material:
    - Glacial till – material deposited directly from the melting glaciers, usually a mixture of loamy-textured material with rocks
    - Glacio-lacustrine deposits – material deposited in glacial lakes, which can be sandy, loamy or clayey.
    - Glacio-fluvial deposits – material deposited by flowing glacial meltwater, usually sands and gravels
    - Eolian deposits – material deposited by the wind, usually sandy material that has been shaped into dunes
    - Alluvium – material deposited by recent streamflow, usually as floodplains bordering streams
    - Bedrock – exposures of the underlying bedrock material, which can be shale (in western Manitoba), limestone (in the Lake Agassiz basin), or granite (in the Precambrian Shield area in the east).
    - Peat – organic material deposited in wetlands where decomposition is slow.
    - Soil texture, which refers to how coarse or fine the material is, determined by the proportions of sand, silt, and clay particles. The main categories of soil texture, from coarse to fine, are: sand, loamy sand, sandy loam, loam, silt loam, clay loam, clay.
- Type of soil profile which has developed on the parent material:
    - Regosolic soils – soils with little development of horizons, usually on land that has been recently deposited by wind or water.
    - Chernozemic soils – typical grassland soils with a dark-coloured A-horizon. Black Chernozemic soils, with a very dark A-horizon, are the predominant soils in the grassland regions of southern Manitoba. Dark Gray Chernozemic soils,

which show the early stages of the leaching process typical of forest soils, are often found in transitional areas where former grasslands have been invaded by forest.
    - Vertisolic soils – grassland soils formed on heavy clay materials which are physically altered by shrink/swell cycles.
    - Luvisolic soils – typical forest soils with a light-coloured A-horizon from which material has been leached, and a finer-textured B horizon resulting from downward movement of clay.
    - Brunisolic soils – forest soils with more weakly developed soil horizons, usually found on sandy materials.
    - Gleysolic soils – soils formed by prolonged saturation with water.
    - Organic soils – soils of peatlands.
- Soil drainage class, which expresses how quickly water drains from the soil:
    - Rapidly drained – water is removed rapidly, usually on coarse-textured materials, shallow soils, or steep slopes.
    - Well drained – water is removed readily but not rapidly, usually on intermediate-textured soils that are not affected by a water table.
    - Imperfectly drained – water is removed slowly enough to keep the soil wet for a significant part of the growing season, either because the soil texture is very fine or because the soil profile is intermittently affected by the water table.
    - Poorly drained – water is removed so slowly that the soil remains wet for a large part of the growing season
    - Very poorly drained – water is removed so slowly that the water table remains at or above the surface for most of the growing season.

This information can be used to identify the most likely Rangeland Ecosite. The maps shown in Section 3.3 and Appendix C were developed by this approach. If one of these ecosite maps is available, it can be used directly in assessing a piece of land.

However, because soil maps, and the ecosite maps derived from them, are somewhat generalized, the information may not be detailed enough to identify the correct ecosite for the area you are looking at. Soil maps are frequently at scales of around 1:100,000, whereas pasture planning or habitat assessment may require more detailed maps (1:10,000 to 1:20,000). Therefore, field observations and/or interpretation of air photos may be needed to provide more detail. Some landscape features to look for, either on air photos or on the ground, include:

- exposed bedrock
- steep slopes – steepness is measured as a percentage: if the land rises 1 metre over a horizontal distance of 5 metres, the steepness is 20%.
- sand dunes – land surfaces in which sand has been pushed up into hills and ridges by wind action.
- alluvial landforms – land surfaces that have been formed by moving water. These will always occur in lower parts of the landscape, such as valley bottoms. Alluvial landforms include:
    - floodplains – level areas bordering streams that are occasionally flooded during high water
    - alluvial fans and aprons – gently sloping areas at the foot of a steep slope or the mouth of a coulee, formed by soil washed down from the higher land.

- wetlands – areas with visible wetness, or with moisture-dependent plant species such as the taller sedges, rushes, willows, cat-tails, and bulrushes.
- saline areas – usually moist to wet areas with white salt crusts appearing on the soil surface and with salt-tolerant plant species.

After observing the landscape, the next step is to dig a soil pit about 60 cm (2 feet) deep, and study the layers (soil horizons). Soil layers may also be viewed in road-cuts. Consult a soils textbook or seek advice from a soils expert to recognize features in the soil profile. Some of the features that are used in identifying range ecosites include:

- Signs of erosion – e.g. soils where the A-horizon appears to be thinner than normal because topsoil has been removed.
- Type of soil profile – see descriptions of Regosolic, Chernozemic, Vertisolic, Luvisolic, Brunisolic, Gleysolic, and Organic soils above.
- Soil drainage class:
    - Rapidly drained soils are recognized by coarse-textured materials, shallow soils, or steep slopes.
    - Well-drained soils are usually intermediate in soil texture, and have the typical features of upland soils (e.g. Chernozemic soil profiles in grassland regions, Luvisolic or Brunisolic soil profiles in forest regions), without mottling or gleying.
    - Imperfectly drained soils usually have the features of upland soil profiles, but have faint to distinct mottling within 50 cm of the surface (e.g. Gleyed Chernozems, Gleyed Luvisols).
    - Poorly drained soils have dull gray colours or prominent mottles (Gleysols), or show accumulation of peat (Organic soils).
    - Very poorly drained soils are recognized by extreme wetness and/or a visible water table.
- Soil texture of the various horizons - Determining soil texture in the field is a skill that requires training and practice. However, Table 3 gives a key that should lead to approximately the correct texture class. To use this key, take a handful of soil from the profile, and add water to form a moist ball that can be worked in the hand. Try to form the moist soil into a ribbon. Add more water and rub the wet soil between the fingers to determine how it feels: a gritty feel indicates sand; a smooth, soapy feel indicates silt; and a sticky feel indicates clay.

The final step is to examine the vegetation. Many plant species are closely linked to particular ecosites. For example, sand grass, sand dropseed, and sand bluestem are indicators of sandy sites. Tall sedges, rushes, cat-tails, and bulrushes are indicators of wet sites. Salt grass, Nuttall's alkali grass, and certain bulrush species are indicators of saline sites. The ecosite descriptions (Section 6) give more detail about the plants to be expected on each ecosite.

Table 3 Key for determining soil texture by hand (modified from Thien 1979).

1 soil does not form a ball	sand
1 soil forms a ball	
2 soil does not form a ribbon	loamy sand
2 soil forms a weak ribbon less than 2.5 cm long before breaking	
3 soil feels very gritty	sandy loam
3 soil feels very smooth	silt loam
3 neither grittiness nor smoothness predominates	loam
2 soil forms a medium ribbon 2.5 to 5 cm long before breaking	
4 soil feels very gritty	sandy clay loam
4 soil feels very smooth	silty clay loam
4 neither grittiness nor smoothness predominates	clay loam
2 soil forms a strong ribbon 5 cm or longer before breaking	
5 soil feels very gritty	sandy clay
5 soil feels very smooth	silty clay
5 neither grittiness nor smoothness predominates	clay

Once you have read the soil map, observed the landscape, dug a soil pit, and noted the plant indicators, you have the information you need to identify the Rangeland Ecosite. A key for this purpose is provided in Table 4. The key is based on a series of two-way choices. For example, the first choice is between “exposed bedrock” and “not exposed bedrock”. The key shows the logical order in which the various pieces of information are used. For example, sites on steep slopes are normally placed in the Eroded Slopes Ecosite. However, steep slopes on sand are placed in the Dunes Ecosite, because this decision comes earlier in the key.

Table 4 Key for identifying Rangeland Ecosites.

Note that areas without vegetation, including water, bare soil, and urban/industrial areas, are not included.

- Exposed bedrock:
  - Exposures of granitic or other acidic rock: **Precambrian Bedrock**
  - Exposures of limestone: **Shallow to Limestone**
- Not exposed bedrock:
  - Uplands (rapidly, well or imperfectly drained):
    - Saline areas as shown by white salt crusts or presence of salt-tolerant plant species: **Moist Saline**
    - Not saline:
      - Alluvial deposits along floodplains of streams: **Alluvium**
      - Not alluvial:
        - Slopes of major valleys (usually mapped as Eroded Slopes): **Eroded Slopes**
        - Not valley slopes:
          - Less than 50 cm of soil over limestone bedrock: **Shallow to Limestone**
          - Not shallow to limestone:
            - Coarse-textured materials (sand, loamy sand, gravelly sand):
              - Steeply sloping because of wind action: **Dunes**
              - Level to undulating, not shaped into dunes:
                - Rapidly to well drained: **Sand**
                - Imperfectly drained: **Moist Sand**
            - Not coarse-textured:
              - Slopes steep enough (e.g. >30%) to show high natural levels of water erosion: **Eroded Slopes**
              - Not steep slopes:
                - Materials with sandy loam texture:
                  - Well drained: **Sandy Loam**
                  - Imperfectly drained: **Moist Sand**
                - Materials with loam, silt loam or clay loam texture:
                  - Well drained:
                    - Highly to extremely calcareous (as described in the soil report for the area): **Calcareous Loam**
                    - Less calcareous: **Loam**
                  - Imperfectly drained: **Moist Loam**
                - Materials with clay texture: **Clay**

Table 4 (continued)

Wetlands (poorly or very poorly drained, with Gleysolic or Organic soils):
- More than 40 cm of peat accumulation (Organic soils):
  - Vegetation consisting of sedges, willows, swamp birch, tamarack: **Fen Peat**
  - Vegetation consisting of *Sphagnum* moss, heath shrubs, black spruce: **Forest Peat**
- Mineral wetlands (less than 40 cm of peat accumulation):
  - Wetlands that are normally flooded for 3-4 weeks in spring, usually with diverse communities of grasses, sedges, and forbs, sometimes with tall willows:
    - Saline as shown by white salt-crusts or presence of salt-tolerant plant species: **Saline Wet Meadow**
    - Non-saline: **Wet Meadow**
  - Wetlands that are normally flooded until July or early August, usually with simpler communities of intermediate-sized sedges and grasses:
    - Saline as shown by white salt-crusts or presence of salt-tolerant plant species: **Saline Shallow Marsh**
    - Non-saline: **Shallow Marsh**
  - Wetlands that are normally flooded throughout the growing season, usually with a few species of tall graminoids (cat-tails, bulrushes, giant reed-grass):
    - Saline as shown by white salt-crusts or presence of salt-tolerant plant species: **Saline Deep Marsh**
    - Non-saline: **Deep Marsh**

The process described above will usually identify the correct ecosite. However, the final step is to compare your answer to the descriptions of Rangeland Ecosites in Section 6. If it does not fit with the description, check some of the other ecosites to see if the description is closer to what you are observing.

4 Potential plant communities

4.1 Background

After ecoregions and ecosites are defined, the next level of the classification is the plant community. This level addresses the variation that results from differences in history. On a single ecosite and ecoregion, some areas will be lightly grazed and others heavily grazed. Some areas will be completely protected from fire, while others will be burned. Some areas will be invaded by exotic plants, whereas others will escape invasion. All of these differences in history can result in different plant communities.

The current approach in range science is to represent these differences by "state-and-transition" diagrams. In an example from the Saskatchewan classification (Figure 4), rough fescue grasslands are altered to a series of other communities by sustained heavy grazing. Absence of fire may shift the entire system from grassland to shrubland. Exotic invasion may shift the system in a different direction, depending on which exotic species is involved. In this example, the community at the top of the diagram, "Plains Rough Fescue – Northern Wheat Grass –

Western Porcupine Grass" is considered to be the "potential" or "reference" community. This is usually assumed to be the community that develops under lightly grazed, uninvaded conditions.

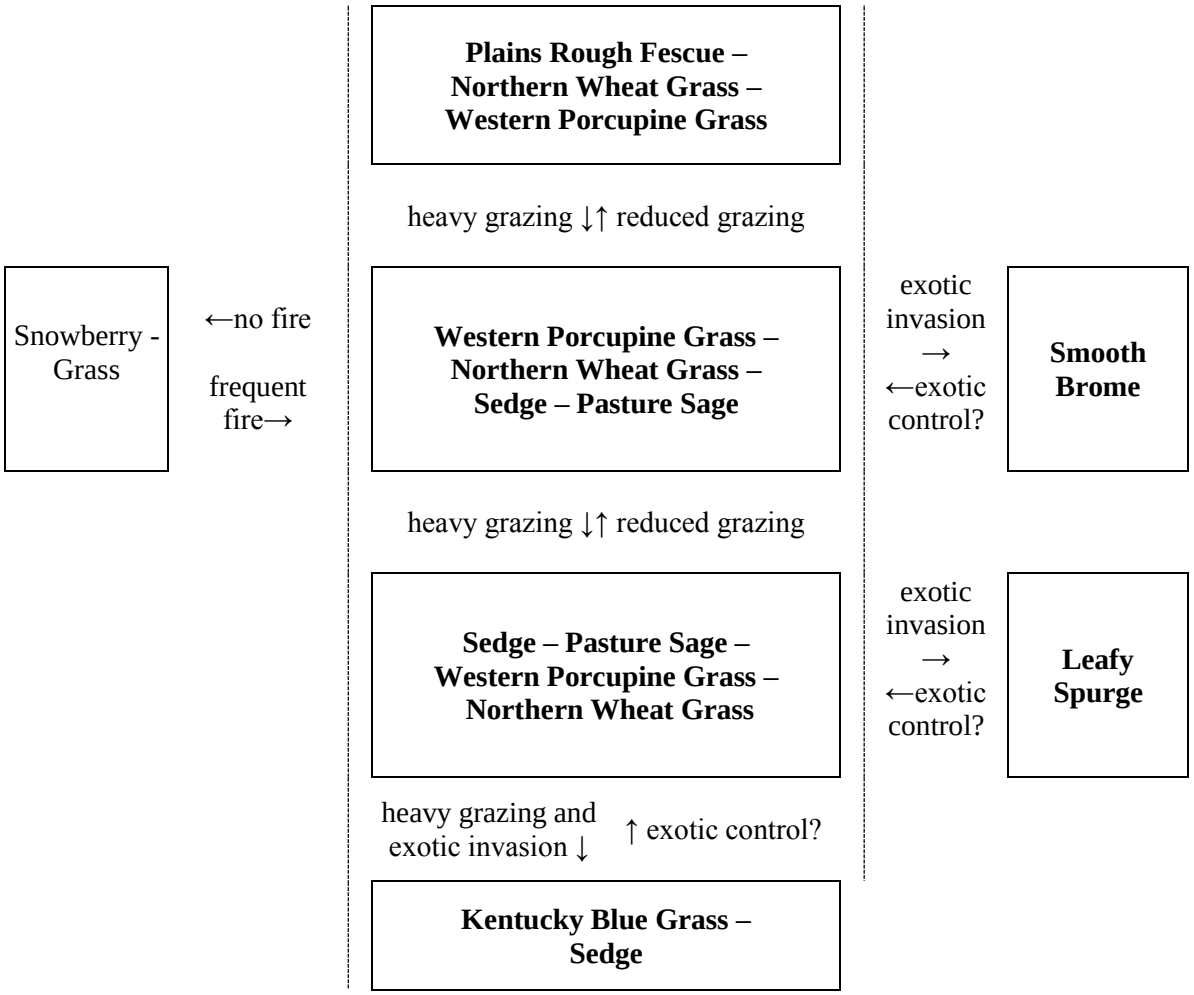

Figure 4 State-and-transition diagram for the Loam Ecosite in the Aspen Parkland of Saskatchewan (after Thorpe 2007d).

Potential plant communities play an important role in rangeland assessment. In assessing a piece of rangeland, we determine the community that is there now, and compare it with the potential community for the ecosite. The difference between the two shows how much alteration has occurred as a result of grazing impact or other factors. The potential plant community also provides a target for improvements in management, or for restoration in the case of systems that have been completely altered (e.g. industrial sites).

A complete community classification, as developed for the neighbouring provinces and states, was outside of the scope of the current work (2013-2014). According to the long-range plan for the Manitoba rangeland project, this classification will be completed in a later phase of the project. However, preliminary community analysis has been done to provide "first-draft" assessments of the potential grassland communities for the various ecoregions and ecosites, if enough information was available. Classification of altered grassland communities, including

those dominated by exotic species, and classification of shrubland and forest communities, will have to be addressed later.

The analysis of potential grassland communities used three main sources of information (details are in Appendix D):

- Existing ecosystem classifications for the neighbouring provinces and states
- Local vegetation data from PFRA Pasture monitoring, the Manitoba Rangeland Benchmarking project, Tall Grass Prairie Preserve monitoring, Wildlife Management Area descriptions, and other sources
- Published scientific literature related to Manitoba vegetation

Identifying potential communities for agri-Manitoba presents a number of challenges. This is the part of the Canadian prairies that has been settled the longest. Most of the landscape has been converted to arable agriculture. The remaining natural ecosystems have been subject to a relatively long period of livestock grazing, and in some cases to episodes of cultivation followed by recolonization by perennial plants. The relatively moist climate favoured woody encroachment on grasslands, once prairie fires had been eliminated. The climate also favoured invasion by several aggressive exotic species, including Kentucky bluegrass, smooth brome, redtop, and leafy spurge.

