Agriculture and Agri-Food Canada
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Rural Municipality of Grey

Information Bulletin 97-21

Soils and Terrain

An introduction to the land resource

Land Resource Unit
Brandon Research Centre

Canada

Rural Municipality of Grey

Information Bulletin 97-21

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PREFACE

This is one of a new series of information bulletins for individual rural municipalities of Manitoba. They serve to introduce the newly developed digital soil databases and illustrate several typical derived and interpretive map products for agricultural land use planning applications. The bulletins will also be available in diskette format for each rural municipality.

Information contained in this bulletin may be quoted and utilized with appropriate reference to the originating agencies. The authors and originating agencies assume no responsibility for the misuse, alteration, re-packaging, or re-interpretation of the information.

This information bulletin serves as an introduction to the land resource information available for the municipality. More detailed information, including copies of the primary soil and terrain maps at larger scales, may be obtained by contacting

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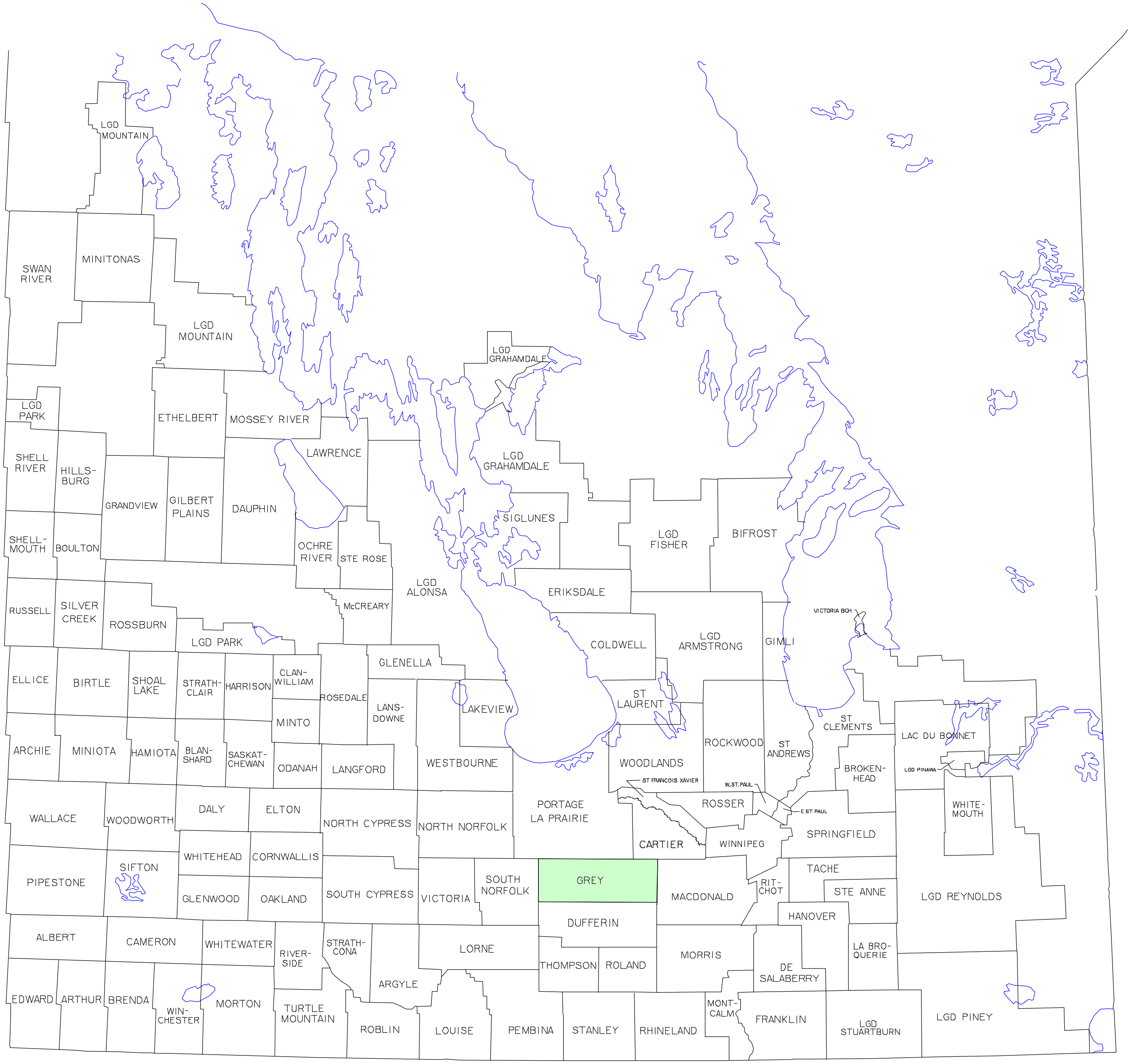


Figure 3. Rural municipalities of southern Manitoba.

INTRODUCTION

The location of Grey municipality is shown in Figure 1. The soil information was derived from detailed 1:20 000 scale surveys (Rural Municipality of Grey, Dufferin, Roland, Thompson, and part of Stanley, Report No. D60, Michalyna et al, 1988). A brief overview of the database information assembled, and general environmental conditions is presented. A set of maps derived from the data for typical agricultural land use and planning applications is also included.

The soil map and database was compiled and registered using the computerized Geographic Information System (PAMAP GIS) facilities of the Land Resource Unit. These databases were used in GIS to create the generalized, derived and interpretive maps and statistics contained in this report.

LAND RESOURCE DATA

The soil and terrain (landscape) information presented in this bulletin was compiled as part of a larger project to provide a uniform level of land resource information for agricultural and regional planning purposes throughout Agro-Manitoba. This information was compiled and analysed in two distinct layers as shown in Figure 2.

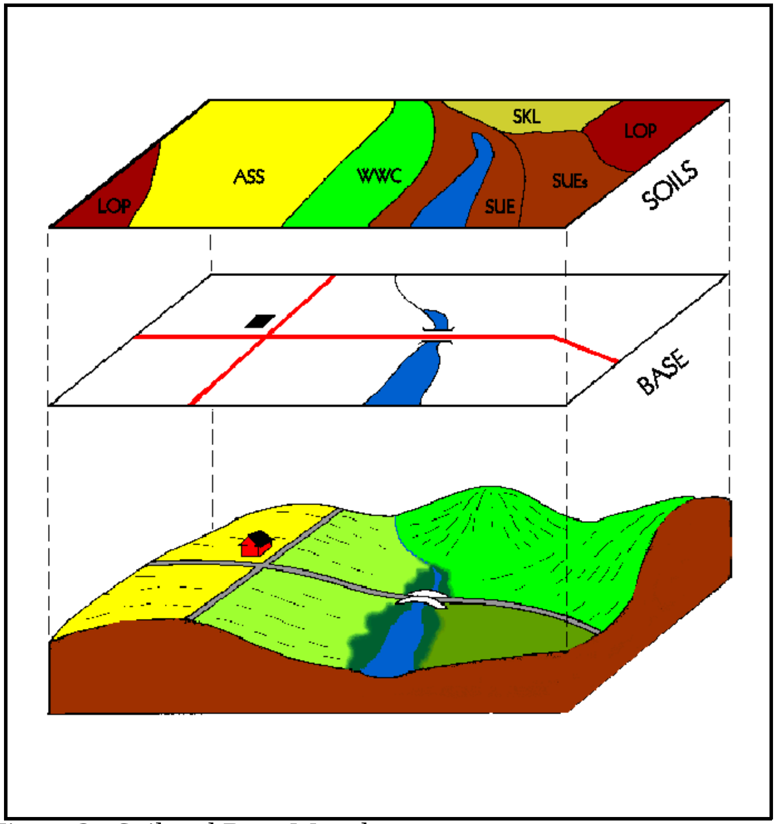


Figure 2. Soil and Base Map data.

Base Layer

Digital base map information includes the municipality and township boundaries, along with major streams, roads and highways. Major rivers and lakes from the base layer were also used as common boundaries for the soil map layer. Water bodies larger than 25 ha in size were digitized as separate polygons.

Soil Layer

The most detailed soil information currently available was selected as the data source for the digital soil layer for each rural municipality. The soil was added and aligned ("georeferenced") to the digital base map.

