Agricultural Land Use and Management in the East Duck Mountain Sagemace Bay Watershed

Submitted by

Agriculture and Agri-Food Canada – Agri-Environment Services Branch (AESB)

and

Manitoba Agriculture Food and Rural Initiatives (MAFRI)

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A. Executive Summary

The East Duck Mountain Sagemace Bay Watershed is approximately 430,632 ha in size and is located between the Duck Mountains and Lake Winnipegosis in the northwestern portion of Manitoba's agricultural extent. An integrated watershed management plan is being developed for this watershed by the Intermountain Conservation District (IMCD) in collaboration with Manitoba Water Stewardship and numerous other stakeholders.

Understanding changes in agricultural land use is essential for the development of an integrated watershed management plan. The overall objective of this report is to examine risks to key watershed resources by analyzing the physical characteristics of the landscape with consideration for how specific agricultural activities may be influencing them. This analysis also assists in identifying where soil and water management efforts could be directed to help address priority issues or identified risks within the watershed.

An assessment of the subwatersheds within the watershed provides an examination over time of the various agricultural activities in the in the East Duck Mountain Sagemace Bay Watershed. Census of Agriculture data, temporal in nature, illustrates influences from external factors like weather, government programs and policies, market drivers, and technology on land use and land management decisions and the community response to those interactions. Such events, with an examination of a watershed's physical resource characteristics and risks, assist to develop an understanding of potential impacts on the basin's water quality, and identify opportunities for future sustainable land use strategies. This is particularly important to the East Duck Integrated Watershed Management Plan where public consultations identified five key categories of concern: Surface Water Management, Groundwater Management, Source Water Protection, Soils and Land Use, and Habitat Impacts.

Ag-Profiling examines variables from 2006 Census of Agriculture database depicted over three subwatershed regions, including farm area, type of farm, cropping practices, tillage practices, fertilizer and pesticide use, financial activity, and livestock numbers. From a time period of 1971 to 2006, the same variables from Census of Agriculture data were used to analyze trends. Land cover data from 1994, 2001, and 2006, based on LANDSAT Thematic Mapper satellite imagery, were used to examine temporal changes in land cover. Using soils data and modeling, environmental indicators were developed for Agricultural Capability, Wind and Water Erosion Risks, and Soil Drainage characteristics. These were examined in combination with the annual cropland identified in the 2006 and 2000 land cover mapping. A review of recent federal and provincial policies and programs was conducted to assess their impact on agricultural land use and management.

Results identify the East Duck Mountain Sagemace Bay Watershed as a diverse agricultural landscape. Differences are evident from the northern portion of the watershed compared to the south and eastern areas with respect to cropping practices, crop types, and types and number of livestock and poultry. Farms in the southern part of the watershed tend to be larger, while the number of farms is decreasing across the watershed. A look at the farm financial activity shows that farms in the south tend to be more profitable, perhaps due to the larger livestock industry in these subwatersheds. Beef production is the dominant livestock industry with similar size herds in each of the three watershed regions. The southern portion of the watershed tends to rely less on commercial fertilizers than the northern regions, likely due to the better farmland located in the south. The areas of rented lands versus owned lands continue to rise, showing a significant dependency on crown lands. Increases are occurring in tame or seeded pastures; corresponding to moderate increases in cattle numbers across the watershed as well. Tillage practices changed over the past 35 years with an increase in conservation or zero tillage and a decrease in summerfallowed and conventionally tilled areas. Conventional tillage and summerfallow, however, continue to be a significant farming practice, particularly in the northern portion of the watershed. Slight increases were also noted to areas seeded to oilseeds.

Analysis of land cover data over a 12-year period corresponds well with the Census data, particularly on changes like the conversion of annual cropland to forages and grasslands, which occurred at a time where external drivers such as the elimination of the Western Grain Transportation subsidy influenced local land use changes. Analysis of soils under annual cropland showed trends toward improved management, with a decreasing amount of annual cropland on Canadian Landuse Inventory (CLI) Class 4 land or lower, on lands with a severe or high wind erosion risk, and on imperfectly drained soils. Areas were identified and mapped within the watershed where the combination of annual cropping and landscape risk factors such as wind erosion, agricultural capability, and drainage indicate special management of these lands may need to be considered. An examination of land cover data changes was undertaken to identify changes in landcover with respect to grasslands, wetlands, forestry and forages and how they relate to the issues of flooding and land conversion. The identification of annual cropland within a 50 m buffer to waterways that has a high or severe water erosion risk indicates a significant area that could contribute to water quality issues because of the likelihood of transport of sediment and nutrients to nearby waterways. Due to data limitations, all geographic analyses using land cover and soils data require further verification such as groundtruthing for accuracy assessment.

Crown lands within the East Duck Mountain Sagemace Bay Watershed study area are an integral part of the agricultural industry. Since the beginning of the settlement period, crown lands have provided an effective and an economical means for forage, as indicated in the high level of rented lands according to census data. There are approximately 205,331 hectares of Crown Lands, representing 48% of the total watershed. Similarly, each of the subwatershed regions have anywhere from 30 to 60% of their landbase as crown lands. Approximately, 69% of the crown lands have a haying and grazing component available to them, with a very small percentage being haying only. Almost 10,000 hectares of the Crown lands are federally administered community pastures.

The interest and willingness of producers within the watershed in addressing environmental issues was demonstrated by their participation in the Environmental Farm Plan (EFP) Program (2003-2008) and Canada-Manitoba Farm Stewardship Program (CMFSP), two key environment based programs under the Agricultural Policy Framework (APF). Eighty-eight (88) beneficial management practice (BMP) projects were completed between 2003 and 2008 with financial and technical assistance through the CMFSP. Of these projects, almost 50% were non-point source crop related and 30 BMPS were for point-source protection (Livestock Manure Related (17) and-other (13)).

Based on the analysis of issues related to drinking water quality and surface water quality, considerations for marginal land management options such as the adoption of BMPs for sustainable land management, water erosion mitigation practices such as grassed waterways, buffer establishment, and land conversion to forages, as well as promoting BMPs that will reduce nutrient transport to waterbodies should be considered. Recommendations related to surface water quantity issue, include a surface water management assessment study to assess water storage potential as well as implementing BMPs for flood control and to restore wetlands. Land management BMPs like perennial cover crops are also recommended for lands that are class 4 and lower, prone to water erosion and/or flooding. Other BMPs, such as cover crops and residue management, as well as, shelterbelt establishment, should be promoted where wind erosion is an issue. Potential indicators were also identified for each recommendation to allow the Integrated Watershed Planning Process to evaluate progress related to addressing the issue in the future.

B. Acknowledgements:

The following individuals contributed to the compilation, interpretation, and derivation of information contained in this submission.

AAFC-AESB: Holweger, U., Michiels, P., Powers, J., Vanrobaeys, J., Bogdan, D., McBurney, M., Kopytko, M.

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C. Preface

In 2008, the Intermountain Conservation District (IMCD) was designated as the Watershed Planning Authority to initiate an Integrated Watershed Management Plan for the East Duck Mountain Sagemace Bay Watershed study area. A Project Management Team (PMT) was formed to guide the watershed planning process. A formal request was made on behalf of the PMT and Manitoba Water Stewardship to Agriculture and Agri-Food Canada - Agri-Environment Services Branch (AAFC-AESB) and Manitoba Agriculture Food and Rural Initiatives (MAFRI) to provide technical support as it relates to their respective mandates (See Appendix A) in support of developing the plan.

This report focuses on information related to agricultural activities and land resources in the watershed. It is important to note that in addition to agriculture, there are other industries, sectors, and users of the watershed's resources that also have an impact on the watershed. As there are scale and accuracy limitations associated with the available data (including soils, land cover, and Census of Agriculture data), it should be noted that the information contained within this report does not replace the need for site-specific analysis; rather, it serves as a guide for general planning purposes in the East Duck Mountain Sagemace Bay Watershed study area. More information on the data used in this document can be found within the Appendices section of the report.

D. Introduction

The East Duck Mountain Sagemace Bay Watershed is a significant watershed in the northwest portion of Agro-Manitoba and it serves as the headwater area to Lake Winnipegosis. The watershed is approximately 430,632 ha in size (refer to Figure 1). Originating in the Duck Mountains, surface water in the East Duck Mountain Sagemace Bay Watershed flows in an easterly direction from the Duck Mountains into Lake Winnipegosis. Eight communities are located within the watershed including Camperville, Cowan, Duck Bay, Ethelbert, Fork River, Garland, Pine River, and Winnipegosis.

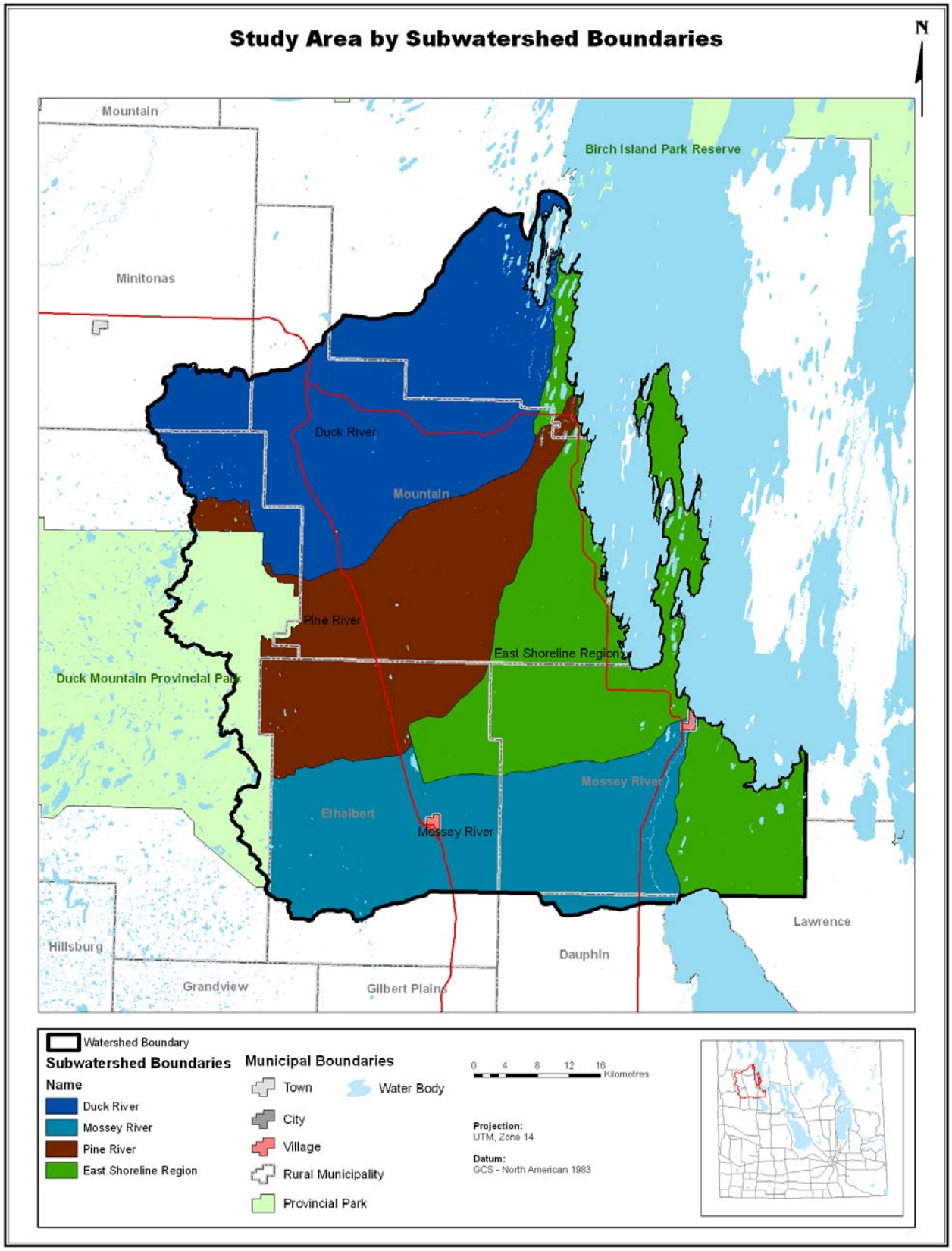
The East Duck Integrated Watershed Management Plan (IWMP) Area is defined by the watershed boundary (***Figure 1)***. The physiographic and demographic features of the watershed lend themselves to a grouping of four distinct regions used for the analysis in this report and where data was available at this scale.

Objective

Understanding the current state and trends in agricultural land use and practices along with landscape characteristics is essential for developing an integrated watershed management plan. Agricultural land use and associated land cover can influence watershed processes and impact issues like water quality and hydrological flow within the watershed. Understanding these factors contributes to developing sustainable land use strategies that will lead to a healthier and more ecologically functioning landscape. To better understand agricultural changes and impacts within the watershed, PFRA and MAFRI partnered to analyze agricultural aspects, focusing on the key issues identified during the 2008 public consultations associated with this IWMP. **Specifically, the document examines the following in order to help guide watershed management:**

1. **"Near-Current" Agricultural Land Use and Management using the latest available Census of Agriculture data and satellite imagery**
2. **Trends in agricultural land use and management using 1971 to 2006 Census of Agriculture data and a time series of satellite imagery**
3. **Land cover data in combination with landscape risk factors pertaining to the soil and water resource**
4. **The impact of recent federal and provincial initiatives, policies and regulations impacting agricultural land management and land use planning activities in the watershed**

Figure 1: East Duck Mountain Sagemace Bay Watershed Study Area and Four Subwatershed Groupings



E. Agricultural Land Use and Management

i. Current Agricultural Land Use of the East Duck Mountain Sagemace Bay Study Area

a) Agricultural Profile

Agricultural profiling refers to the characterization of agricultural production in an area or a region. The ability to use Census of Agriculture information collected from producers can provide a snapshot in time of the various agricultural activities on the landscape. The information can be portrayed either on a municipal or geographical boundary (like a watershed) and can provide an understanding of the influence and trends of the industry within the area.

Census of Agriculture data at a subwatershed scale has been obtained from Statistics Canada for the 2006 Census year. Further details on the method used to interpolate Statistics Canada's Census of Agriculture data from a geographic boundary to a subwatershed boundary are provided in ***Appendix B***. For reporting purposes, numbers have been rounded to the nearest 5 for farm numbers, 10 for livestock and smaller area data, and 100 for poultry, financial data and for larger areas.

Due to the different boundaries between the IWMP study area and the Manitoba Watershed layer which has the Census data rolled up to a subwatershed boundary, only 73% of the watershed can be accurately represented in the following agricultural profile. For the purpose of this report, three areas will be described with respect to agricultural activities (***Table 1)***. The Duck Subwatershed can be described as the area draining into the Drake, North Duck and Sclater Rivers. The Pine Subwatershed refers to the area which drains into North Pine, South Pine and Garland Rivers. The Mossey Subwatershed is the area drained by the Mossey River, including the Fishing and Fork Rivers (not including Dauphin Lake). Table 1 lists these subwatersheds with their respective sizes.

Table 1 - Subwatershed Groupings

Subwatershed name	Area (hectares)	Percent of East Duck Mountain/Sagemace Bay IWMP study area
Duck	128,600	28%
Pine	111,353	24%
Mossey	96,978	21%

In the subsequent sections, a profile of land use and land management, as well as farm financial characteristics, will describe agriculutural activities in each of these three subwatersheds. A comparison of these profiles for the three subwatersheds follw each section and will provide an understanding of the differences in the agricultural industry within the East Duck/Sagemace Bay Watershed. Further information on the profile information are provided in table format in ***Appendix C***.

Summary of Land Use and Land Management

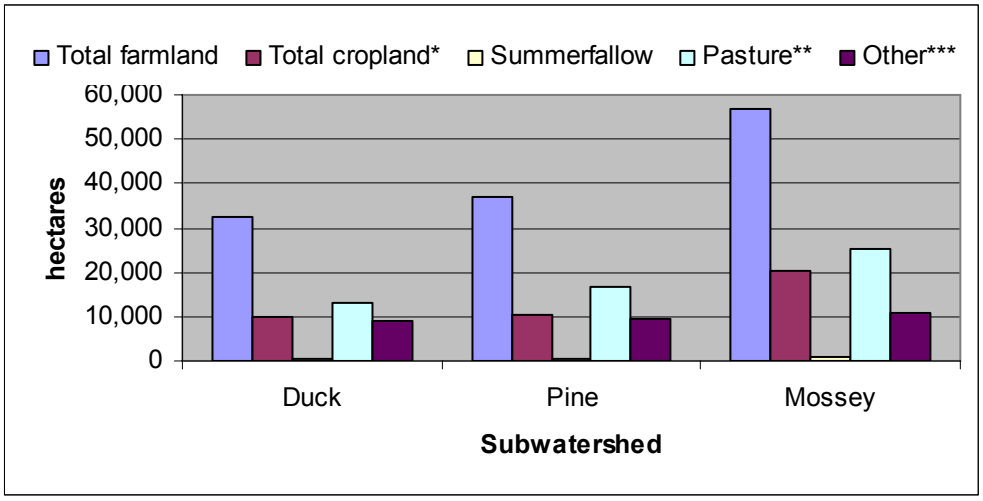
Duck River Subwatershed:
According to the 2006 Census of Agriculture data, almost 20% of the farmland in the Duck Subwatershed was dedicated to annual crop production and 55% to pasture, alfalfa, and hay and fodder crops. Cereals made up over 30% of the cultivated land while almost 20% was seeded to oilseeds (mostly canola). There was little to no pulse crops reported, but almost 45% of the cultivated land was in forages. Land management practices included over 60% of the cultivated land prepared using conventional tillage practices, while the remaining area was prepared using conservation or zero tillage. Beef production was the main livestock raised in the area, with 35 farm operations reporting beef cows with an average of over 75 cows per farm. Total cattle and calves in the area added up to almost 5,400 animals. Approximately 5 farms reported poultry with an average flock size of almost 75 birds per farm, for a total of over 350 birds in the subwatershed. Fewer than 5 farms reported pig production.

Pine River Subwatershed:
In 2006, almost 15% of the farmland in the Pine Subwatershed was dedicated to annual crop production and another 60% to pasture, alfalfa, and hay and fodder crops. Cereals made up almost 30% of the cultivated area and oilseeds another 10%. Forages made up over half of the cultivated land. Land management practices included almost 65% of the cultivated land managed using conventional tillage practices, 10% using conservation tillage practices and over 25% prepared with zero tillage. Over 5 farms had poultry with an average flock size of 75 birds per farm for a total of almost 500 birds reported. Fewer than 5 operations reported pigs. Beef production is the main livestock type in the subwatershed, with over 40 farm operations in the subwatershed reporting beef cows, an average of over 75 cows per farm. Total cattle and calves reported in the area added up to almost 6,300 animals.

Mossey River Subwatershed:
In the Mossey Subwatershed, about 20% of the farmland was dedicated to annual crop production and over 60% to pasture, alfalfa, and hay and fodder crops. Cereals made up over 30%of the cultivated land while over 10% was seeded to oilseeds. Forages covered almost 45% of the cultivated land. Land management practices included almost 40% of the cultivated land prepared using conventional tillage practices, almost 35% using conservation tillage practices and 20% prepared with zero tillage. Fewer than 10 farms reported poultry with an average flock size of about 60 birds per farm, for a total of around 550 birds in the subwatershed. Less than 5 operations reported pig production. Over 70 farm operations reported beef cows, with an average of over 75 cows per farm. Total cattle and calves reported in the area added up to almost 11,700 animals.

In comparing the three sub-watersheds, although Mossey has more reported total farmland, all had a similar proportion of each agricultural land use type, as reported by farmers (***Figure 2***). In all three subwatersheds, cropland made up around 30% of the total farmland reported (with Mossey a little higher), summerfallow 1%, pasture almost 45% (with Duck having slightly less) and other land uses ranging from 29% in Duck to almost 20% in Mossey.

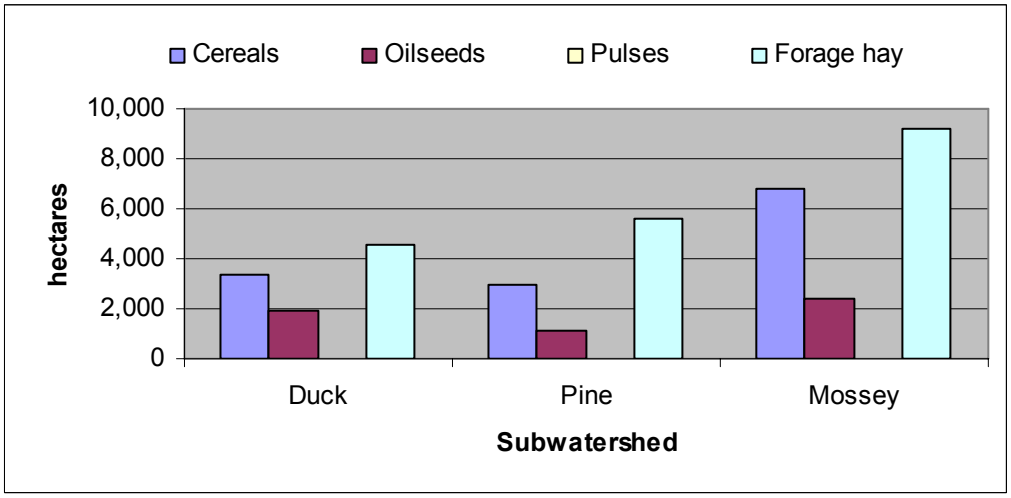
Figure 2 - Distribution of Agricultural Land Use (2006 Census of Agriculture)



* Total cropland includes all field crops, vegetables, fruit and nuts and sod
** Pasture includes tame pasture and natural areas used for pasture
*** Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.

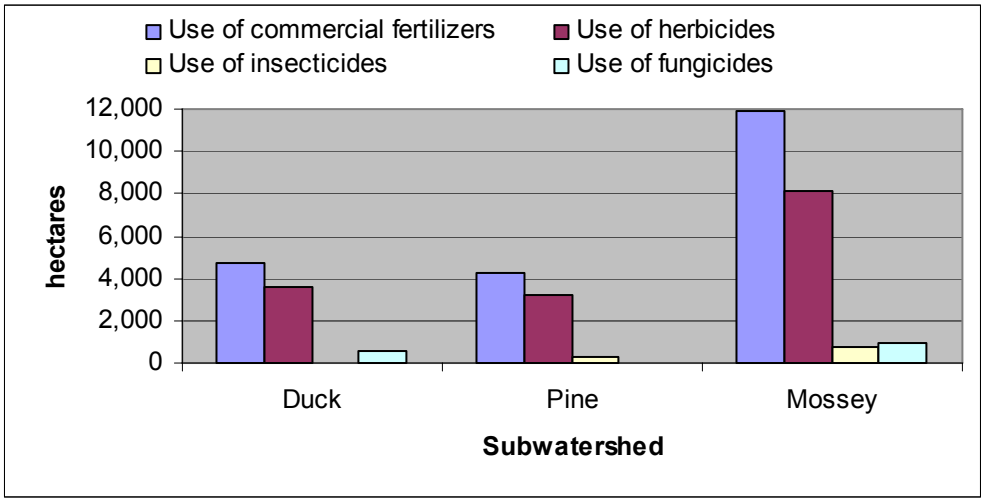
The main crops grown in 2006 in the study area were wheat, barley, oats, canola and forages for hay and feed (***Figure 3)***. In all three subwatersheds, seeded forages made up the majority of the crops; in Pine, it made up over half of the cropland, while slightly less then half of the other two subwatersheds, Approximately one third of the cropland was dedicated to cereals. Oilseeds, which consisted mainly of canola, made up about 10% in Mossey and Pine, and 20% in the Duck Subwatershed.

Figure 3 - Distribution of the main crop types grown in the East Duck Mountain/Sagemace Watershed (2006 Census of Agriculture)



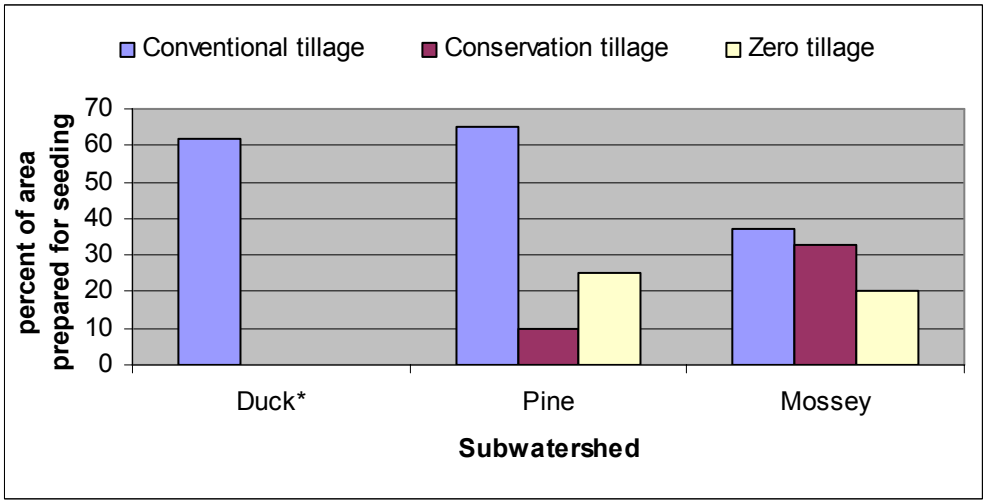
As Mossy has a larger cropland area, it also has a larger area treated to crop inputs. Farmers in Mossey applied fertilizer and herbicides to 60% and 40% of the cropland, respectively. In the other two subwatersheds, these numbers are less, with Pine having this lowest proportion of cropland with crop inputs (***Figure 4)***.

Figure 4 - Area treated to crop inputs in the 2005 crop year (2006 Census of Agriculture)



With respect to seedbed preparation, tillage practices tend to be dominantly conventional with over 60% of the cropland prepared for seeding using conventional tillage practices in the Duck and Pine subwatersheds. In the Mossey subwatershed, just over half of the cropland was managed using conservation and zero tillage (***Figure 5)***.