Apart from these processes of human disturbance, this area may be confusing because of natural transitions. Coupland and Brayshaw (1953), in a study of the rough fescue grasslands that characterize the aspen parkland region in most of Saskatchewan and Alberta, found that the southeastern part of the region (i.e. eastern Saskatchewan and western Manitoba) shows a patchwork of fescue prairie, mixed prairie, and areas with some tallgrass prairie species. They considered this part of the parkland to be an ecotone or transition zone between the fescue grassland to the northwest and the tallgrass prairie to the southeast.

Potential grassland communities are included in the Rangeland Ecosite descriptions in Section 5. Because of the factors discussed above, uncertainty is identified in many of these descriptions. For example, some of the communities appear to be somewhat altered, based on the abundance of exotic or increaser species, but they are shown because they are closer to potential composition than any other communities in the available data.

5 Productivity

One of the main uses of ecosite classification in an agricultural context is to provide guidance for setting of appropriate stocking rates. Stocking rates depend directly on the productivity of rangeland. Range ecosites that provide abundant moisture and nutrients to growing plants support higher levels of forage production than ecosites in which these resources are more limited.

Primary data on the productivity of Manitoba rangelands was provided by the Manitoba Forage Benchmarking Project led by Manitoba Agriculture, Food and Rural Initiatives. In this project, three study areas were established in each of four regions of the province. At each study area, plots were laid out in upland grassland, transitional grassland, lowland grassland, open woodland, and dense woodland. Exclosure cages were used at each plot to prevent current-year defoliation. Forage yield was clipped in the cages to measure the annual production. At most plots, measurements were made over seven years, from 2004 to 2010 inclusive. Species

composition was also inventoried at the beginning and end of the project. Data on production and species composition in the benchmarking plots were provided by Mae Elsinger (Agriculture and Agri-Food Canada).

Benchmark plots (excluding the woodland types) were assigned to the ecoregions and ecosites used in the rangeland classification (Table 5). The four original clusters of study areas fell into four ecoregions (Table 5). Ecosite assignments were based on soil profile descriptions available for some of the plots, and on comparison of the species composition to general trends observed in the community analysis (Section 4). Only one of the upland plots was described as well drained, the Brandon Hills upland plot on Sandy Loam. The other upland plots were imperfectly drained according to the soil descriptions, so were assigned to Moist Sand, Moist Loam, or Clay ecosite, depending on the soil texture. Half of the transitional plots fell into Moist Sand or Moist Loam, whereas half were assigned to Wet Meadow, based on differences in species composition. The lowland plots all fell into Wet Meadow.

Table 5 Manitoba Forage Benchmarking plots on grassland types, in relation to the rangeland classification.

Ecoregion	Study Area	Position	Ecosite	Average Yield (lb/ac)
Aspen Parkland	Brandon Hills	Upland	Sandy Loam	1,966
Aspen Parkland	Brandon Hills	Transition	Moist Sand	3,847
Aspen Parkland	Ebor	Lowland	Wet Meadow	3,877
Aspen Parkland	Ebor	Upland	Moist Loam	2,937
Aspen Parkland	Ebor	Transition	Moist Loam	2,568
Aspen Parkland	Oak Lake	Lowland	Wet Meadow	2,805
Aspen Parkland	Oak Lake	Upland	Moist Sand	2,227
Aspen Parkland	Oak Lake	Transition	Moist Sand	1,672
Aspen/Oak Parkland	Alice Cooper McGregor	Lowland	Wet Meadow	3,075
Aspen/Oak Parkland	Alice Cooper McGregor	Upland	Moist Sand	1,274
Aspen/Oak Parkland	Alice Cooper McGregor	Transition	Moist Sand	1,732
Aspen/Oak Parkland	Beehive McGregor	Lowland	Wet Meadow	3,382
Aspen/Oak Parkland	Beehive McGregor	Upland	Moist Sand	1,904
Aspen/Oak Parkland	Beehive McGregor	Transition	Moist Sand	2,119
Aspen/Oak Parkland	Plumas	Lowland	Wet Meadow	2,664
Aspen/Oak Parkland	Plumas	Upland	Moist Loam	2,126
Aspen/Oak Parkland	Plumas	Transition	Wet Meadow	2,521
Interlake Plain	Garson	Lowland	Wet Meadow	3,911
Interlake Plain	Garson	Upland	Moist Clay	2,725
Interlake Plain	Garson	Transition	Wet Meadow	2,181
Interlake Plain	Meharry	Lowland	Wet Meadow	4,611
Interlake Plain	Meharry	Upland	Moist Loam	2,335
Interlake Plain	Meharry	Transition	Wet Meadow	3,268
Interlake Plain	Selina	Lowland	Wet Meadow	2,015

Table 5 (continued)

Ecoregion	Study Area	Position	Ecosite	Average Yield (lb/ac)
Interlake Plain	Selina	Upland	Moist Sand	1,343
Interlake Plain	Selina	Transition	Wet Meadow	2,745
Lake of the Woods	East Braintree	Lowland	Wet Meadow	2,543
Lake of the Woods	East Braintree	Upland	Moist Sand	1,663
Lake of the Woods	East Braintree	Transition	Moist Sand	1,405
Lake of the Woods	Lac du Bonnet	Lowland	Wet Meadow	5,233
Lake of the Woods	Lac du Bonnet	Upland	Moist Clay	2,759
Lake of the Woods	Lac du Bonnet	Transition	Wet Meadow	4,685
Lake of the Woods	Sprague	Lowland	Wet Meadow	1,924
Lake of the Woods	Sprague	Upland	Moist Sand	1,948
Lake of the Woods	Sprague	Transition	Wet Meadow	1,832

Analysis of variance showed a significant effect of ecosite on yield, but no significant effect of ecoregion. Therefore, yields were averaged by ecosite (Table 6).

Yield can be used to estimate grazing capacity, defined as the level of stocking that the rangeland can sustain without degradation. Alberta's method for estimating grazing capacity from forage yield is as follows (ASRD 2004):

Grazing capacity in AUM/ac = (yield in lb/ac * utilization rate) / 1,000

Division by 1,000 implies that 1,000 pounds of forage are required to support one AUM. In the Alberta method, utilization rates can vary from 25% to 50%. Applying this calculation to the yields in Table 6, with a utilization level of 35%, results in grazing capacity values that appear appropriate in relation to those recommended for comparable sites in Saskatchewan and North Dakota, and in relation to the actual stocking recorded in Manitoba PFRA pastures. Grazing capacities for other ecosites were estimated in relation to those determined for the five ecosites in Table 6, using the North Dakota ratings (Sedivec and Printz 2012) as a guide to the productivity trends among ecosites. Grazing capacity estimates appear in the ecosite descriptions in Section 6.

Table 6 Average forage yield and grazing capacity for native grassland on five ecosites, based on the Manitoba Forage Benchmarking plots.

Ecosite	Yield (lb/ac)	Grazing Capacity (AUM/ac)
Sandy Loam (n=1)	1,966	0.69
Moist Sand (n=11)	1,921	0.67
Moist Loam (n=4)	2,492	0.87
Moist Clay (n=2)	2,742	0.96
Wet Meadow (n=17)	3,134	1.10

These grazing capacity values provide an initial estimate of the sustainable stocking rate for a grazing unit, particularly if all of the unit is made up of upland grassland in reasonably good condition. Total stocking in Animal Unit Months can be determined by multiplying the grazing capacity by the area of the unit. However, in many situations, other factors must also be taken into account. The grazing unit may include a mix of ecosites and cover types. Forested areas will generally have lower grazing capacity than grassland areas. Wet meadows will have higher grazing capacity, but because cattle prefer the upland grasslands, they can over-graze the uplands before making use of the forage available in the meadows. For these reasons, it may be necessary to base stocking rates on the area of the preferred cover type or ecosite, rather than on the total area. If plant communities have been degraded by past over-grazing, it may be necessary to reduce stocking rates or even remove livestock altogether to allow for recovery. The best approach to setting stocking rates is to keep good records of the historic stocking in each grazing unit, and regularly monitor the health of key areas. If good health is maintained, then historic stocking rates are appropriate, whereas a declining trend in rangeland health indicates that stocking rates should be reduced.

6 Descriptions of Rangeland Ecosites and Potential Grassland Communities

The ecosites identified in Section 4 are described below, in terms of their general landscape and soil characteristics. Soil series that correspond to each ecosite are listed.

Approximate grazing capacity values are given for each ecosite. However users are reminded that these provide only initial estimates of the stocking rates for particular grazing units, and other factors should also be considered, such as the mix of cover types and ecosites, and the need for recovery from past over-grazing (see discussion in Section 5).

Potential grassland communities on the ecosite are shown separately by ecoregion. Potential communities are those that would develop under light grazing and no invasion by exotic species (see discussion in Section 4.1). The potential communities shown are those which were judged to be best supported by available information. Community types derived from analysis of local species composition data were preferred, but if the local data were sparse, a community type from an existing classification was substituted. Uncertainty about successional status is identified in many of these descriptions. Some of the communities appear to be somewhat altered (i.e. not the true potential community), based on the abundance of exotic or increaser species, but they are shown because they are closer to potential composition than any other communities in the available data. Because of the variation in methods among these sources, no species quantities are shown, but the dominant plant species are listed in downward order of abundance. Only common names are shown here; for scientific names see Appendix B.

Precambrian Bedrock Ecosite

Ecosite Description
The Precambrian Bedrock Ecosite includes areas with exposed granite or other acidic bedrock. The ecosite may include thin deposits of loamy or clayey material over bedrock. This ecosite is restricted to the Lake of the Woods Ecoregion, the only part of agri-Manitoba that is underlain by the Precambrian Shield. The natural vegetation usually consists of boreal forest.

On the soil maps, these areas are mapped as Acidic Bedrock.

Approximate grazing capacity: 0.3 AUM/acre, varying with soil depth and amount of exposed rock.

Ecoregion	Potential Grassland Community	Comments
Lake of the Woods	Not described	No information found

Shallow to Limestone Ecosite

Ecosite Description
The Shallow to Limestone Ecosite includes areas with exposed limestone or other calcareous bedrock, or with shallow soils (approximately <50 cm) over limestone. This ecosite is mainly found in the Interlake Plain, an area of relatively shallow till over limestone bedrock. It is an extreme environment for plant growth, because the thin soil can be saturated with water in the spring, but totally dried out in summer. The area of this Ecosite is relatively small, but it supports a distinctive plant community referred to as "alvar", which is considered to be restricted to areas with less than 10 cm of soil over bedrock.

On the soil maps, areas of exposed limestone are mapped as Carbonate Bedrock. Shallow soils over limestone include Alonsa, Faulkner, Hilbre, Narcisse, Stonewall, and Sandridge soils.

Approximate grazing capacity: 0.3 AUM/ac, varying with soil depth and the amount of exposed rock.

Ecoregion	Potential Grassland Community	Comments
Interlake Plain	**Poverty oatgrass** **Porter's brome** **Awned wheatgrass** **Annual bluegrass** **June grass** **Abundant moss and lichen cover** (Alvar Grassland, Neufeld et al. 2012)	The community type shown here was described for alvars, which are the most extreme parts of this Ecosite. Areas with somewhat deeper soil would be expected to have more of the taller grasses (e.g. big bluestem). Shrublands with creeping juniper, bearberry, swamp birch, and shrubby cinquefoil are common.
Other ecoregions	Not described	This ecosite is uncommon in regions other than the Interlake Plain

Eroded Slopes Ecosite

Ecosite Description
The Eroded Slopes Ecosite mainly consists of steep valley slopes, along major rivers as well as smaller tributary streams and ravines. The largest areas of this ecosite are found in the more elevated land west of the Manitoba Escarpment. Eroded Slopes tend to have high natural rates of water erosion resulting in thin soil profiles. Eroded Slopes are usually relatively dry because of rapid drainage, but steep north-facing slopes may be relatively moist because of the cool microclimate. There are also zones of seepage where the slope intersects the water table. The vegetation varies from native prairie on dry slopes to woodland on moist slopes and seepage areas.

The Eroded Slopes Ecosite corresponds closely with the Eroded Slope Complex on soil maps. Due to the complexity of this landscape, soils may range from Chernozems to Regosols. Small areas of steep slopes in a variety of other soil types are also included in this ecosite.

Approximate grazing capacity: usually low because of inaccessibility to grazers

Ecoregion	**Potential Grassland Community**	**Comments**
Aspen Parkland	**Little bluestem** **Big bluestem** **Prairie muhly** **Blue grama** (data from Cowessess inventory, n=5)	The community shown here is based on a limited amount of data, and could be modified with further work. Some data from WMAs in Manitoba show rough fescue grassland on Eroded Slopes. The NRCS 55B Thin Loamy site in North Dakota also shows porcupine grass, needle-and-thread, and green needle grass.
Tall Grass Prairie	**Little bluestem** **Porcupine grass** **Big bluestem** **Prairie dropseed** **Side-oats grama** **Indian grass** **Prairie muhly** **Sun-loving sedge** **June grass** **Leiberg's panicum** (Dry Prairie Hill, Minnesota DNR 1993)	This community type was described for similar sites in tall grass prairie in Minnesota.
Other ecoregions	Not described	No information found for other ecoregions.

Dunes Ecosite

Ecosite Description
The Dunes Ecosite includes sands that have been shaped into distinctive hills and ridges by wind movement. This reshaping occurred when the sands were mostly bare, but most dunes have since been stabilized by vegetation. However, there are still small areas of bare, active dunes. Because the sand material has low water-holding capacity, elevated dunes are dry habitats, but the water table tends to be high, providing extra moisture to deep-rooted vegetation on lower slopes and inter-dune flats.

Because of the complexity of the dune landscape, the vegetation is a mosaic of cover types (grassland, shrubland, woodland) associated with aspect, slope position, depth to the water table, and fire history. In some areas such as the Assiniboine Delta, boreal conifers such as white spruce and jack pine extend farther south into the Prairie Ecozone on Dunes than on adjacent areas of other ecosites.

The largest areas of Dunes Ecosite are found in the Aspen Parkland and Assiniboine Delta Ecoregions. On soil maps, the Dunes Ecosite is mapped as:

- Regosols on eolian materails (e.g. Shilox, Grande-Clairière, Skelding)
- Chernozems on sandy lacustrine or beach deposits, where slopes are steep enough to indicate dunes (e.g. Stockton, Dobbin, Davidson)
- Brunisols on sandy outwash, where slopes are steep enough to indicate dunes (e.g. Sandilands)

Approximate grazing capacity: 0.4 AUM/acre

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Sedges** **Western porcupine grass** **Sand grass** **June grass** **Needle-and-thread** (PFRA data, n=4)	The community shown here is based on limited data and could be modified with further work. Sedges may not be as abundant in communities with less grazing impact. The NRCS 55B Choppy Sands site in North Dakota also shows sand bluestem and little bluestem.
Assiniboine Delta	**Little bluestem** **June grass** **Big bluestem** **Sand grass** **Creeping juniper** (CFB Shilo, Shay et al. 2000)	Less stabilized areas may also have Indian ricegrass, sand dropseed, and Canada wild-rye. Ward (1980) also shows porcupine grass and blue grama on Stabilized Sandhill Prairie. The Whitemud Watershed WMA shows an ungrazed transect dominated by sedges, little bluestem and blue grama. The NRCS 55B Choppy Sands site in North Dakota also shows sand bluestem and needle-and-thread.
Aspen/Oak Parkland	**Not described**	The general pattern of vegetation on Dunes in the Portage Sandhills WMA is similar to that in the Assiniboine Delta.
Other ecoregions	Not described	No information found.

Sand Ecosite

Ecosite Description

The Sand Ecosite includes sands that have not been shaped into dunes. It usually occurs as level to undulating plains. However, areas of very low dunes (less than 1 metre of vertical relief, less than 5% slopes) are usually considered to belong in the Sand Ecosite rather than the Dunes Ecosite. Sands were deposited on the beds of glacial lakes, or on deltas where meltwater streams flowed into those lakes. The Sand Ecosite is generally stable, and mature upland soils such as Chernozems and Luvisols have developed. However, there may be small wind-eroded patches.

The Sand Ecosite as used here has been expanded to include some areas with gravelly materials, which were deposited by glacial streams or as beach ridges. These gravelly materials are usually in a complex mixture with sand materials, making them difficult to separate. If more detailed work in the future identifies mappable areas of gravel with vegetation that is distinctive from that on sand, then they could be separated as a Gravelly Ecosite.