A comprehensive semi-detailed (1:20 000 scale) soil map (Michalyna et al, 1988), was digitized and compiled as a single georeferenced layer to match the digital RM base. Map polygons have one or more soil series components, as well as erosion, slope, stoniness, and salinity classes. Soil database information was produced for each polygon, to meet national standards (MacDonald and Valentine, 1992). Slope length classes were added, based on photo-interpretation.

Each soil polygon on the map was assigned the following legend characteristics:

soil series
modifier codes
polygon number.

The soil and modifier codes provide a link to additional databases of soil properties. In this way, soil map polygons were related to soil drainage, surface texture, and other properties to produce the generalized, derived, and interpretative maps presented in this bulletin.

SOIL AND TERRAIN OVERVIEW

The Rural Municipality (RM) of Grey covers 10.0 Townships (approximately 96 800 ha) in south-central Manitoba. Agricultural communities include Haywood, Elm Creek, and Fannystelle with the town of St. Claude being the largest centre.

Soils in the municipality have been mapped (1:20 000 scale) previously and published in report D60, Soils of the Rural Municipalities of Grey, Dufferin, Roland, Thompson, and part of Stanley (Michalyna et al, 1988).

Based on climatic data from Graysville (Environment Canada, 1993), mean annual temperature is 2.7EC; mean annual precipitation is 538.7 mm; average frost-free period is 116 days (Environment Canada, 1982) and growing degree days above 5°C are 1647. The calculated seasonal moisture deficit between May to September period is 250 to 300 mm; effective growing degree days (EGDD) above 5°C accumulated from May to September are 1500 to 1600. This parameter provides an indication of heat energy available for crop growth (Agronomic Interpretations Working Group, 1992).

The two dominant surficial deposits in the RM of Grey consist of the sandy glacio-fluvial and lacustrine deposits of the Assiniboine Delta, and the clayey deposits of the Red River Plain. The sandy deposits vary in thickness from less than one meter adjacent to the clayey area to greater than 5 meters on the western part of the municipality. Localized areas of medium textured sediments occur in the vicinity of St. Claude. Eolian sand dunes are common in the northwestern part of the municipality.

The dominant soils on the sandy delta deposits are well to imperfectly drained Black Chernozems. The clay textured deposits consist of imperfectly drained Black Chernozems and poorly drained Humic Gleysols.

The main soil limitations are wetness, droughtiness and to a minor degree, soil degradation due to wind erosion. Poorly drained clayey soils with improved drainage experience continuing wetness problems following periods of high rainfall or rapid spring snow melt.

Sandy soils with moderately severe to severe droughtiness are susceptible to erosion by wind and require good crop residue management to minimize this risk. Most of the nearly level sandy soils have seasonal high water tables which vary between 0.75 and 1.5 meters from the surface throughout the summer. These soils tend to be more productive due to the high water tables since water through capillary rise is available to plants during the growing season. Thus these soils are less subject to droughtiness. Stabilized duned sandy soils; poorly drained sandy soils with minimal drainage outlets; poorly drained soils with peaty layers; and deeper organic soils also occur in the municipality.

Land use within the rural municipality is predominantly agriculture. Imperfectly drained clayey soils are used for grain and pulse crops; level to depressional clay soils with improved drainage are used for dominantly grain production. Sandy soils are used for production of cereal grains, corn, flax, canola and legumes. Duned areas are used for native grazing or limited grass-legume production.

The main problems on clayey soil are maintenance of adequate surface drainage, structure, and tilth. Sandy soils require careful management to keep soil erosion to a minimum; these include the maintenance of sufficient trash cover, shelter belts, and suitable crop rotations. Precaution must be taken not to overdrain sandy soils since drainage of low lying areas could result in lowering the water table of adjacent better drained land and increase the risk of droughtiness.

Clayey soils have slow to very slow permeability, high shrink-swell properties, and are very plastic. They are also subject to surface ponding and slow runoff unless adequate drainage is provided. Subsoils at a depth of 1 to 2 m are weakly saline in some areas; the average electrical conductivity is about 4 to 5 dS/m and composition of the salts is mainly magnesium and calcium sulfates.

Sandy soils have high seasonal water table, rapid permeability, low moisture retention capacity and are subject to wind erosion. Some highly carbonated sandy soils have very low bearing capacity and are subject to ice lensing and frost heave.

DERIVED AND INTERPRETIVE MAPS

A large variety of computer derived and interpretive maps can be generated, once the soil and landscape data are stored in digital format. These maps are based on selected combinations of database values and assumptions.

Derived maps show information that is given in one or more columns in the computer map legend (such as surface soil texture, drainage, salinity, or slope class).

Interpretive maps portray more complex land evaluations based on information presented in the legend. Interpretations are based on soil and landscape conditions in each polygon. Interpretative maps typically show land capabilities, suitabilities, or risks related to sustainability.

Several examples of derived and interpretive maps are included in this information bulletin:

Derived Maps
Slope Classes
Surface Texture
Soil Drainage
Soil Salinity
Management Considerations

Interpretative Maps
Agricultural Capabilities
Irrigation Suitability
Potential Environmental Impact
Water Erosion Risk
Land Use.

The maps have all been reduced in size and generalized (simplified) in order to portray conditions for an entire rural municipality on one page. These generalized maps provide a useful overview of conditions within a municipality, but are not intended to apply to site specific land parcels. On-site evaluations are recommended for localized site specific land use suitability requirements.

Digital databases derived from recent detailed soil inventories contain additional detailed information about significant inclusions of differing soil and slope conditions in each map polygon. This information can be portrayed at larger map scale than shown in this bulletin.

Information concerning particular interpretive maps, and the primary soil and terrain map data, can be obtained by contacting the Manitoba Soil Resource Section of Manitoba Agriculture, the local PFRA office, or the Land Resource Unit.

Slope Map.

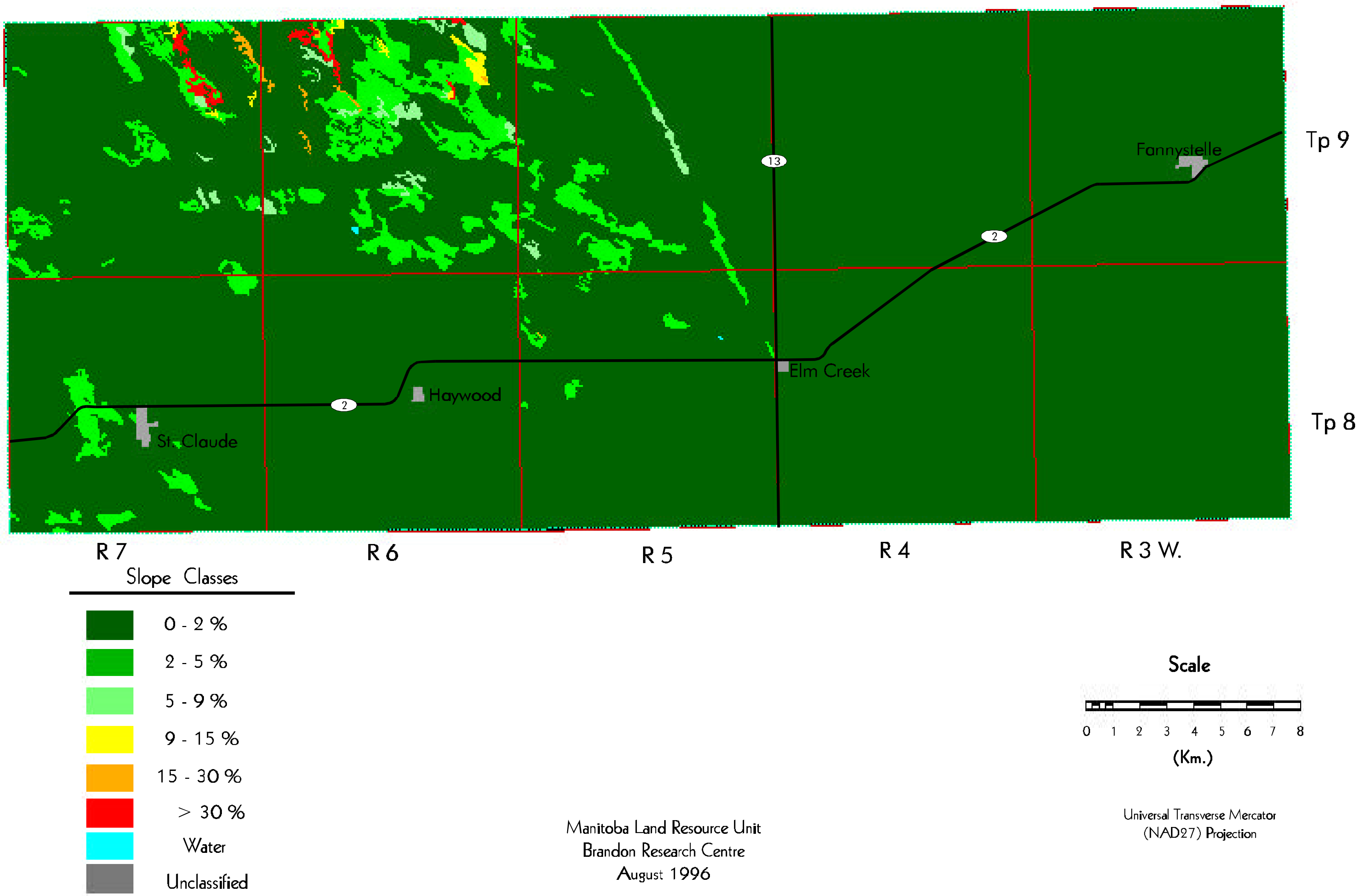
Slope describes the steepness and complexity of the landscape surface. The slope classes shown on this map are derived from the digital soil layer database. Specific colours are used to indicate the dominant slope class for each soil polygon in the RM. Additional slope classes may occur in each polygon area, but cannot be portrayed at this reduced map scale.