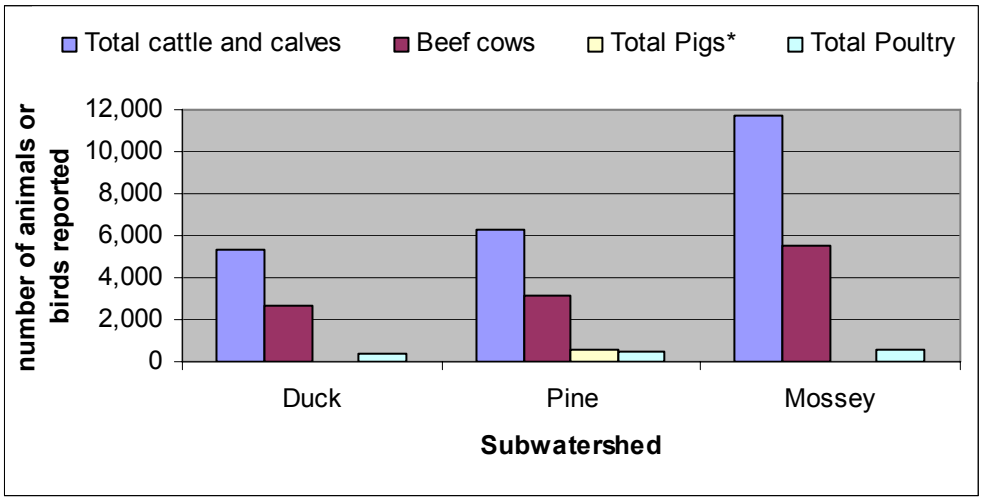
Figure 5 - Tillage practices in the East Duck study area (2006 Census of Agriculture)



* Area of cultivated land prepared using conservation or zero tillage has been suppressed by Statistics Canada to preserve confidentiality

Figure 6 summarizes the livestock numbers in the East Duck Mountain/Sagemace Watershed. The livestock industry is important in all three subwatersheds, though beef production is the main livestock present. In all three subwatersheds, beef cows make up about half of the total cattle and calves number, indicating that cow/calf operations are dominant. Pigs and poultry production is present, though only in small numbers.

Figure 6 - Total livestock numbers in the East Duck Mountain/Sagemace Watershed (2006 Census of Agriculture)



* Some suppression of total pig numbers occur in the Duck subwatershed

Total Animal Units (AU) produced in the watershed has been estimated using Manitoba's AU coefficients (based on annual nitrogen production) and by making several assumptions (refer to ***Appendix C***). As represented in ***Table 2***, cattle and calves, consisting mainly of beef cattle, contributed the majority of animal units produced in each of the subwatersheds (over 90% in Pine and Mossey, over 80% in Duck). Since beef production consists of mainly cow/calf operations, it is assumed that manure nitrogen (and phosphorous) will be deposited on pastureland naturally by the animals during the grazing season, and accumulated in more concentrated areas during the winter season.

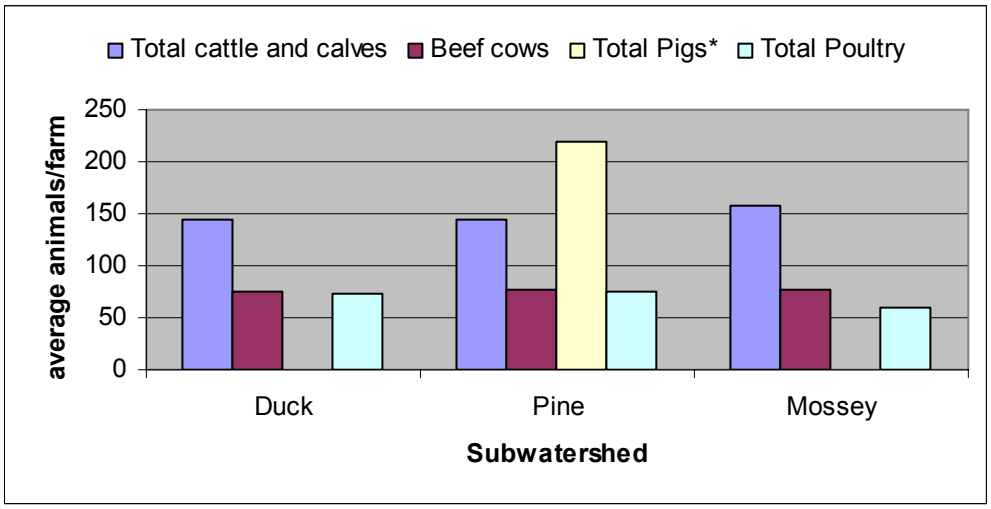
Table 2 - Estimated annual animal units produced in the three subwatersheds of East Duck Study Area* (according to the number of livestock reported on Census day, 2006)

Livestock Type	Animal Units (AU)			Total Animal Units
	Duck	Pine	Mossey	
Total Cattle and Calves	3,599	4,176	7,479	15,254
Total Pigs	0*	0	0	0
Total Poultry	0	2	1	3
Total Horses and Ponies	688	290	160	1,138
Other livestock - sheep, goats, bison, elk)	0	10	0	10
TOTAL AU*	**4,287**	**4,478**	**7,640**	**16,405**

* some livestock numbers have been suppressed to preserve confidentiality of the Census data and are not included in the calculations of total animal units.

Intensity of the livestock industry can be determined by the average size of flocks and herds. In all three subwatersheds, the average number of animals or birds per farm is similar, though farms in Mossey tend to have slightly more cattle and calves per farm (***Figure 7)***. Pigs and poultry numbers are small in all subwatersheds and are likely for sustenance use or farm gate sales.

Figure 7- Average livestock or poultry per farm size in the East Duck Mountain/Sagemace Watershed (2006 Census of Agriculture)



* Suppression of total pig numbers occurs in Duck

Summary of Farm Financial Characteristics

Duck River Subwatershed:
In 2006, there were over 55 farms in the Duck subwatershed operating a total farm area equivalent to over 25% of the Subwatershed area. Generally, the average farm size (including rented and leased fields) was almost 570 ha/farm (1410 acres) with an average capital investment of almost $950 per hectare of farmland (or over $541,100 per farm). Livestock-related expenses per hectare of farmland were over $15/ha of farmland, while crop-related expenses were just over $100/ha. Per farm, profit was estimated to be almost $13,700 and the sales to expense ratio was reported to be 1.19 (farm operations received $1.19 gross revenue for every $1 of agricultural expense).

Pine River Subwatershed:
In the Pine Subwatershed, approximately 65 farm operations managed an area of farmland equivalent to almost 35% of the subwatershed area. Another 23% of this subwatershed falls within the Duck Mountains Provincial Park and is not available to agriculture. The balance of the land consists of bush and beaver wetlands that have been not considered agricultural in value. Generally, the average farm size was slightly over 565 ha/farm (1400 acres) and farms had an average capital investment of almost $810 per hectare or almost $457,800 per farm. Average livestock-related expenses per hectare of farmland were almost $19/ ha farmland, while crop-related expenses were 70/ha. Per farm, profit was estimated to be almost $8,500 and the sales to expense ratio was reported to be 1.13.

Mossey River Subwatershed:
In 2006, there were approximately 110 farms in the Mossey subwatershed reporting a total farm area equivalent to almost 60% of the Subwatershed area. Generally, the average farm size was over 515 ha/farm (almost 1280 acres) with an average capital investment of over $1,000 per hectare of farmland (or over $527,300 farm). Livestock-related expenses per hectare of farmland were $35/ha of farmland, while crop-related expenses were almost $90/ha. Per farm, profit was estimated to be almost $27,400 and the sales to expense ratio was reported to be 1.30.

When comparing the three subwatersheds, farm operations were large (over 500 ha (1235 acres) per farm), with the average farm in Mossey being slightly smaller than the average farm in the other two areas ***Figure 8***. Despite having a smaller area, Mossey contains almost twice as many farm operations as the other two subwatersheds. There was a trend of farms being larger in the west and smaller in the

east. In the descriptions above, farmland accounts for approximately a quarter of the area in both Duck and Pine Subwatershed. While the Provincial Park does cover another quarter of the Pine subwatershed, it only covers a very small portion of Ducks (less than 1%). A look at the farm financial activity shows that farms in Mossey tend to have slightly higher sales and expense activity. Estimated profit per farm was highest in Mossey and lowest in Pine (***Figure 9)***.

Figure 8 - Total number of farms and average farm size in the East Duck Mountain/Sagemace Watershed (2006 Census of Agriculture)

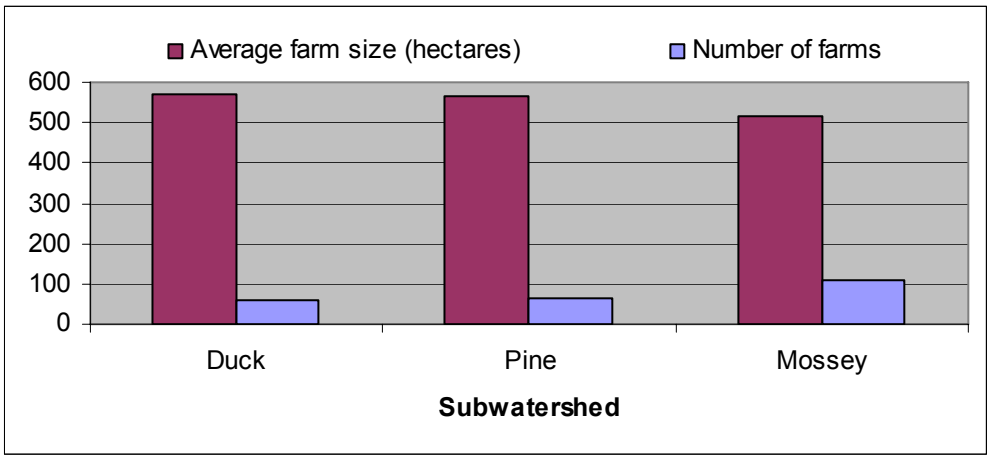
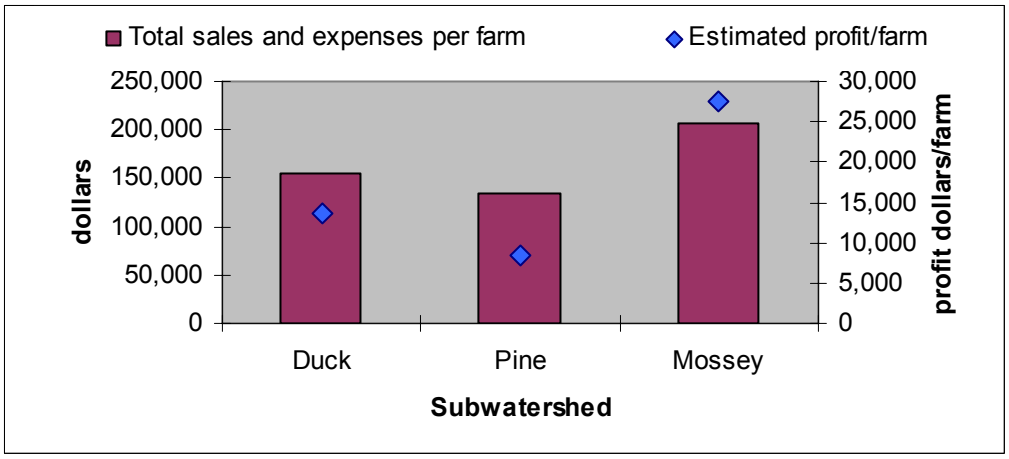
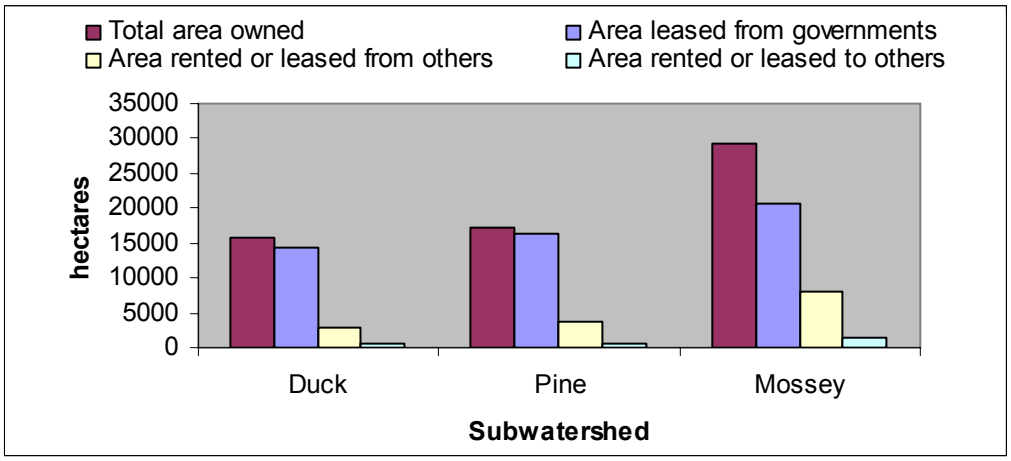


Figure 9 - Summary of farm financial activity for the 2005 calendar year (2006 Census of Agriculture)



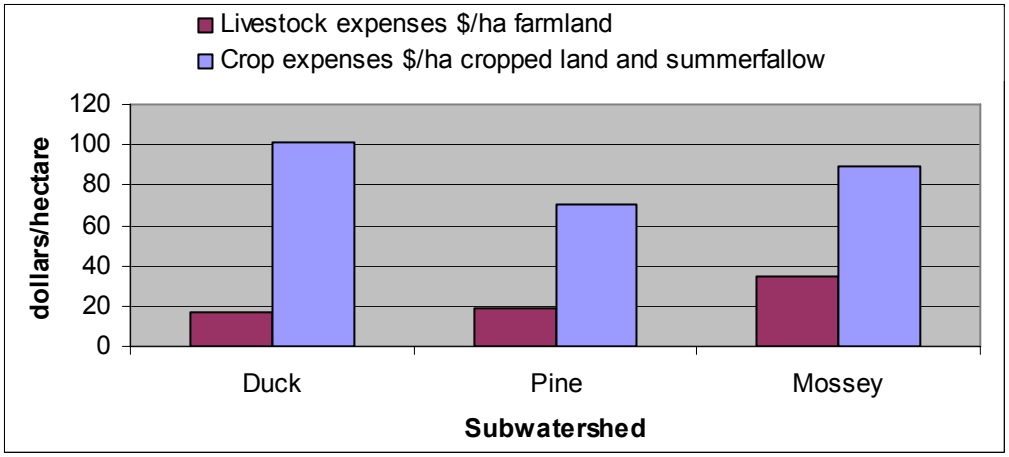
Land tenure is of interest in this watershed in that there is a significant amount of crown land leased to producers for agricultural purposes. In Duck and Pine, almost half of the land operated by farmers is leased from various levels of governments ***Figure 10***. In Mossey, the total area leased from governments is larger in the other two, though this makes up just over 35% of the total farmland. A small portion of the land is rented from other landowners in all three subwatersheds.

Figure 10 - Summary of land tenure as reported by producers in East Duck Mountain/Sagemace Watershed (2006 Census of Agriculture)



Livestock and crop-related expenses reported for the 2005 crop year have been determined on a per hectare basis. ***Figure 12*** shows that on average, farm operations in Mossey had slightly higher expenses for livestock production than those in Pine or Duck. Influencing factors could include herd size, differences in income, proximity to veterinarian services, etc. With respect to crop-related expenses, producers in the Duck subwatershed had the largest expense per hectare of cropped land and summerfallow. A closer look at the crop input costs could provide an explanation for this. Analysis shows that farms in Mossey spent the least on fertilizer and pesticides per ha compared to the other two (***Table 3***), indicating the possibility of higher prices for fertilizer and pesticides in Duck and Pine.

Figure 11 - Average livestock and crop-related expenses per hectare for the 2005 calendar year (2006 Census of Agriculture)



* Livestock-related expenses include total feed, supplements, and hay purchases, livestock and poultry purchases, veterinary services, drugs, semen, breeding feeds, etc

** Crop-related expenses include purchases of fertilizer, lime, herbicides, insecticides, fungicides, and seed and plant (excluding materials purchased for resale)

Table 3 - Average dollars per hectare spent on fertilizer and pesticides in the 2005 calendar year (2006 Census of Agriculture)

Subwatershed name	Dollars spent on fertilizer per hectare applied	Dollars spent on pesticides per hectare applied
Duck	$122.44	$76.06*
Pine	$99.24	$65.86*
Mossey	$83.74	$59.49

* Values are an overestimation, due to some suppression of data on area treated to insecticides or fungicides

2006 Agriculture Profile Summary

- Total farmland reported by producers in Pine and Duck is equivalent to an area approximately 35% and 25% of the respective subwatershed.
- In Pine and Duck, land leased from governments make up almost half of the farmland, and in Mossey, this amounts to about a third of the farmland.
- The average farm size was similar in all three subwatershed, with farms in Mossey tending to be more profitable.
- While producers in Mossey reported the spending the lowest amount on crop inputs per hectare of cropland and summerfallow, they also reported spending the greatest amount on livestock-related expenses. Producers in Duck spend the largest amount per hectare of cropland on crop-inputs.
- Although Mossey reported the most farmland, all three subwatersheds report similar proportions of cropland and pasture (both native and tame).
- The main crops grown in all three subwatersheds were cereals, canola and forages.
- Tillage practices in Duck and Pine tended to be conventional (over 60% of cropland), whereas in Mossey, conservation and zero tillage were used on just over 50% of the cropland.
- Beef production is the dominant livestock industry with similar size herds in all three subwatersheds. Hogs and poultry occur on a small scale and are likely more for sustenance or farm gate sales.

b) 2006 Land Cover Summary

Land cover data used for this analysis was derived from 30 metre resolution LANDSAT Thematic Mapper satellite imagery. The land cover data provides information on the spatial extent of general types of land cover within a given area at that point in time. For this report, the landcover analysis consisted of the 16 classes of landcover. Further details on the land cover data, acquisition dates and the constraints associated with this data are provided in ***Appendix D***.

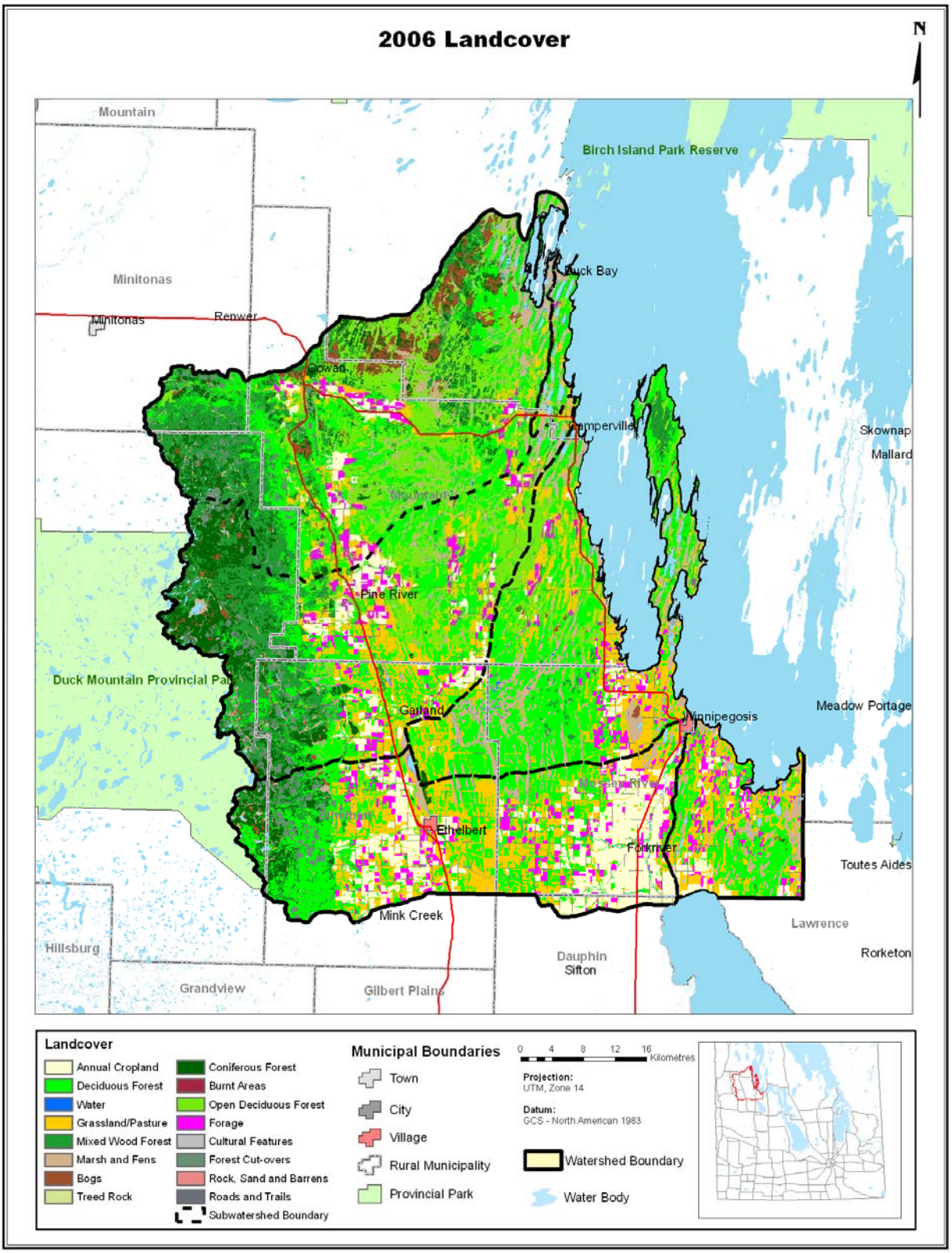
Summary of 2006 Land Cover

Forested lands (for the purposes of this document, “Forested Lands” is a combination of Deciduous, Mixed Wood, Coniferous, and Open Deciduous Forest classes) is the primary land cover in the East Duck Mountain Sagemace Bay as demonstrated by or as a result of forest being the dominant the land cover data (***Table 4, Figures 12 and 13)***. As part of the watershed occupies the Duck Mountain Provincial Forest, a majority of the forested area is located in the eastern and central portions of the watershed. In 2006, 38,667 ha (or 9%) of the land was classified as annual cropland, with the Mossey River subwatershed region having 4 times the amount of annual hectares than any other region (24,367 ha). Grassland/pasture areas cover 69,613 ha (16%) of the watershed and are more prevalent in the eastern and southern subwatersheds (Mossey River and East Shoreline Region). Forage land cover, mostly consisting of alfalfa stands, makes up about 5% of the watershed and is most common in the south and eastern subwatersheds (Mossey River and East Shoreline Region). A large treed area can also be found in the western portion of the East Duck Mountain Sagemace Bay Watershed along the Duck Mountain Escarpment. Marsh, Fens, and Open Water occupy significant portions of the watershed

(35,357 ha, 8%) and become significantly more common as one moves eastward through the subwatershed. Most of the wetland areas are marsh type landscapes that exist between old beach ridges formed from receding glacial lakes. Because there are few communities in the watershed, land classified as cultural along with roads and trails occupies the least amount of land within the watershed, accounting for only approximately 1%.

With respect to the four subwatershed regions, there is a clear distinction between the land cover of each of the regions and how it defines agricultural use within the region. The Mossey River subwatershed has the most impact to agriculture in the East Duck Mountain Sagemace Bay Watershed, as it has more, of the annual cropland and forages than any other region. More than 75% of the land cover is divided up between annual cropland, grasslands and deciduous forest. Forestry activities are greatest in the Duck and Pine River watersheds as noted by the larger amount of forest cutovers in these areas.