The Sand Ecosite includes areas rated as rapidly drained to well drained. Because of the low water-holding capacity of the coarse-textured material, it tends to be a drier habitat than loamy or clayey materials. Sands that are imperfectly drained because of the influence of a high water table are separated as Moist Sand (see below).

On soil maps, the Sand Ecosite is mapped as:

- Black Chernozems of grassland regions (e.g. Agassiz, Bede, Birkenhead, Broomhill, Chater, Chaucer, Croyon, Dorset, East Bay, Eastbank, Gilbert, Hallboro, Marringhurst, Miniota, Seech, Stanton, Stockton, Wheatland).
- Dark Gray Chernozems of transitional regions (e.g. Davidson, Dobbin, Gunton, Leary, Vandal)
- Gray Luvisols of forest regions (e.g. St. Labre, Woodridge, Zaparosa)
- Brunisols of forest regions (e.g. Pine Ridge, Sandilands)
- Regosols on eolian materials where the slope steepness is too low to place them in Dunes Ecosite (e.g. Shilox, Grande-Clairière, Skelding)

Approximate grazing capacity: 0.5 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Porcupine grass** **Western porcupine grass** **Blue grama** **Sedges** (PFRA data, n=18)	A few areas dominated by plains rough fescue have been recorded on Sand/ Sandy Loam. Local ecologists think that the porcupine grass community shown here could succeed to a fescue community with protection from grazing, but more evidence is needed. The NRCS 55B Sands site also shows sand grass, big bluestem and sand bluestem.

Assiniboine Delta	**Sedges** **Porcupine grass** **Blue grama** **Big bluestem** **June grass** (Spruce Woods, Higgs and Holland 1999, n=12)	This community type is from inventory of prairie in Spruce Woods Prov. Park. It is not known how close this community is to the potential, but sedges, blue grama, and june grass could be less abundant in sites with lower grazing impact. The NRCS 55B Sands site in North Dakota also shows sand grass and sand bluestem.
Aspen/Oak Parkland	**Little bluestem** **Porcupine grass** **Sedges** **Kentucky bluegrass** **Plains rough fescue** (PFRA data, n=3)	This community is based on a small amount of data, and could be modified with further work. Less disturbed areas would have less Kentucky bluegrass.
Tall Grass Prairie	**Little bluestem** **Porcupine grass** **Big bluestem** **Blue grama** **Prairie dropseed** **Side-oats grama** **Hairy grama** **Prairie muhly** **Sun-loving sedge** **June grass** (Dry Prairie Sand-Gravel, Minnesota DNR 1993)	This community type is described from tall grass prairie in Minnesota. A few plots on this ecosite in Manitoba show dominance by big bluestem and Indian grass. The NRCS 56X Sands site in North Dakota also shows sand bluestem and sand grass.
Other ecoregions	Not described	No data available

Sandy Loam Ecosite

Ecosite Description
The Sandy Loam Ecosite includes stable, well-drained upland sites on soil materials with sandy loam texture. These materials were usually deposited on the beds of glacial lakes. They are relatively coarse-textured, but they have higher clay content that Sand Ecosite, so their water-holding capacity is intermediate between Sand and Loam. Imperfectly drained sandy loams are included in **Moist Sandy**.

The Sandy Loam Ecosite occupies relatively small areas of rangeland in Manitoba. On soil maps, the Sandy Loam Ecosite is mapped as:

- Black Chernozems of grassland regions (e.g. Hibsin, Hochfeld, Langvale, Lyleton, Maon)
- Dark Gray Chernozems of transitional regions (e.g. Durban, Halstead, Morton, St. Malo)
- Gray Luvisols of forest regions (e.g. Crestview, Arthur)
- Brunisols of forest regions (e.g. Nora Lake, Armit)

Approximate grazing capacity: 0.6 AUM/ac

Ecoregion	**Potential Grassland Community**	**Comments**
Aspen Parkland	**Porcupine grass** **Western porcupine grass** **Blue grama** **Sedges** (PFRA data, n=18)	A few areas dominated by plains rough fescue have been recorded on Sand/ Sandy Loam. Local ecologists think that the porcupine grass community shown here could succeed to a fescue community with protection from grazing, but more evidence is needed. Also, one area dominated by big bluestem has been recorded. The NRCS 55B Sandy site in North Dakota also shows sand grass, big bluestem and needle-and-thread.
Other ecoregions	Not described	No information found

Moist Sand Ecosite

Ecosite Description

The Moist Sand Ecosite includes imperfectly drained sites on coarse to moderately coarse-textured materials (gravel, sand, sandy loam). These have the soil profiles of upland soils such as Chernozems or Luvisols, but have abundant mottling which shows the influence of a fluctuating water table. In some landscapes, these sites occur on intermediate slope positions, between the well-drained sites on ridges and the poorly drained sites in depressions. In such complexes, Moist Sand may be the most areally extensive of the ecosites, so would be shown as the dominant ecosite on maps. In dune landscapes, the flats between dunes will often be Moist Sand because they are influenced by the high water table. These sites tend to show an intermingling of upland grasses with lowland species such as sedges.

On soil maps, the Moist Sand Ecosite is mapped as:

- Gleyed Black Chernozems of grassland regions (e.g. Almasippi, Colby, Garrioch, Glenella, Glenhope, Kronstal, Lauder, Laurier, Lenswood, Napinka, Plum Ridge, Reinland, Sevick, Souris, Swanford, Switzer, Willowcrest)
- Gleyed Dark Gray Chernozems of transitional regions (e.g. Beaverdam Lake, Kergwenan, Pelan, Poppleton)
- Gleyed Luvisols of forest regions (e.g. Caliento, Hadashville, Selina, Sirko, Vita, Wampum, Wintergreen)
- Gleyed Brunisols of forest regions (e.g. Lonesand, Pansy)
- Gleyed Regosols (e.g. Long Plain, Onahan)

Approximate grazing capacity: 0.7 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Kentucky bluegrass** **Tufted hairgrass** **Big bluestem** **Sedges** (Manitoba Benchmark data, n=2)	This community is based on a small amount of data, and could be modified with further work. Dominance by the exotic Kentucky bluegrass would not be expected in the potential community, but because of the abundance of this species on moist sites, reference areas with completely natural composition may be hard to find. The Low Prairie type described by Stewart and Kantrud (1972) in North Dakota is dominated by Kentucky bluegrass and slender wheatgrass.
Aspen/Oak Parkland	**Sedges** **Kentucky bluegrass** **Fowl bluegrass** **Northern reedgrass** **Horsetail** **Prairie cordgrass** (PFRA data, n=4)	This community is based on a small amount of data, and may be modified with further work. Less disturbed areas may have lower abundance of Kentucky bluegrass, although it is currently very abundant on this site.

Tall Grass Prairie	**Big bluestem** **Sedges** **Northern reedgrass** **Baltic rush** (data from PFRA and TGPP inventory, n=4)	This community is based on a small amount of data, but the Minnesota classification for tall grass prairie shows a similar "Northern Wet Prairie" type, with additional dominant species including mat muhly, prairie cordgrass, and tufted hairgrass.
Interlake Plain	Not described	No information found
Lake of the Woods		

Loam Ecosite

Ecosite Description

The Loam Ecosite includes stable, well-drained upland sites on materials with loam, silt loam, or clay loam texture. These may be found on moraines (glacial till deposited directly from the melting ice), or on medium-textured glacial lake basin deposits. Loam would be the most widespread upland ecosite, but in Manitoba most of it has been converted to cropland. The Loam Ecosite can be considered the modal or average site type, neither excessively dry nor excessively wet. Imperfectly drained soils on loamy materials are included in **Moist Loam** (see below).

On soil maps, the Loam Ecosite is mapped as:

- Black Chernozems of grassland regions (e.g. Cameron, Carroll, Clementi, Darlingford, Dutton, Fairland, Hathaway, Jaymar, Kenville, Knudson, Lenore, Manitou, Newdale, Newstead, Ramada, Ryerson, Timberton, Waskada, Wellwood)
- Dark Gray Chernozems of transitional regions (e.g. Altamont, Erickson, Firdale, Horton)
- Gray Luvisols of forest regions (e.g. Carrick, Grifton, Rackham, Waitville)

Approximate grazing capacity: 0.8 AUM/ac

Ecoregion	**Potential Grassland Community**	**Comments**
Aspen Parkland	**Porcupine grass &** **western porcupine grass** **Awned wheatgrass** **Green needle grass** **Sedges** (data from Alameda inventory, n=20)	A few areas dominated by plains rough fescue have been recorded. Local ecologists think that the porcupine grass community shown here could succeed to fescue grassland with protection, but more evidence is needed. The Saskatchewan classification shows a rough fescue community as the potential for this site. The NRCS 55b Loamy site in North Dakota also shows big bluestem and western wheatgrass.
Tall Grass Prairie	**Big bluestem** **Prairie dropseed** (data from TGPP inventory, n=5)	This community is based on a small amount of data, but the classification for tall grass prairie in Minnesota shows a similar "Northern Mesic Prairie" type, with additional dominant species including little bluestem, Indian grass, mat muhly, prairie cordgrass, June grass, and slender wheatgrass.

Interlake Plain	**Porcupine grass** **Sedges** **Timber oatgrass** **Plains rough fescue** (PFRA data, n=2)	This community is based on a small amount of data. Sedges may be less abundant in areas with less grazing impact, and big bluestem may be abundant in some areas. One area dominated by plains rough fescue has been recorded, and it is possible that the long-term trend under protection would be to fescue grassland.
Other ecoregions	Not described	No information found

Calcareous Loam Ecosite

Ecosite Description

Loam sites on highly to extremely calcareous glacial tills are distinguished as Calcareous Loam. These are found in areas where the glacial till is derived from limestone. Most of the loam sites in and near to the Interlake region are Calcareous Loam, whereas the loam sites further west in the Aspen Parkland are less calcareous.

Calcareous Loam may be deficient in available phosphorus compared to Loam Ecosite, because of somewhat lower amounts of phosphorus-containing minerals in the parent material and the complexing of plant-available phosphorus by calcium, resulting in lower forage yield and nutritional quality. Forages grown on highly calcareous soils, especially those that are somewhat wetter, are often deficient in copper, zinc and other micronutrients.

On soil maps, the Calcareous Loam Ecosite is mapped as:

- Black Chernozems of grassland regions (e.g. Hilton, Isafold, Meharry)
- Dark Gray Chernozems of transitional regions (e.g. Aneda, Dezwood, Rose Ridge, Tiger Hills)

Approximate grazing capacity: 0.7 AUM/ac

Ecoregion	**Potential Grassland Community**	**Comments**
All ecoregions	Not described	No information found

Moist Loam Ecosite

Ecosite Description
The Moist Loam Ecosite includes imperfectly drained sites on materials with loam, silt loam, or clay loam textures. These have soil profiles similar to other upland soils (e.g. Chernozems, Luvisols), but have abundant mottling in the lower part of the profile under the influence of a fluctuating water table. In undulating landscapes, these sites are found on intermediate slope positions, between the well-drained ridges and the poorly drained Wet Meadow sites in the depressions. In such complexes, Moist Loam may be the most areally extensive of the ecosites, so would be shown as the dominant soil on soil maps. Moist Loam sites often show an intermingling of upland grasses with lowland species such as sedges.

On soil maps, the Moist Loam Ecosite is mapped as:

- Gleyed Black Chernozems of grassland regions (e.g. Barwood, Beresford, Coatstone, Cranmer, Gnadenthal, Graysville, Hartney, Joyale, Lakeland, Lundar, McCreary, Methley, Minitonas, Montgomery, Neuenberg, Neuhorst, Niverville, Oberon, Prodan, Rignold, St. Claude, Taggart, Two Creeks, Ulrich, Valley)
- Gleyed Dark Gray Chernozems of transitional regions (e.g. Inwood, Zinman)
- Gleyed Luvisols of forest regions (e.g. Piney)

Approximate grazing capacity: 0.9 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Kentucky bluegrass** **Sedges** **Big bluestem** **Little bluestem** **Northern reedgrass** (PFRA data, n=2)	This community is based on a small amount of data, and could be modified with further work. Dominance by the exotic Kentucky bluegrass would not be expected in the potential community, but because of the abundance of this species on moist sites, it may be difficult to find reference areas with completely natural composition. In North Dakota, Stewart and Kantrud (1972) described a "Low Prairie" type dominated by Kentucky bluegrass and slender wheatgrass.
Tall Grass Prairie	**Big bluestem** **Mat muhly** **Prairie cordgrass** **Tufted hairgrass** **Northern reedgrass** (Northern Wet Prairie, Minnesota DNR 2005)	This community type is described for tall grass prairie in Minnesota. Manitoba data for Moist Loam (from PFRA pastures, TGPP, and Lake Francis WMA) support a similar community dominated by big bluestem and with abundant mat muhly and northern reedgrass, but the available plots have significant exotic invasion (Kentucky bluegrass and redtop).

Interlake Plain	**Sedges** **Timber oatgrass** **Kentucky bluegrass** **Northern reedgrass** (PFRA data, n=7)	This community appears to be somewhat degraded based on the abundance of Kentucky bluegrass, but it may be difficult to find Moist Loam sites without this species.
Other ecoregions	Not described	No information found

Clay Ecosite

Ecosite Description
The Clay Ecosite Stable includes upland sites on soil materials with clay or heavy clay texture, usually deposited on the beds of glacial lakes. This ecosite is moister than average because of the fine soil texture. Most Clay sites are imperfectly drained, although some well-drained areas may be included.

The Clay Ecosite occupies relatively small areas of rangeland, as most such areas have been converted to cropland. On soil maps, the Clay Ecosite is mapped as:

- Black and and Gleyed Black Chernozems of grassland regions (e.g. Daly, Dauphin, Deadhorse, Dencross, Dugas, Egilson, Gretna, Harding, Horndean, Hubbell, Lidstone, Marquette, McClernon, Myrtle, Pipestone, Plainview, Plum Coulee, Sigmund, Winkler)
- Dark Gray and Gleyed Dark Gray Chernozems of transitional regions (e.g. Framnes, Libau, Meadowbrook, Peguis, Thalberg)
- Vertisols of heavy clays (e.g. Morris, Red River, Scanterbury, St. Norbert)
- Luvisols and Gleyed Luvisols of forest regions (e.g. Arnes, Blackstone, Duck Mountain, Lettonia, Mantagao, Pine Valley)

Approximate grazing capacity: 1.0 AUM/ac

Ecoregion	**Potential Grassland Community**	**Comments**
Aspen Parkland	**Green needle grass** **Western wheatgrass** **Big bluestem** **Side-oats grama** **Slender wheatgrass** **Awned wheatgrass** (NRCS North Dakota: 55B Clayey)	This community type is described for neighbouring parts of North Dakota. In Manitoba there may be less western wheatgrass and side-oats grama.
Interlake Plain	Not described	No information found
Lake of the Woods	Not described	No information found

Alluvium Ecosite

Ecosite Description
The Alluvium Ecosite includes land formed by recent alluvial deposition along floodplains of streams. Alluvial soils are variable in soil texture. Soil profiles are usually weakly developed (Regosols) because of the recent deposition. Most alluvium sites are imperfectly drained, although some well-drained areas may be included. However, the Alluvium Ecosite usually has enhanced soil moisture because of occasional stream overflow or runoff from surrounding valley-slopes. Poorly drained portions of floodplains are placed in Wet Meadow or Marsh Ecosites rather than in the Alluvium Ecosite.

The Alluvium Ecosite accounts for relatively small areas of rangeland, because of its restriction to narrow floodplains, and because much of it has been converted to cropland or hayland. On soil maps, Alluvium Ecosite is usually mapped as Regosols on alluvial materials (e.g. Assiniboine, Black Lake, Birch River, Bell River, Blumengart, Chortitz, Elm River, Edwards, Fisher, Fortier, Gervais, Heatley, Hodgson, Homestead, La Broquerie, Levine, Liege, La Salle, McMunn, Mowbray, Poplar Point, Seine River, Turtle River). However, there are some areas of more mature soils such as Chernozems (e.g. Arrow Hills, Coulter, Ochre River) or Luvisols (e.g. Elma).

Approximate grazing capacity: 0.9 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Big bluestem** **Switch grass** **Indian grass** **Porcupine grass** **Slender wheatgrass** **Awned wheatgrass** **Western wheatgrass** (NRCS North Dakota: 55B Loamy Overflow)	This community type is described for similar sites in neighbouring parts of North Dakota. It is not known whether tall-grasses would be as abundant on these sites in Manitoba Aspen Parkland.
Other ecoregions	Not described	No information found

Moist Saline Ecosite

Ecosite Description
The Moist Saline Ecosite includes imperfectly drained sites that are moderately to strongly saline (EC ≥ 8 dS/m). These are usually relatively small areas that support a mix of normal upland species with distinctive salt-tolerant species such as salt grass. In the field, Moist Saline Ecosite is recognized by white salt crusts on the soil surface, and by the presence of salt-tolerant species. Productivity tends to be lower than on non-saline sites.