Table 1. Slope Classes[1]

Slope Class	Area (ha)	Percent of RM
0 - 2 %	90911	93.8
2 - 5 %	4862	5.0
5 - 9 %	480	0.5
9 - 15 %	146	0.2
15 - 30 %	99	0.1
> 30 %	219	0.2
Unclassified	154	0.2
Water	8	0.0
Total	96878	100.0

[1] Based on **dominant** slope gradient of each soil polygon.

Slope Map



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Surface Texture Map.

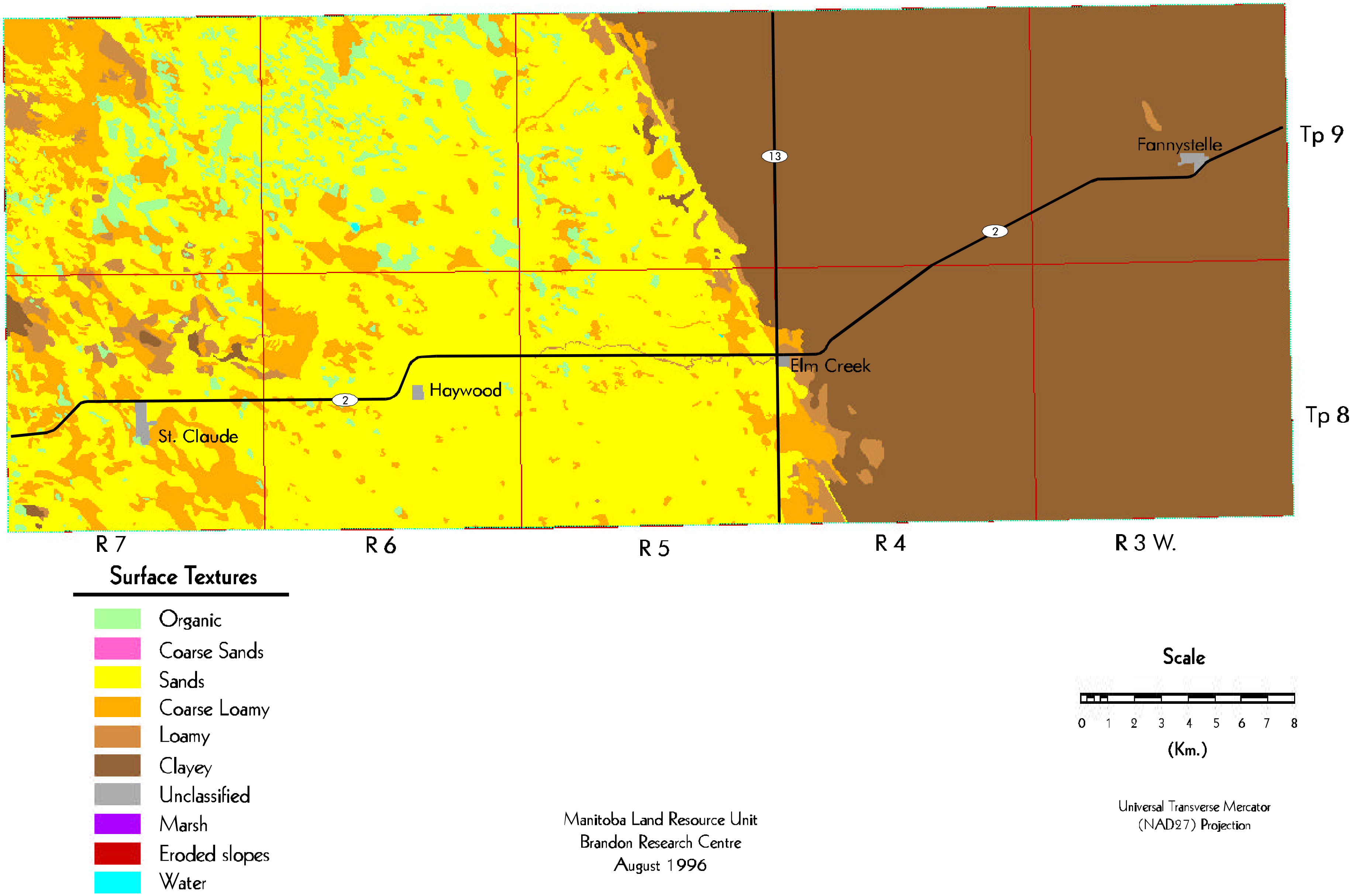
The soil textural class for the upper most soil horizon of the dominant soil series within a soil polygon was utilized for classification. Texture may vary from that shown with soil depth and location within the polygon.

Table 2. Surface Texture[1]

Surface Texture	Area (ha)	Percent of RM
Organics	3287	3.4
Coarse Sands	0	0.0
Sands	40589	41.9
Coarse Loamy	9461	9.8
Loamy	2179	2.2
Clayey	41200	42.5
Eroded Slopes	0	0.0
Marsh	0	0.0
Unclassified	154	0.2
Water	8	0.0
Total	96878	100.0

[1] Based on **dominant** soil series for each soil polygon.

Surface Texture Map



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August 1996

Universal Transverse Mercator
(NAD27) Projection

Soil Drainage Map.