Figure 12 - 2006 Land Cover in the East Duck Mountain Sagemace Bay Watershed*



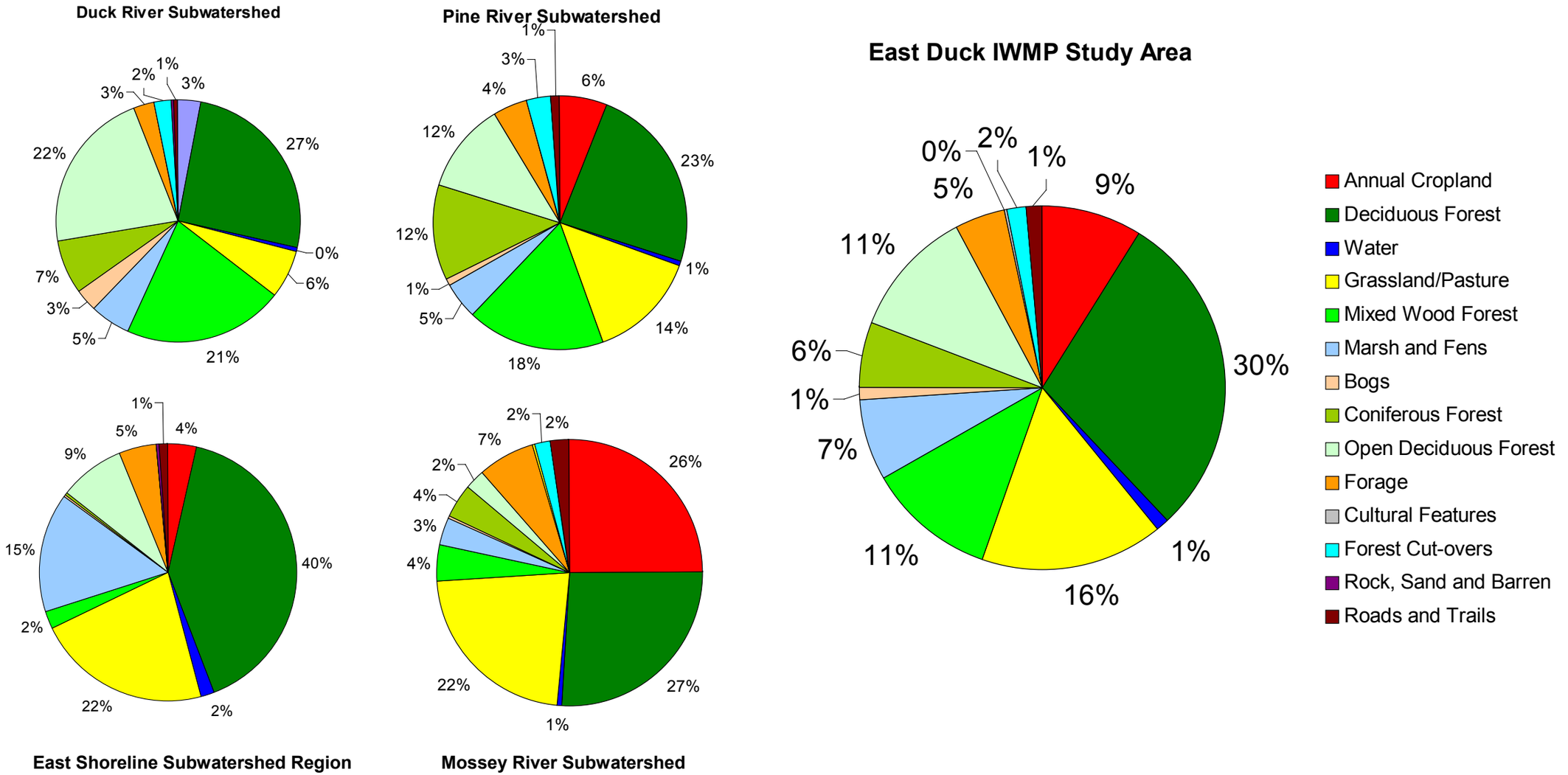
*The majority of the watershed land cover was derived from satellite imagery captured August 27, 2006,

Table 4 - 2006 Land Cover by Subwatershed (in hectares)*

NAME	Annual Cropland	Deciduous Forest	Water	Grassland /Pasture	Mixed Wood Forest	Marsh and Fens	Bogs	Coniferous Forest	Open Deciduous Forest	Forage	Cultural Features	Forest Cut-overs	Rock, Sand and Barren	Roads and Trails	Total
East Shoreline	4,342	47,222	2,145	25,755	2,600	17,376	333	266	9,978	5,529	22	17	103	1,362	117,050
Duck River	3,302	26,896	384	6,722	22,234	5,597	3,426	7,367	23,097	2,997	-	2,533	44	700	105,298
Pine River	6,657	26,594	822	15,451	19,588	5,108	916	13,570	13,135	4,733	62	3,363	57	1,295	111,349
Mossey River	24,367	24,785	757	21,685	4,309	3,168	233	4,087	2,396	6,908	188	1,924	36	2,094	96,936
Total (ha)	**38,667**	**125,497**	**4,109**	**69,613**	**48,731**	**31,248**	**4,908**	**25,289**	**48,606**	**20,167**	**272**	**7,837**	**240**	**5,450**	**430,632**

* Area totals are approximate due to the nature of the image analysis procedure.
** Due to seasonal changes in wetland size, date of imagery will affect area

Figure 13 - Distribution of Land Cover within the East Duck Mountain Sagemace Bay Watershed in 2006



ii. Agricultural Land Use Trends

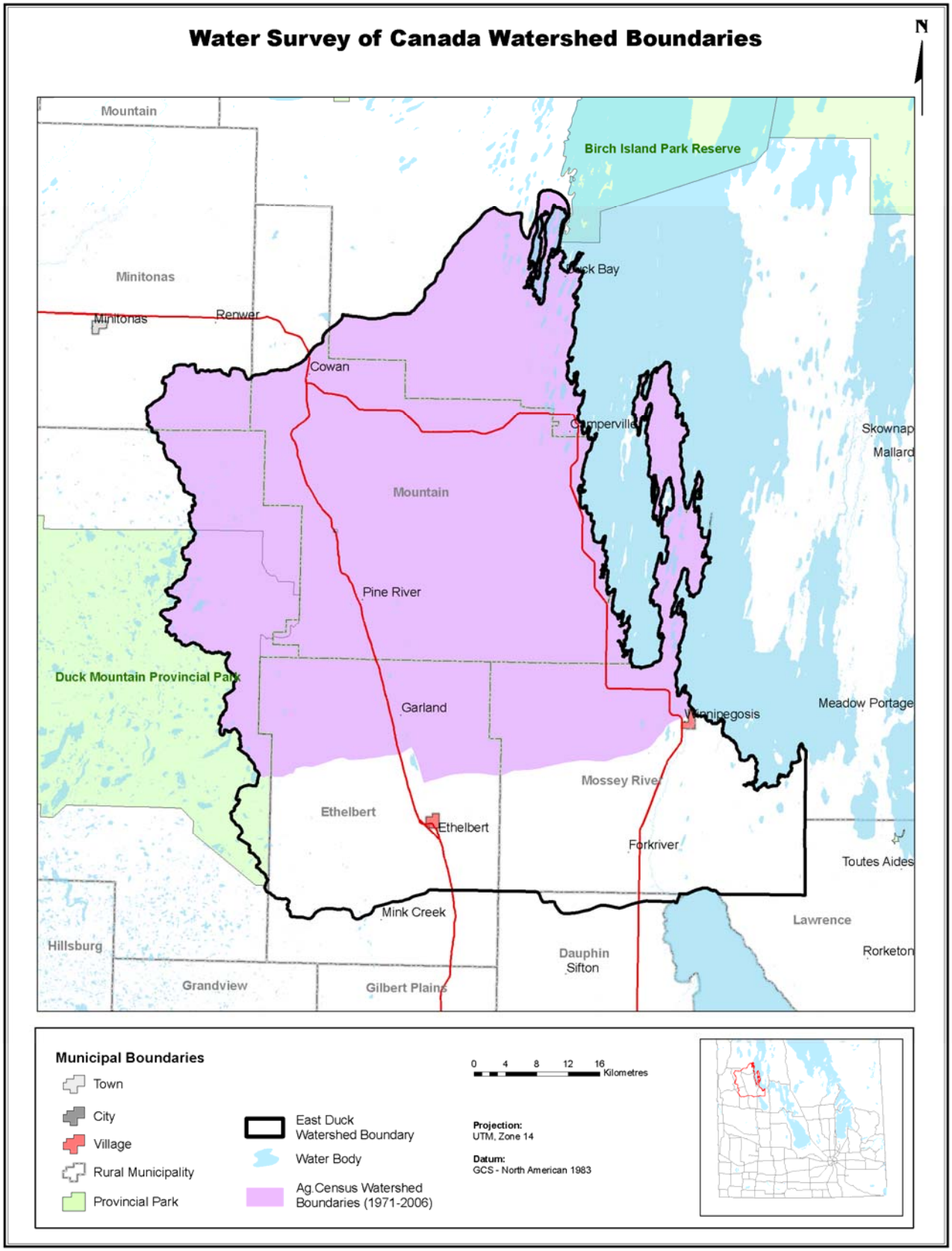
Agricultural land use is dynamic and there are many factors influencing changes over time. The factors vary from economic drivers like commodity prices, land values, input costs, and government policies to social influences like changing demographics and increasing environmental awareness. Changes in land use can have an environmental and economic impact on the health of a watershed. By assessing anticipated changes, land use trends can be used to guide future policies (or approaches) and actions to encourage sustainable resource management in the watershed.

Census of Agriculture – 1971 to 2006

Census of Agriculture data has been obtained from Statistics Canada for the Census years from 1971 to 2006 and has been interpolated on a national scale to the Water Survey of Canada Sub-Sub Drainage Area boundaries. Further details on the method used to interpolate Statistics Canada's Census of Agriculture from a geographic boundary to a subwatershed boundary are provided in Appendix B.

Water Survey of Canada Sub-Sub Drainage Area boundaries may, at times, correspond well to watershed boundaries used on a provincial or conservation district level. In the case of the East Duck Mountain Sagemace Bay Watershed, however, there is only one sub-sub drainage area that has Census of Agriculture data dating back to 1971 (***Figure 14***) and is completely within the study area. In this section of the report, the subwatershed will be referred to as Upper East Duck (about 239,000 ha). Although the boundaries of the Census of Agriculture data differ from the actual watershed boundaries, the data is still applicable for characterizing long term trends. For reporting purposes, numbers have been rounded to the nearest 5 for farm numbers, 10 for livestock and smaller area data, and 100 for poultry and for larger area and financial data.

Figure 14 – Watershed Boundaries for 1971 to 2006 Census of Agriculture Data

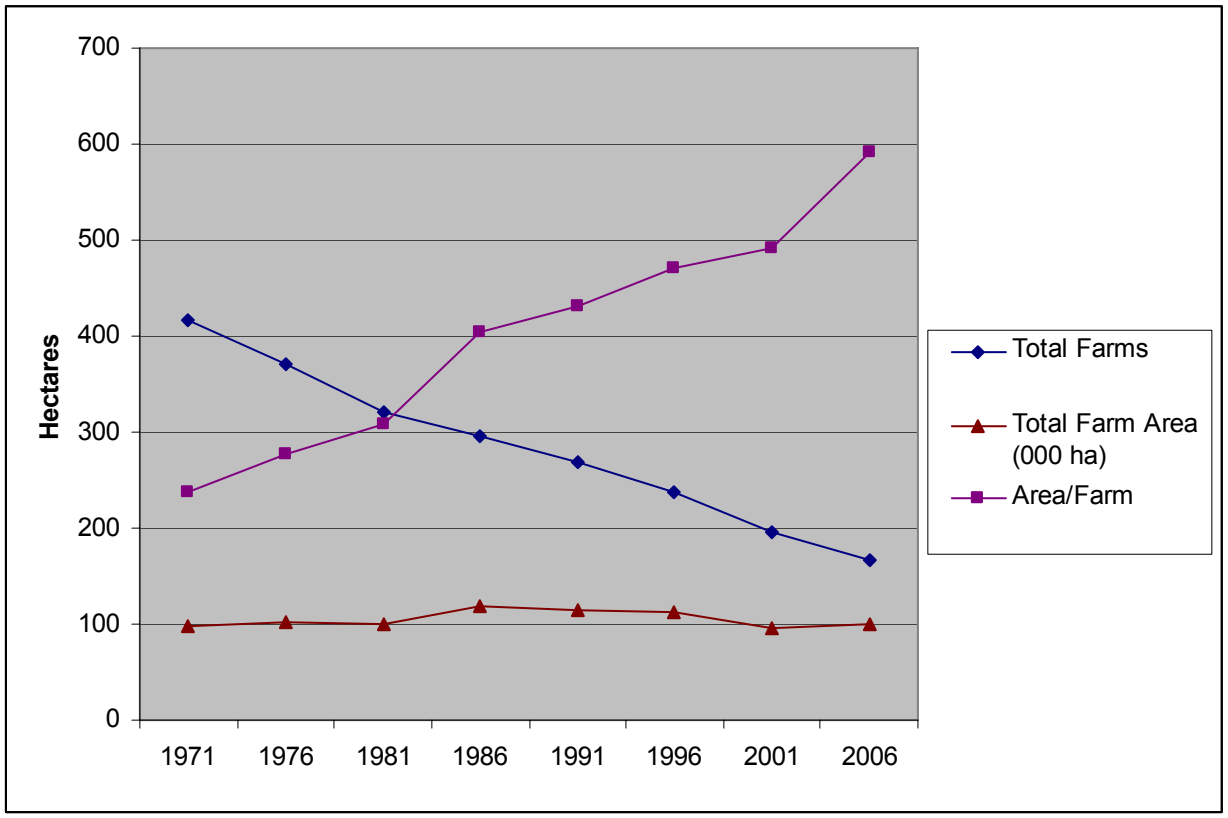


Land Use Change and Trends

Number of Farms and Farmed Area

The number of farms in the Upper East Duck Watershed has declined steadily from about 1,745 farms in 1971 to approximately 1,015 farms in 2006, a decrease of approximately 40% (***Figure 15***). Land use analysis confirms that in rural areas the trends to farm consolidation. As the amount of farmed land in the watershed has declined slightly from approximately 441,000 ha to approximately 414,000 ha, the average size of these farms, in terms of area per farm, has increased steadily from about 250 ha to about 410 ha, an increase of about 60%.

Figure 15 - Farm size in hectares, number of farms and total farm land in hectares in the Upper East Duck Watershed from 1971 to 2006

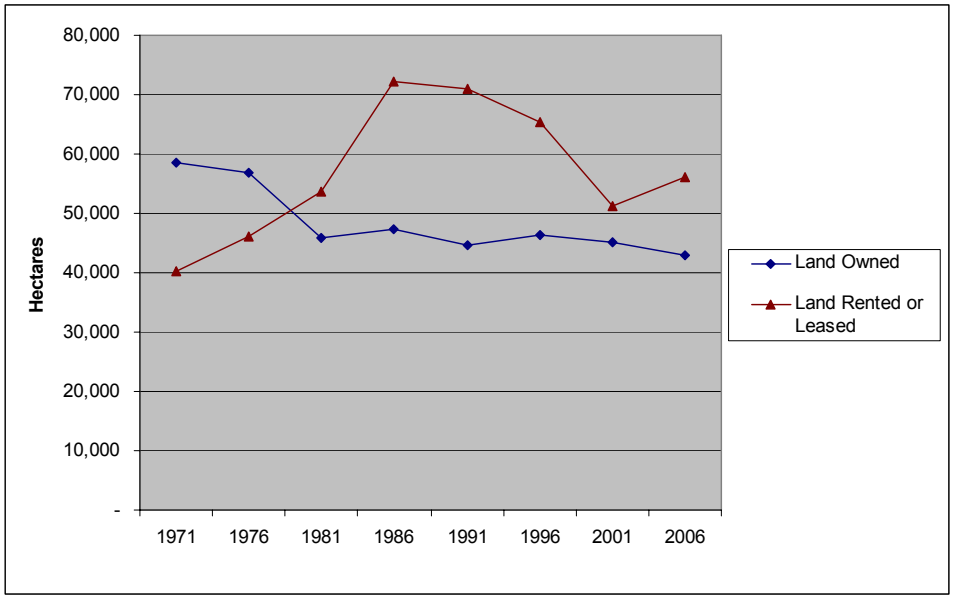


Owned and Rented Lands

In the East Duck Mountain Sagemace Bay Watershed, a significant amount of agricultural crown land is primarily used for hay or pasture in support of livestock production in the watershed (see ***Section vi***).

For the Upper East Duck Watershed, the amount of land owned by producers decreased between 1971 and 1981 with the amount of rented or leased land reported in 1981 being greater than the amount owned (See ***Figure 16***). Since 1981, the amount of land owned has been reported at a consistent level while lands rented or leased reached the highest amounts in 1986 and 1991, then dropped to a level in 2001 that is consistent to 1976. This drop in leased lands in 2001 may be attributed to external market factors such as Bovine spongiform encephalopathy **(**BSE) which influenced the livestock industry significantly during this time period.

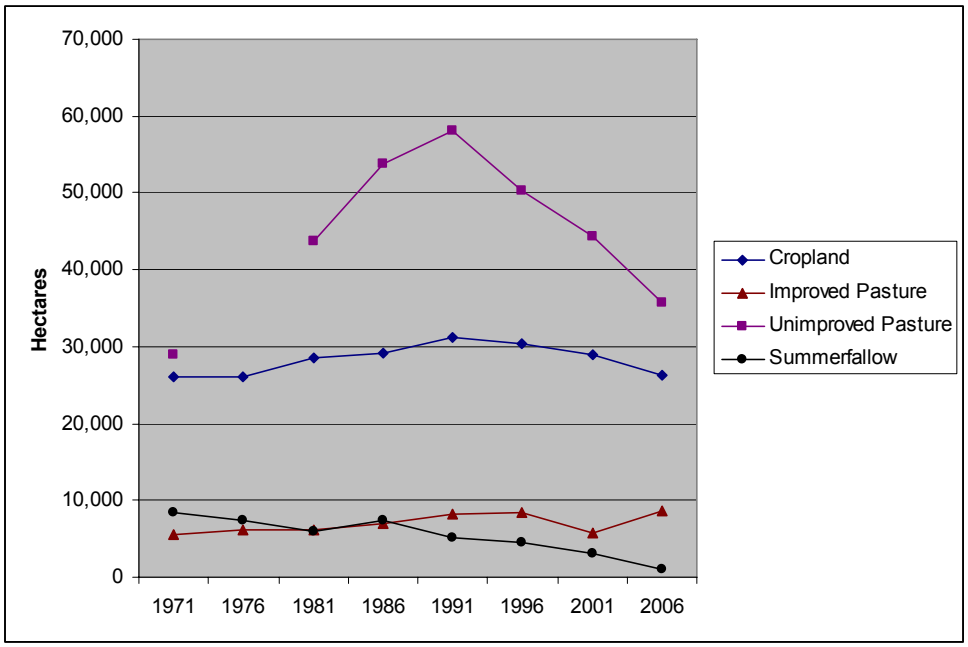
Figure 16 – Land owned and rented in the Upper East Duck Watershed from 1971 to 2006



Cropland and Pasture Area

The area of cropland in the Upper East Duck watershed has remained somewhat constant from 1971 to 2006, averaging around 28,000 hectares (or 24% of what has been identified as total available farming hectares, 119,400 ha.). Dependency of unimproved or natural lands for pasture increased to a peak in 1991(58,100 ha.) but decreased to the second lowest recorded level in 2006 (35,800 ha.) The area of improved pasture, otherwise known as tame or seeded pasture, was at its highest level in 2006 (8,550 ha., or 7% of the total available farming hectares) and is similar to what was seen in 1996 (***Figure 17***). The practice of summer fallow dropped significantly in the watershed, from 8,300 ha in 1972 to 1,100 ha in 2006, a drop of 87%.

Figure 17 – Cropland/Pasture Area trends in the Upper East Duck Watershed from 1971 to 2006*

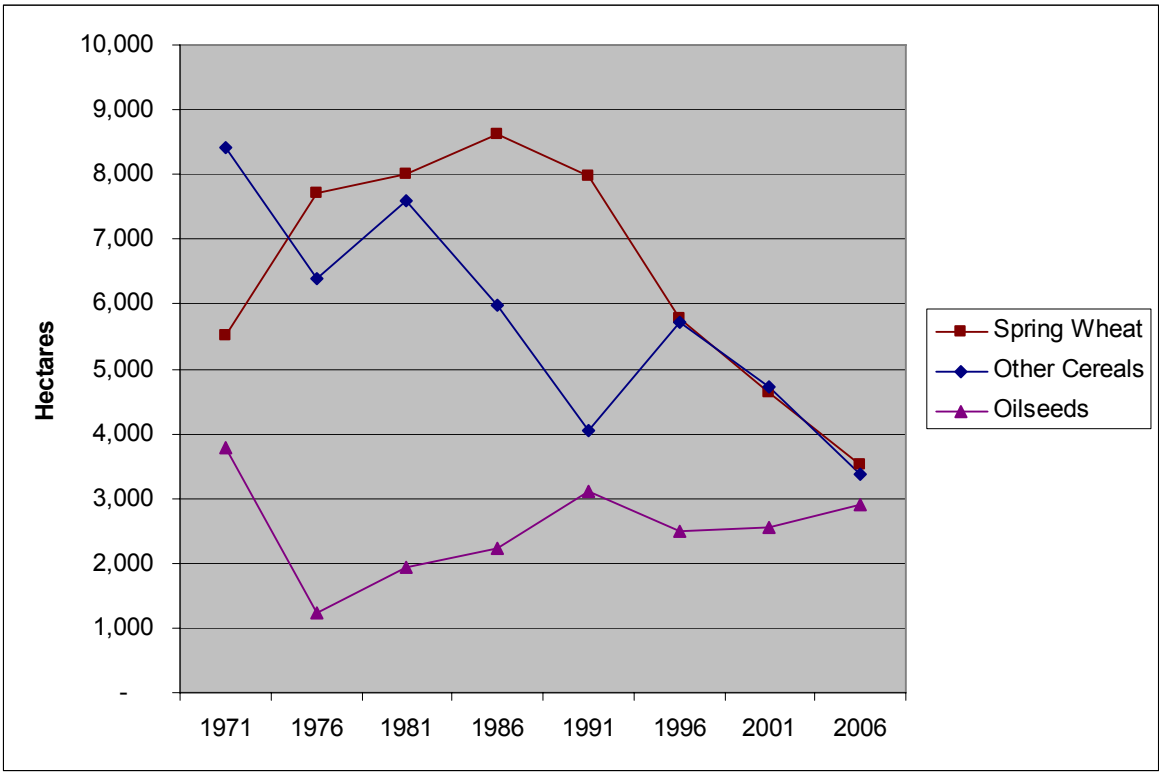


* data was not collected for unimproved pasture in the 1976 Census of Agriculture

Cropping Trends

The area of land seeded to annual crops from 1971 to 2006 has revealed some significant trends in the Upper East Duck watershed (***Figure 18***). The most dramatic shift has been in the area used to produce cereal crops like oats, barley, mixed grains where a dramatic decrease has taken place/can be noted since 1972 to 1991. This decrease saw the lowest level in 1991, where 4,000 hectares were reported (approximately 13% of the available cropland) from 8,400 hectares in 1972 (approximately 32% of the available cropland). Steady increases can bee seen in the production of spring wheat crops with 5,500 hectares being used for these crops in 1972 and 8,600 hectares in 1986. From that point, steady declines have occurred, with the lowest level identified in 2006 (3,525 ha, or 13% of the identified cropland area). There has been a steady increase in oilseeds from 1976 (1,224 hectares) to 2006 (2,900 ha). The highest level was seen in 1972 with 3,800 hectares (***Figure 18***).

Figure 18 - Major crop types in the Upper East Duck Watershed Trends from 1971 to 2006 (1)



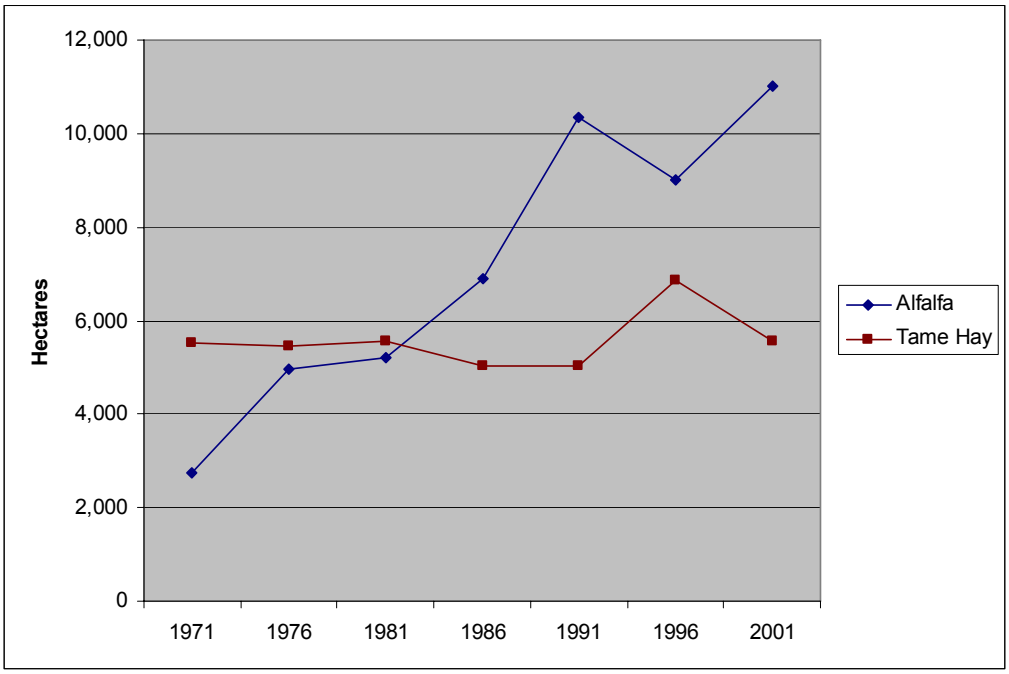
(1) Other Cereals are all grains that include oats, barley, mixed grains, corn for grain, buckwheat, triticale and winter wheat.

(2) Oilseeds include canola, flaxseed, mustard seed, sunflowers, and safflower

Alfalfa and Hay

The amount of alfalfa grown has increased significantly since 1971; with increases from 2,750 hectares in 1972 (representing 3% of the identified available farmland) to 9,500 hectares in 2006 (this represents 10% of the available farmland). The highest amounts were noted in 2001 with 11,000 hectares (***Figure 19***). The amount of hay and fodder crops also had a marginal increase from 1972 to 2006, an increase of 5,550 hectares. The highest amount was noted in 1996 at 6,850 hectares (representing approximately 6% of available farmland).

Figure 19 – Alfalfa and Hay trends in the Upper East Duck Watershed from 1971 to 2006 (1)

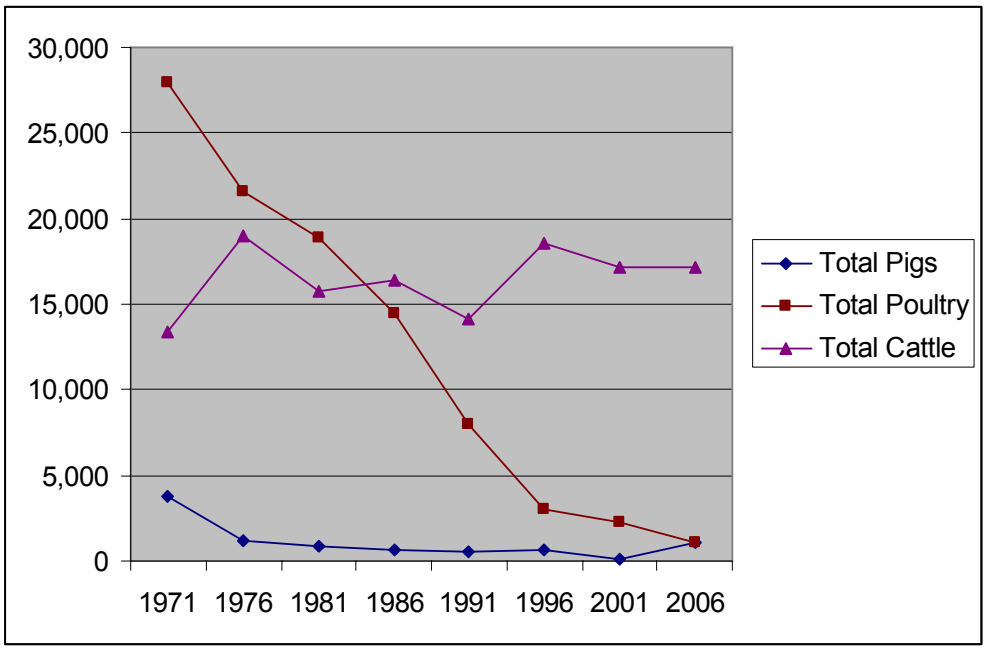


(1) tame hay or fodder crops that includes clovers, oats, barley and sorghum that would be used for hay or silage.