On soil maps, Moist Saline Ecosite is mapped as saline areas within soils that would otherwise be mapped as Moist Loam or Moist Sand.

Approximate grazing capacity: 0.7 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland	**Slender wheatgrass** **Western wheatgrass** **Alkali cordgrass** **Prairie cordgrass** (NRCS North Dakota: 55B Saline Lowland)	This community type was described for adjacent parts of North Dakota.
Tall Grass Prairie	**Big bluestem** **Little bluestem** **Switch grass** **Mat muhly** **Prairie cordgrass** **Salt grass** **Scratch grass** **Alkali cordgrass** (Wet Prairie Saline Subtype, Minnesota DNR 1993)	This community type was described for tall grass prairie in Minnesota. No data have been found for Manitoba, but this type is probably appropriate.
Other ecoregions	Not described	No information found

Wet Meadow Ecosite

Ecosite Description
The Wet Meadow Ecosite includes wet low-lying sites that are normally flooded for 3-4 weeks in spring. The poorly drained soils show signs of prolonged saturation, such as dull colours or prominent mottles (Gleysolic soils). The potential vegetation includes diverse communities of fine-leaved sedges, grasses, and forbs, sometimes with tall willows. The productivity of Wet Meadow is higher than that of upland sites. However, cattle prefer to graze the grasses on upland sites, and move onto the sedges in Wet Meadow only after the uplands are depleted.

On soil maps, Wet Meadow Ecosite is mapped as poorly drained Gleysols (e.g. Balmoral, Basker, Berry Island, Carvey, Clarkleigh, Drokan, Emblem, Fyala, Glenfield, Glenmoor, Guerra, Klline, Lelant, Magnet, Malonton, Marsden, Meleb, Novra, Oak Lake, Partidge Creek, Paulson, Pineimuta, Roblin, Sifton, Sprague, Tadpole, Tarno, Valpoy).

Approximate grazing capacity: 1.1 AUM/ac

Ecoregion	Potential Grassland Community	Comments
Aspen Parkland, Aspen/Oak Parkland, Interlake Plain, Lake of the Woods	**Sedges** **Baltic rush and other rushes** **Northern reedgrass** (data from PFRA Pastures, Manitoba Benchmarks, and WMA inventories; n=22).	Other classifications for Wet Meadow identify woolly sedge and graceful sedge as major sedges, and marsh reedgrass and fowl bluegrass as major grasses. Areas with less grazing impact (i.e. closer to the true potential) may have higher proportions of northern and marsh reedgrass. Tall willows (beaked willow, pussy willow, basket willow) also occur on some areas of Wet Meadow.
Tall Grass Prairie	**Sedges** **Baltic rush and other rushes** **Northern reedgrass** (data from TGPP and PFRA Pasture monitoring, n=19	Other classifications in the region identify Sartwell's sedge and woolly sedge as major sedges, and prairie cordgrass as a major grass. Tall willows (beaked willow, pussy willow, basket willow) also occur on some areas of Wet Meadow.

Saline Wet Meadow Ecosite

Ecosite Description
The Saline Wet Meadow Ecosite includes Wet Meadow sites that are moderately to strongly saline, as indicated by the presence of white salt crusts on drying surfaces and/or the presence of salt-tolerant plant species.

On soil maps, Saline Wet Meadow is mapped as saline areas within the Gleysolic soils that would otherwise be mapped as Wet Meadow.

Approximate grazing capacity: 0.9 AUM/ac

Ecoregion	Potential Grassland Community	Comments
All ecoregions	**Northern reedgrass** **Baltic rush** **Foxtail barley** **Salt grass** (Millar 1976)	This community type is from a general wetland classification for the Canadian Prairies, for moderately saline wet meadow. More severely saline areas are dominated by salt grass.

Shallow Marsh Ecosite

Ecosite Description
The Shallow Marsh Ecosite includes wetlands that are normally flooded until July or early August. The Gleysolic soils are rated as very poorly drained. The potential vegetation includes simpler communities of intermediate-sized grasses and sedges.

On soil maps, Shallow Marsh is mapped as very poorly drained portions of the same sorts of Gleysolic soils listed under Wet Meadow.

Ecoregion	Potential Grassland Community	Comments
All ecoregions	**Awned sedge** **Spangletop** **Common spikerush** **Water smartweed** (Millar 1976)	This community type is from a general wetland classification for the Canadian Prairies.

Saline Shallow Marsh Ecosite

Ecosite Description
The Saline Shallow Marsh Ecosite includes Shallow Marsh sites that are moderately to strongly saline, as indicated by the presence of white salt crusts on drying surfaces and/or the presence of salt-tolerant plant species.

On soil maps, Saline Wet Meadow is mapped as saline areas within the Gleysolic soils that would otherwise be mapped as Shallow Marsh.

Ecoregion	Potential Grassland Community	Comments
All ecoregions	**Spangletop** **Common spikerush** (Millar 1976)	This community type is from a general wetland classification for the Canadian prairies, for moderately saline shallow marsh. Stewart and Kantrud (1972) added the following dominant species: narrow-leaved water plantain, three-square bulrush, awned sedge, and slough grass. More severely saline areas are dominated by Nuttall's alkali grass, red samphire, and western sea-blite.

Deep Marsh Ecosite

Ecosite Description
The Deep Marsh Ecosite includes wetlands that are normally flooded throughout the growing season. The Gleysolic soils are very poorly drained. The potential vegetation consists of a few species of tall, coarse graminoids (e.g. cattails, bulrushes), with patches of open water. On soil maps, Deep Marsh is mapped as the Marsh Complex.

Ecoregion	Potential Grassland Community	Comments
All ecoregions	**Soft-stem bulrush** **Hard-stem bulrush** **Common cat-tail** **Giant reedgrass** (Millar 1976)	This community type is from a general wetland classification for the Canadian prairies.

Saline Deep Marsh Ecosite

Ecosite Description
The Saline Deep Marsh Ecosite includes Deep Marsh sites that are moderately to strongly saline, as indicated by the presence of white salt crusts on drying surfaces and/or the presence of salt-tolerant plant species.

On soil maps, Saline Deep Marsh is mapped as saline areas within the Marsh Complex.

Ecoregion	Potential Grassland Community	Comments
All ecoregions	**Hard-stem bulrush** **Prairie bulrush** **Giant reedgrass** (Millar 1976)	This community types is from a general wetland classification for the Canadian Prairies, for moderately saline deep marsh. More severely saline marshes are dominated by prairie bulrush.

Fen Peat Ecosite

Ecosite Description
The Fen Peat Ecosite includes wetlands in which organic matter accumulates as peat (Organic soils), because of slow decomposition of plant remains. Peatlands usually develop in forested areas, but Fen Peat is sometimes found in the moister parts of the Prairie Ecozone. Fens are somewhat enriched in nutrients, usually because they are influenced by groundwater flowing from adjacent mineral terrain. The potential vegetation varies from sedge stands, to willow or bog birch shrublands, to open tamarack woodlands. Sedge fens may be used for livestock grazing, with grazing values similar to Wet Meadow or Shallow Marsh.

On soil maps, Fen Peat is mapped as Organic Soils (e.g. Cayer, Crane, Howell, Kircro, Katimik, Murray Hill, Overflowing, Perillo, Stead, Xavier).

Ecoregion	Potential Grassland Community	Comments
Tall Grass Prairie	**Hairy-fruited sedge** **Northern reedgrass** **Brown sedge** **Bog muhly** **Livid sedge** **Sartwell's sedge** **Shrubby cinquefoil** (Prairie Rich Fen, Minnesota DNR 2005)	This community type was described for tall grass prairie in Minnesota.
Mid-Boreal Upland and Transition, Interlake Plain	**Sedges** **Marsh reedgrass** **Northern reedgrass** **Buck-bean** **Mosses** (Beckingham et al. 1996)	This community type is from a forest ecosite classification for the Mid-Boreal Upland in Saskatchewan.

Lake of the Woods	**Lake-shore sedge** **Water sedge** **Bog birch** **Willow** **Mosses** (Mueller-Dombois 1964)	This community types is from a forest ecosite classification for southeastern Manitoba

Forest Peat Ecosite

Ecosite Description

The Forest Peat Ecosite includes wetlands in which undecomposed plant material accumulates as peat (Organic soils). Compared to Fen Peat, Forest Peat is poorer in nutrients because it is not influenced by groundwater flow from mineral soils. Forest Peat is usually restricted to forested ecoregions. The potential vegetation consists of *Sphagnum* moss, heath shrubs (e.g. Labrador-tea, leatherleaf, bog-laurel), and sometimes stunted black spruce trees.

On soil maps, Forest Peat is mapped as Organic Soils (e.g. Baynham, Cut Lake, Grindstone, Molson, Okno, Orok, Rat River, Sand River, Whithorn, Waskwei).

Ecoregion	**Potential Grassland Community**	**Comments**
All ecoregions	Not described	No grassland communities on this ecosite

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Appendix A: Methods for ecoregion mapping and climatic analysis

The Rangeland Ecoregions map was developed from existing source maps, modified by discussions among the steering committee about the features that are important for Manitoba rangelands.

Two main sources were used:

- The National Ecological Framework for Canada map (ESWG 1996), for which there is good linework available at the ecoregion and ecodistrict levels. The Manitoba portion of this map was previously used in the report "Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba" (Smith et al. 1998). Linework was downloaded from the Manitoba Land Initiative website (https://mli2.gov.mb.ca).
- The Manitoba's Natural Regions map, which was developed by the Manitoba Protected Areas Initiative.

The Rangeland Ecoregions map was primarily based on the National Ecological Framework. The analysis was restricted to agri-Manitoba, which was assumed to include the following units:

- Aspen Parkland Ecoregion
- Lake Manitoba Plain Ecoregion
- Southwest Manitoba Uplands Ecoregion
- Interlake Plain Ecoregion
- Boreal Transition Ecoregion
- Mid-Boreal Upland Ecoregion
- Ecodistrict 669 in the Mid-Boreal Lowland Ecoregion
- Lake of the Woods Ecoregion

One of the limitations of the National Ecological Framework map is that it shows all of the Lake Manitoba Plain as one ecoregion. The current map follows the approach of the Manitoba's Natural Regions map in dividing this area into Tallgrass Prairie in the south and Aspen/Oak Parkland in the north. But the actual boundaries of the Tallgrass Prairie include a somewhat larger area, following a map developed by The Nature Conservancy (C. Hamel, Nature Conservancy of Canada, personal communication). This corresponds to the following ecodistricts on the National Ecological Framework map:

- In the southern part of the Lake Manitoba Plain, Ecodistricts 846, 848, 849, 851, 852, and 853
- In the Interlake Plain, Ecodistrict 726 and the southern part of Ecodistrict 724.

Remaining areas of the Lake Manitoba Plain were included in the Aspen/Oak Parkland, while remaining areas of the Interlake Plain were shown as Interlake Plain.

The approach of the Manitoba's Natural Regions map was also followed in combining the Mid-boreal Upland Ecoregion (i.e. Riding Mountain, Duck Mountain, Porcupine Hills) with the narrow fringe of Boreal Transition Ecoregion surrounding the upland.

The approach of the Manitoba's Natural Regions map was also followed in showing the Assiniboine Delta as a separate ecoregion, because of its distinctive landscapes and vegetation.

Boundaries of this area were taken from the Manitoba's Natural Regions map, and were cut out of the Aspen Parkland Ecoregion, in which this area is included on the National Ecological Framework map.

Characterization of the climates of the ecoregions was based on 1961-90 climatic normals. These 30-year normals are measured at an irregular network of Environment Canada climate stations. Their usefulness for mapping has been increased by interpolation among stations to form a continuous data surface for each climatic variable. The latest and apparently best of these interpolations for western Canada uses the PRISM model, which was originally developed in the western U.S. by Daly et al. (1994). In addition to interpolating in the horizontal direction, this model adjusts for elevation using locally calculated lapse rates. Outputs are available for a 2.5 arc-minute grid (approximately 3 km east-west by 5 km north-south), providing a relatively fine-resolution representation of climate in relation to topography. This grid has been made available by Dr. Andreas Hamann of the University of Alberta. Data were downloaded from http://www.ales2.ualberta.ca/rr/people/hamann/data.htm for gridpoints in southern Manitoba up to 52° North.

The baseline climatology represents monthly values of basic climatic variables:

- Tmax – monthly maximum temperature (i.e. mean of daily maximum values) (°C)
- Tmin – monthly minimum temperature (i.e. mean of daily minimum values (°C)
- Tmean – mean monthly temperature (calculated from Tmax and Tmin) (°C)
- PPT – monthly precipitation (mm)

In addition to these basic variables, a number of derived variables have been found useful for representing climate/vegetation relationships:

- Growing degree days (GDD) is the sum of daily departures above a base temperature of 5°C. Development of plants is often closely related to GDD.
- Potential evapotranspiration (PET) is the amount of evaporation that would occur from a vegetated surface if soil moisture were freely available. PET depends mainly on temperature, although it is also influenced by other variables. A number of methods have been developed for estimating PET. For the current project, PET was estimated using Hogg's (1997) simplified Penman-Monteith method, which requires only temperature and elevation data.
- Hogg's (1994) Climatic Moisture Index (CMI) was calculated as annual PPT minus annual PET. This shows the degree to which the water input from precipitation matches the potential water output through evaporation. Hogg found that the forest/grassland transition in the Prairie Provinces closely matches the CMI isoline of zero, with positive values in the forest and negative values in the grassland.

These derived variables were calculated for each of the PRISM model gridpoints. Monthly temperature data and gridpoint elevations were used to calculate potential evapotranspiration, while monthly precipitation data were used to calculate the proportion of precipitation in May through September. Maps were produced by drawing contours on each data surface using Geographic Information System (GIS) software.

The PRISM gridpoints were overlaid with the Range Ecoregion boundaries to identify the points falling within each ecoregion. Climatic variables were averaged over these points.

Appendix B: List of plant species referred to in the text

COMMON NAME	SCIENTIFIC NAME	ORIGIN	GROWTH FORM
balsam fir	*Abies balsamifera*	native	tree
Manitoba maple	*Acer negundo*	native	tree
Indian ricegrass	*Achnatherum hymenoides*	native	graminoid
redtop	*Agrostis stolonifera*	exotic	graminoid
narrow-leaved water-plantain	*Alisma gramineum*	native	forb
perennial ragweed	*Ambrosia psilostachya*	native	forb
big bluestem	*Andropogon gerardii*	native	graminoid
sand bluestem	*Andropogon hallii*	native	graminoid
bearberry	*Arctostaphylos uva-ursi*	native	prostrate shrub
pasture sage	*Artemisia frigida*	native	forb
slough grass	*Beckmannia syzigachne*	native	graminoid
bog birch	*Betula glandulosa*	native	shrub
swamp birch	*Betula pumila*	native	shrub
river bulrush	*Bolboschoenus fluviatilis*	native	graminoid
prairie bulrush	*Bolboschoenus maritimus ssp. paludosus*	native	graminoid
side-oats grama	*Bouteloua curtipendula*	native	graminoid
blue grama	*Bouteloua gracilis*	native	graminoid
hairy grama	*Bouteloua hirsuta*	native	graminoid
smooth brome	*Bromus inermis*	exotic	graminoid
Porter's brome	*Bromus porteri*	native	graminoid
marsh reedgrass	*Calamagrostis canadensis*	native	graminoid
northern reedgrass	*Calamagrostis stricta*	native	graminoid
sand grass	*Calamovilfa longifolia*	native	graminoid
water sedge	*Carex aquatilis*	native	graminoid
awned sedge	*Carex atherodes*	native	graminoid
brown sedge	*Carex buxbaumii*	native	graminoid
sun-loving sedge	*Carex inops ssp. heliophila*	native	graminoid
lake-shore sedge	*Carex lacustris*	native	graminoid
hairy-fruited sedge	*Carex lasiocarpa*	native	graminoid
livid sedge	*Carex livida*	native	graminoid
woolly sedge	*Carex pellita*	native	graminoid
graceful sedge	*Carex praegracilis*	native	graminoid
Sartwell's sedge	*Carex sartwellii*	native	graminoid
sedge (genus)	*Carex spp.*	native	graminoid
timber oatgrass	*Danthonia intermedia*	native	graminoid
poverty oatgrass	*Danthonia spicata*	native	graminoid
shrubby cinquefoil	*Dasiphora fruticosa*	native	shrub

tufted hairgrass	*Deschampsia cespitoa*	native	graminoid
Leiberg's panicum	*Dichanthelium leibergii*	native	graminoid
salt grass	*Distichlis spicata var. stricta*	native	graminoid
common spikerush	*Eleocharis palustris*	native	graminoid
Canada wild-rye	*Elymus canadensis*	native	graminoid
northern wheatgrass	*Elymus lanceolatus*	native	graminoid
awned wheatgrass	*Elymus trachycaulus ssp. subsecundus*	native	graminoid
slender wheatgrass	*Elymus trachycaulus ssp. trachycaulus*	native	graminoid
horsetail (genus)	*Equisetum spp.*	native	forb
plains rough fescue	*Festuca hallii*	native	graminoid
black ash	*Fraxinus nigra*	native	tree
green ash	*Fraxinus pensylvanica*	native	tree
needle-and-thread	*Hesperostipa comata*	native	graminoid
western porcupine grass	*Hesperostipa curtiseta*	native	graminoid
porcupine grass	*Hesperostipa spartea*	native	graminoid
spear grass (genus)	*Hesperostipa spp.*	native	graminoid
fox-tail barley	*Hordeum jubatum*	native	graminoid
Baltic rush	*Juncus arcticus*	native	graminoid
rush (genus)	*Juncus spp.*	native	graminoid
creeping juniper	*Juniperus horizontalis*	native	prostrate shrub
June grass	*Koeleria macrantha*	native	graminoid
tamarack	*Larix laricina*	native	tree
duckweed (genus)	*Lemna spp.*	native	forb
buck-bean	*Menyanthes trifoliata*	native	forb
scratch grass	*Muhlenbergia asperifolia*	native	graminoid
prairie muhly	*Muhlenbergia cuspidata*	native	graminoid
bog muhly	*Muhlenbergia glomerata*	native	graminoid
mat muhly	*Muhlenbergia richardsonis*	native	graminoid
green needle grass	*Nassella viridula*	native	graminoid
switch grass	*Panicum virgatum*	native	graminoid
western wheatgrass	*Pascopyrum smithii*	native	graminoid
water smartweed	*Persicaria amphibia*	native	forb
giant reedgrass	*Phragmites australis*	native	graminoid
white spruce	*Picea glauca*	native	tree
black spruce	*Picea mariana*	native	tree
jack pine	*Pinus banksiana*	native	tree
red pine	*Pinus resinosa*	native	tree
eastern white pine	*Pinus strobus*	native	tree
annual bluegrass	*Poa annua*	exotic	graminoid
Canada bluegrass	*Poa compressa*	exotic	graminoid
fowl bluegrass	*Poa palustris*	native	graminoid