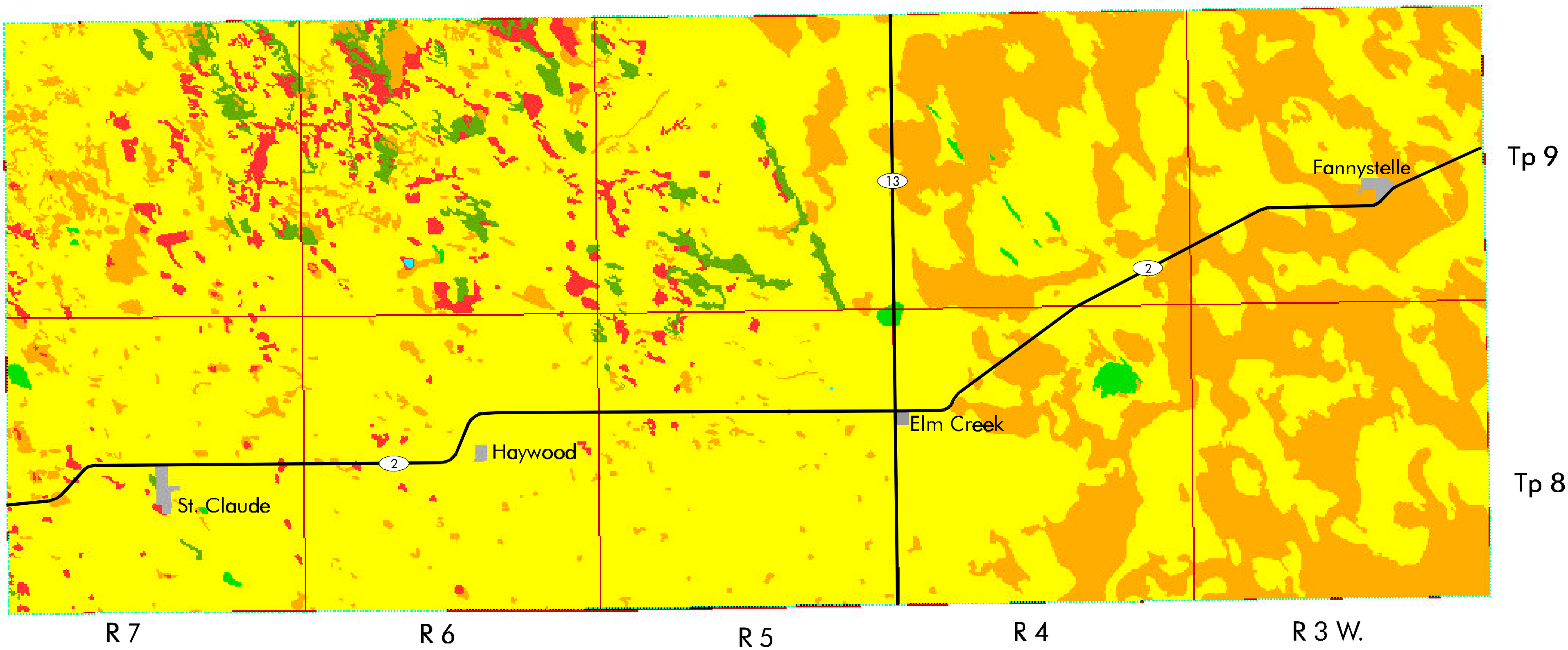
Drainage is described on the basis of actual moisture content in excess of field capacity, and the length of the saturation period within the plant root zone. Drainage classification was based upon the dominant soil series of each individual soil polygon. A description of the various soil drainage classes can be found in Soils of the Rural Municipality of Grey, Dufferin, Roland, Thompson, and part of Stanley, Report No. D60 (Michalyna et al, 1988).

Table 3. Drainage Classes[1]

Drainage Class	Area (ha)	Percent of RM
Very Poor	2528	2.6
Poor	22117	22.8
Imperfect	70037	72.3
Well	332	0.3
Rapid	1702	1.8
Marsh	0	0.0
Unclassified	154	0.2
Water	8	0.0
Total	96878	100.0

[1] Area has been assigned to the dominant drainage class for each soil polygon.

Soil Drainage Map



Drainage Classes

- Very poor
- Poor
- Imperfect
- Moderately well
- Well
- Rapid
- Unclassified
- Marsh
- Eroded Slopes
- Water

Scale

0 1 2 3 4 5 6 7 8

(Km.)

Universal Transverse Mercator
(NAD27) Projection

Land Resource Unit
Brandon Research Centre
May 1999

Soil Salinity Map.

A saline soil contains soluble salts in such quantities that they interfere with the growth of most crops. Soil salinity is determined by the electrical conductivity of the saturation extract in decisiemens per metre (dS/m). Approximate limits of salinity classes are:

non-saline	0 to 4 dS/m
slightly saline	4 to 8 dS/m
moderately saline	8 to 16 dS/m
strongly saline	> 16 dS/m

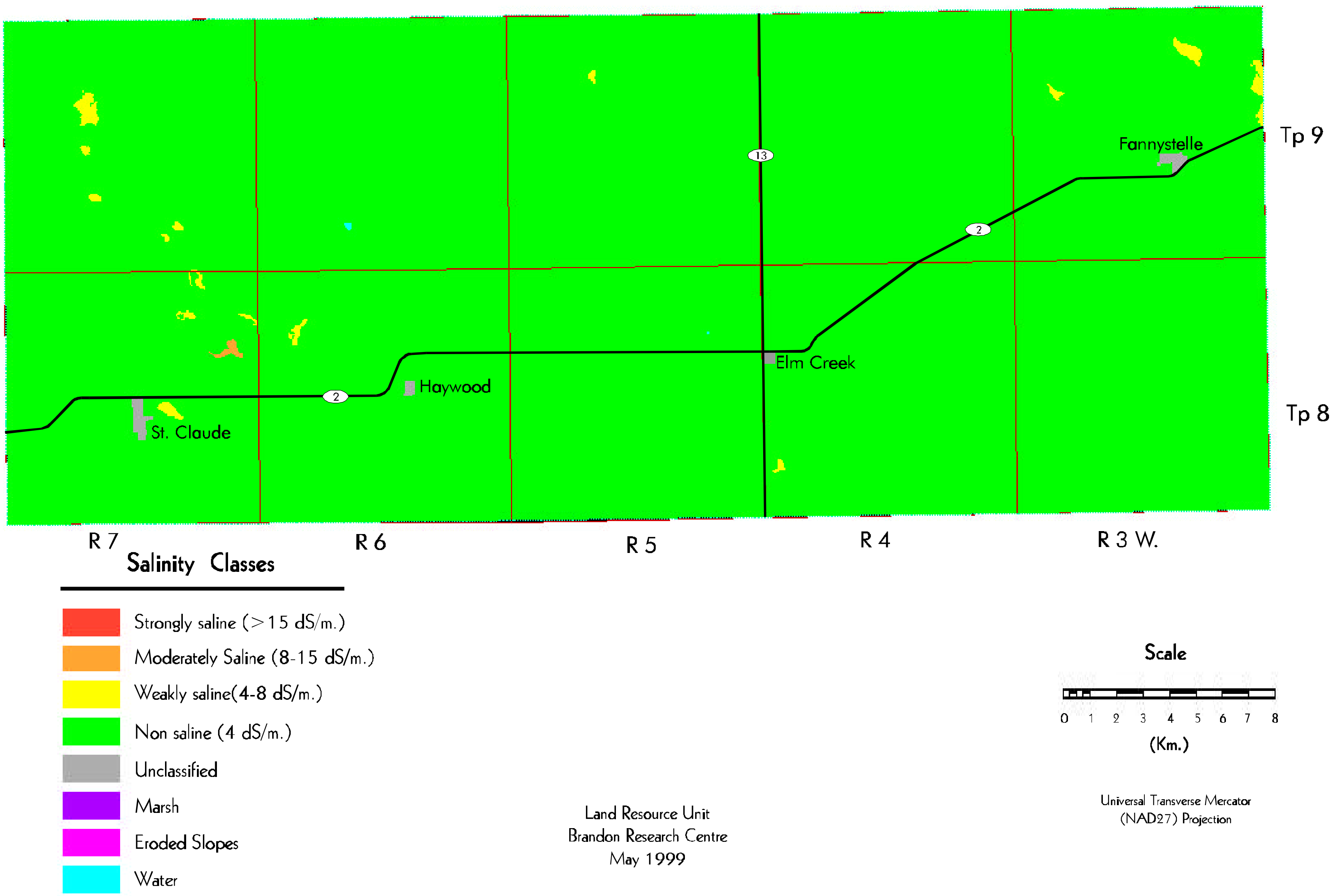
The salinity classification of each individual soil polygon was determined by the most severe salinity classification present within that polygon.

Table 4. Salinity Classes[1]

Salinity Class	Area (ha)	Percent of RM
Non Saline	96299	99.4
Weakly Saline	382	0.4
Moderately Saline	36	0.0
Strongly Saline	0	0.0
Eroded Slopes	0	0.0
Marsh	0	0.0
Unclassified	154	0.2
Water	8	0.0
Total	96878	100.0

[1] Area has been assigned to the dominant salinity class for each soil polygon.

Soil Salinity Map



Management Considerations Map.

Management consideration maps are provided to focus on awareness of land resource characteristics important to land use. This map does not presume a specific land use. Rather it portrays the most common and wide spread attributes that apply to most soil landscapes in the province.