Livestock Production

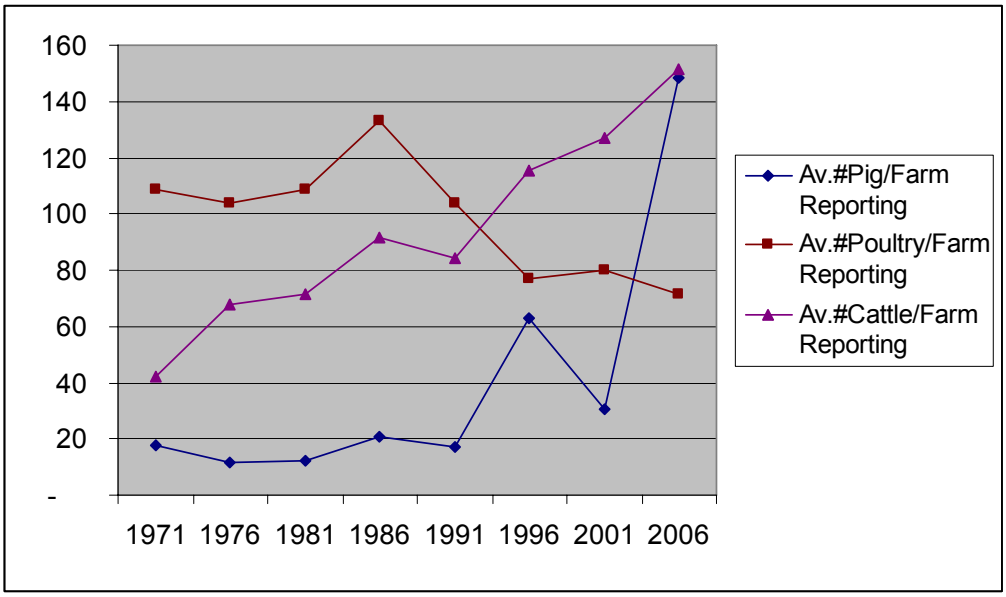
The amount of livestock and poultry produced in the watershed has varied during the 1971 to 2006 period (***Figure 20***). The number of poultry in the watershed has decreased significantly from about 27,900 in 1971 to about 1,100 birds in 2006. Hog numbers have been low in the watershed and have seen a small decline in the twenty year span. In contrast, the number of cattle in the watershed has fluctuated but has seen modest increases from 13,330 head in 1972 to 17,110 head in 2006. This may be indicative of livestock being the more important agricultural commodity to the watershed.

Figure 20 - Major livestock production trends in the Upper East Duck Watershed from 1971 to 2006



There is also a correlation between declining farm numbers reporting livestock to the increase in livestock numbers per farm; with an increase in the number of animals or birds per farm reporting livestock (***Figure 21***). The number of cattle per farm has increased most dramatically, from about 40 per farm in 1971 to almost 150 in 2006. The number of pigs per farm has increased as well, from about 20 in 1971 to about 150 in 2006. Although leveling off in the last decade, the number of poultry per farm has seen a decrease over the 35-year period, from about 260 in 1971 to about 15 in 2006.

Figure 21 - Average number of livestock per farm reporting in the Upper East Duck Watershed from 1971 to 2006



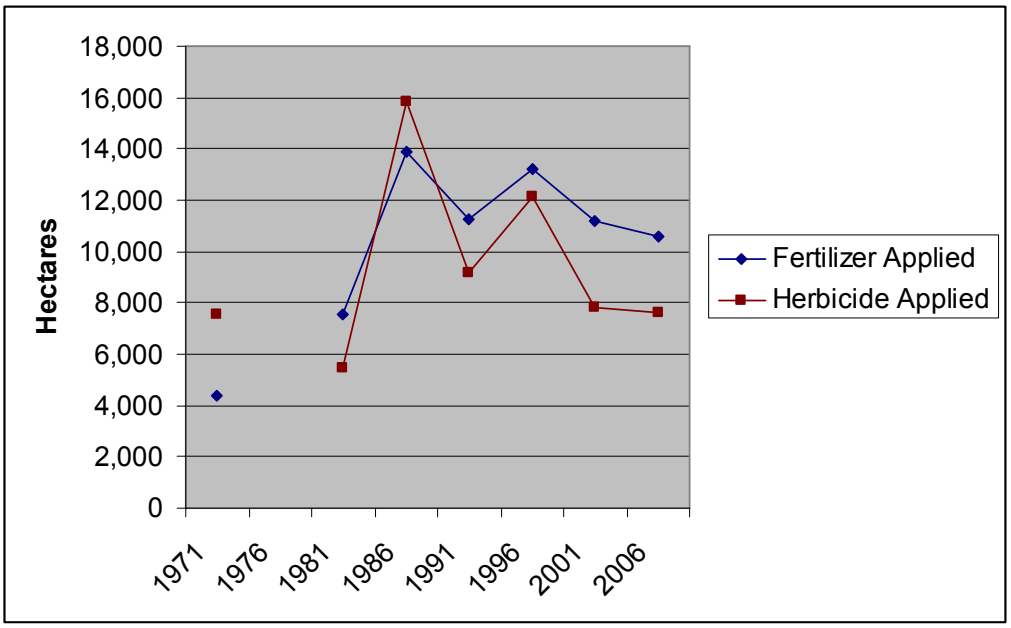
Land Management

Fertilizer and Herbicide Usage

The area of land in the watershed that receives commercial fertilizer each year has fluctuated since its low in 1971 of about 4,400 ha to a peak of about 13,900 ha in 1986 (***Figure 22***). With the exception of an increase from 2001 to 2006, there has been a steady decline since this peak, with about 10,600 ha of land having commercial fertilizer applied in 2006.

Herbicide usage has shown similar trends to fertilizer applications. Land with herbicide applied increased dramatically from 1971 (about 7,600 ha) to its peak in 1986 (about 15,800 ha), then declined to 2006 with herbicides applied to approximately 7,600 ha that year.

Figure 22 - Trend of fertilizer/herbicide applications in the Upper East Duck Watershed from 1971 to 2006*

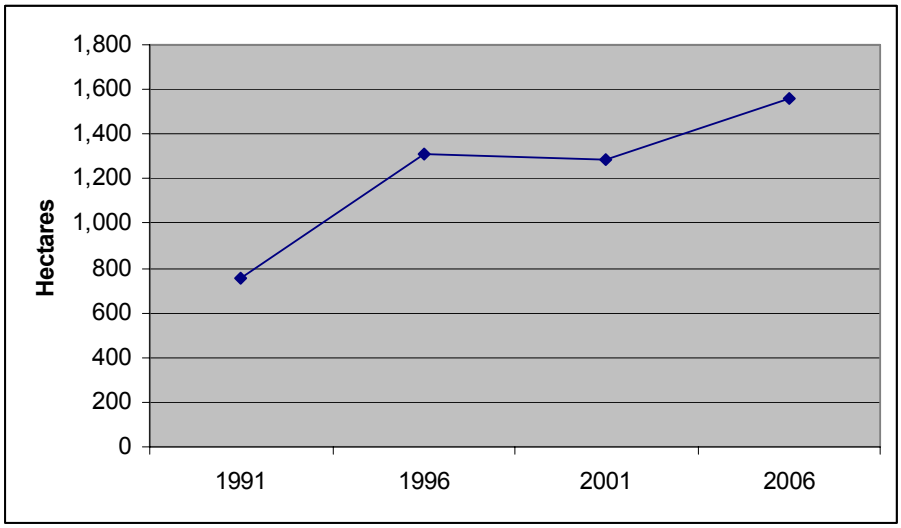


* data for fertilizer and herbicide application was not collected in the 1976 Census of Agriculture

Manure application

The amount of land in the watershed with manure applied is small and has increased every census year since the data has been recorded with an increase from 800 ha in 1991 to approximately 1,600 ha in 2006 (***Figure 23***). Herd size in the IWMP area has steadily increased over time (see ***Figure 22***). This has provided the producer with a more economical alternative to synthetic fertilizers, which may account for lower fertilizer costs in some subwatersheds such as Mossey River.

Figure 23 - Manure application trends in the Upper East Duck Watershed from 1991 to 2006

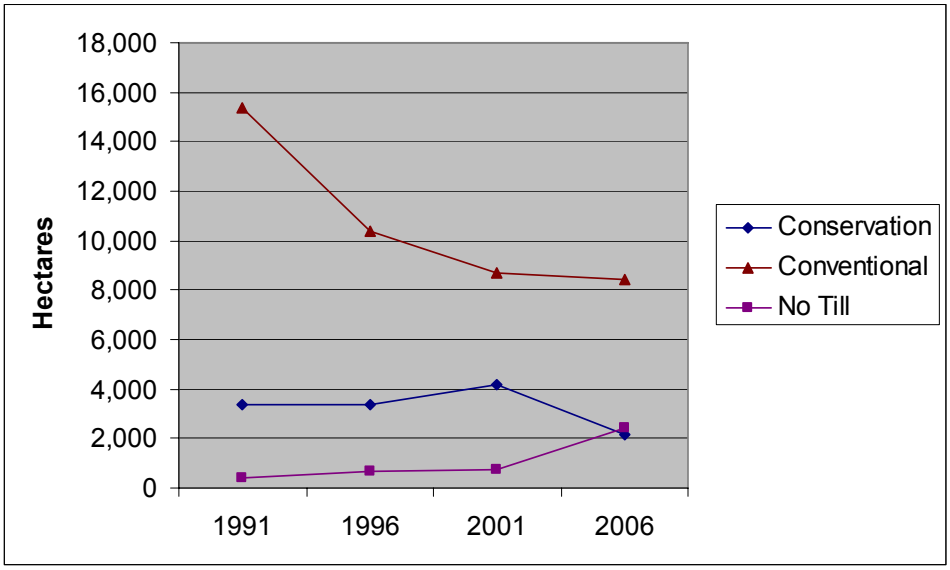


Tillage practices

The type of tillage practices used in the watershed since 1991 shows some definite trends (***Figure 24***). Conventional tillage continues to be much higher than other tillage practices, in terms of the area of land where it is used. The use of no till or zero tillage practices, although applied to somewhat smaller areas, has seen some increase. The amount of conservation tillage stayed relatively the same until

2006 where a small decrease was seen. During the 1991 to 2006 period, the amount of land with zero tillage increased by 541% (from approximately 400 ha to about 2,500 ha). During the same time frame, conventional tillage dropped by about 45% (from about 15,400 ha to about 8,500 ha).

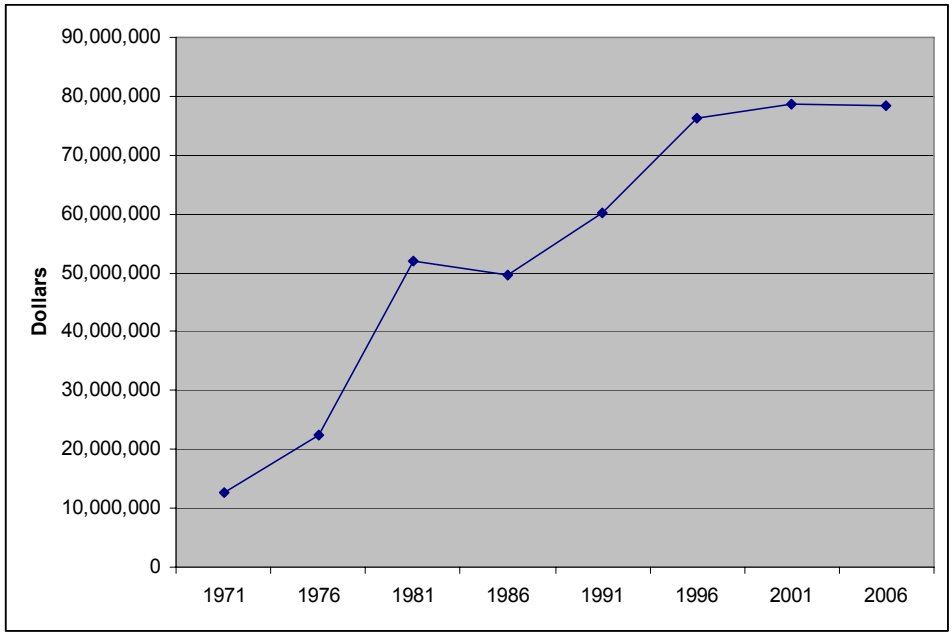
Figure 24 - Trend of tillage practices in the Upper East Duck Watershed from 1991 to 2006



Financial Characteristics

The financial picture for the agriculture sector as captured in the census of agriculture reflects a number of trends since 1971. The amount of capital in the sector has increased dramatically from about $12,699,100 in 1971 to about $78,340,900 in 2006 With the exception of small declines in 1986 and 1991 this increase has been steady (***Figure 25***).

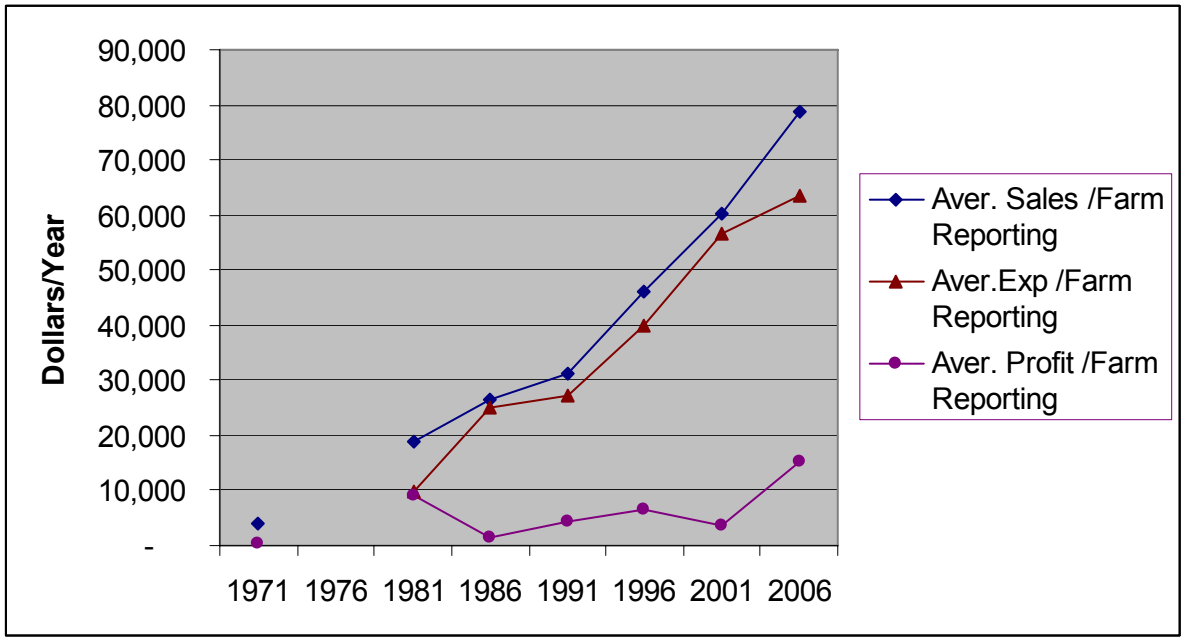
Figure 25 - Total farm capital trends in the Upper East Duck Watershed from 1971 to 2006



Average Farm Sales and Expenses

Farm sales and expenses from 1981 to 2006 indicate that while sales have seen modest increases, expenses have had greater increases, leading to lower profits in the sector (***Figure 26***). While average sales increased significantly, average expenses per farm reporting also increased at a similar rate. The average profit per farm reported in 1981 amounted to approximately $ 9,000 which declined to approximately $3,800 in 2001. In 2006, the average profit per farm increased to $15,200, suggesting a 69% increase over a 25 year period.

Figure 26 - Farm financial characteristics in the Upper East Duck Watershed from 1981 to 2006



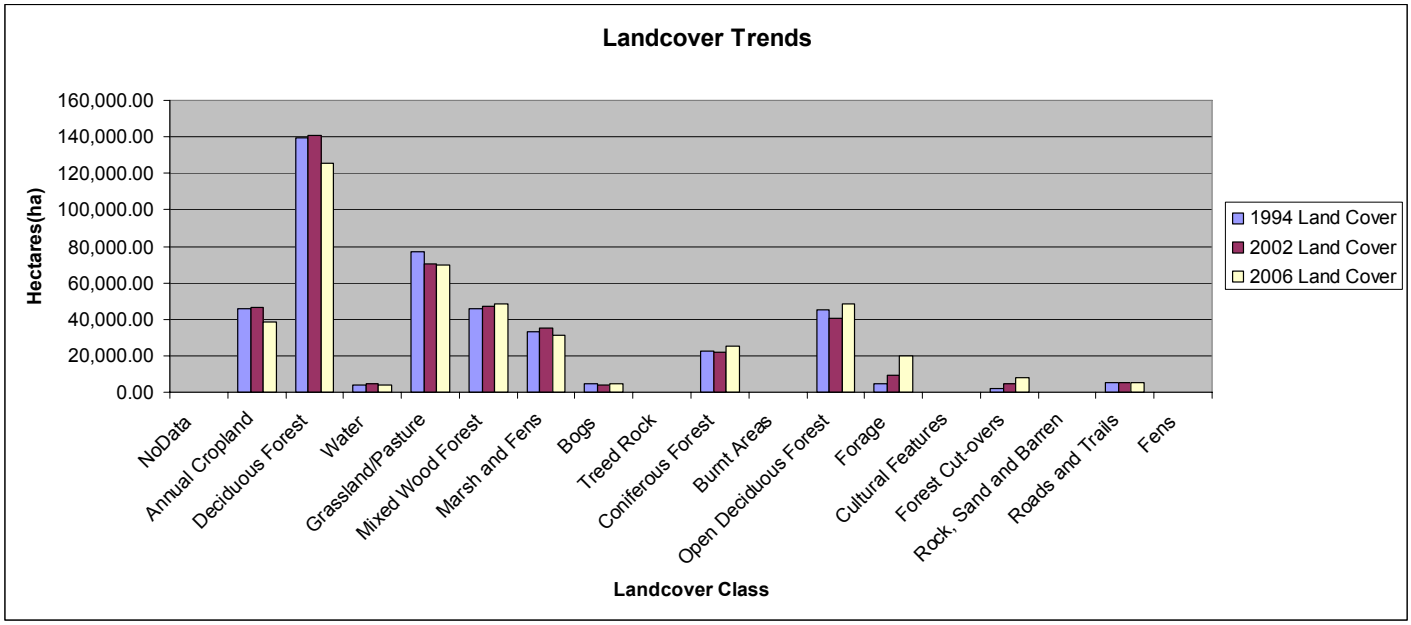
Land Cover – 1994, 2000, 2006

Land cover maps used in this analysis were developed using raster-based data sets derived from 30 metre resolution LANDSAT Thematic Mapper satellite imagery. These data sets are point in time and allow users to see the spatial extent of general types of land cover within a given area over time. Further details on the information used for the land cover analysis and the constraints associated with this data are provided in ***Appendix D***.

Change in Land Cover

An analysis of land cover data from 1994, 2000 and 2006 satellite imagery supports the trends seen in the census data with modest declines in cropland since the 1990s and an increase in forest land (Deciduous, Mixed Wood, Coniferous, and Open Deciduous), forage, and forest cutovers classes over the same period (***Figure 27***).

Figure 27 - Comparison of change in land cover from 1994 to 2006(1)



(1) Date of Imagery for the East Duck/ Segemace Bay for 1994 Landcover is Sept. 6, 1994, for 2002 Landcover is May 31st, 2002, and for 2006 Landcover is August 27th, 2004.

Although there are some inherent limitations in utilizing land cover analysis methods to determine changes in land use, some changes were noted through this analysis:

- Deciduous forest remains the predominant land cover in the watershed (***Table 5***).
- In correlation with the decrease in annual cropland, there is an increase in forages and grassland from 1994 to 2000. This can be attributed, in part, to the Permanent Cover Program (PCP) introduced in the early 1990s and Green Cover Canada available to Manitoba producers between 2003 and 2008 years to encourage the conversion of marginal lands for agriculture from annual crop production to perennial cover (1,023 hectares enrolled under Permanent Cover Program and 458 hectares in Green Cover Canada). The repeal of the Western Grain Transportation Act (WGTA) also influenced the conversion of annual cropland to forage production on marginal lands. Impacts of the PCP/Green Cover Programs and the removal of the WGTA coupled with strong cattle pricing, favourable exchange rates (higher Canadian dollar versus United States dollar) led to accelerated land conversion of both viable lower class and prime agricultural land to forages.
- There was an increase in the number of cattle reported in the census data during this time period (see ***Figure 21***), resulting in a higher demand for pasture and hayland. Strong livestock markets in 2001 may have attracted local farm operations to switch over to livestock production or increase existing livestock herds. Such changes also influence land management decisions such as converting marginal annual croplands to a perennial cover.

Table 5 - Change in Land Cover from 1994 to 2000 to 2006

Land Cover	1994 Area (ha)	2002 Area (ha)	2006 Area (ha)	Percent Change[1] from 1994 to 2002	Percent Change[2] from 2002 to 2006
Annual Cropland	45,884	46,625	38,668	2	-17
Forage	4,943	9,223	20,167	87	119
Grassland/Pasture	77,207	70,486	69,617	-9	-1
Deciduous Forest	139,717	141,035	125,497	1	-11
Mixed Wood Forest	45,592	46,957	48,731	3	4
Coniferous Forest	22,652	22,180	25,289	-2	14
Open Deciduous Forest	45,409	40,456	48,606	-11	20
Treed Rock	-	3	-	-	-
Water	4,305	4,518	4,109	5	-9
Marsh and Fens	32,924	34,901	31,248	6	-10
Bogs	4,404	4,215	4,908	-4	17
Burnt Areas	-	-	-	-	-
Cultural Features	285	281	272	-1	-
Forest Cut-overs	1,972	4,389	7,837	123	79
Rock, Sand and Barren	123	195	240	59	-
Roads and Trails	5,546	5,496	5,450	-1	-1
Totals[3]	**430,963**	**430,963**	**430,637**		

1. Percent change is calculated as Year 2000-Year 1994/Year 1994 x 100
2. Percent change is calculated as Year 2006-Year 2000/Year 2000 x 100
3. Landcover Total Area in 2006 has a smaller area due to satellite coverage

ii. Other Agricultural Land Use Trends/Impacts

According to the Census of Agriculture, it has been determined that beef production plays a significant role to the region's agriculture and that leased lands from the government represent from 1/3 to ½ of the reported agricultural lands in the study area. This section aims at analyzing how other land activities such as treed areas and wetlands are impacting or being impacted by the agricultural region and the identified public issues of flooding, wetlands, and leased land management considerations.

Landcover changes from 1994 compared to data collected from the 2006 imagery can not only tell us how much one land use classification has changed over a time period but it can also identify what the new (or more recent) land use is thereby giving some indication about the influences on land management or land use change. It should be noted that data classification limitations and the timing of when the satellite images were taken can introduce discrepancies into these values and further ground-truthing would be required to verify these findings.

Conversion to Forages

The significant increase in forages between 1994 and 2006 are most likely due to agricultural management practices adopted by producers to address management issues associated with sensitive soils and/or producers responding to market trends.

Of the approximately 17,600 ha of land that were converted from another land use to forages (refer to Table 5). During this time period, the majority was converted from annual cropland (9,600 ha) and from grassland or pasture (7,500 ha). Most of the conversion to forages has taken place in the Pine and Mossey River Subwatersheds regions (***Figure 28, 29***). Some of this conversion is most likely due to programs like the Permanent Cover Program (during the early 1990's) and Green Cover Canada (a component of the Agriculture Policy Framework initiated in 2003) offered to producers to assist with the conversion of annually cropped marginal lands into a long-term permanent cover. Cumulatively, there were approximately 2,400 hectares converted to permanent cover during those programs, primarily in the central and south eastern portions of the East Duck Watershed.

The changes noted in forage landcover class may also be indicative of other farming trends within the watershed. The large amount of hectares changing from other classes to forages suggests that this may be also part of ongoing crop rotations or an indication that the producers are moving away from annual crops to more livestock/pasture management systems.