Kentucky bluegrass	*Poa pratensis*	exotic	graminoid
bluegrass (genus)	*Poa spp.*	exotic	graminoid
balsam poplar	*Populus balsamifera*	native	tree
cottonwood	*Populus deltoides*	native	tree
trembling aspen	*Populus tremuloides*	native	tree
Nuttall's alkali grass	*Puccinellia nuttalliana*	native	graminoid
bur oak	*Quercus macrocarpa*	native	tree
red samphire	*Salicornia rubra*	native	forb
beaked willow	*Salix bebbiana*	native	shrub
pussy willow	*Salix discolor*	native	shrub
basket willow	*Salix petiolaris*	native	shrub
willow (genus)	*Salix spp.*	native	shrub
little bluestem	*Schizachyrium scoparium*	native	graminoid
hard-stem bulrush	*Schoenoplectus acutus*	native	graminoid
slender bulrush	*Schoenoplectus heterochaetus*	native	graminoid
three-square bulrush	*Schoenoplectus pungens*	native	graminoid
soft-stem bulrush	*Schoenoplectus tabernaemontani*	native	graminoid
spangletop	*Scolochloa festucacea*	native	graminoid
Indian grass	*Sorghastrum nutans*	native	graminoid
alkali cordgrass	*Spartina gracilis*	native	graminoid
prairie cordgrass	*Spartina pectinata*	native	graminoid
Sphagnum moss	*Sphagnum spp.*	native	moss
sand dropseed	*Sporobolus cryptandrus*	native	graminoid
prairie dropseed	*Sporobolus heterolepis*	native	graminoid
western sea-blite	*Suaeda calceoliformis*	native	forb
western snowberry	*Symphoricarpos occidentalis*	native	shrub
eastern white cedar	*Thuja occidentalis*	native	tree
basswood	*Tilia americana*	native	tree
common cat-tail	*Typha latifolia*	native	graminoid
white elm	*Ulmus americana*	native	tree

Appendix C: Methods for ecosite mapping and Rangeland Ecosite maps for selected municipalities

Ecosite maps were developed for 14 municipalities distributed across agri-Manitoba. Similar maps could be developed for all of the municipalities, but this was outside of the scope of the current phase of the project.

All source maps (municipal boundaries, soil maps, land cover maps) were downloaded from the Manitoba Land Initiative website (https://mli2.gov.mb.ca). Maps are projected to UTM Zone 14 (NAD1983 datum).

The database accompanying the soil maps was analyzed to determine which attributes could be related to the definitions of the Rangeland Ecosites. A key was developed to predict the Rangeland Ecosite based on these attributes (Table 7). The key was applied to the database to determine the probable ecosite for each soil polygon. Nonproductive areas (bare soil, urban, water) were separated using the soil survey data.

Table 7 Key for predicting Rangeland Ecosites from attributes in the soil survey database.

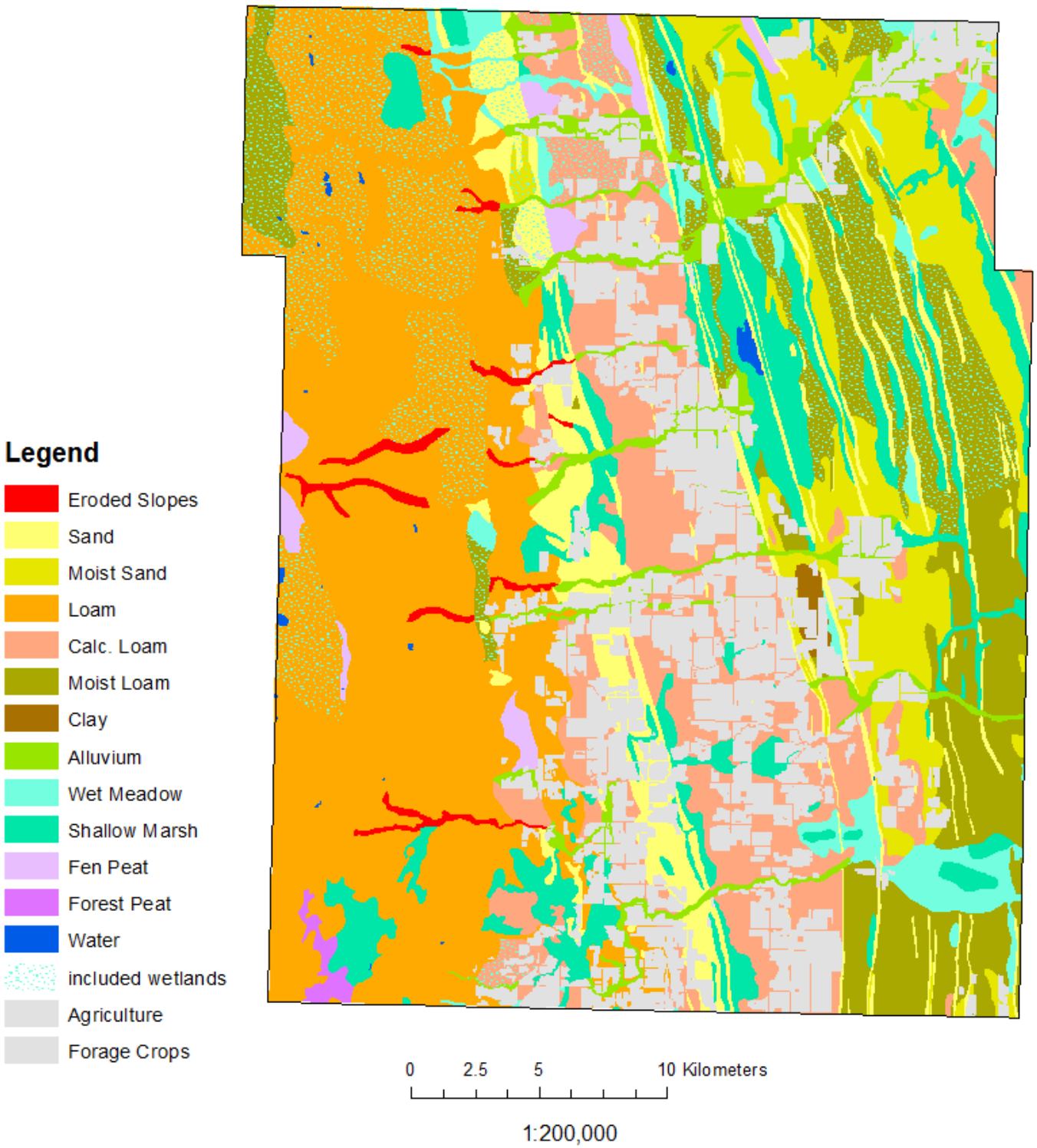
CSOIL=2:
Urban
CSOIL=6:
Water
CSOIL=16 (Salt Flats): **Bare Soil**
CSOIL=18 and SOILCODE1=$SB (sand beach): **Bare Soil**
CSOIL=71: **Precambrian Bedrock**
CSOIL=73: **Shallow to Limestone**
CSOIL=19: **Eroded Slopes**
CSOIL=35, 36: **Fen Peat**
CSOIL=68, 69: **Forest Peat**
CSOIL=49:
    CSALT=21,22 (Non to Slightly Saline): **Deep Marsh**
    CSALT=23,24 (Moderately to Strongly Saline): **Saline Deep Marsh**
Other values of CSOIL:
    CDRAIN=27 (Very Poorly Drained):
        CSALT=21,22 (Non to Slightly Saline): **Shallow Marsh**
        CSALT=23,24 (Moderately to Strongly Saline): **Saline Shallow Marsh**
    CDRAIN=26,29 (Poorly Drained):
        CSALT=21,22 (Non to Slightly Saline): **Wet Meadow**
        CSALT=23,24 (Moderately to Strongly Saline): **Saline Wet Meadow**
    CDRAIN=22,23,25 (Rapidly, Well, or Imperfectly Drained):
        CDRAIN=25 (Imperfectly Drained) and CSALT=23,24 (Moderately to Strongly Saline): **Moist Saline**
        Not (CDRAIN=25 and CSALT=23,24):
            CSOIL=22: **Alluvium**
            CSOIL=21 (Sandy Lacustrine) or 26 (Sandy Eolian):

CSLOPE=23,24,25,26 (>5% slopes): **Dunes**
CSLOPE=21,22 (0-5% slopes):
CDRAIN=21,22,23 (Very Rapidly, Rapidly, Well): **Sand**
CDRAIN=25 (Imperfectly): **Moist Sand**
CSOIL not 21 or 22:
CSLOPE=26 (>30% slopes): **Eroded Slopes**
CSLOPE=21,22,23,24,25 (<30% slopes):
CSOIL=18, 72:
CDRAIN=21,22,23 (Very Rapidly, Rapidly, Well): **Sand**
CDRAIN=25 (Imperfectly Drained): **Moist Sand**
CSOIL=30,53,54:
CDRAIN=23 (Well Drained): **Sandy Loam**
CDRAIN=25 (Imperfectly Drained): **Moist Sand**
CSOIL=27,28,31,48,51:
CDRAIN=23 (Well Drained): **Loam**
CDRAIN=25 (Imperfectly Drained): **Moist Loam**
CSOIL=50,52,56,57:
SOILCODE1=AOS, FKR, HIB, NCS, SDE, STW: **Shallow to Limestone**
Other SOILCODE1s:
CDRAIN=23 (Well Drained): **Calcareous Loam**
CDRAIN=25 (Imperfectly Drained): **Moist Loam**
CSOIL=32,33,42,64: **Clay**

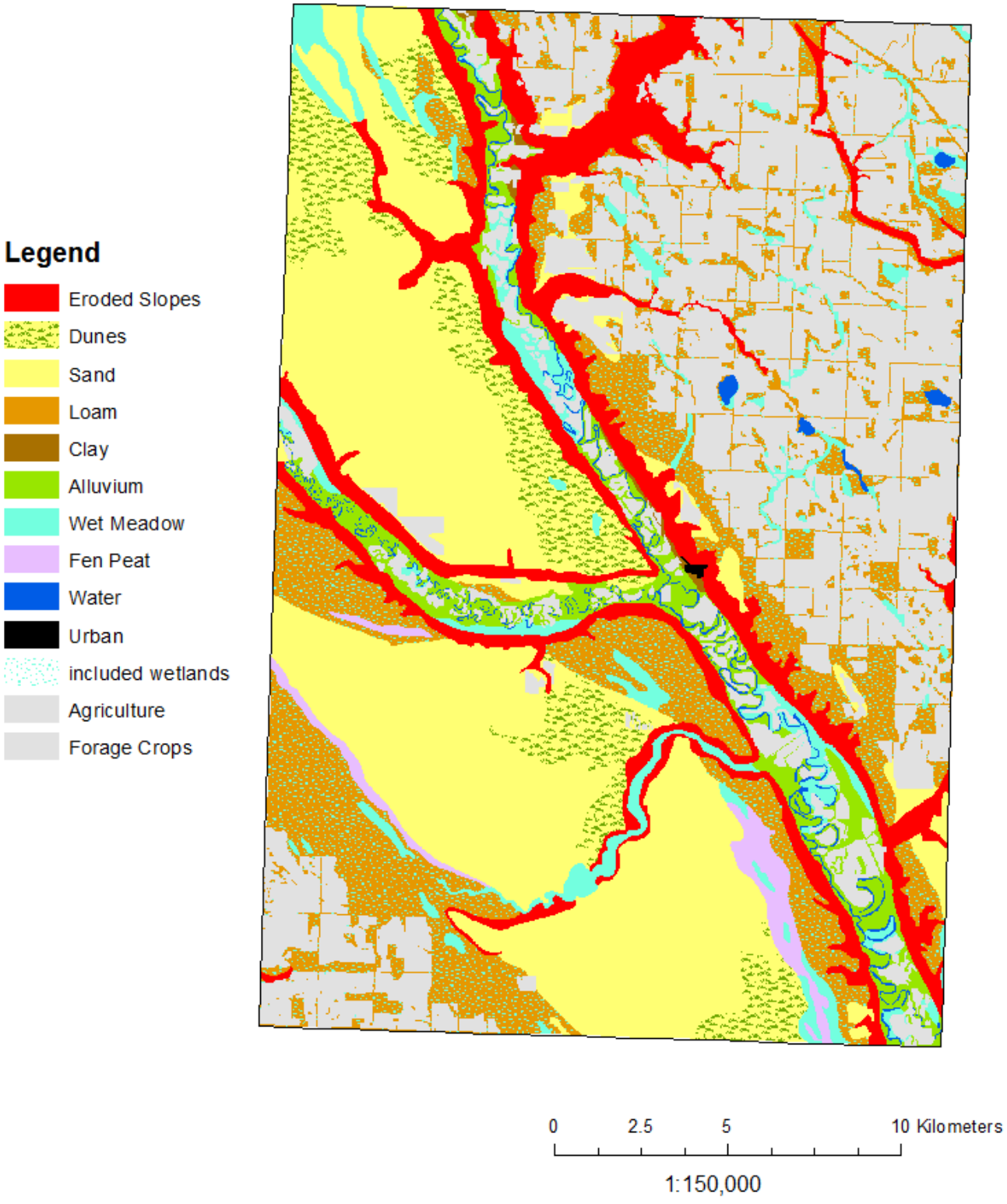
For the final maps, areas that are not in rangeland because they have been converted to annual crops or forage crops were masked out using satellite-based land cover maps. The remaining areas (not masked out) include grasslands (both native and exotic), forests and wetlands.

Many of the polygons on soil maps represent complexes of different soil types. The types assigned on the ecosite map mainly reflect the dominant soil type in such complexes. However, for complexes that are dominantly upland but include significant proportions of wetland (i.e. Wet Meadow, Shallow or Deep Marsh, Fen Peat), a pattern for "included wetlands" was superimposed on the colour representing the dominant ecosite.