These maps **highlight attributes** of soil-landscapes that the land manager must consider for any intended land use.

- **Topography**
- **Wetness**
- **Coarse texture**
- **Medium texture**
- **Fine texture**
- **Organic**
- **Bedrock**

F = Fine texture - soil landscapes that have **fine textured soils (clays and silty clays)**, and thus low infiltration and internal permeability, require special considerations to mitigate surface ponding (water logging), runoff, trafficability. Timing and type of tillage practices used may be restricted.

C = Coarse texture - soil landscapes that have **coarse to very coarse textured soils (loamy sands, sands and gravels)**, and hence a high permeability throughout the profile, require special management practices related to application of agricultural chemicals, animal wastes, and municipal effluent to protect and sustain the long term quality of the soil and water resources. The risk of soil erosion can be minimized through the use of shelterbelts and maintenance of crop residues.

M = Medium texture - soil landscapes that have medium to moderately fine texture **(loams to clay loams)**, and hence have good water and nutrient retention properties, require good management and cropping practices to minimize leaching and the risk of erosion.

T = Topography - soil landscapes that have **slopes greater than 5 %** are steep enough to require special management practices to minimize the risk of erosion.

W = Wetness - soil landscapes that have **poorly drained soils and/or >50 % wetlands** (due to seasonal and annual flooding, surface ponding, permanent water bodies (sloughs), and/or high water tables), require special management practices to mitigate adverse impact on water quality, protect subsurface aquifers, and sustain crop production during periods of high risk of water logging.

O = Organic - soil landscapes that have organic soils, require special management considerations of drainage, tillage, and cropping to sustain productivity and minimize subsidence and erosion.

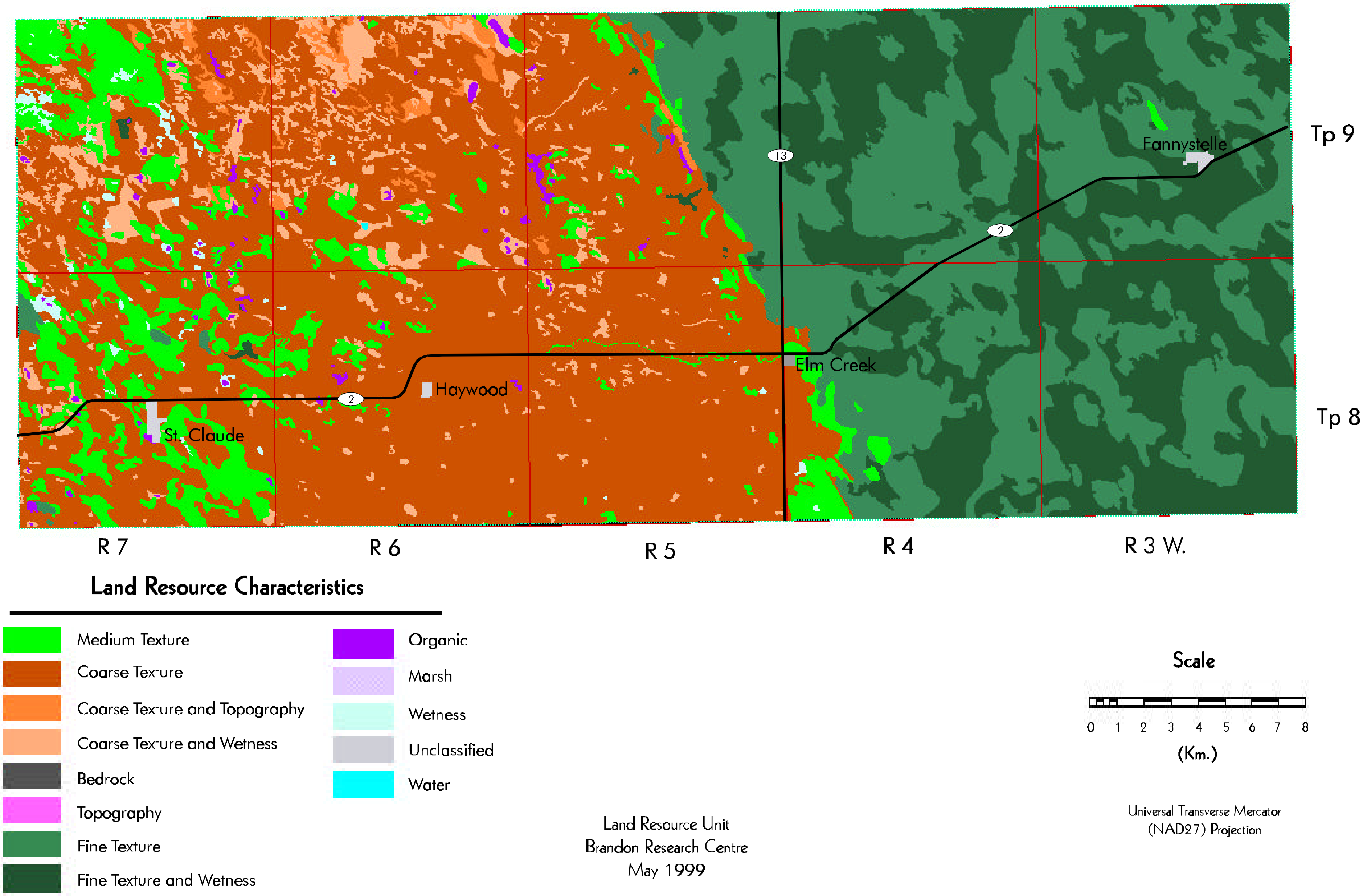
R = Bedrock - soil landscapes that have shallow depth to bedrock (< 50 cm) and/or exposed bedrock which may prevent the use of some or all tillage practices as well as the range of potential crop. They require special cropping and management practices to sustain agricultural production.

Table 5. Management Considerations[1]

Land Resource Characteristics	**Area (ha)**	**Percent of RM**
Fine Texture	**22161**	**22.9**
Fine Texture and Wetness	**19075**	**19.7**
Fine Texture and Topography	**0**	**0.0**
Medium Texture	**7792**	**8.0**
Coarse Texture	**41257**	**42.6**
Coarse Texture and Wetness	**4566**	**4.7**
Coarse Texture and Topography	**944**	**1.0**
Topography	**0**	**0.0**
Bedrock	**0**	**0.0**
Wetness	**462**	**0.5**
Organic	**461**	**0.5**
Marsh	**0**	**0.0**
Unclassified	**154**	**0.2**
Water	**8**	**0.0**
Total	**96878**	**100.0**

[1] Based on **dominant** soil series for each soil polygon.

Management Considerations Map



Agricultural Capability Map.

This evaluation utilizes the 7 class Canada Land Inventory system (CLI, 1965). Classes 1 to 3 represent the prime agricultural land, class 4 land is marginal for sustained cultivation, class 5 land is capable of perennial forages and improvement is feasible, class 6 land is capable of producing native forages and pasture but improvement is not feasible, and class 7 land is considered unsuitable for dryland agriculture. Subclass modifers include structure and/or permability (D), erosion (E), inundation (I), moisture limitation (M), salinity (N), stoniness (P), consolidated bedrock (R), topography (T), excess water (W) and cumulative minor adverse characteristics (X).

This generalized interpretive map is based on the dominant soil series and phases for each soil polygon. The CLI subclass limitations cannot be portrayed at this generalized map scale.