Figure 28 - Area of 1994 Landcover Classifications that changed to Forage Classification in 2006

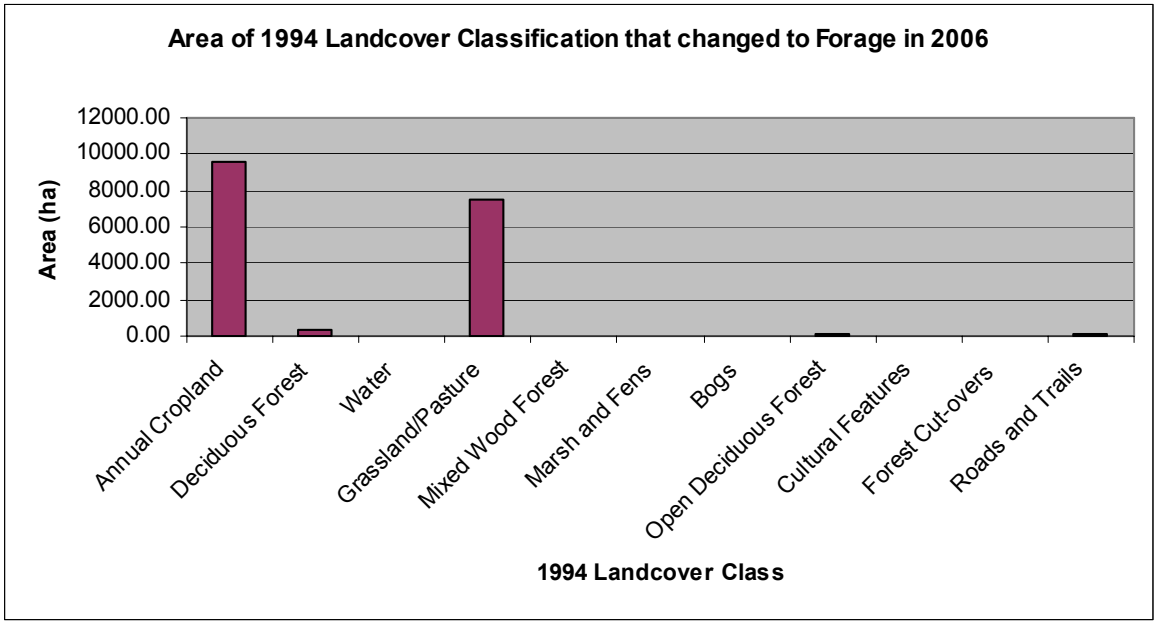
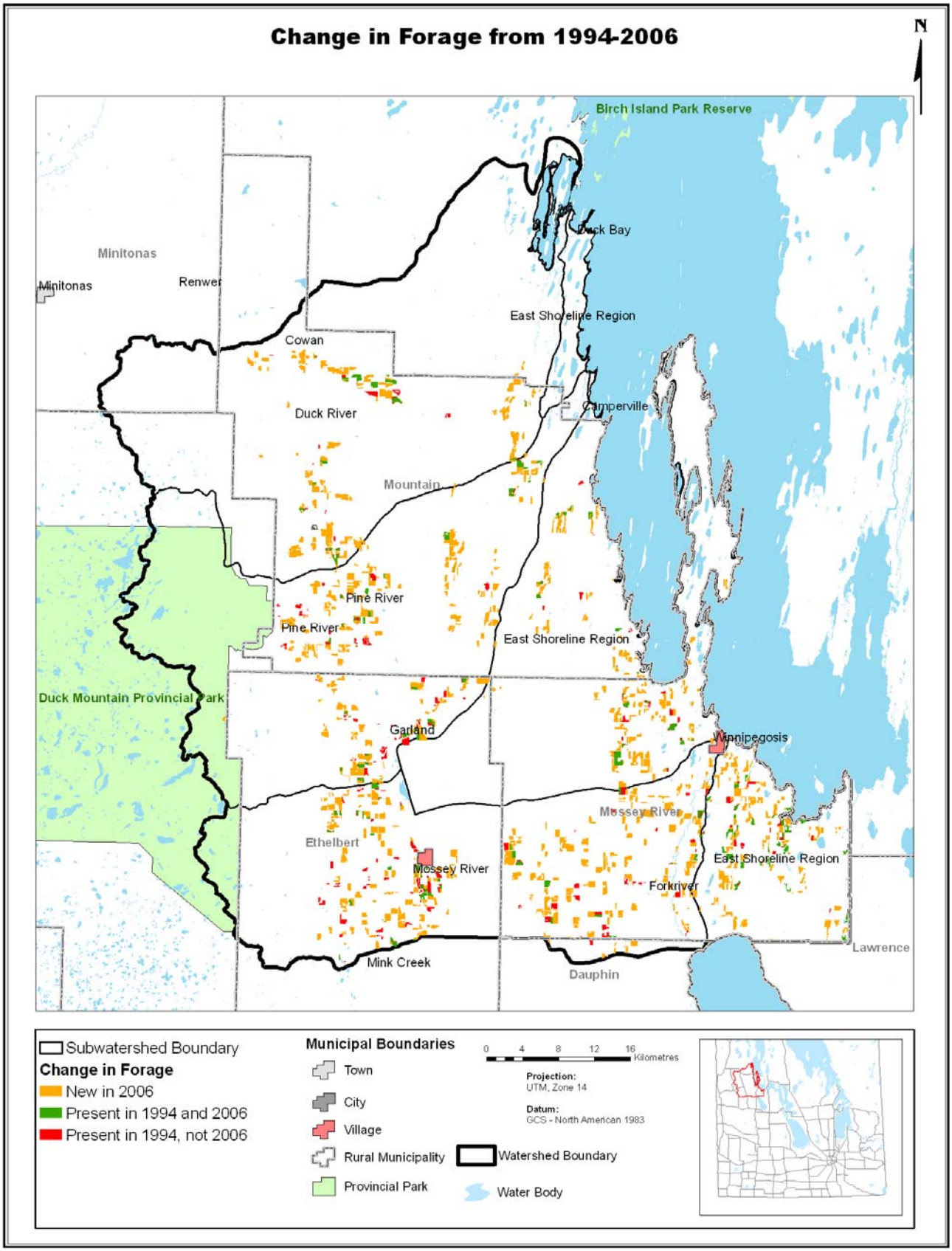


Figure 29 - Map showing areas of 1994 Landcover Classifications that changed to Forage Classification in 2006



Changes to Grasslands

Changes in the grasslands/pasture landcover from 1994 to 2006 are indicative of issues such as flooding, afforestation or land use conversions as potential ongoing issues within the watershed.

Correlations between 1994 and 2006 land cover data indicate that 18,900 ha (***Figures 30*** and ***31***) of land which was predominately classified as trees, annual cropland, marsh and fens, forage or wetlands in 1994 had changed to grasslands in 2006. Most of the change was from treed areas (7,900 ha) to grassland especially in the Duck River (1,500 ha) and Pine River (2,400 ha) Subwatersheds suggesting possible land clearing or conversion to pasture. In the Mossey River and Pine River subwatersheds, annual cropland accounted for 1,300 ha. and 1,600 ha. of the noted 2006 grassland landcover changes. Marsh and Fens also experienced a loss of approximately 4,800 ha. in the entire watershed, a possible result from the greater demand for pasture and grazing requirements.

Conversion to Grasslands/Pasture may be the result of market trends in agriculture, but there are other local drivers such as interest from the logging industry which is also very active in the watershed.

Land clearing of forested areas could lead to some potential short-term environmental concerns such as exposed soils, risk to erosion from spring run off, and possible increased flooding downstream. Appropriate management practices such as selected harvesting through agro forestry management, perennial cover, buffer establishment, and grassed waterways could address those types of issues and should be considered for affected land.

Figure 30 - Area of 1994 Landcover Classifications that changed to Grassland Classification in 2006

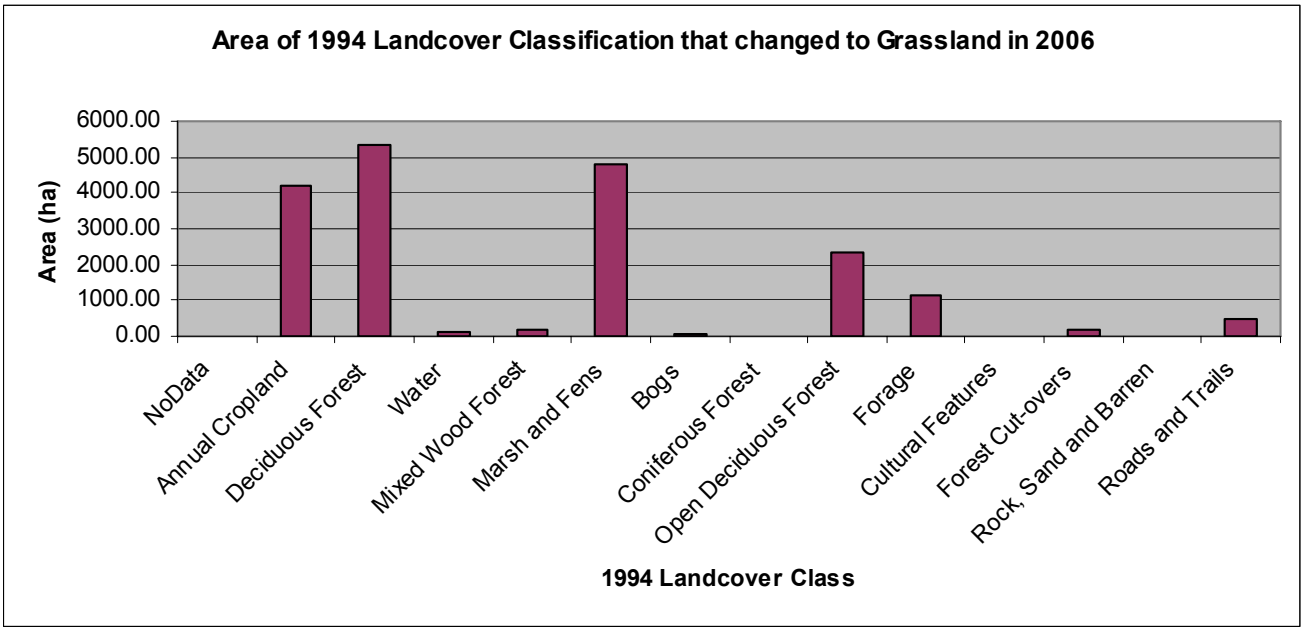
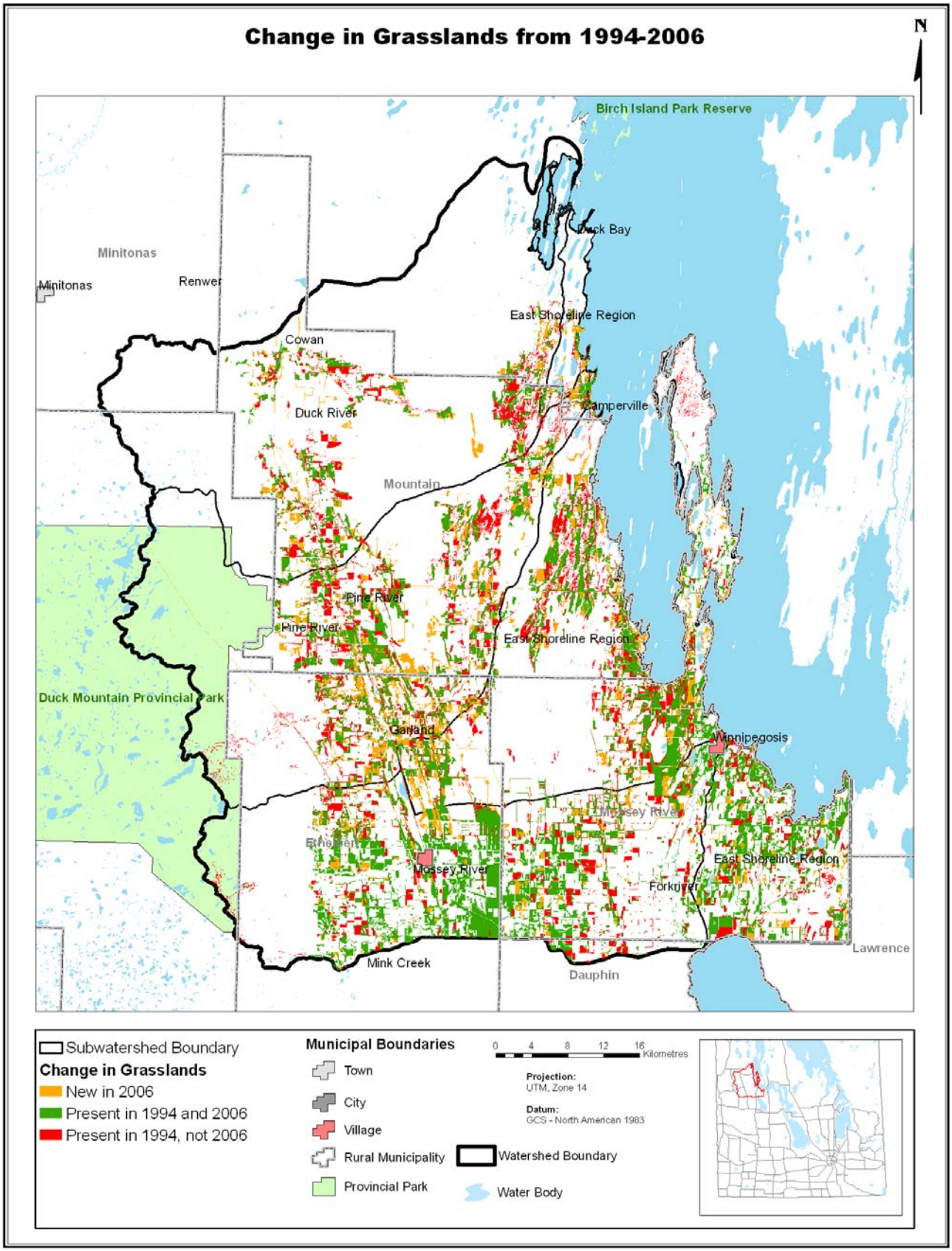


Figure 31 - Map showing area of 1994 Landcover Classifications that changed to Grassland Classification in 2006



Conversions to Trees

Changes from various landcover classifications in 1994 to treed areas in 2006 can indicate that some encroachment on agricultural land has taken place. For the analysis, forest land classes were grouped (Deciduous Forest, Mixed Wood Forest, Coniferous Forest, and Open Deciduous Forest) to provide a more comprehensive understanding.

The 18% increase in the land with forest was noted in all forest categories with the exception of Deciduous Forests, which declined by 10% or 15,500 ha.

Through the landcover class change analysis, approximately 10,700 ha classified as treed areas in 2006 were identified as grassland in 1994 (***Figure 32*** and ***33***). At the subwatershed level, all areas had a greater than 35% change from grasslands, most notably in Mossey River (1,300 ha) and Pine River (3,500 ha) subwatershed regions. The second largest change came from the areas that were classified as marsh and fens (7,200 ha) in 1994, most notably in the Duck River (2,000 ha) and the East Shoreline Region (2,900 ha) subwatersheds.

Impacts to grasslands as a result of forest encroachment suggest that many of these areas could lose their forage potential, limiting the ability for summer pasture use. More so, the loss of forage potential leads to greater stress on the remaining intact grasslands/pastures, thereby increasing the potential for overgrazing, erosion, and soil compaction. It also suggests that management of grassland areas becomes more critical, and that possible beneficial management practices to address brush encroachment may be required.

Figure 32 - Area of 1994 Landcover Classifications that changed to Forested Classification in 2006

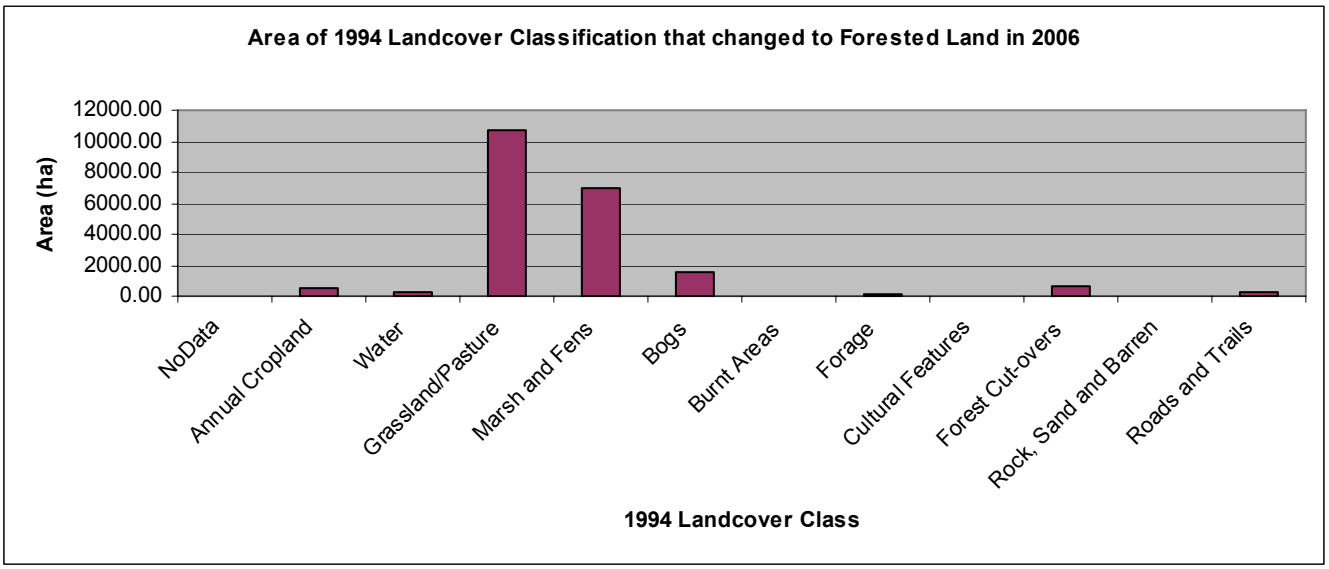
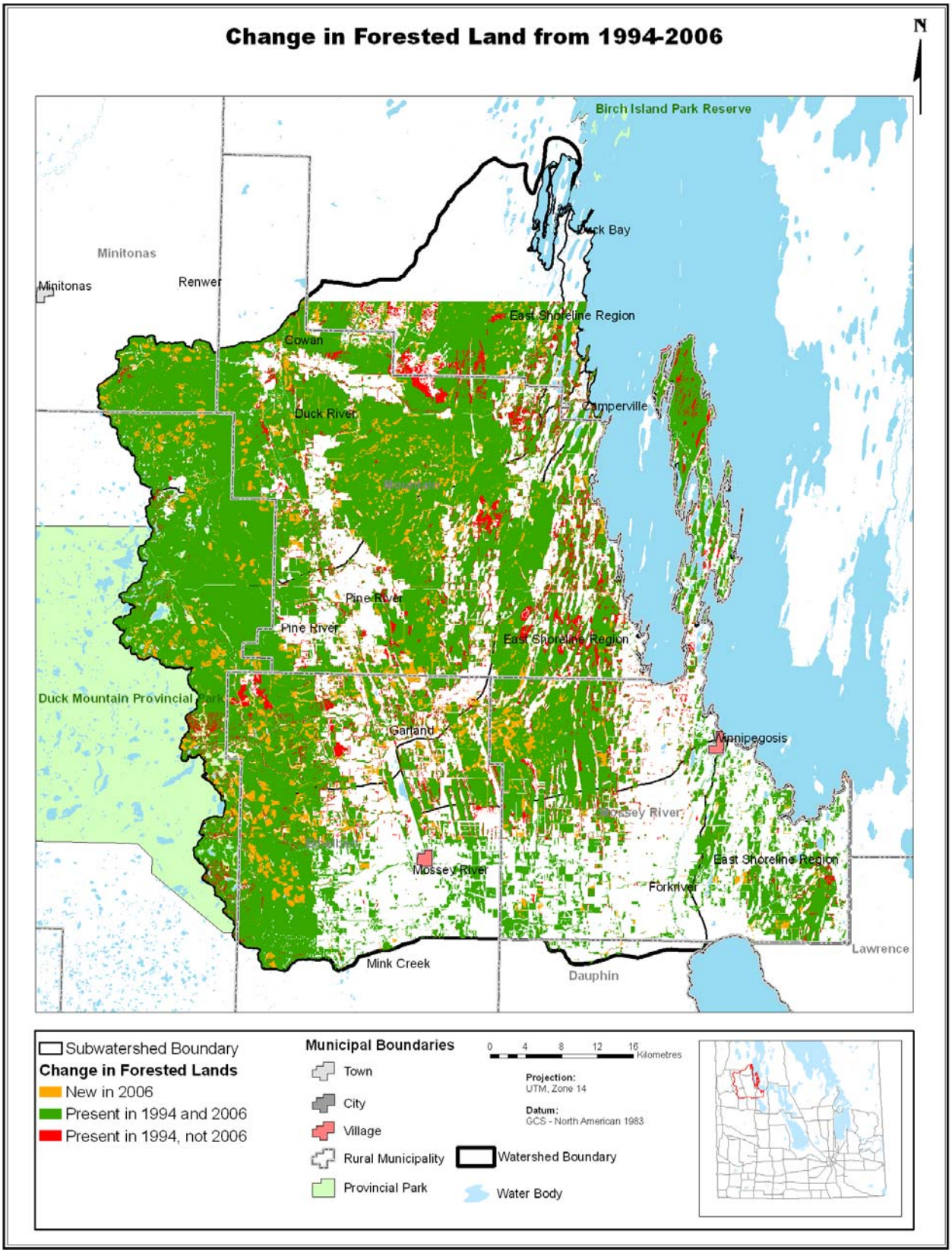


Figure 33 - Map showing area of 1994 Landcover Classifications that changed to Forested Land Classification in 2006



Conversions to Wetlands

Assessing the wetland classification change can provide an overview of impacts such as flooding caused by beaver activity or other drainage activity, one of the primary issues identified during the stakeholder consultations of the East Duck IWMP. It can also indicate where other issues like salinity, water quality, and possible nutrient loading issues may be associated with these impacts.

The 2006 landcover data indicates that the total area of wetlands or water was similar or slightly lower than what was identified in 1994 (4,100 ha of water; 31,200 ha of marsh and fens (***Figure 34*** and ***35***). Examination of the 2006 wetland classification change indicates that most of the 2006 wetlands were in new locations having changed from Deciduous or Open Deciduous Forests (8,000 ha,) and grasslands/pasture (2100 ha) in 1994. This is evidenced in all of the subwatershed regions, particularly the Duck River, Pine River, and the East Shoreline Region.

It should also be noted that there were no new wetlands on what was identified as annual cropland or forage areas in 1994, suggesting that there was little or no impact to those agricultural areas. The transformation of wetland areas to other landcover classes like grasslands and pastures can impact grazing potential and livestock productivity and probably cause an increased concern of flooding.

One of the reasons for the amount of wetlands identified in 1994 may be attributed to the timing of the imagery or due to the landcover classification definitions applied. The majority of the imagery for the watershed was captured in the fall (1994 -September 6th, 2006 -August 27th) and depending on fall moisture conditions for that year, there could be a higher or lower number of wetlands than the 2006 landcover. Another factor may be that in the Landcover definitions for the 16 Classification System (see definitions in ***Appendix D)***, “Open Deciduous” is defined as shallow soils and/or poor drainage, which may include a small amount of wetland but are not the dominant landcover class. As such, there is the possibility of some wetlands noted in 1994 landcover imagery that may have been classified as open deciduous in 2006.

Local knowledge suggests that drainage activity within the watershed has led to wetland consolidation and/or downstream migration which may also be influenced by beaver activity. Due to the high percentage of poorly or imperfectly drained soils in the watershed, this is probable (see ***Table 10***). In addition, there has been an increase to forest harvesting in the Duck Mountain in the recent past. Such activities could result in increased runoff from storm events and possibly lead to flooding, erosion, and water quality issues in downstream areas.

Figure 34 - Area of 1994 Landcover Classifications that changed to Wetland Classification in 2006

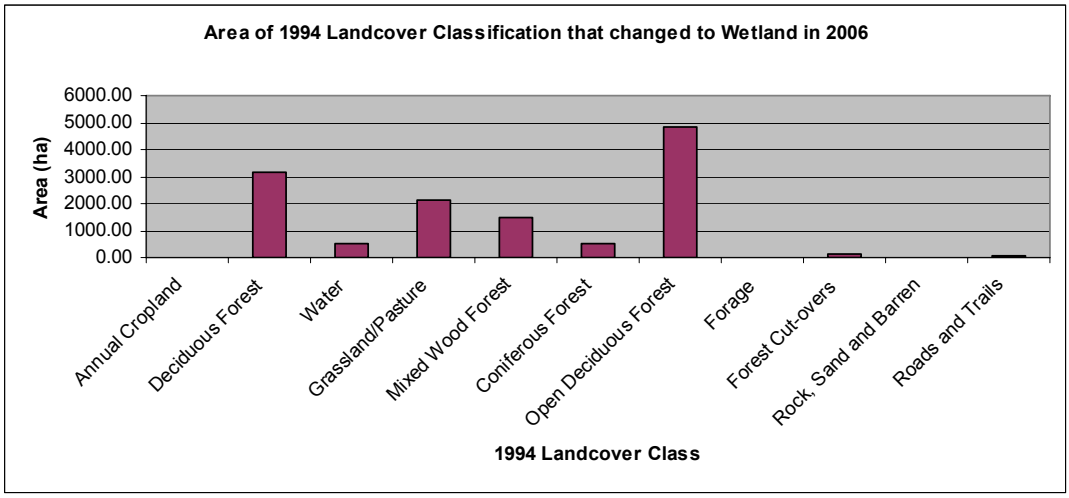
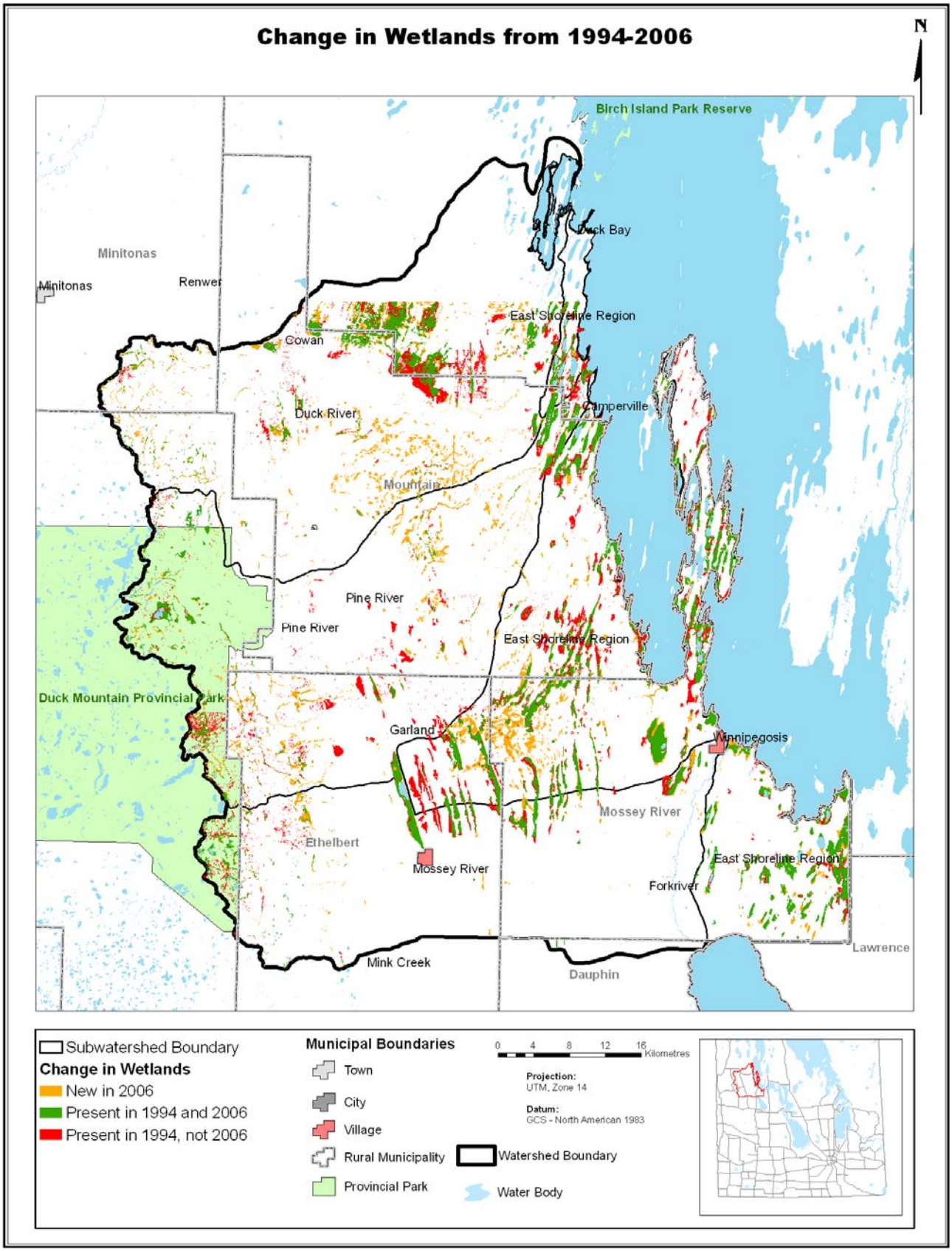


Figure 35 - Map showing area of 1994 Landcover Classifications that changed to Wetland Classification in 2006



F. Agricultural Land Use and Management Considerations

This section involves the analysis of a combination of factors such as land use and the characteristics of the local landscape, in order to determine where consideration should be given to how the land is used or managed including the potential for adoption of BMPs. Land cover data represents an indicator of how the land is being used while relevant landscape characteristics and risk factors are included in the soils dataset. Further information about land cover data can be found in ***Appendix D***, while more information about the soils data can be found in ***Appendix E***.

i. Agricultural Capability Analysis

The Canada Land Inventory System (CLI) was used to classify land based on agricultural capability. The CLI is a comprehensive survey of land capability and land use aimed at providing a basis for making land-use planning decisions. Under the CLI, lands are classified according to physical capability for agricultural use (PFRA, 2005).