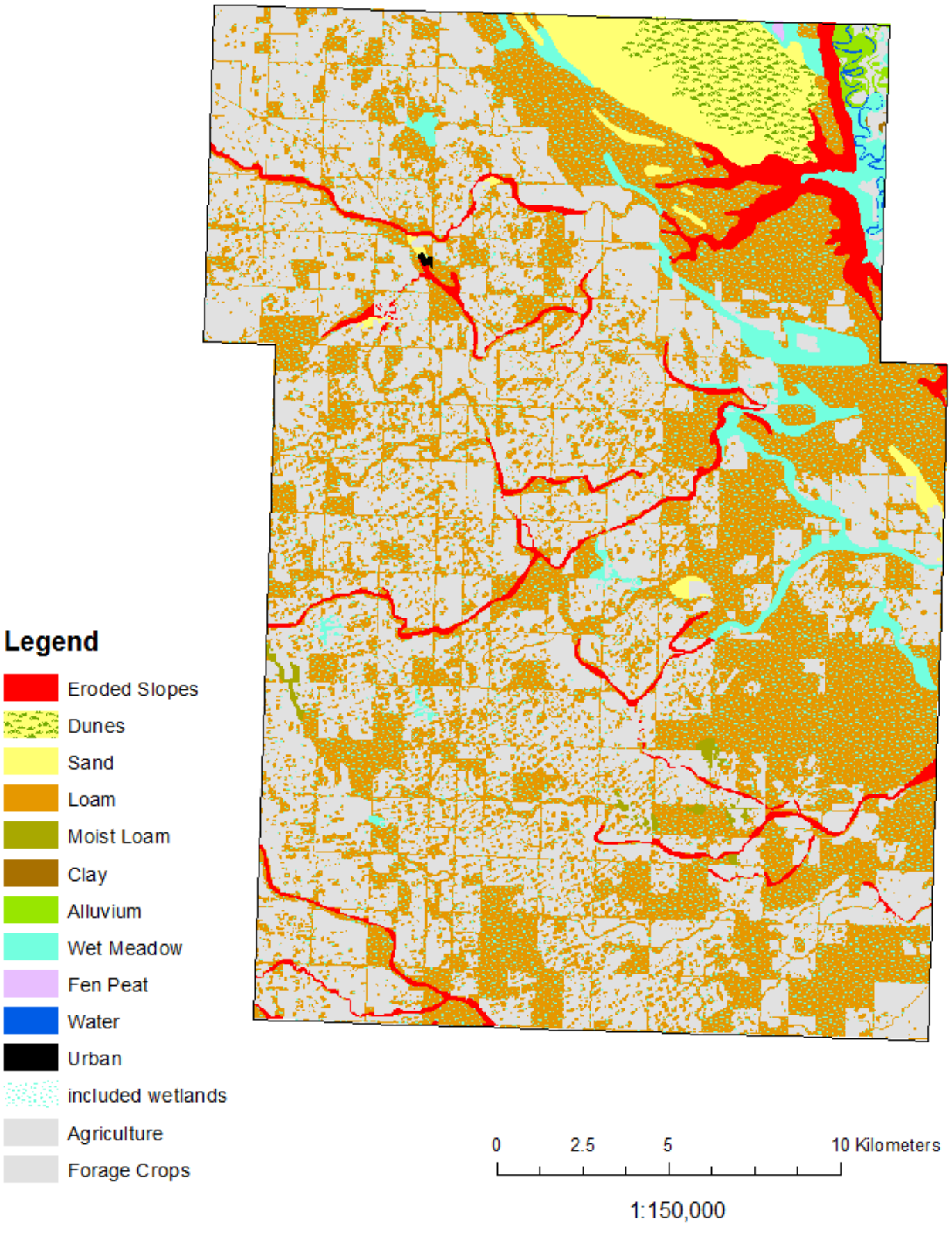
Range Ecosites of Ethelbert Municipality