Table 6. Agricultural Capability[1]

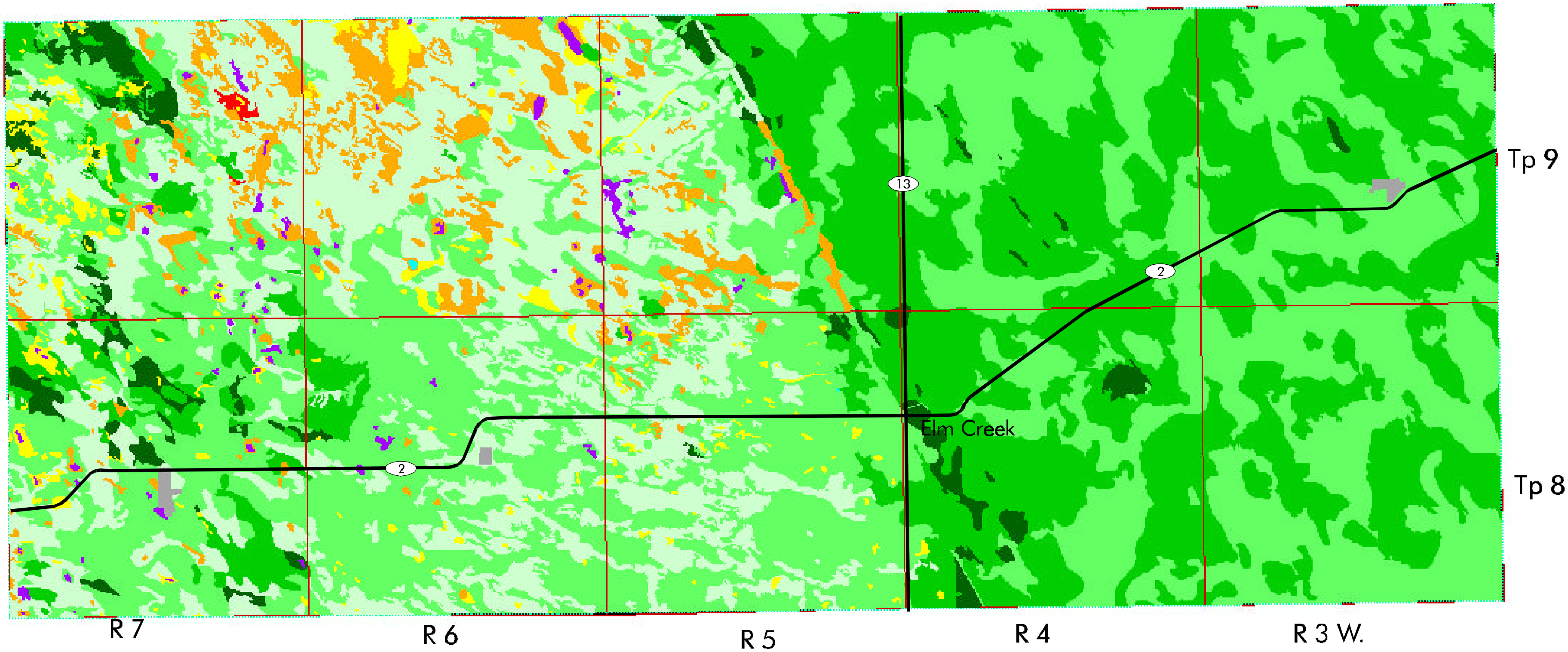
Class / Subclass	**Area (ha)**	**Percent of RM**
1	**2354**	**2.4**
2	**25931**	**26.8**
2DW	61	0.1
2M	3485	3.6
2T	72	0.1
2W	22300	23.0
2X	13	0.0
3	**42153**	**43.5**
3I	70	0.1
3M	19822	20.5
3ME	96	0.1
3N	126	0.1
3NW	84	0.1
3W	21955	22.7

Table 6. Agricultural Capability[1] (cont)

Class / Subclass	**Area (ha)**	**Percent of RM**
4	**20174**	**20.8**
4M	18957	19.6
4ME	12	0.0
4N	36	0.0
4W	1169	1.2
5	**1788**	**1.8**
5W	1788	1.8
6	**3792**	**3.9**
6M	1478	1.5
6MT	161	0.2
6W	2126	2.2
6WI	28	0.0
7	**64**	**0.1**
7E	64	0.1
Unclassified	**154**	**0.2**
Water	**8**	**0.0**
Organic	**461**	**0.5**
Total	**96878**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Agriculture Capability Map



Canada Land Inventory Classes

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 6
- Class 7
- Organic
- Unclassified
- Water

Scale

0 1 2 3 4 5 6 7 8

(Km.)

Manitoba Land Resource Unit
Brandon Research Centre
August 1996

Universal Transverse Mercator
(NAD27) Projection

Irrigation Suitability Map.

Irrigation ratings are based on an assessment of the most limiting combination of soil and landscape conditions. Soils in the same class have a similar relative suitability or degree of limitation for irrigation use, although the specific limiting factors may differ. These limiting factors are described by subclass symbols at detailed map scales. The irrigation rating system does not consider water availability, method of application, water quality, or economics of irrigated land use.

Irrigation suitability is a four class rating system. Areas with no or slight soil and or landscape limitation are rated **Excellent** to **Good** and can be considered irrigable. Areas with moderate soil and/or landscape limitations are rated as **Fair** and considered marginal for irrigation providing adequate management exists so that the soil and adjacent areas are not adversely affected by water application. Soil and landscape areas rated as **Poor** have severe limitations for irrigation.

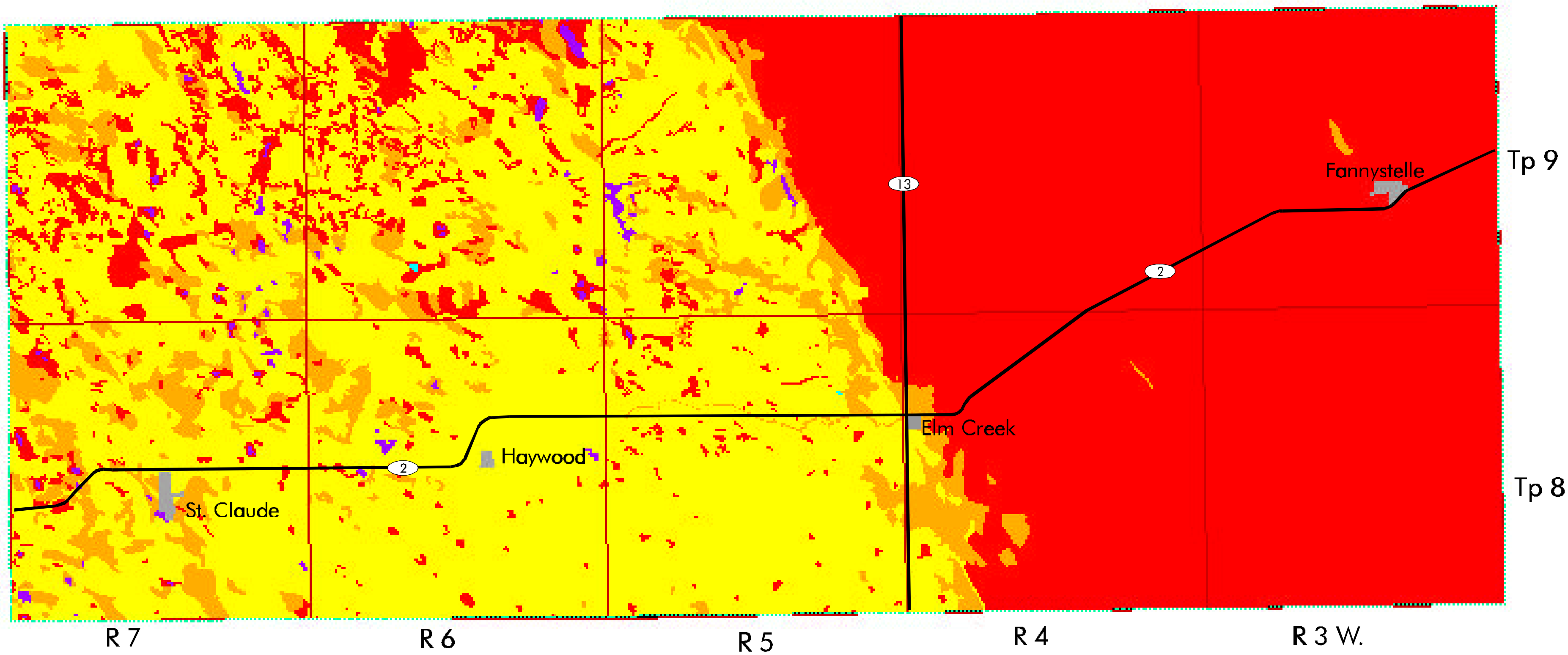
This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class. The nature of the subclass limitations and the classification of subdominant components is not shown at this generalized map scale.