Agriculture capability can best be described as the ability of the land to support the appropriate type of crops and agriculture management techniques. Not all land can be managed in the same manner with soil types, topography, stoniness, soil moisture deficiency and low fertility and other potential limitations influencing land use and practices. Classes ranging from 1 to 7 have been established with 1 being the highest rated land class with no limitations to annual crop production and 7 being the lowest rated land for agriculture (not suitable for agriculture). Further information about CLI and specific characteristics and limitations associated with individual land classes is provided in ***Appendix F***.

Analytical Methods
Analysis of the land classes with respect to land cover helps to understand the extent of agricultural activity over marginal lands. An examination of annual cropland from the 2006 land cover will provide estimation to the extent of how much annual cropping is occurring on those marginal lands. Such analysis can also provide an indication of where producers are demonstrating good land management practices by utilizing these marginal lands for purposes other than annual crop production. As well, comparisons examining land cover analysis from the 2001 and 1994 data sets provide opportunity to examine how much change has occurred in agricultural activity with respect to time.

Within the East Duck Watershed study area, lands classified as Class 1, 2, and 3, cover approximately 39% of the study area (Table 6).

2006 Cropland Class 4 and lower
Approximately 61 % (215,100 ha.) of all lands within the study area are considered Class 4 and lower (including what has been classified as organic soils) (***Table 6***). Examination of 2006 land cover data indicates that approximately 6,600 ha (or approximately 17%) of annual cropland is located on land rated as Class 4 or lower (Table 6 and Figure 36). The amount of marginal land being annually cropped has shown a slight decrease since 2002 (9.3 %) and 1994 (10.4%)

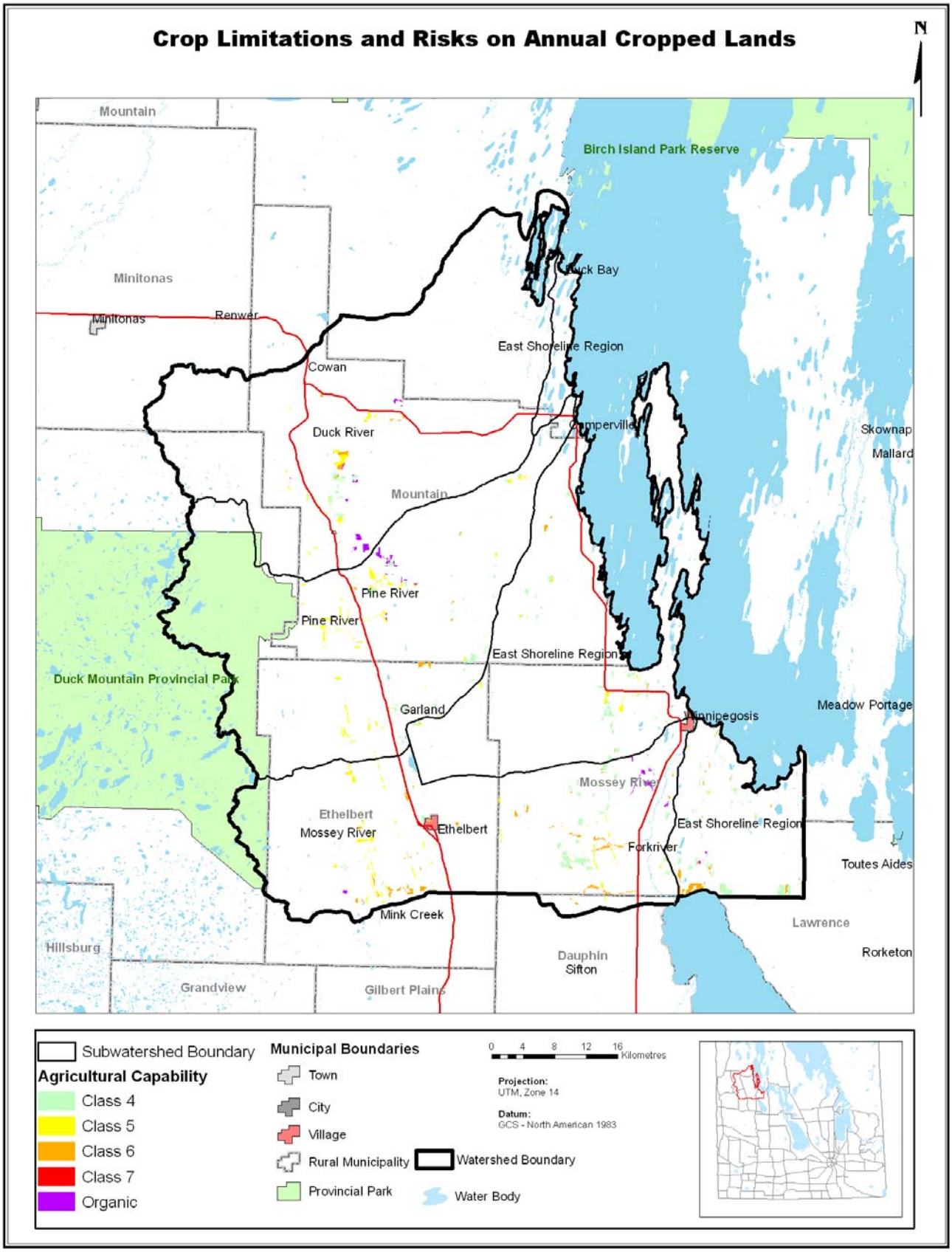
From the 1994 land cover analysis, it was noted that annual cropland had decreased by 12% (7,184 a), due to land conversions to grasslands and forages as noted in the earlier in this document. The most significant changes occurred in the Class 2, 3, and 4 soils, where 6,615 ha (7%) changed from annual cropland to another land cover category (**Figure 36**).

Table 6 - Agricultural Capability in the East Duck Mountain Sagemace Bay Watershed Study Area [1]

Class	Area of Entire Watershed (ha)	2006 Land Cover (Annual Cropland) Area (ha)	Distribution of Annual Cropland[2]	1994 Land Cover (Annual Cropland) Area (ha)[2]	Change from 1994 Land Cover (Annual Cropland) Area (ha & %) [3]	
Class 1	-	-	-	-	-	
Class 2	53,688	19,238	50%	21,417	- 2,179	(+3%)
Class 3	88,121	12,834	33%	16,026	- 3,192	(-2%)
Class 4	100,289	2,928	8%	4,172	- 1,244	(-1%)
Class 5	41,137	1,841	5%	2,086	- 245	
Class 6	45,202	1,263	3%	1,354	- 90	
Class 7	1,116	2	-	4	- 2	
Organic	27,347	522	1	791	- 269	(+1%)
Unclassified	8	4	-	5	-1	
Water	1,784	39	-		39	
TOTAL	**358,695**	**38,671**	**100%**	**45,855**	**-7,183**	

1. Agricultural Capability is based on the CLI Rating of the dominant soil series for each soil polygon
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery)
3. Figure derived from the difference of Land Cover Data - Annual Cropland in Study Area (2006) minus Annual Cropland in Study Area (1994) in each Soil Class

Figure 36 - Agricultural Lands located on Class 4, 5, and 6 lands as identified in the 2006 Land Cover data



iii. Wind Erosion Risk Analysis

Wind erosion risk information in Manitoba has been developed from the provincial soil survey data and the Soil Landscapes of Canada (SLC Ver 1.0 - See Appendix H). The Wind Erosion Risk model used for the Agriculture Canada Wind Erosion Risk Maps (1989) incorporates soil moisture, surface roughness and aggregate size, and drag velocity by wind. Erosion risk classes were assigned based on the weighted average soil loss for each map polygon. The five classes of soil erosion risk (ranging from negligible to severe) are based on a bare, unprotected soil condition and do not consider land use and crop management factors. Cropping and residue management practices can significantly reduce erosion risk depending on crop rotation, soil type, and landscape features. Basing soil erosion risk on a bare soil scenario helps to identify areas dominated by sensitive, erosive soils which may otherwise be masked if a land use or surface vegetation cover factor was considered (Eilers *et. al*. 1989).

Approximately 17% of the East Duck Mountain Sagemace Bay Watershed study area is considered to have a high or severe wind erosion risk (***Table 8***), primarily in the southern portion of the watershed (***Figure 37***). Affected areas generally correspond to the portions of the study area where fine textured clay over till soils are found Approximately 49% of the watershed is considered low or negligible for soil erosion risk.

Based on the 2006 land cover data, approximately 19% of the annual cropland is located on soils with a high to severe risk for wind erosion (***Table 7***). When compared to 1994 land cover, there is a decreasing trend of annual cropland associated with high or severe wind erosion soil types, (approximately 3,700 hectares). This decrease was noted in all wind erosion categories, indicating that the changes were probably more attributed to the decrease in annual cropland acres from 1994 to 2006 than due to wind erosion risk factors.

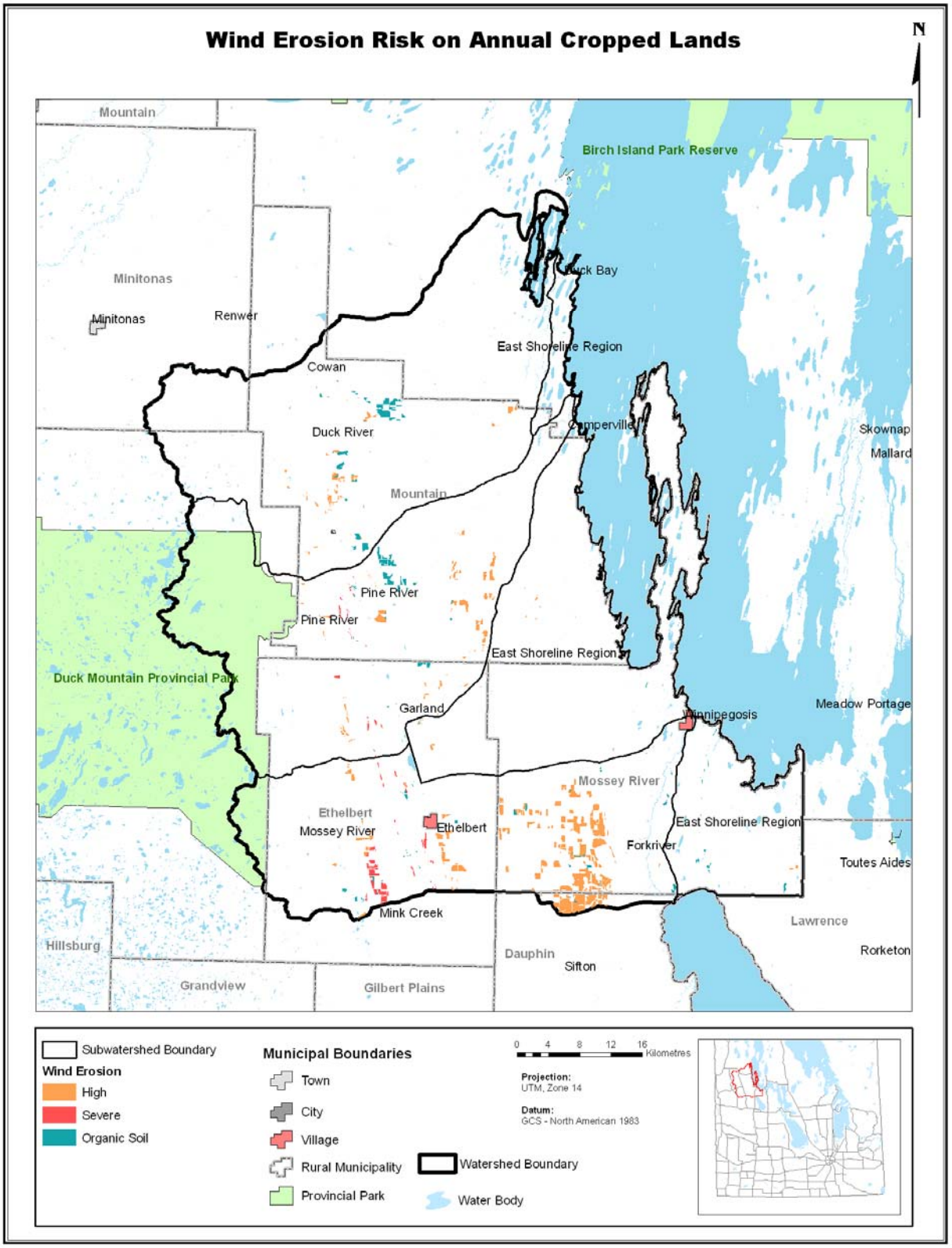
Organic soils, when dry and exposed, are also at risk to wind erosion. The 2006 land cover data indicates that less than 1% of the annual cropland was located on organic soils.

Table 7 - Wind Erosion Risk on Annual Cropland in the East Duck Mountain Sagemace Bay Watershed Study Area from 2006 Landcover [1]

Class	Area (ha)	2006 Landcover Annual Cropland (ha)	Distribution of Annual Cropland (%)[2]	1994- 2002 Landcover Change (Annual Cropland) Area (ha &%)[3]		2002-2006 Landcover Change (Annual Cropland) Area (ha &%)[3]	
Negligible	35,978	1,743	5	- 44		- 463	
Low	138,511	17,073	44	- 616	-2%	- 3,619	
Moderate	42,577	10,832	28	322		- 1,250	+2%
High	57,628	6,491	17	751	+2%	- 1,799	-1%
Severe	2,991	775	2	77		- 95	
Organic Soil	74,391	1,708	4	249		- 724	-1%
Water	4,283	39	0	0		5	
Unclassified	2,336	6	0	1		- 10	
TOTAL	**358,695**	**38,668**	**100%**	**740**		**-7,955**	

1. Wind Erosion Risk is based on the weighted wind erosion rating for each soil polygon and assumes bare soil.
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery)
3. Figure derived from the difference of Land Cover Data - Annual Cropland in Study Area (2006) minus Annual Cropland in Study Area (1994 or 2002) in each Soil Class

Figure 37 - Wind Erosion Risk on 2006 Annual Cropland in the East Duck Mountain Sagemace Bay Watershed[1]



1. Wind Erosion Risk is based on bare soil and does not take into account negative cover on management practice.

iv. Water Erosion Risk Analysis

The overland flow of water can, under certain circumstances, carry particles of soil with it. Rain splash erosion, sheet erosion, rill erosion and gully erosion are all caused by water. Where this occurs, there is the potential to carry large quantities of sediment and contaminants to nearby waterways and waterbodies throughout the watershed. This section examines where in the watershed that there may be a greater potential for this to happen.

The analytical component of this section focuses on annual cropland from land cover data ***(Appendix D***) in conjunction with water erosion risk (***Appendix H***) and the proximity of these areas to water courses.

Water Erosion Risk

The risk of water erosion was estimated using the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith (1965). The USLE predicted soil loss (tonnes/hectare/year) was calculated for each soil component in the soil map polygon. Water erosion risk factors used in the calculation include mean annual rainfall, slope length, slope gradient, vegetation cover, management practices, and soil erodability (Eilers *et. al*. 2002). Erosion risk classes were assigned based on the weighted average soil loss for each map polygon. The five classes of soil erosion risk (ranging from negligible to severe) are based on bare and unprotected soil conditions. See ***Appendix G*** for more information about Water Erosion Risk. Cropping and residue management practices can significantly reduce this risk depending on crop rotation, soil type, and landscape features. Basing the soil erosion risk on a bare soil scenario helps to identify areas dominated by sensitive, erosive soils which may otherwise be masked if a land use or surface vegetation cover factor was considered (Eilers *et. al*. 2002).

Over 56,100 hectares (18%) of the watershed are noted as high or severe risk of water erosion. Analysis of landcover shows that 7,700 hectares was under annual cropland in 2006 which is a decrease from 2001. (***Table 8, Figure 38***).

Buffer Identification: Analytical Methods

In order to focus on areas that may have significant potential to contribute sediments and nutrients to water courses, this section examines three factors. They are (a) land cover, specifically whether the land was in annual crop which significantly increases the likelihood of bare soil conditions and high nutrient application rates, (b) water erosion risk, which takes into account important factors such as slope and slope length, rainfall, and soil erodibility, and (c) proximity to water courses where these other factors considered that would likely increase the probability of sediment and nutrients reaching surface waters.

A 50 metre buffer was chosen for this particular analysis (note that subsequent analysis could be undertaken with a buffer of a different size) and applied to all provincially designated drains in the watershed. All polygons classified as annual crop in 2006 and are located on land with a high or severe risk of water erosion within 50 m of a designated drain was selected.

The analysis does not take into account land adjacent to lakes and wetlands, but does include streams and rivers of all sizes and intermittent or permanent. Forage land was not selected but could be considered in future analyses, as it is part of annual crop rotations in some areas. This analysis did not consider other factors that can contribute to bare soil and nutrient transport such as tillage practices or livestock grazing and wintering in riparian areas and along streambanks.

Results

Analysis revealed that in 2006, approximately 90 ha of annual cropland was located on land with a high to severe risk of waters erosion and located within 50 m of a waterway, with the majority found in the Mossey River Subwatershed (approximately 5 % of total buffers in subwatershed) (***Table 9***). It should also be noted that the area of cropland located within 50 m of a designated drain totaled over 87,000 ha and the importance of tillage practices, crop rotation, and nutrient management on these lands is also significant as there is a likelihood that runoff from these fields could enter nearby streams and rivers.

Although this analysis identifies areas in the watershed that may be worthy of consideration for future action or mitigation, it is important to note that limitations in the datasets used dictate that ground-truthing of these sites is required. Data limitations include the scale of the soils data in some areas of the watershed (***Appendix E***), spatial accuracy of watercourses in the map, and the limitations associated with land cover to identify land use. Land cover data is never completely accurate and land use is dynamic and changes may have occurred since the 2006 data was collected. It is important to further investigate whether specific sites are actually at high risk to water erosion to verify if actual site characteristics correlate with the results derived from the soils data (greatly dependant on amount of overland flow, soil type, topography, and vegetation cover). Although there are data limitations, this methodology can potentially be considered as an approach to identifying sites where BMPs that reduce water erosion could have a significant positive influence on the watershed.

Table 8 - Water Erosion Risk on Annual Cropland in the East Duck Mountain Sagemace Bay Watershed Study Area from 2006 Landcover [1]

Class	Area (ha)	2006 Landcover Annual Cropland (ha)	Distribution of Annual Cropland (%)[2]	1994- 2002 Landcover Change (Annual Cropland) Area (ha &%)[3]		2002-2006 Landcover Change (Annual Cropland) Area (ha &%)[3]	
Negligible	240,794	17,265	45	1,575		- 4,761	-2%
Low	27,185	6,185	16	- 328		- 801	1%
Moderate	21,986	7,473	19	- 500		- 887	1%
High	10,823	2,571	7	113	1%	- 511	
Severe	56,114	5,134	13	- 120	-1%	- 1,003	
Unclassified	8		-	-		-	
Water	1,784	39	-	0		7	
TOTAL	**358,695**	**38,668**	**100%**	**740**		**-7,955**	

Water Erosion Risk is based on the weighted water erosion rating for each soil polygon and assumes bare soil.

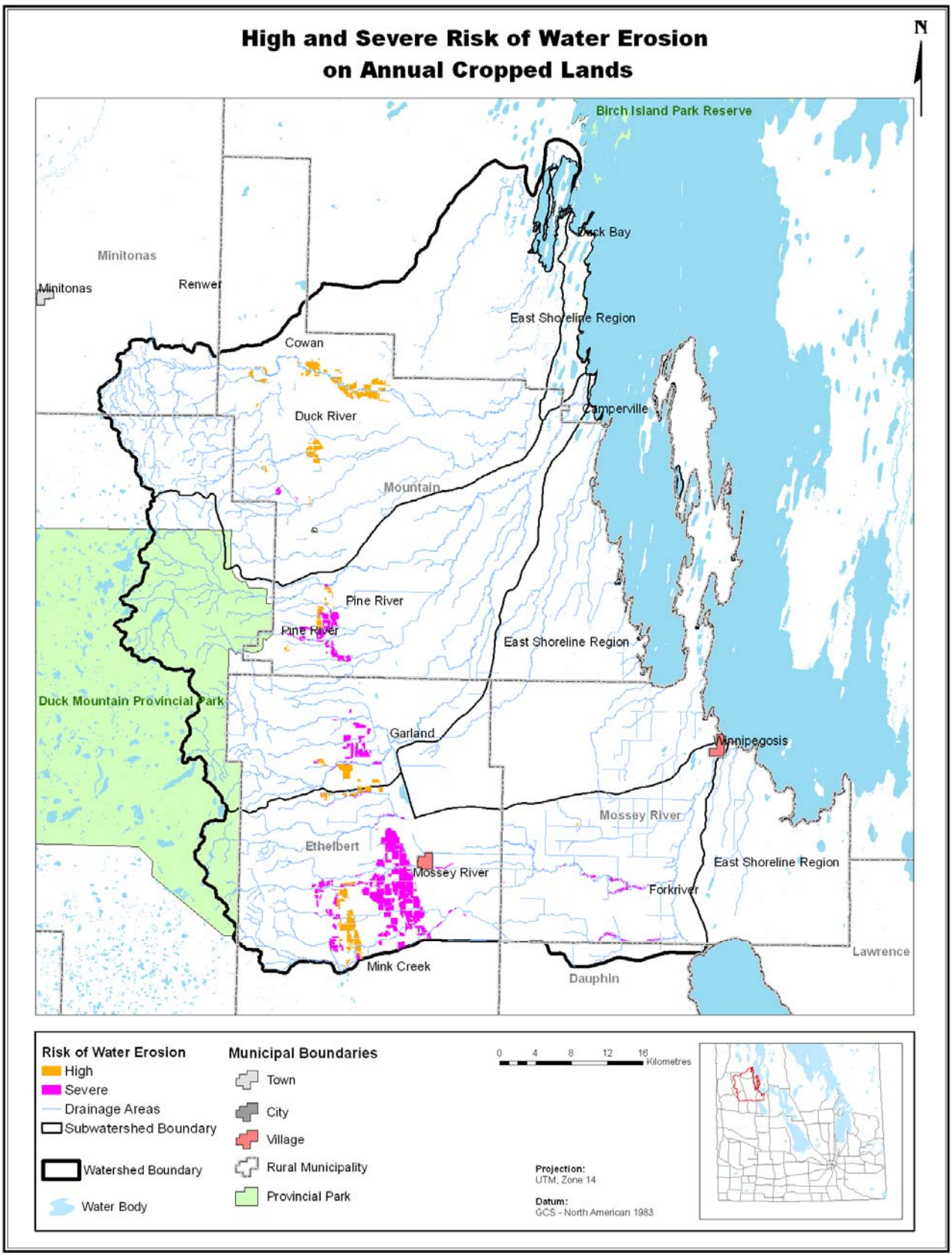
2. Annual Cropland taken from the 2006 Land Cover (from Landsat Imagery)

3. Figure derived from the difference of Land Cover Data - Annual Cropland in Study Area (2006) minus Annual Cropland in Study Area (1994 or 2002) in each Soil Class

Table 9 – Annual cropland located within 50 metres of a provincially designated drain that has a high to severe risk of water erosion by subwatershed

Watershed	Buffer (within 50m of a watercourse) area (ha)	Area of buffer in annual cropland in 2006 with high or severe risk of water erosion (ha)	Percent of buffer in annual cropland in 2006 with high or severe risk of water erosion (ha)
Duck River	1,879	8	0%
East Shoreline Region	409	-	-
Mossey River	1,301	65	5%
Pine River	1,930	16	1%
Entire East Duck	**5,519**	**89**	**1.61%**

Figure 38 – High and Severe Risk of Water Erosion on 2006 Annual Cropland in the East Duck Mountain Sagemace Bay Watershed[1]



v. Soil Drainage Analysis

Soil drainage reflects the actual moisture content in excess of field capacity and the length of the saturation period within the plant root zone. Excess water content in the soil limits the free movement of oxygen and decreases the efficacy of nutrient uptake. Delays in spring tillage and planting are more likely to occur in depressional or imperfectly to poorly drained areas of individual fields. Surface drainage improvements and tile drainage are management practices that can potentially be used to manage excess moisture conditions in soils but should only be used if deemed appropriate for a site specific situation and only where regulations requirements can be met. Agriculture and Agri-Food Canada (AAFC) has classified soils for their drainage capacity using a five class system (***see Appendix I***).