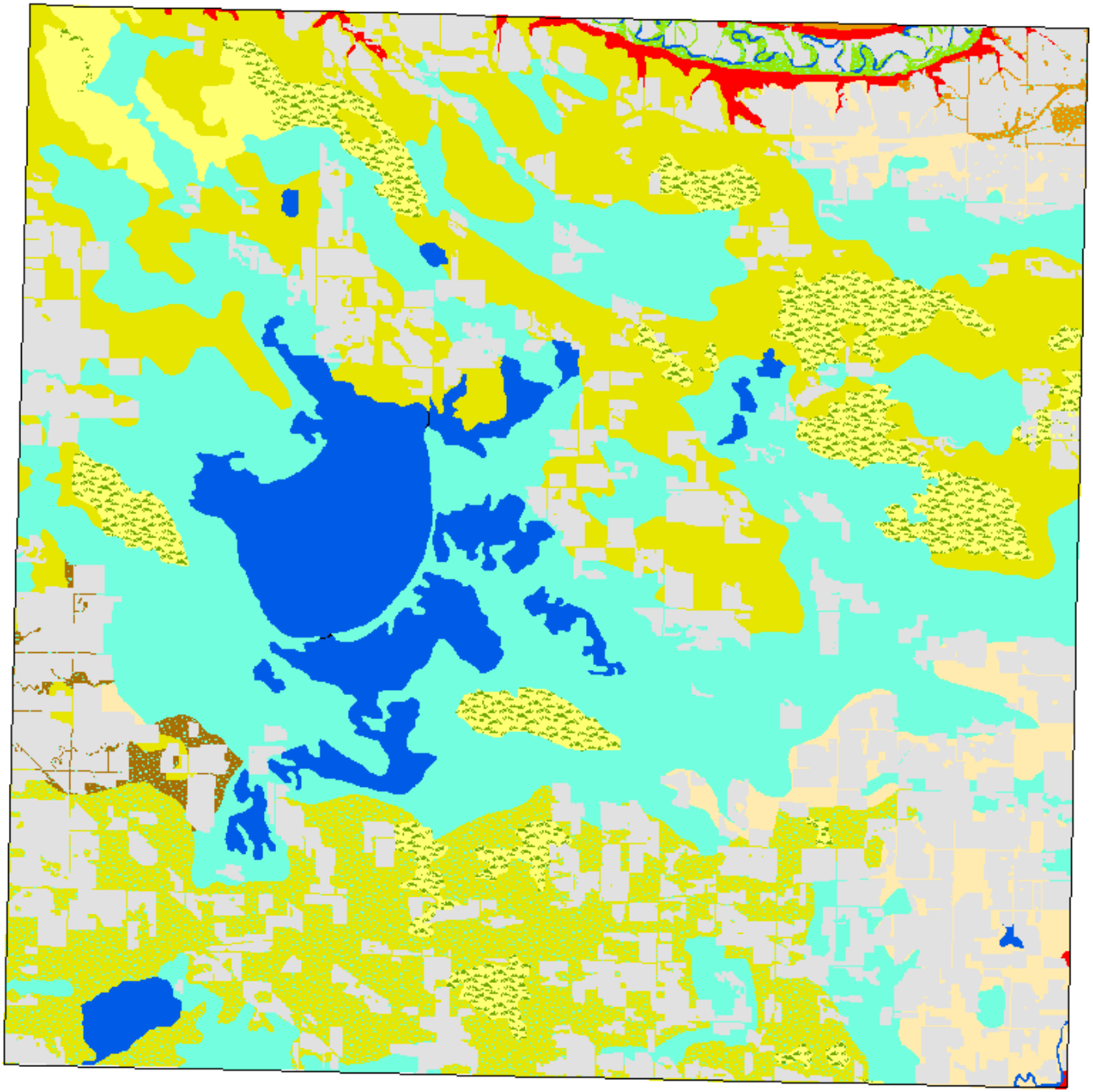
Range Ecosites of Ellice Municipalilty



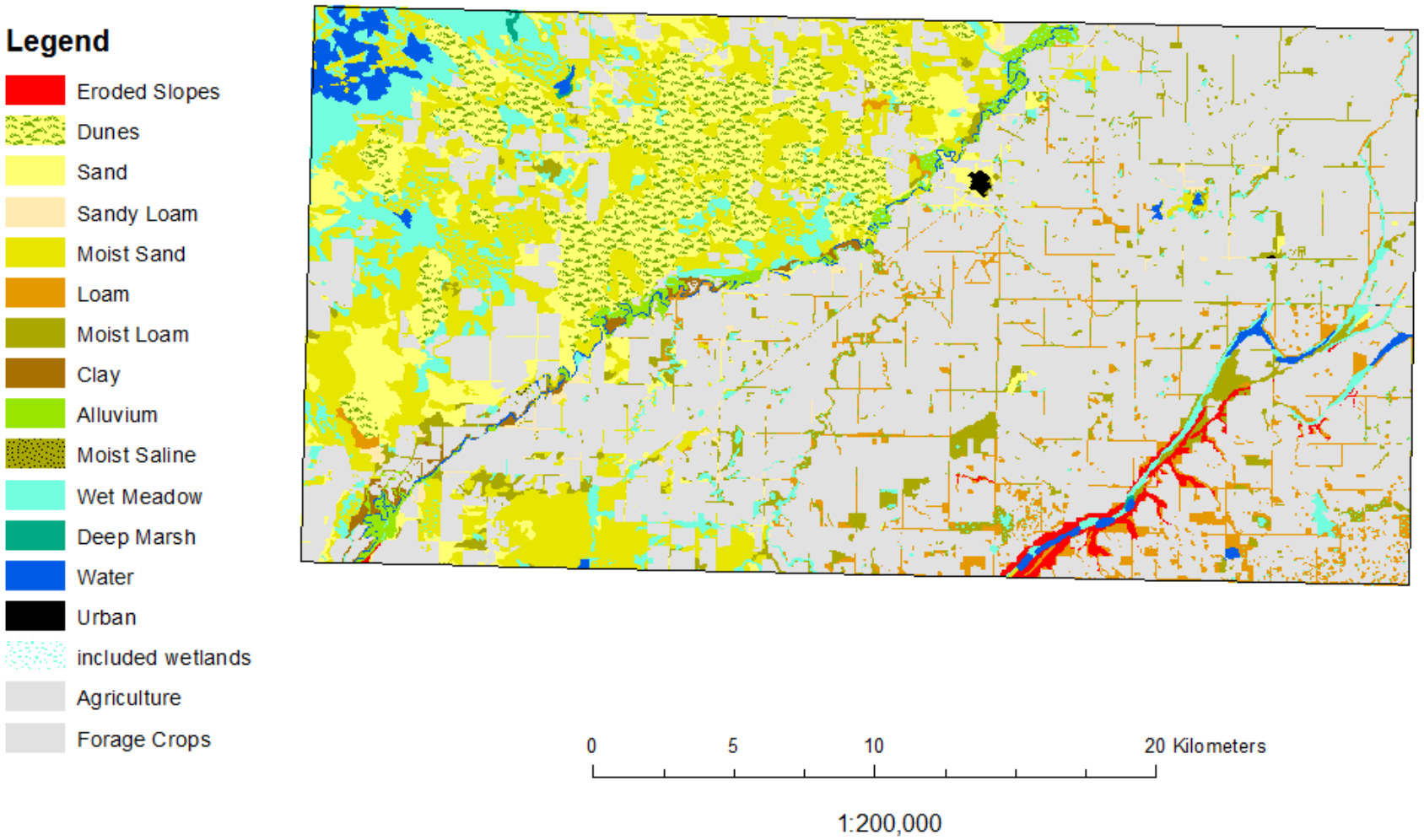
Range Ecosites of Archie Municipality



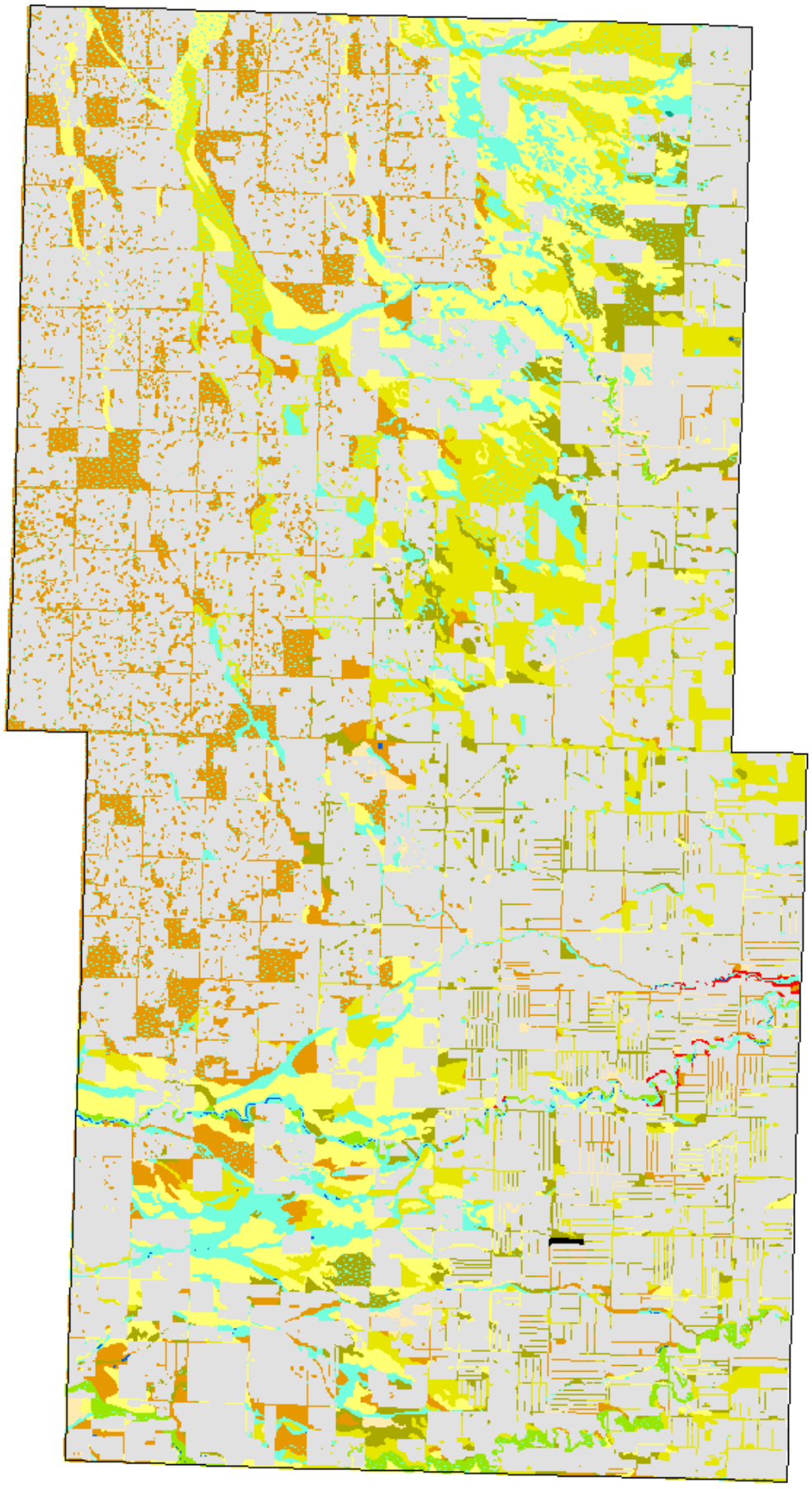
Range Ecosites of Sifton Municipality



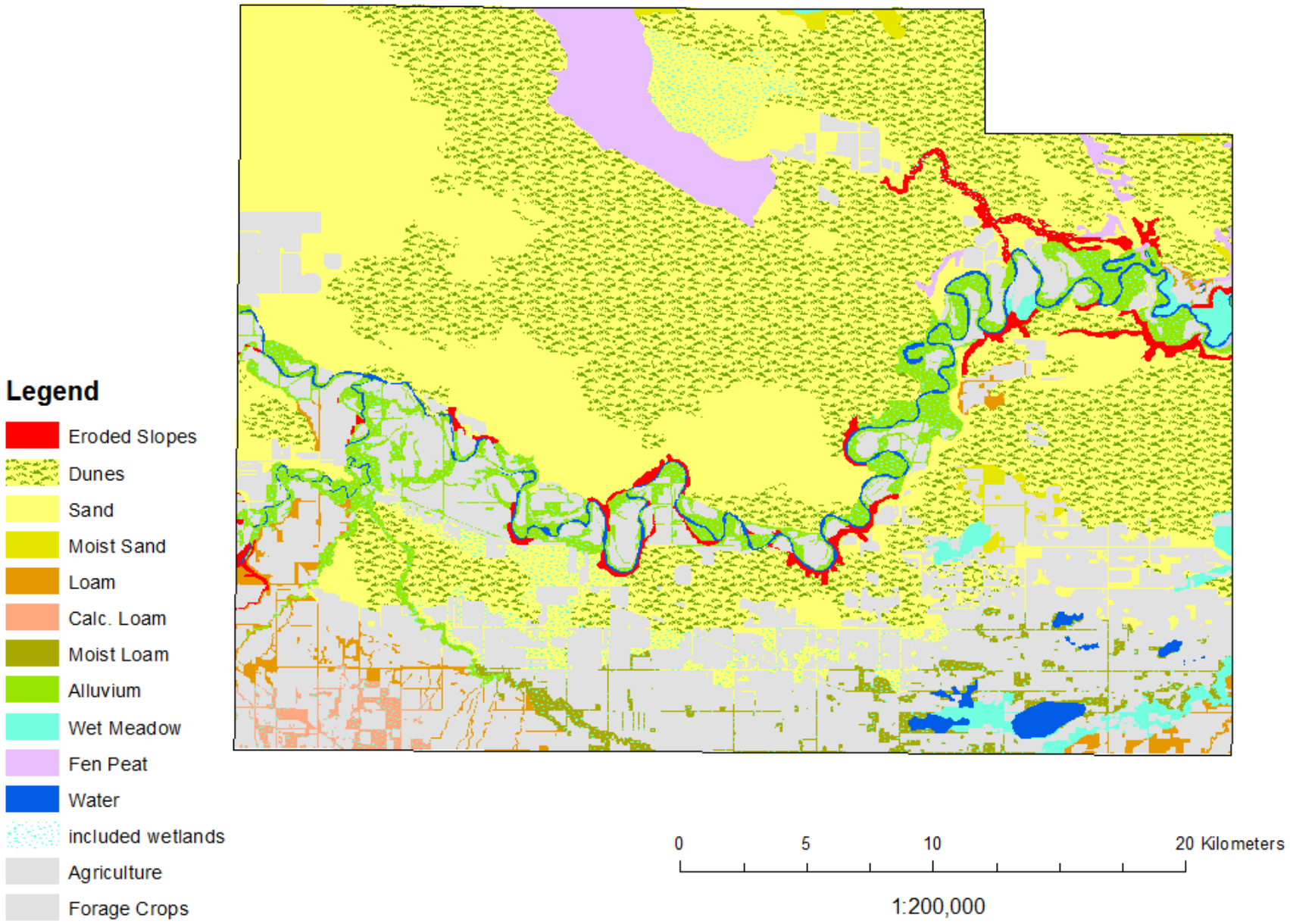
Range Ecosites of Cameron Municipality

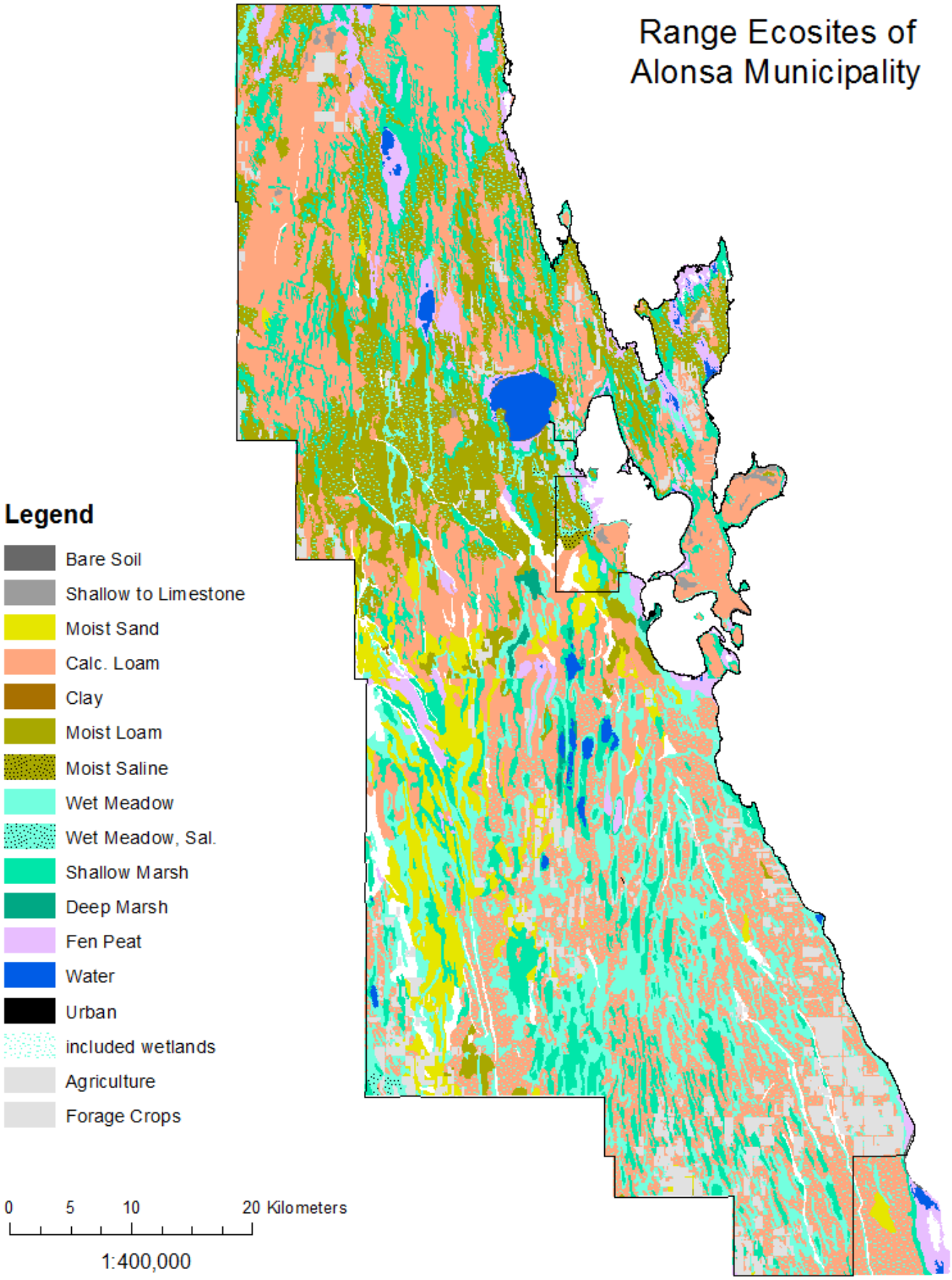


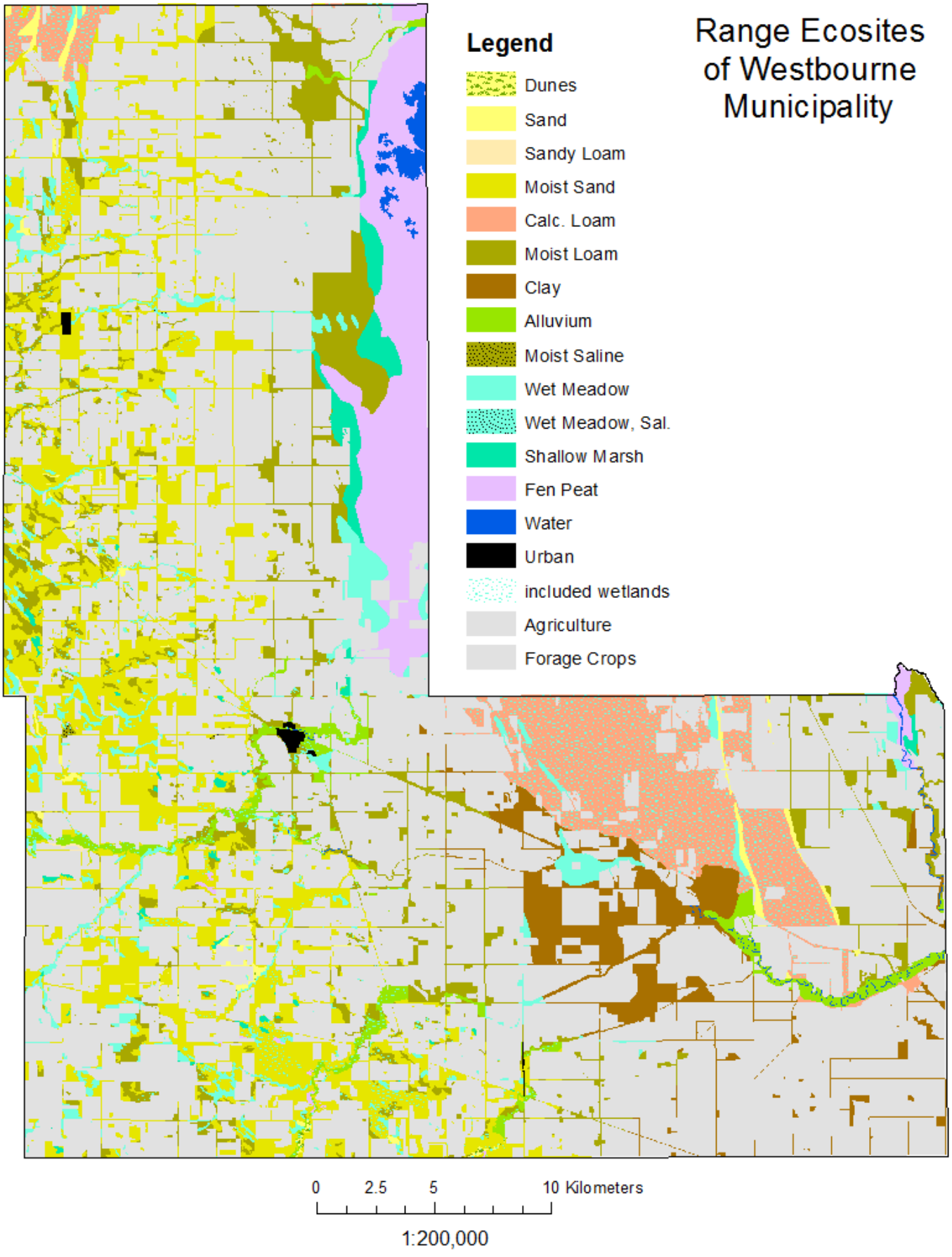
Range Ecosites of Edward Municipallity



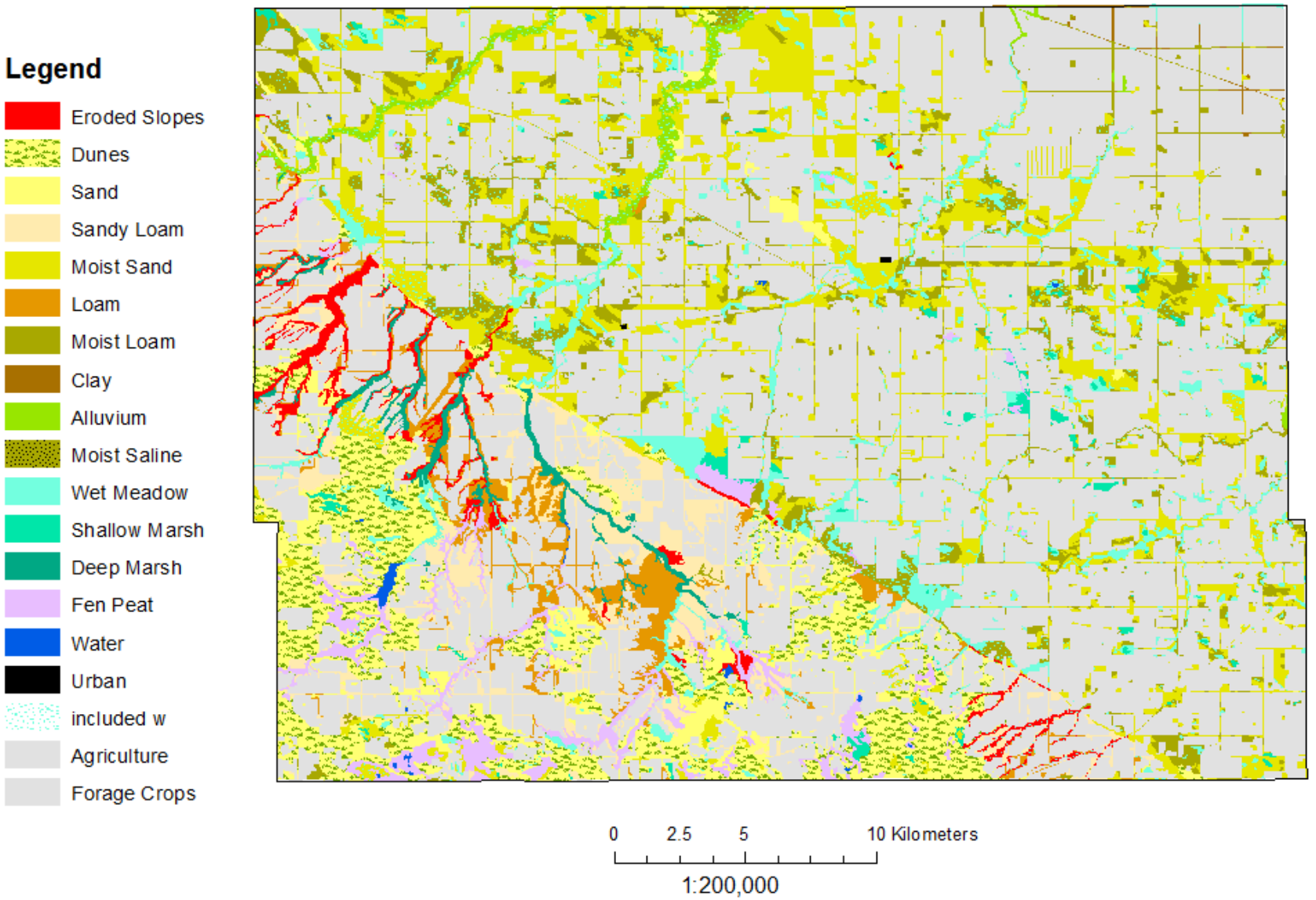
Range Ecosites of South Cypress Municipality



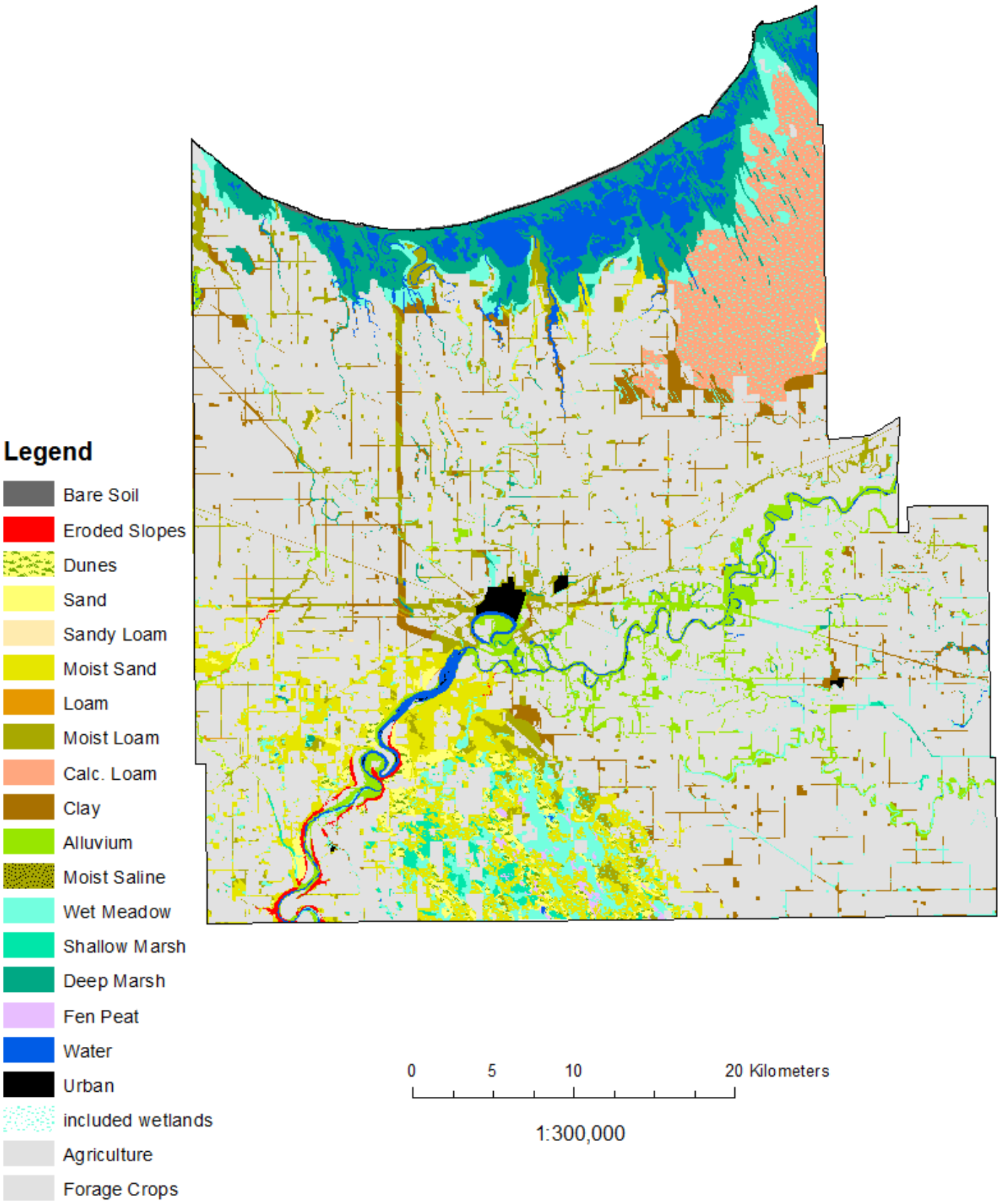

Range Ecosites of
Alonsa Municipality
Legend
Bare Soil
Shallow to Limestone
Moist Sand
Calc. Loam
Clay
Moist Loam
Moist Saline
Wet Meadow
Wet Meadow, Sal.
Shallow Marsh
Deep Marsh
Fen Peat
Water
Urban
included wetlands
Agriculture
Forage Crops
0 5 10 20 Kilometers
1:400,000