Table 7. Irrigation Suitability[1]

Class	Area (ha)	Percent of RM
Excellent	**0**	**0.0**
Good	**41905**	**43.3**
Fair	**7880**	**8.1**
Poor	**46471**	**48.0**
Organic	**461**	**0.5**
Unclassified	**154**	**0.2**
Water	**8**	**0.0**
Total	**96878**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Irrigation Suitability Map



Irrigation Suitability Classes

- Excellent
- Good
- Fair
- Poor
- Organic
- Unclassified
- Water

Scale

0 1 2 3 4 5 6 7 8

(Km.)

Manitoba Land Resource Unit
Brandon Research Centre
August 1996

Universal Transverse Mercator
(NAD27) Projection

Potential Environmental Impact Under Irrigation Map.

A major concern for land under irrigated crop production is the possibility that surface and/or ground water may be impacted. The potential environmental impact assessment provides a relative rating of land into 4 classes (minimal, low, moderate and high) based on an evaluation of specific soil factors and landscape conditions that determine the impact potential.

Soil factors considered are those properties that determine water retention and movement through the soil; topographic features are those that affect runoff and redistribution of moisture in the landscape. Several factors are specifically considered: soil texture, hydraulic conductivity, salinity, geological uniformity, depth to water table and topography. The risk of altering surface and subsurface soil drainage regimes, soil salinity, potential for runoff, erosion and flooding is determined by specific criteria for each property.

Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

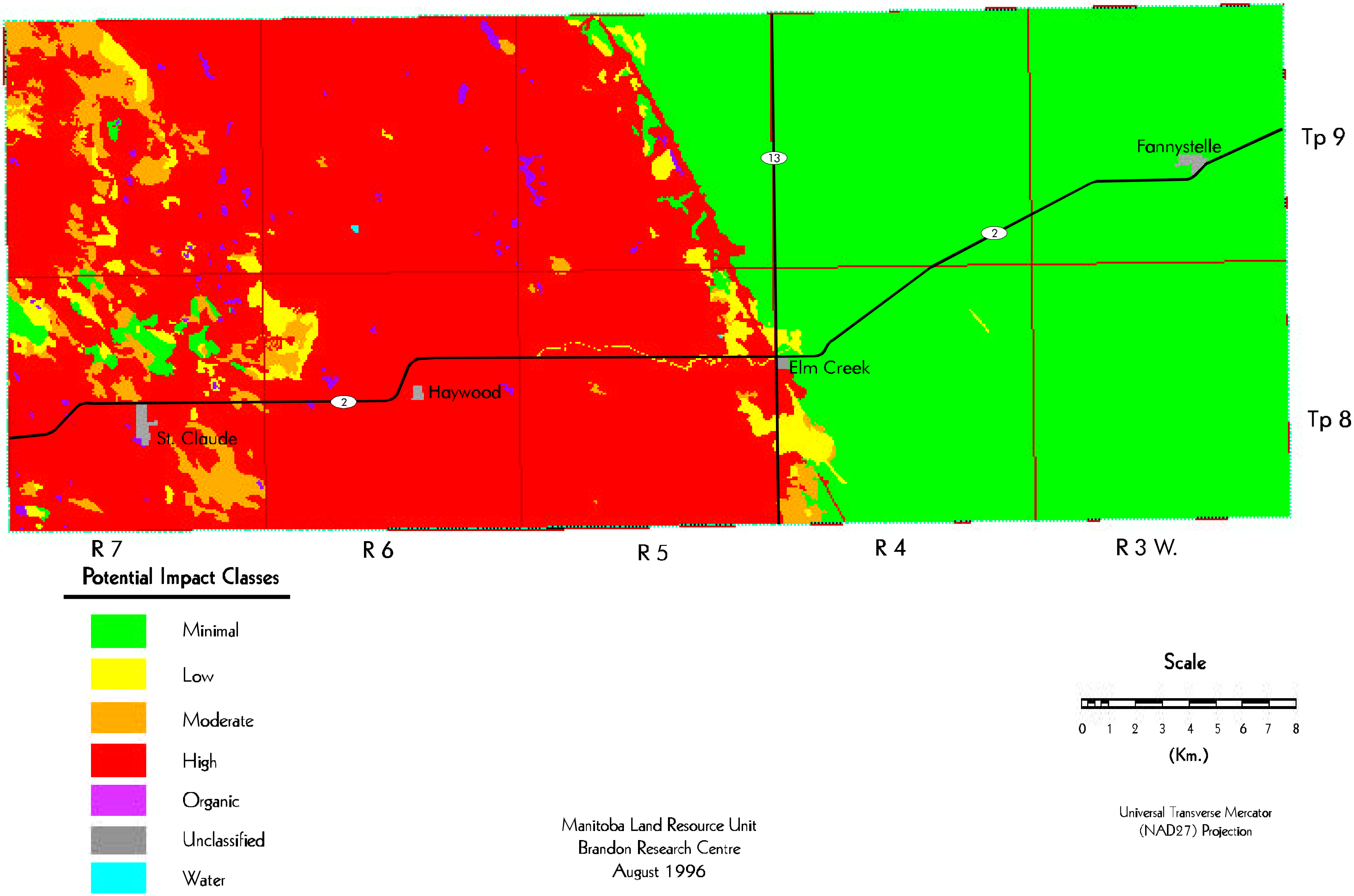
This generalized interpretive map is based on the dominant soil series and slope class for each soil polygon. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

Table 8. Potential Environmental Impact Under Irrigation[1]

Class	Area (ha)	Percent of RM
Minimal	**42543**	**43.9**
Low	**2452**	**2.5**
Moderate	**3231**	**3.3**
High	**48030**	**49.6**
Organic	**461**	**0.5**
Unclassified	**154**	**0.2**
Water	**8**	**0.0**
Total	**96878**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Potential Environmental Impact Under Irrigation



Water Erosion Risk Map.

The risk of water erosion was estimated using the universal soil loss equation (USLE) developed by Wischmeier and Smith (1965). The map shows 5 classes of soil erosion risk based on bare unprotected soil:

negligible
low
moderate
high
severe.

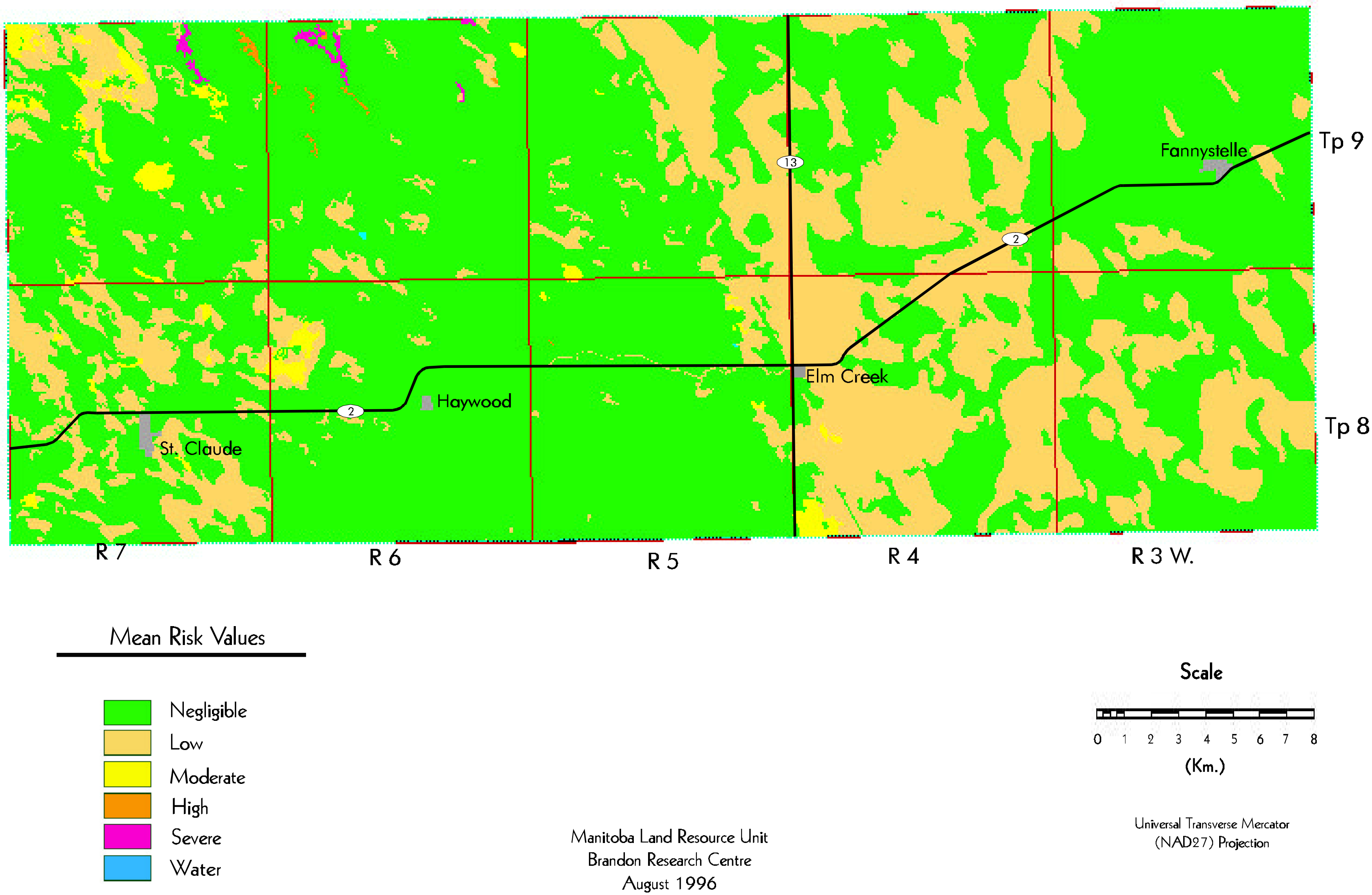
Cropping and residue management practices will significantly reduce this risk depending on crop rotation program, soil type, and landscape features.