Approximately 38% (72 400 ha) of the landbase within the study area can be considered poor to imperfectly drained. These types of lands make up 70% (27,000 ha) of annual crop production in the overall watershed (***Table 10***). Most of the imperfectly drained and poorer soils are associated with the south-southeastern portion of the watershed in the Mossey River Subwatershed or along portions of the Duck Mountain Escarpment (***Figure 39***).

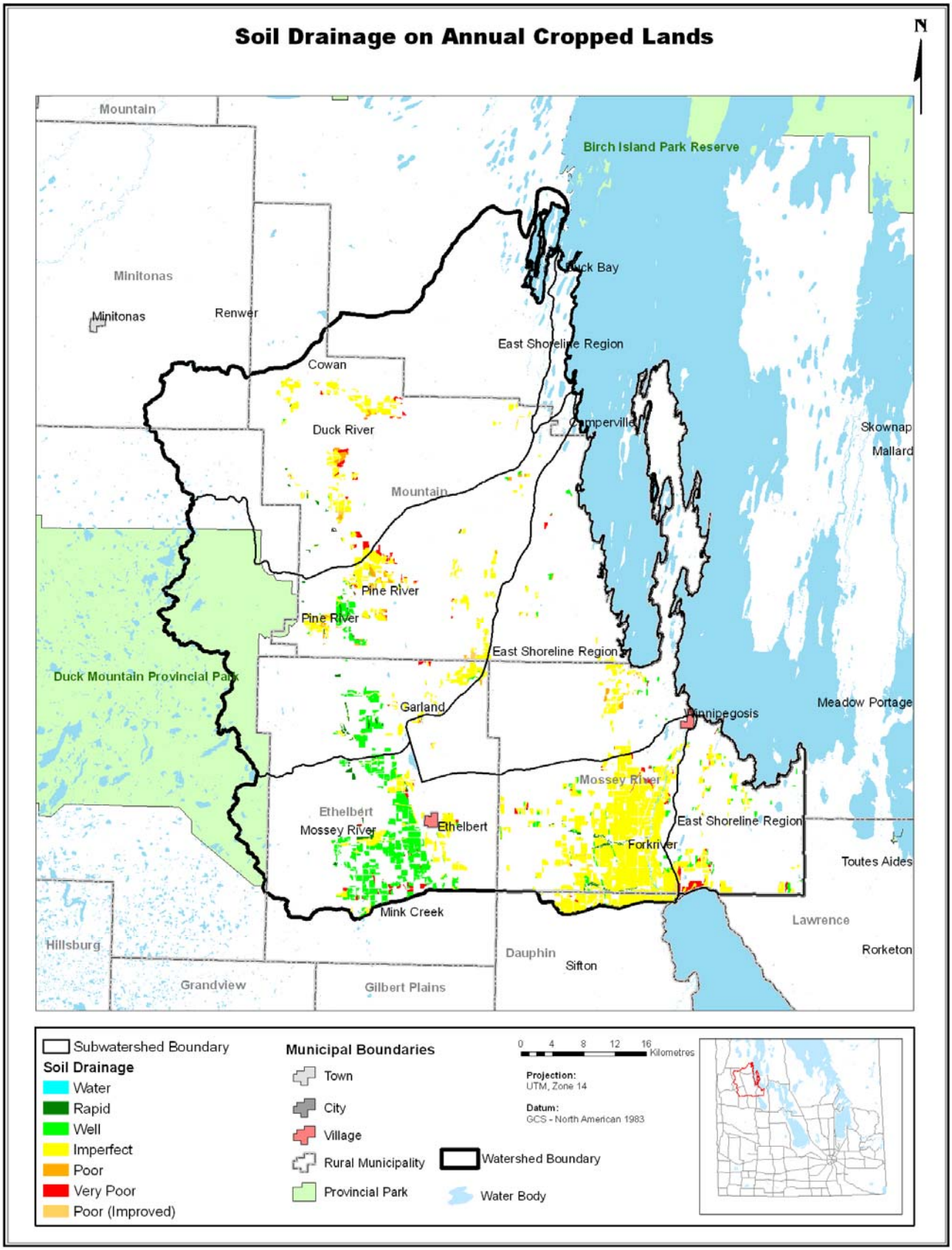
Changes in Land Cover from 1994 to 2006 have shown that the amount of acres in annual cropland experiences some modest decreases in the imperfect and poorly drained classes. With regards to forages land cover, there have also been significant increases in area on imperfectly drained soils. Improved drainage indicates areas where networks of surface drains accelerate surface runoff and reduce the duration of surface ponding. While these drains effectively move water off fields and decrease the amount of standing water in agricultural fields, other adverse effects need to be considered. The drains facilitate water moving off fields more quickly than under natural runoff conditions resulting in river channels being filled to high water levels during heavy precipitation events. High water levels could lead to a flood or near-flood stage, thereby increasing the risk for water erosion or property damage. Also, man-made drainage systems tend not to have riparian buffers associated with them, unlike natural and undisturbed watercourses. With decreased or non-existing riparian buffers, there is an increased risk of nutrient and sediment loading into watercourses. Riparian areas and perennial vegetation on adjacent lands are able to trap and store sediment and nutrients from field runoff during the growing season, reducing the risk of contaminating surface water.

Table 10 - Soil Drainage Classes in the East Duck Mountain Sagemace Bay Watershed [1]

Drainage Class	Area (ha)	Percent of Study Area	Distribution of Annual Cropland[2]
Rapid	15,753	4%	2%
Well	113,705	32%	22%
Imperfect	136,268	38%	69%
Poor (Improved)[3]	975	0%	1
Poor	19,453	5%	2
Very Poor	70,564	20%	4
Unclassified	8	0%	-
Marsh	185	0%	0
Water	1,784	1%	0
TOTAL	**358,695**	100%	**100%**

1. Soil Drainage is based on the dominant soil series for each soil polygon
2. Annual Cropland taken from the 2005 Land Cover (from Landsat Imagery)
3. Poor (Improved) represents soils that were considered poorly drained soils that have been improved with drainage.

Figure 39 - Soil Drainage on 2006 Annual Crop Land in the East Duck Mountain Sagemace Bay Watershed Study Area



G. Crown Lands in East Duck Sagemace Bay Study Area.

Crown Lands are properties that are owned by governments (federal, provincial, municipal, or a combination of). These lands usually have limited or multi-use policies, allowing for special interests such as agriculture, forestry, mining, wildlife, fisheries, and waterfowl and others. In some cases, and in particular for the East Duck Study area, agriculture use has been developed and included in the management plans to a number of the crown land parcels, provided through a lease agreement to producers. In the watershed also exists a federally managed community pasture (Ethelbert) that is part of the crown lands. Further information about CLI and specific characteristics and limitations associated with individual land classes is provided in ***Appendix J***.

The planning and classification of Crown land in agro-Manitoba is the ultimate responsibility of the Crown Lands Assistant Deputy Minister's Committee (CLADMC), previously known as the Crown Land Classification Committee (CLCC). The CLCC was created in 1975 by the Premier of Manitoba for the specific purpose of Crown land use planning and resolution of land and resource use conflicts between departments of government. It is an interdepartmental committee with representation from Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Conservation, Water Stewardship, Aboriginal and Northern Affairs, Science Technology Energy & Mines (STEM) and Intergovernmental Affairs (IAF). The committee reports to cabinet.

The CLCC determined that to achieve its objectives, there was a need for on-the-ground planning and resource management expertise. This was obtained by creating local Block Planning Committees (BPC's), comprised of regional specialists from those departments on CLADMC. Eight BPCs were created in 1976. The BPC's meet every two months or as needed to discuss issues related to crown lands in their respective regions. Minutes are then forwarded to CLADMC for final approval.

The overall objective of CLADMC and the BPC's is to provide a systematic and integrated approach to planning and development of Crown land, its allocation and use, integration of uses and the protection, conservation and sustainability of provincial resources.

The Provincial Crown Land Planning Process is strongly guided by the concept of multiple resource use whereby Crown Lands may be used by both competing and complementary users.

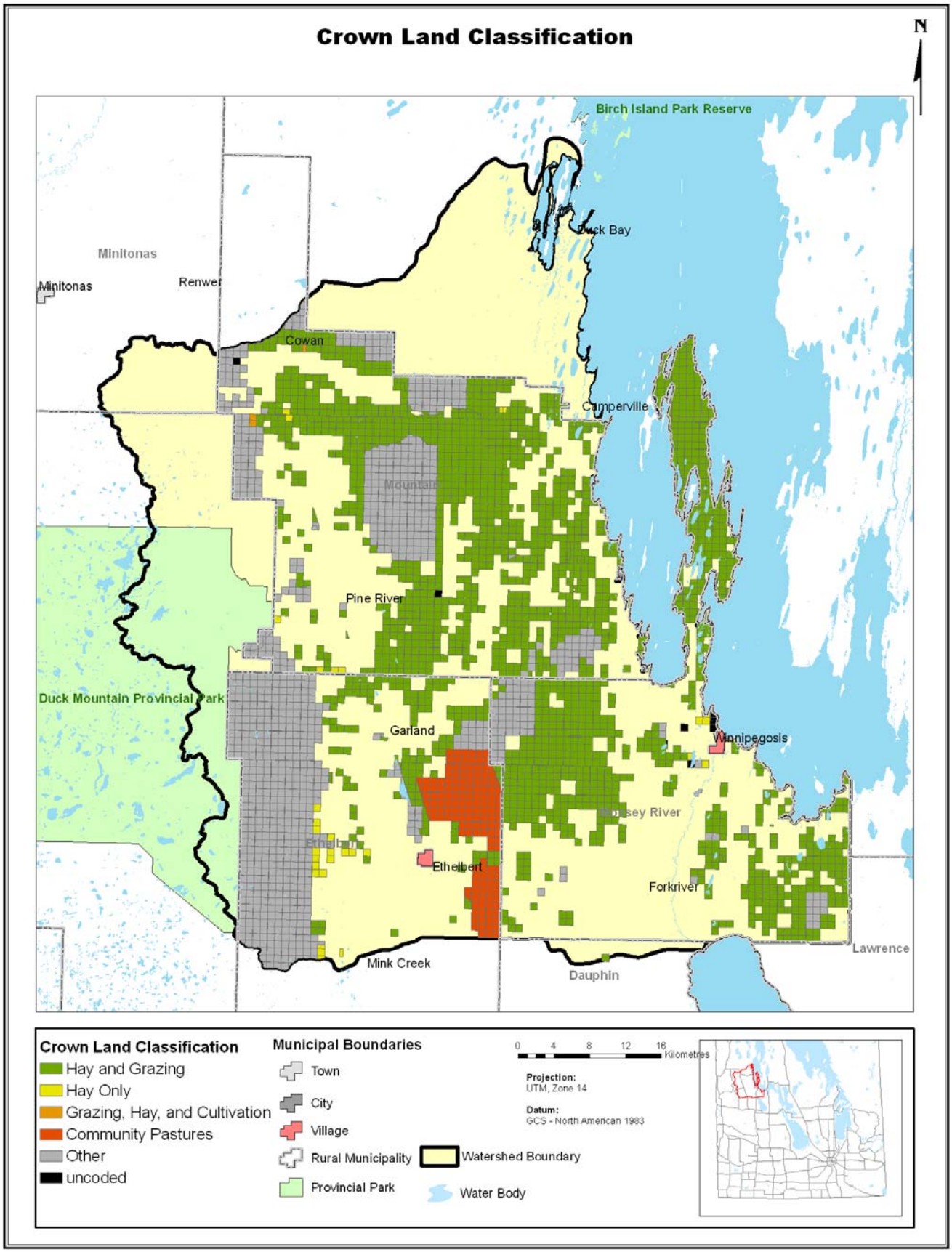
Complementary use of Crown land requires special consideration be given to management in order to ensure that one resource use does not compromise the other. One such example is timber harvesting/livestock grazing, where a project initiated by MAFRI (Garland Project) is showing that proper management (of livestock grazing and forestry practices) can result in long term benefits to both resource users. The science and research from this project will be very beneficial in resolving a longstanding land use issue, and ultimately make more land available for complementary use. The information from this project will also assist private landowners in terms of managing their resources (e.g.; in instances where the land management objective is to enhance both forestry potential and livestock grazing).

In the East Duck Mountain Sagemace Bay Watershed study area, there are approximately 205,331 hectares of Crown Lands, representing 48% of the total watershed (***Table 11***). Similarly, each of the subwatershed regions have anywhere from 30 to 60% of their landbase as crown lands. Approximately, 57,700 ha (32% of the Crown lands or 13% of total watershed) of the crown lands in the East Duck Lake Study area have no agricultural use (***Figure 40***). The remaining 69% of the crown lands have a haying and grazing component available to them, with a very small percentage being haying only. Almost 10,000 hectares of the Crown lands are federally administered community pastures.

Table 11- Crown Land within the East Duck Mountain Sagemace Bay Watershed Study Area

Watershed Region	Area (ha.)	% of Subwatershed Region	% of Total Watershed
Mossey River Subwatershed	30,829	32	7
Pine River Subwatershed	44,310	40	10
Duck River Subwatershed	40,678	39	9
East Shoreline Subwatershed Region	71,812	61	16
Total Watershed	**187,629**	**-**	**44**

Figure 40 – Crown lands and their primary agricultural use in the East Duck Mountain Sagemace Bay Watershed Study Area



H. Recent Federal and Provincial Policies and Programs Affecting Agricultural Land Use and Management

i. Agriculture and Land Use Planning Policies

Integrated watershed planning is a community based focused planning process around issues which affect water quality. This planning needs to support the existing community framework for economic development and land use planning. In most cases, this means, integration of the IWMP into the existing Development Plan. The Development Plan is the local legal framework built around the Provincial Land Use Policies.

All of the municipalities included in the East Duck Mountain / Sagemace Bay area have Development Plans which govern land use decisions including the protection and use of agricultural lands. Development of rural lands for non-agricultural use can impact watershed health, and may result in enhanced drainage above agricultural requirements. Because of this, the ability of the landscape to provide ecological goods and services such as the retention and filtering of water is impacted with development. Within a Development Plan, protecting agricultural land from non agricultural use may also mean protecting wetlands and tree cover, especially if the farmland is maintained for grazing purposes. For these reasons, having agricultural lands protected in a Development Plan will have benefits for the five issues (surface water quality, ground water quality, source water protection, soils and land use and habitat & wildlife) identified in the public consultations.

There are 3 planning districts within the East Duck Mountain / Sagemace Bay area:

- Swan Valley Planning District (R.M. of Mountain S)
- Lakeshore Planning District (R.M.'s of Mossey River, Dauphin & Lawrence)
- Mountainview Planning District (R.M.'s of Ethelbert & Gilbert Plains

The following sections describe the framework for land use planning from a legal perspective, set out by the Provincial Government.

Provincial Land Use Policies (PLUPs); These policies guide local and provincial authorities in preparing Development Plans and in making land use decisions. The PLUPS cover nine broad policy areas, of which Agriculture is one component. The other areas, besides agriculture, are General Development, Renewable Resources, Water and Shoreline, Recreational Resources, Natural Features and Heritage Resources, Flooding and Erosion, Provincial Highways, and Mineral Resources. The various government departments "own" their policies and are involved in establishing them.

Development Plans: The Development Plan is the agreement between the local and provincial governments on matters concerning land use. Once in place, all proposed development and land use changes must be evaluated under the policies of the development plan. This is where the policies governing the protection of prime agricultural land and agricultural operations are set out.

The Provincial Land Use Policies are applied at the local level through the Development Plans, initiated by a municipality or planning district (group of municipalities). The purpose is to set out land use objectives and patterns or characteristics of development for an area. Through the Development Plan, lands are designated for certain uses such as agriculture, agriculture restricted, residential, industrial or commercial.

Zoning By-Laws – Regulating the Use of the Land: Following the approval of a development plan, a municipality must enact a zoning by-law that is consistent with their development plan. A municipal zoning by-law contains the rules and regulations that control development as it occurs. A zoning by-law further divides a municipality into various zones such as rural residential, highway-commercial and

general agricultural. For example, an area that is designated as Agricultural in a development plan may be further zoned as Agricultural General and Agricultural Restricted, with both zones having separate criteria for agricultural development. The zoning by-law sets out requirements and criteria under which development may occur, including property site size, dimensions, separation distances and other siting criteria. It also specifies permitted and conditional uses within each zone.

Zoning by-laws can influence the consumption of agricultural land by the types of development it will permit within the agricultural areas. Generally, only resource-related and agriculturally related developments should be permitted in agricultural areas.

As a **Permitted Use,** a development has the basic right to be established but a development permit must be issued. **Conditional Uses** are certain types of development (e.g. livestock operations), which due to their inherent characteristics may have potential adverse impacts on nearby properties and resources and therefore have to undergo a special process of review and approval, including a public hearing.

PLUPS Agriculture Policy: The Provincial Land Use Policies outline Agriculture's interests to protect land that is used for agriculture by minimizing the subdivision and wasteful use of this land and protecting farms from encroachment and disturbance by other uses which may be incompatible with normal farming operations. These interests are addressed in the PLUPs Policy #1- General Development, Policy #2 – Agriculture and Subdivision Policies sections of the Provincial Land Use Polices Regulation.

Policy #2 – The objectives of the Agriculture Policy are to maintain a viable base of agricultural lands for present and future food production and agricultural diversification, and to protect economically viable agricultural operations from encroachment by other land uses which could adversely affect their sustainability.

Soils and Provincial Land Use Planning: It is important to recognize that for planning purposes, the determination of the classification of the agricultural capability of an area is based on the capability class of 60% or greater of the quarter section or river lot. If 60% or greater of a river lot or quarter section is Class 3 or better for agricultural capability, then the entire river lot or quarter section is considered to be prime agricultural land from a planning perspective. For example, MAFRI staff often review subdivision applications in designated agricultural areas for 5-10 acre lots for residential purposes. The 5 acre site itself may have an agricultural capability rating of CLI Class 4 or poorer but the remaining quarter section may be considered prime agricultural land by definition in the Provincial Land Use Policies. Because the majority of the quarter section is prime agricultural land and the surrounding area is actively farmed, MAFRI would not recommend approval of the subdivision.

Another key consideration has been an increasing trend amount of agricultural lands being subdivided into rural residences, cabins, acreages, and hobby farms. There has been a significant increase in subdivision applications throughout Manitoba over the past few years, with this number doubling in the last 4 years. In 2007/2008 approximately 700 subdivision applications in rural areas were reviewed by Land Use Specialists in MAFRI. Many of these subdivisions involve multiple lots and contribute to the loss and/or fragmentation of agricultural lands, land use conflicts, and pressure for increased infrastructure in rural Manitoba.

One non-farm dwelling in an agricultural area can have a shadow effect that covers a much larger area than the 5 acre lot that it is located on. The potential for land use conflicts increases as the number and the density of non-farm dwellings increase.

For planning purposes, MAFRI supports only the use of detailed soil survey information (at a scale of 1:50,000 or better) in making site specific decisions pertaining to land use.

Reconnaissance scale information published by Manitoba Soil Survey and Canada Land Inventory Maps as published by the Government of Canada may be used in the development plan as reference maps, but should never be used as the basis for a site specific land use decision. In any case, Prime Agricultural Land and Viable Lower Class land are areas of concern for agriculture.

Prime Agricultural Lands: Land composed of mineral soil determined by Manitoba Agriculture to be of dryland Agricultural Capability Class 1, 2 or 3 and includes a land unit of one quarter section or more or a river lot, 60% or more of which is comprised of land of dryland Agricultural Capability Class 1, 2, or 3.

Viable Lower Class Land – Land that is not prime agricultural land but that is used for agriculture or has the potential to be used for agriculture. It is defined in the Provincial Land Use Policies Regulation 184/94 as "land other than prime agricultural land on which agricultural activities that contribute to the local economic base are the dominant land use". Lower class agricultural lands (i.e. Class 4 and 5) are well suited for expanding forage production and pastureland to support the Province's beef industry.

Some municipalities, particularly those municipalities with smaller areas of prime agricultural land, have included policies to protect land that is Class 4. Careful planning for the use of this lower rated land in an agricultural area provides for maximum agricultural diversification opportunities. It should be noted that protection of Viable Lower class soil often protects areas of biodiversity on the landscape.

Livestock: MAFRI recommends that new livestock operations should not be permitted on soils determined by detailed soil survey (scale of 1:50,000 or better) to have an agricultural capability of Class 6, 7 or on unimproved organic soils as described under the Canada Land Inventory.

It is important to note that MAFRI recommends that livestock operations for this purpose be defined as "a permanent or semi-permanent facility or non-grazing area, including all associated manure collection facilities, where at least 10 animal units of livestock are kept or raised". Therefore, this does not include enclosed grazing areas and use of Class 6 and 7 soils within areas used for pasture should still be permitted. This reflects new regulations for manure application and residual nitrate nitrogen levels permissible based on the agricultural capability class and subclass of the soil under the Livestock Manure Management and Mortalities Regulation under The Environment Act.

Municipalities are encouraged to use the agricultural capability maps as a support tool when making planning decision related to livestock development.

Livestock Operations Policy (LOP): In 2000, the Manitoba Government announced its Livestock Stewardship Initiative with the aim to ensuring the sustainable development of Manitoba's livestock industry. Following consultations with public, municipalities, environmental groups and industry, the government announced changes to *The Planning Act* and other legislation with respect to livestock operations. This included the following:

- Mandatory adoption of a development plan by Jan. 1, 2008 with a livestock operation policy
- All livestock operations of a size of 300 animal units (AUs) or greater are a conditional use and require a Technical Review (3 km notification)
- Specifies the types of conditions that may be imposed on the approval of a livestock operation
- Development agreements can involve timing of construction, control of traffic, and construction or maintenance of roads or landscaping required to service the livestock operation
- Municipalities or planning districts must designate areas in the development plan where expansion or development of livestock operations: may be allowed; may be allowed up to a specified maximum size; and/or, will not be allowed
- A Development Plan should state the general separation distances for livestock operations with reference to the minimums

These guidelines provide better “up-front” planning for livestock – done in the development plan process, more certainty in terms of how LO’s will be handled in the municipality – and reduced conflict at the conditional use stage. Municipalities continue to have a final say in where LO’s are permitted in their municipality.

Note: NO conditions may be set regarding the storage, handling, application or transportation of manure, other than requiring a cover.

Additional Considerations from an Agricultural Perspective

The Nature of the Surrounding Area: If the surrounding area is predominantly agricultural and is generally maintained in large parcels, the conversion of farmland to non-farm uses can influence the commercial viability of farms in the following ways:

- Loss of farmland and presence of non-farm development may reduce a farmer’s ability to respond and adapt to changing economic and market conditions and ultimately manage their business.
- Increased rural residential development in agricultural areas generally tends to increase land assessment values and property taxes.
- Increased non-farm uses in agricultural areas increases land use conflicts (crop spraying, dust, odours).

Proximity of Livestock Operations: The creation of a rural residential lot may impose a minimum separation distance, which may restrict the expansion of existing livestock operations and the establishment of any new operations.

Municipal zoning by-laws set out separation distances between livestock operations and residential development. MAFRI recommends that municipalities use the minimum separation distances from livestock operations to non-farm land uses (ex. single residence and designated residential and recreational areas) in *Table 13: Recommended Criteria for Siting Livestock Operations* of the Farm Practices Guidelines for Livestock Producers. These separation distances are based on odour considerations and are therefore greater for operations using an earthen manure storage facility. The separation distance also increases as the size of the livestock operation increases. It is important to note that the recommended separation distances for siting livestock operations are much greater from designated residential areas than from a single residence. The distances are about 4 times as great.

Manure Application in the Surrounding Area: Proposed changes to the *Pesticide and Fertilizer Control Act* will bring into regulation recommended setbacks for manure spreading in found in *Table 5: Nutrient Loss, Odour Suppression and Recommended Setbacks for Spreading Livestock Manure with Different Methods* of the Farm Practices Guidelines. These distances were determined based on odour considerations and vary with the method of application. Distances are significantly greater for designated residential areas than they are from a single residence.

Development Plans are a key tool for land management at the local level, and are crucial for meeting environmental goals within the economic and social framework of the area. Protection of agricultural lands is one means of meeting environmental goals on the landscape, while keeping the stewards of the land; the farmers; on the land, so they can care for the soil and water resources of our communities.

ii. Recent Federal-Provincial Programs

Environmental Farm Planning and Canada-Manitoba Farm Stewardship Program - On-Farm Beneficial Management Practices Adoption

In 2003, the Agricultural Policy Framework (APF) was launched as a new national approach to support agricultural activities associated with Business Risk Management, food safety and quality, science and innovation, environment, and skill development. In support of priorities related to soil, air, water and biodiversity, various environmental initiatives were introduced across Canada including Environmental Farm Planning and the National Farm Stewardship Program. Environmental Farm Planning (EFP) is awareness and planning tool used to enhance producers' understanding of potential on-farm environmental risks and to develop action plans for how these risks can be addressed. Many producers in Manitoba, including those in the watershed, have participated in the EFP process to gain an improved understanding of the potential environmental risks associated with agriculture, as well as, those on their own farms. The EFP process also allowed producers to develop an action plan that outlines how potential risks on their farms can be addressed through the adoption of beneficial management practices (BMPs). Financial and technical support has been offered to producers wishing to adopt BMPs through the Canada Manitoba Farm Stewardship Program (CMFSP) between 2003 and 2009. This program offered 30 different BMPs to producers that had completed an EFP. (For a list and description of the BMPs see ***Appendix M***).