Range Ecosites of Westbourne Municipality
Legend
Dunes
Sand
Sandy Loam
Moist Sand
Calc. Loam
Moist Loam
Clay
Alluvium
Moist Saline
Wet Meadow
Wet Meadow, Sal.
Shallow Marsh
Fen Peat
Water
Urban
included wetlands
Agriculture
Forage Crops
0 2.5 5 10 Kilometers
1:200,000

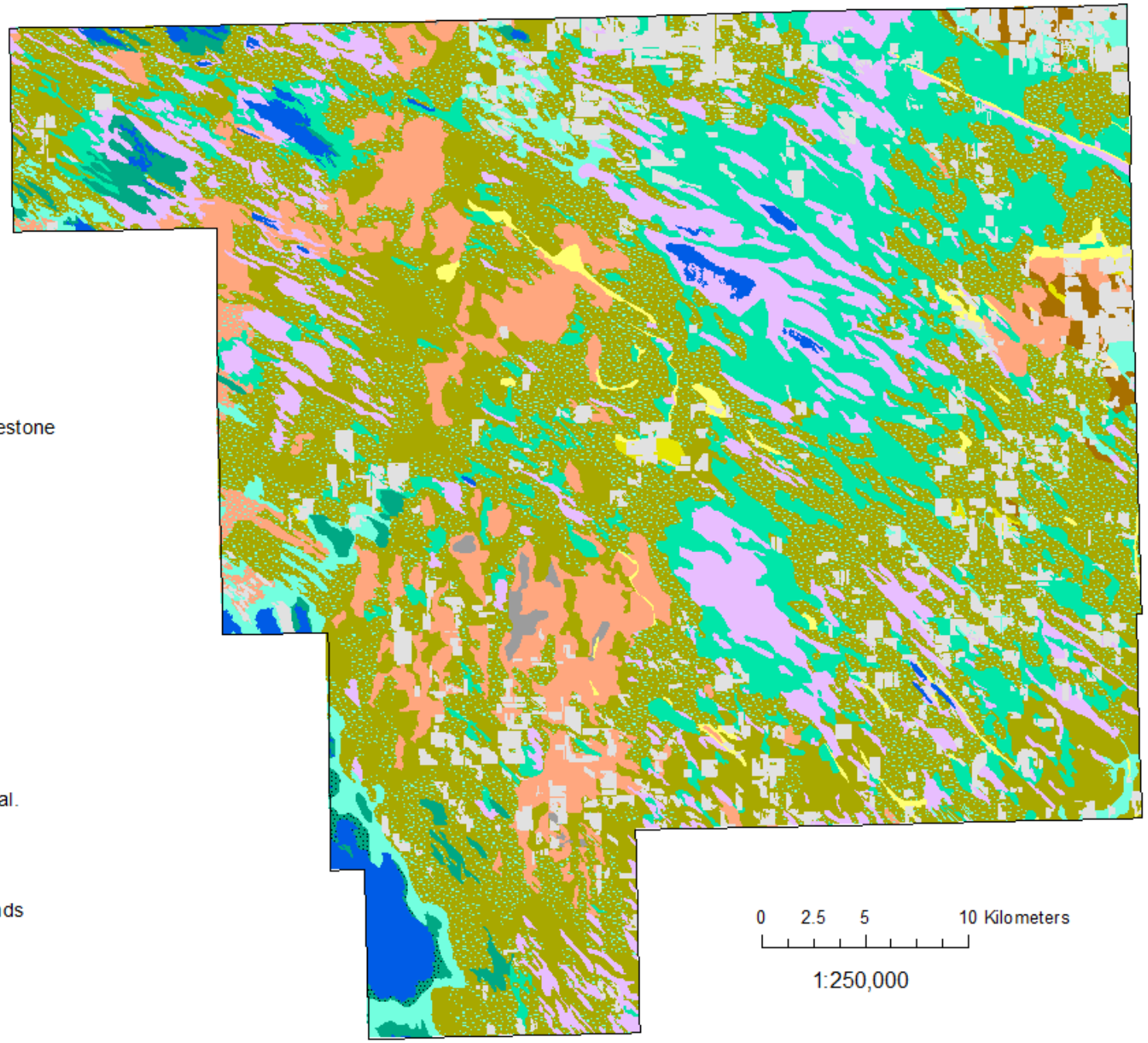
Rangeland Ecosites of North Norfolk Municipallity



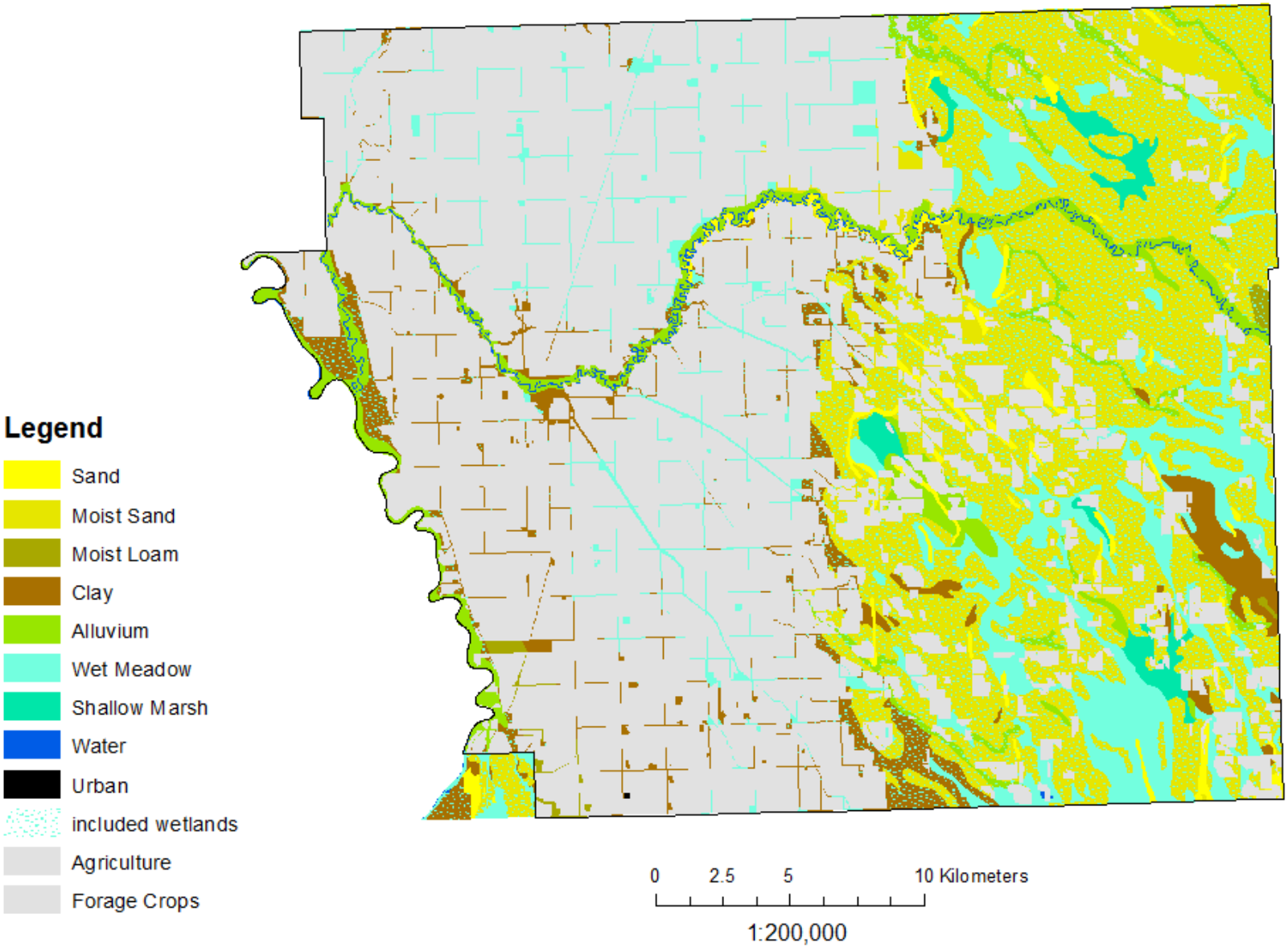
Range Ecosites of Portage la Prairie Municipality



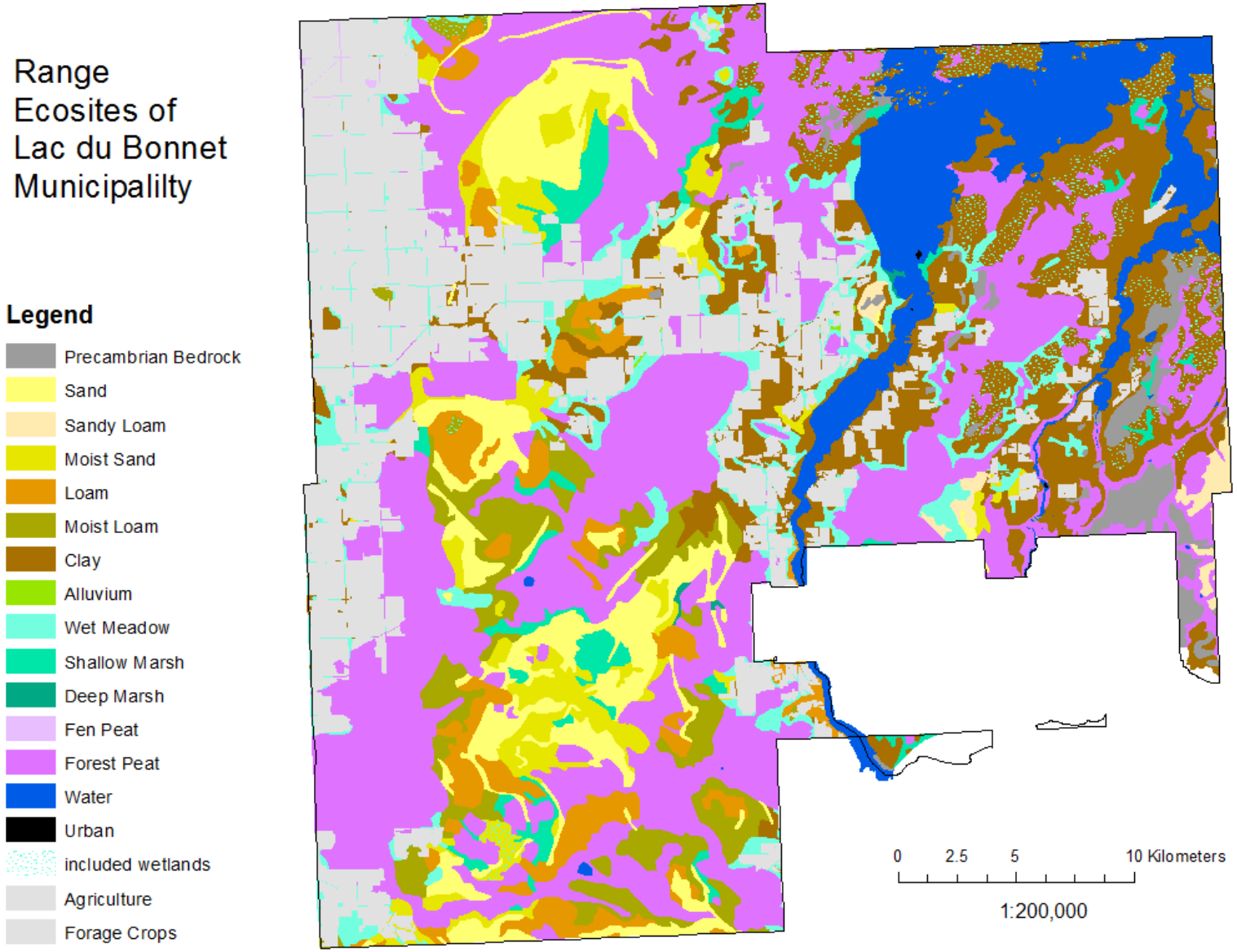
Range Ecosites of Armstrong Municipality



Range Ecosites of Franklin Municipality



Range Ecosites of Lac du Bonnet Municipalilty



Appendix D Methods for community analysis

Data sources:
Ecosystem classifications for adjacent jurisdictions:

- Minnesota:
  - MDNR. 2005. Field guide to the native plant communities of Minnesota: the Prairie Parkland and Tallgrass Aspen Parklands Provinces. Minnesota Department of Natural Resources.
  - Aaseng, N.E., et al. 1993. Minnesota's native vegetation: a key to natural communities. Minnesota Department of Natural Resources.
- North Dakota:
  - Natural Resources Conservation Service (NRCS) Ecological Site Descriptions (www.nrcs.usda.gov)
- Saskatchewan:
  - Thorpe, J. 2007a. Saskatchewan Rangeland Ecosystems. Sask. Prairie Conservation Action Plan. Saskatchewan Research Council Publication No. 11881-1E07.

Local vegetation data:

- Manitoba PFRA Pasture Monitoring data (n=699 transects)
- Manitoba Forage Benchmarking Sites (n=80 groups of cages)
- Tall Grass Prairie Preserve Monitoring (n=97 plots)
- Alameda Reservoir monitoring (southeastern Saskatchewan, approx. 50 km west of Manitoba) (n=392 transects)
- Cowessess First Nation inventory (Qu'Appelle Valley in Saskatchewan, approx. 80 km west of Manitoba) (n=31 plots)
- Tabular data from published vegetation studies

Analysis methods

The object of the analysis for the current publication was to determine the potential grassland community for each ecosite in each ecoregion. As discussed in Section 4.1, the potential community is that which would develop under light grazing and limited invasion by exotic species. A full classification of community types, including more disturbed types, was outside of the scope of the current phase of project.

All data were converted to a standardized format. The main component requiring standardization was the scientific names of plant species. A standard list of names was prepared, reflecting current taxonomic concepts, starting with a database already prepared for Saskatchewan, then adding any new species not found in Saskatchewan.

Much of the data consisted of percent biomass (i.e. the percentage contributed by each species to the total biomass). Percent cover data were converted to relative cover (i.e. the cover of the

species divided by the sum of the cover values of all species) for approximate comparability to percent biomass data.

Each plot (in the broad sense, including transects, clusters of cages, etc.) was assigned to a Rangeland Ecoregion, by overlaying its location data on the Ecoregion map. Each plot was assigned to a Rangeland Ecosite using the classification developed in this publication. Ecosite assignment was based on:

- Information provided in the data source, such as descriptions of soils and other site properties.
- Use of plot location data to overlay with a soil map and determine the ecosite predicted for that location by the methods in Table 7

Plots were sorted by major physiognomic types: grassland, shrubland, woodland. The current analysis was largely restricted to grasslands. Plots were also sorted by ecoregion and ecosite.

Within a given ecoregion/ecosite combination, plots were sorted to exclude obviously altered communities. Two main variables were used:

- The percentage of the herbaceous community made up of exotic species.
- An approximate grazing index, calculated as the average of the decreaser/increaser scores of the plant species, weighted by their percent biomass or percent relative cover. Decreaser/increaser scores were assigned to species on a scale from 0 to 1, based on knowledge of their response to grazing:
  - 1.0 for decreasers in every region (e.g. *Andropogon gerardii*)
  - 0.8 for decreasers in most regions, except increasers in the moistest regions (e.g. *Hesperostipa curtiseta*)
  - 0.6 for marginal decreasers (e.g. *Hesperostipa comata*)
  - 0.4 for marginal increasers (e.g. *Koeleria macrantha*)
  - 0.2 for increaser graminoids (e.g. *Bouteloua gracilis*)
  - 0.0 for increaser forbs
  - 0.0 for exotics
  - 0.5 for species considered neutral with respect to grazing

Initially, data were restricted to plots with <30% exotic species, and a grazing index >0.30. For ecosites that had adequate numbers of plots, these criteria were further tightened, to obtain the lowest-exotic and highest-seral plots available for a given ecosite.

For the candidate late-seral plots within a given ecoregion/ecosite combination, plots were sorted by dominant species. If the dominant species were different, then the data were split into more than one community type. The latest-seral community type was selected based on naturalness and the grazing responses of the dominant species.