Table 9. Water Erosion Risk[1]

Class	Area (ha)	Percent of RM
Negligible	**69441**	**71.7**
Low	**25778**	**26.6**
Moderate	**1237**	**1.3**
High	**99**	**0.1**
Severe	**161**	**0.2**
Unclassified	**154**	**0.2**
Water	**8**	**0.0**
Total	**96878**	**100.0**

[1] Based on **dominant** soil, slope gradient, and slope length of each soil polygon.

Water Erosion Risk Map



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Brandon Research Centre
August 1996

Land Use Map.

The land use classification of the RM has been interpreted from LANDSAT satellite imagery, using supervised computer classification techniques. Many individual spectral signatures were classified and grouped into the seven general land use classes shown here. Although land use changes over time, and some land use practices on individual parcels may occasionally result in similar spectral signatures, this map provides a general representation of the current land use in the RM.

The following is a brief description of the land use classes:

Annual Crop Land - land that is normally cultivated on an annual basis.

Forage - perennial forages, generally alfalfa or clover with blends of tame grasses.

Grasslands - areas of native or tame grasses, may contain scattered stands of shrubs.

Trees - lands that are primarily in tree cover.

Wetlands - areas that are wet, often with sedges, cattails, and rushes.

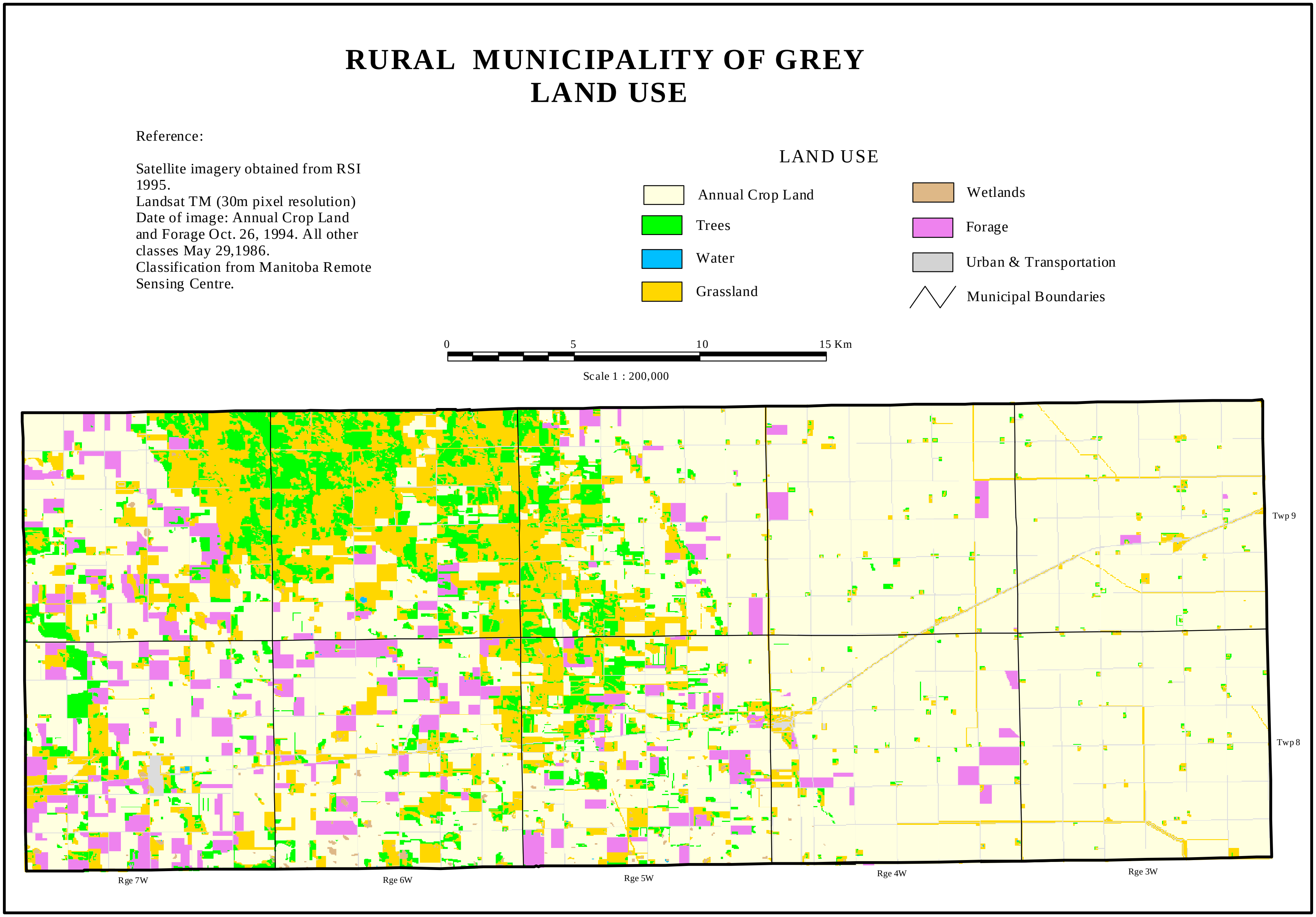
Water - open water - lakes, rivers streams, ponds, and lagoons.

Urban and Transportation - towns, roads, railways, quarries.

Table 10. Land Use[1]

Class	Area (ha)	Percent of RM
Annual Crop Land	**65398**	**67.0**
Forage	**6228**	**6.4**
Grasslands	**13883**	**14.2**
Trees	**7892**	**8.1**
Wetlands	**214**	**0.2**
Water	**27**	**0.0**
Urban and Transportation	**3911**	**4.0**
Total	**97553**	**100.0**

[1] Land use information (1995) and map supplied by Prairie Farm Rehabilitation Administration. Areas may vary from previous maps due to differences in analytical procedures.


RURAL MUNICIPALITY OF GREY
LAND USE
Reference:
Satellite imagery obtained from RSI 1995.
Landsat TM (30m pixel resolution)
Date of image: Annual Crop Land and Forage Oct. 26, 1994. All other classes May 29,1986.
Classification from Manitoba Remote Sensing Centre.
LAND USE
Annual Crop Land
Trees
Water
Grassland
Wetlands
Forage
Urban & Transportation
Municipal Boundaries
0
5
10
15 Km
Scale 1 : 200,000
Twp 9
Twp 8
Rge 7W
Rge 6W
Rge 5W
Rge 4W
Rge 3W

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