Participation in the Environmental Farm Plan Program is reported by municipalities in and around the study area (***Appendix N***). The information portrays the number of participants in the Environmental Farm Planning process based on where EFP workshops were held. Therefore it should be noted that participants may reside in the surrounding area and not necessarily in location of the workshop. Environmental Farm Planning Workshops were well attended, with a high degree of producers completing the process to receive a Statement of Completion for eligibility to BMP funding through the CMFSP. These numbers within the study area were at the Manitoba average as well, indicating that producers in the Pembina watershed are proactive in nature and environmental issues are high on their priorities.

In the East Duck Mountain Sagemace Bay Watershed study area; there were a total of 88 BMP projects that were adopted by producers (***Table 12***). All of these BMPs contribute to reducing risks to water quality. Of the 88 adopted, 52 of the BMPs were related to non point source. Almost 50% were non-point source crop related and 30 BMPS were adopted for Point Source Protection. It should also be noted that a majority of the point source and non point source crop related BMPs were implemented in the southern part of the watershed (Mossey River Subwatershed).

The top three BMPs adopted by producers in the study area through the CMFSP were Improved Cropping Systems, Product and Waste Management, and Winter Site Management which is consistent with trends throughout the rest of Manitoba.

The adoption BMPs by producers is not limited to those funded through the CMFSP. Other agencies like Conservation Districts, Ducks Unlimited Canada, and Manitoba Habitat Heritage Corporation also support the adoption of various BMPs. In addition, as indicated in the public consultation process for the IWMP, there have been many producers who have adopted BMPs on their own initiative, so it is difficult to determine precise adoption levels. However, the CMFSP program data does suggest that producers in the watershed are progressive in terms of BMP adoption and that future conservation programs that may stem from IWMP implementation are likely to have considerable levels of participation in this region.

Table 12 - BMP Adoption through the Canada-Manitoba Farm Stewardship Program 2003-2008[8]

BMP Categories	East Duck Total
Point Source - Livestock Manure Related[1]	17
Point Source - Other (Petroleum, Nutrients from Feed, Pesticides, etc.)[2]	13
Non-Point Source - Livestock Related[3]	7
Non-Point Source - Crop Related[4]	35
Non-Point Source - Crop Related (Pesticides)[5]	10
Soil Erosion, Flood Protection [6]	<5
Biodiversity[7]	<5
Total	**88**

(1) These include BMPs 1, 2, 4, 5, 6
(2) These include BMPs 8, 9, 17
(3) These include BMPs 3, 7, 10, 26, 30
(4) These include BMPs 14, 18, 24, 29
(5) These include BMPs 16, 20, 25
(6) These include BMPs 11, 12, 13, 15, 19, 27 Due to uptake numbers being <5, numbers had to suppressed
(7) These include BMPs 21, 22, 23, 28. Due to uptake numbers being <5, numbers had to suppressed
(8) Refer to Appendix M for BMP category and names

I. Agricultural Land Use and Management Recommendations*

Watershed Issue		Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Flooding /Drainage	**Surface Water Management**	• **Soil Drainage** - Approximately 38% (72 402 ha) of the landbase within the study area can be considered poor to imperfectly drained. These poor to imperfectly drained soils make up 70% (26,984 ha) of annual crop production in the overall watershed. Most of the imperfectly drained and poorer soils are associated with the south-southeastern portion of the watershed in the Rural Municpalities of Mossey River or along portions of the Duck Mountain Escarpment • **Wetlands** – It was identified that a majority of the wetlands classified in 2006 were primarily classified as forest and pasture in 1994. Most of the wetland locations in 2006 were not the same as in 1994, suggesting that new wetlands were developed as a result of land activities (beavers, indiscriminate drainage, land improvements, etc.). It was identified that a majority of the wetlands classified in 2006 were located on the eastern portions of the watershed, indicating that this area is more prone to flooding • **Grasslands** – A majority of the grassland identified in the 2006 landcover was previously identified as forest, marsh and fens, or annual cropland in 1994. The conversion of forested land and to some extent marsh and fens suggest possible land conversions that could increase spring melt and surface runoff • **Water Retention and Management-** Significant high or severe erosion risk areas were identified along the Duck Mountain Escarpment to address flooding issues on the eastern portion of watershed. There also has been less than 5 BMPS developed in the watershed that deal with flood protection and soil erosion • **Timing of Landcover Imagery** -Timing of Imagery and classification definitions may provide a higher or lower number of wetlands than present and should be verified with local examination for proper site identification	**Surface Water Management Assessment-** Examine potential for the development of a long term water management similar to what was completed at Turtle Mountain Conservation District for entire watershed. **Point Source BMP Implementation Water Management Landscape Approach** - Promote and provide technical support for water management BMPs prioritized in a particular region (e.g.riparian buffer design and, riffle structures/ headwater storage options, and erosion control). **Non Point Source BMP Implementation Water Management Landscape Approach** - Promote and provide technical support for BMPs in prioritized water management on a landscape level (e.g.perennial forage establishment establishment assistance programs, Sustainable woodlot management options, sustainable rotational grazing plans, offsite watering systems, exclusion and riparian grazing). Support the potential development of a **Wetland Restoration Program for the western portion of the watershed.** **Coordinate BMP initiatives** to alleviate regional flooding issues on landscape approach.	Areas in the watershed that are: • western Half of the East Duck Mountain Sagemace Bay Watershed • along the headwater portions of the Subwatersheds to the Duck Mountain /Sagemace Bay watershed • annual cropped lands of class 4 and lower • 1st – 2nd order waterways • grazing lands that have or are near riparian areas	Proportion of watersheds in Landcover analysis that: • have changes in wetland sizes and numbers, • in forestry to grasslands/pasture • is annual cropland on imperfectly drained soils • is wetland, tree, grassland/pasture and forage land cover classes • has BMPs implemented related to flood control and wetland restoration • stream Flow Monitoring of the watershed
	Soils and Land Use - (related issues such as increased flow rates)	See Surface Water Management Analysis • **Landcover Analysis** – Marshes and fens increased from 32,924 hectares in 1994 to 34,901 hectares in 2001 (6 % increase). From 2001 to 2006, there was a 10% decrease noted in marshes and fens as well (31,248 hectares, a 4 % decrease overall from 1994). The area classified as water also showed an overall decrease of 4 % from 1994. • **Farm Size**- Less farms were reported for the same amount of farming area which means there are less producers implementing sustainable farm practices on the same amount of agricultural land	**Point Source BMP Implementation Water Management Mitigation** - Promote and provide technical support for BMPs in prioritized water control strategies (e.g.grassed waterways, headwater storage, wetland restoration) **Non- Point Source BMP Implementation Water Management Landscape Approach** – **Grazing Management-** In environmentally sensitive areas that are not in annual cropland, like pastures in riparian areas, grazing management BMPs, Agro-Woodlot Management Plans should be implemented or promoted. **Marginal Land Management** - Promote appropriate management considerations and support the adoption of sustainable beneficial management practices where annual cropland is located on soils with agricultural capabilities of Class 4 and, poorer, as well as organic soils in source watersheds **Coordinate BMP initiatives** to alleviate regional flooding issues	Areas in the watershed that are: • wetland or perennial cover (forest, grassland or pasture) on class 3 or higher land • annual cropped lands of class 4 and lower	Proportion of the watershed that: • Is treed and wetland areas • has grazing BMPs implemented in riparian areas ▪ is Cropland of class 4 or lower • has BMPs implemented on cropland of class 4 or lower

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators, need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

Watershed Issue		Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Erosion	**Surface Water Management**	• **Approximately 61% (215,101 ha) of all lands within the study area are considered Class 4 and lower** • **Water Erosion Risk** - 56,121 hectares (18%) within the watershed are indicated to be of high or severe risk of erosion. 7,705 hectares (20% of the landcover class) was under annual cropland • Annual cropland landuse has been decreasing on high or severe water erosion risk soils • **Water erosion risk on annual cropland near watercourses** - soils and land cover data suggest there are areas of the watershed with high risk of water • **More acres were noted for oilseed production (Agriculture Census Data, 2006) noted in Mossey River Subwatershed than any other subwatersheds** • Tillage practices in the Duck and Pine subwatersheds tend to be managed using conventional tillage (over 60% of cropland) whereas in Mossey, conservation and zero tillage were used on just over 50% of the cropland (Census of Agriculture 1971 -2006) • **Mossey River has 5% of a 50 meter buffer area in annual crop production** • Forage lands have increased since 1994 • Annual Cropland area has declined notably since 1994 • Summerfallow hectares are declining since 1972, No-Till Management hectares have been increasing since 1972 (Census of Agriculture 1971 -2006)	**Point Source BMP Implementation** **i) Water Erosion Mitigation** - Promote and provide technical support for BMPs in prioritized water erosion risk areas (e.g.erosion control structures, controlled livestock crossings, offer design and establishment assistance programs) **ii) Riparian BMPS-** In environmentally sensitive areas that are not in annual cropland, like pastures in riparian areas, grazing management BMPs in should be implemented or promoted	Areas within **drinking water source watersheds**, specifically those that are: • wetland or perennial cover (forest, grassland or pasture) on class 3 or higher land	Source water quality results Change in area of watershed that : • are forested and wetland areas • have grazing BMPs implemented in riparian areas
	Soils and Land Use	• **Water Erosion Risk** - An examination of the watershed shows 56,121 hectares (18%) are at high or severe risk to erosion. 7,705 hectares (20% of the landcover class) was under annual cropland • Annual cropland landuse has been decreasing on high or severe water erosion risk soils • **Livestock Numbers** – Increase in cattle numbers reported could represent potential increased stresses on pasture lands and management (1971-2006 Census of Agriculture) • **Wind Erosion Risk** - Approximately 5% of the East Duck Mountain Sagemace Bay Watershed study area is considered to have a high or severe wind erosion risk • There is a decreasing trend of annual cropland associated with high or severe wind erosion soil types • Approximately 61% (215,101 ha) of all lands within the study area are considered Class 4 and lower • **Water erosion risk on annual cropland near watercourses** - soils and land cover data suggest there are areas of the watershed with high risk of water • **More acres were noted for oilseed production (Agriculture Census Data, 1972-2006)** • **Conventional tillage continues to be applied by many producers in the Duck and Pine River Subwatershed Regions (Agriculture Census Data, 1972-2006)** • **Mossey River has 5% of a 50 meter riparian buffer area in annual crop production** • **Forage lands** have increased significantly since 1994 • **Annual Cropland area** has declined significantly since 1994 • **Summerfallow** hectares are continued to be significant in the watershed (1,100 hectares reported) but have been declining since 1972 • **No-Till Management** hectares have been increasing since 1972 (1971-2006 Census of Agriculture)	Examine other **Land Management Opportunities** that provide value to landowner and still maintains the environmental buffer services for wetland or riparian areas) **Non Point Source BMP Implementation**- **i) Water Erosion Mitigation** (e.g. riparian buffer design, Zero Tillage, and establishment assistance programs) for the lower class of lands in severe or highly erosive areas, and Rotational Grazing Plans **ii)Wind Erosion Mitigation** -.(e.g.of cover crops and residue management techniques, as well as shelterbelt establishment where wind erosion is an issue) **Point Source BMP Implementation Water Erosion Mitigation** - Promote and provide technical support for BMPs in prioritized water erosion risk areas (e.g. riparian buffer design and establishment assistance programs)	Areas in the watershed that are: • in the southern portion of the East Duck Mountain Sagemace Bay Watershed (Mossey River subwatershed • imperfectly drained soils and annual cropland • headwater, wetland areas, • wetland or on class 3 or higher land • no-Till or minimum tillage on annual croplands in Duck and Pine River subwatersheds	Proportion of the watershed that: • is at high or severe risk to water erosion, in annual cropland, within 50 m of a water course • where water erosion mitigation BMPs (e.g. cover crops, buffer strips, etc.) have been implemented • BMP adoption within those critical areas or targeted areas; water quality results or report card larger waterways, Land Cover Analysis of Forage
Water Quality Issue- Source Water Protection	**Source Water Protection**	**Contamination from Various Sources/Source Water Quality** • **Annual cropping of marginal lands**, Class 4 land and lower is considered to be at significant risk to soil erosion and nutrient transfer to surface waters when cropped annually • More farms are reporting using herbicides and pesticides (Census of Agriculture 1971 -2006) • Conventional tillage continues to be applied by many producers in the watershed (Census of Agriculture 1971 -2006) • Summerfallow is still a recognized practice in the watershed although declining (Census of Agriculture 1971 -2006) • Nutrient Management Planning has been an adopted BMP in the watershed. • Forage lands have increased significantly since 1994 • Beef production is the dominant livestock industry with similar size herds in all three subwatersheds (Agriculture Census Data, 2006)	**Riparian Assessment (Snake Creek Project) –** Develop an assessment of the riparian vegetation and condition of the riparian shoreline areas **Point Source BMP Implementation** - Promote BMPs within source watersheds related to reducing nutrient transport to waterbodies (e.g., soil testing, manure testing, livestock relocations, riparian area management and buffer strips) **Non Point Source BMP Implementation** - Promote BMPS that provide opportunities for moving nutrient loading onto field and away from surface waters (that include winter site management, nutrient management planning, variable rate applications, and perennial forage /legumes in crop rotation	Areas within **drinking water source watersheds**, specifically those that are: • in annual crop production • receive fertilizer or manure application	• Number of BMPS implemented to limit nutrient losses from cropland (e.g. nutrient management plans, buffer strips, soil and manure testing) implemented • Source water quality results
	Groundwater	**Private water wells** are the primary drinking water source for the majority of farms in the watershed	**Private Water Source Assessments** - Continued promotion of private source assessments and action plans like those included in the EFP program **Point Source BMP Implementation** - Continue to provide assistance to producers to upgrade or protect their well	• Entire watershed	• Number of assessments/plans developed as a percentage of total farms

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators, need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

Watershed Issue		Analysis	Recommended Actions*	Target Areas*	Potential Indicators*
Land Use	**Soils and Land Use**	• **Annual cropping on imperfectly drained soils**- Up to 70% (27,000 ha) of annual crop production is located on poor to imperfectly drained soils in the overall watershed ,and would be prone to flooding. • **Grassland Analysis** – A majority of the grassland landcover in 2006 was primarily forest landcover, marsh and fens, and annual cropland in 1994. • **Forestry Analysis** - A majority of the forest landcover in 2006 was primarily grasslands/pasture landcover in 1994, suggesting that forest encroachment is an issue to pastures that are not managed to address potential encroachment. • **Income Levels** – Average level of Income reported suggests external factors have played a role and could impact pasture acres and ability to invest in on-farm management practices (1971-2006 Census of Agriculture).	**Non- Point Source BMP Implementation Water Management Landscape Approach** – **Forest Encroachment** - Promote the adoption of sustainable beneficial management practices such as rotational grazing strategies, brush mowing, and controlled burns	Areas in the watershed that are: • Wetland or perennial cover (forest, grassland or pasture) on class 3 or higher land • Annual cropped lands of class 4 and lower	Number of farms (or hectares) that have: • grazing management strategies developed as a percentage of total farms • Agro-woodlot plans initiated
	Marginal or Crown Lands	• **Crown Land Analysis** - In the East Duck Mountain Sagemace Bay Watershed study area, there are approximately 187,629 hectares of Crown Lands, representing 41% of the total watershed. • In the Duck and Pine River subwatersheds, almost half of the land operated by farmers is leased from governments. In Mossey, the total area leased from governments is larger in the other two, though this makes up just over 35% of the total farmland (2006 Census of Agriculture) • **Livestock Numbers** – Increase in cattle numbers reported could represent potential stresses on Marginal Lands should appropriate management practices not be applied (1971-2006 Census of Agriculture) • **Income Levels** – Average level of Income reported suggests external factors have played a role and could impact pasture acres and ability to invest into farm management improvements management (1971-2006 Census of Agriculture). • Less farms by same amount of Farming Area = less amount of time for implementing sustainable farm practices on marginal lands • More dependency of rented lands less responsibility to invest into proper stewardship (1972 -2006 Census Data)	**Non- Point Source BMP Implementation Water Management Landscape Approach** – **i) Marginal Land Management** - Promote the adoption of sustainable beneficial management practices where annual cropland is located on soils with agricultural capabilities of Class 4 and, poorer, as well as organic soils **ii) Ecological Goods and Services Model –** Explore the concept on Ecological Goods and Services to reduce impacts on marginal lands	• Assess lands that are Class 4 and lower in the entire East Duck Mountain Sagemace Bay Watershed. • Target Crown Land areas as part of Rental Agreement for BMP Implementation. Areas in the watershed that are: • At high or severe risk of water erosion, in close proximity to waterways and in annual crop production	Number of farms (or hectares) that are: • Applying BMPs on leased or crown lands • Utilizing BMPs that are directed at securing or stabilizing soils • Number of BMPs that are implemented for protecting marginal lands (Class 4 or lower). • Proportion of target areas, fitting the above criteria, where key BMPs are implemented (e.g. cover crops, buffer strips, etc.)

* Specific approaches and opportunities related to recommended actions, including potential target areas and indicators, need to be explored further by the Project Management Team. Potential collaboration with partners and stakeholders should be considered Specific recommendations from the IWMP process must be forwarded to local councils for consideration within the Development Plan. These recommendations should take agricultural land management into consideration, for preservation of existing farm land and operations.

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J. Appendices

Appendix A: Mandates of Federal and Provincial Agriculture Departments

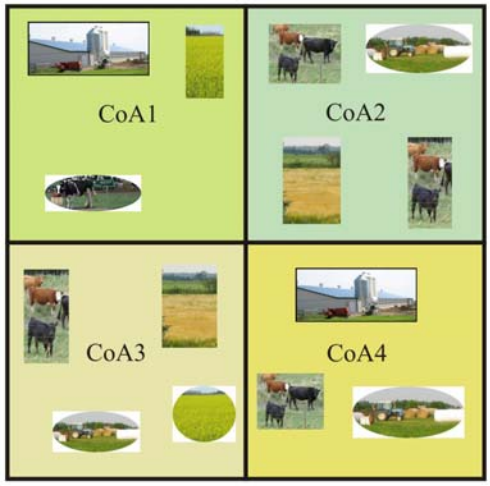
i) **Agriculture and Agri-Food Canada – Agri-Environment Services Branch (AESB)** mission is to provide integrated expertise and innovative environmental solutions to the agriculture and agri-food sector. AESB's focus is on providing knowledge and information; leading adaptation and practice change; and developing and coordinating policy and programs.

ii) **Manitoba Agriculture, Food and Rural Initiatives (MAFRI)**
MAFRI's mission is to assist with the compilation of a technical resource package and deliver expertise with the technical information to aid in issue identification, and to assist the proponent in completing the final Integrated Watershed Management Plan.

Appendix B: Diagram for Interpolating Census of Agriculture Data (Area Weighting Method)

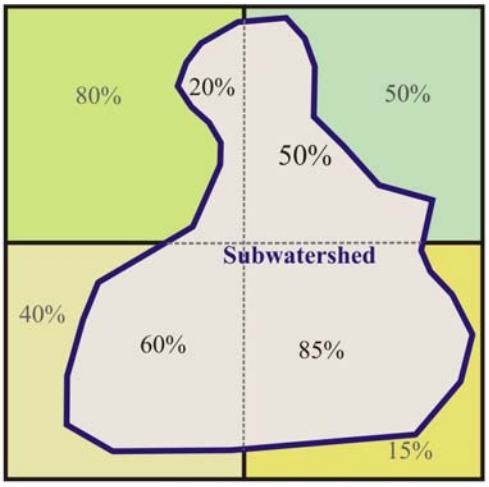
Basic concept of interpolating Census of Agriculture (CoA) using the area weighting method*

Census of Agriculture (CoA) from Statistics Canada's geographic boundaries



CoA from Statistics Canada's geographic boundary

CoA interpolated to subwatershed boundary



CoA is the sum of all survey forms of farms with farm headquarters located in the specific boundary

For Example - Total cattle and calves

CoA1 = 540 total cattle
CoA2 = 300 total cattle
CoA3 = 125 total cattle
CoA4 = 1200 total cattle

Interpolated CoA for Subwatershed =
(CoA1: 540 cattle x 20%) +
(CoA2: 300 cattle x 50%) +
(CoA3: 125 cattle x 60%) +
(CoA4: 1200 cattle x 85%) = 1353.6 total cattle and calves**

** due to the methodology of interpolating data, final census numbers are estimates.

*This is a simplified explanation of the methodology used to interpolated Census of Agricultural data from Statistic Canada's geographic boundaries into other specified boundaries such as watersheds. There are other factors not explained here that are taken into account during the process.

Appendix C: – 2006 Census of Agriculture data

Table 1: Agricultural Land Use types reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Total Farmland	Total Cropland**	Summerfallow	Pasture***	Other*
Duck	32,689	10,064	345	13,282	8,998
Pine	36,971	10,437	427	16,683	9,423
Mossey	56,872	20,169	714	25,374	10,615

*Other category includes all other land uses including farmyard, woodlots, Christmas trees, wetlands, etc.
** Total cropland includes all field crops, vegetables, fruit and nuts and sod
*** Pasture includes tame pasture and natural areas used for pasture.

Table 2: Distribution of crop types as reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Total Cropland*	Cereals	Oilseeds	Pulse	Forage for hay	Forage for seed	Other**
Duck	10,064	3,336	1,895	0	4,593	x	240
Pine	10,437	2,998	1,087	0	5,624	x	729
Mossey	20,169	6,776	2,404	0	9,231	149	1,609

x – data has been suppressed by Statistics Canada to preserve confidentiality of the data
* Total Cropland includes all field crops, vegetables, fruits and nuts, and sod
** Other category includes other special field crops, fruits and nuts, sod, vegetables, and all suppressed hectares in the listed categories

Table 3: Total area treated with crop inputs for the 2005 cropping year, as reported in the 2006 Census of Agriculture (hectares)

Subwatershed	Use of commercial Fertilizers	Use of Herbicides	Use of Insecticides	Use of Fungicides
Duck*	4,702	3,624	x	603
Pine	4,254	3,189	239	x
Mossey	11,942	8,086	792	966

x – data has been suppressed by Statistics Canada to preserve confidentiality of the data

Table 4: Total dollars spent on crop inputs for the 2005 cropping year, as reported in the 2006 Census of Agriculture

Subwatershed	Total crop expenses	Total fertilizer and lime	Total herbicides, insecticides & fungicides	Total seed
Duck	$1,054,987	$575,712	$321,518	$157,757
Pine	$765,566	$422,197	$225,786	$117,582
Mossey	$1,855,928	$999,967	$585,665	$270,296

Table 5: Tillage practices on areas prepared for seeding as reporting as a percentage of total cultivated land

Subwatershed	Tillage incorporating most crop residue into the soil	Tillage retaining most crop residue on the surface	No-till or zero-till seeding
Duck	62%	x	x
Pine	65%	10%	25%
Mossey	37%	33%	20%

x – data has been suppressed by Statistics Canada to preserve confidentiality of the data

Table 6: Total number of livestock and poultry on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Duck	5,366	2,681	x	x	x	346
Pine	6,261	3,160	x	573	x	490
Mossey	11,694	5,501	0	0	0	550

x - Some suppression of dairy cow numbers occurs in Rock-Swan and Snowflake subwatersheds, and all dairy cow numbers suppressed for Pelican subwatershed

Table 7: Total number farms reporting livestock and poultry on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Duck	37	35	1	2	1	5
Pine	44	42	0	3	1	7
Mossey	74	71	1	4	2	9

Table 8: Average number of livestock animals or poultry birds per farm on Census Day in 2006, as reported in the 2006 Census of Agriculture

Subwatershed	Total cattle	Beef cows	Dairy cows	Total Pigs	Sows	Total Poultry
Duck	145	76	x	x	x	73
Pine	144	76	x	219	x	75
Mossey	158	77	0	0	0	59

x – data has been suppressed by Statistics Canada to preserve confidentiality

Table 9: Summary of Farm financial characteristics

Subwatershed	Number of Farms	Average farm size (ha)	Average Capital investment ($/farm)	Average livestock-related expenses ($/ha farmland)*	Average crop-related expenses ($/ha farmland)*	Estimated profit ($/farm)*
Duck	57	570	541,114	16.66	101.35	13,680
Pine	65	566	457,770	18.91	70.46	8,490
Mossey	110	517	527,347	34.73	88.87	27,401

* Calculations are based on the expenses for the 2005 calendar year, as reported in the 2006 Census of Agriculture

Table 10: Summary of farmland land tenure

Subwatershed	Total area of land operated by this operation		Total area owned		Area leased from governments		Area rented or leased from others	
	# of Farms	Total ha	# of Farms	Total ha	# of Farms	Total ha	# of Farms	Total ha
Duck	57	32,689	56	15,908	26	14,355	16	2,957
Pine	65	36,971	64	17,275	30	16,317	18	3,805
Mossey	110	56,872	108	29,143	48	20,559	39	8,060

Animal Unit Calculations

Summary of Animal Unit coefficients used in Manitoba as compared to those used for calculations in this report[1]. Assumptions are given in the following Table:

Livestock	Animal Units produced by one animal (MAFRI)	Animal Unit coefficient used in report
Dairy		
Milking Cows (including associated livestock)	2.000	2.000
Beef		
Beef Cows, incl. associated livestock	1.250	1.250
Backgrounder	0.500	\
Summer pasture	0.625	} 0.631
Feedlot	0.769	/
Hogs		
Sows, farrow-to-finish	1.250	--
Sows, farrow-to-weanling	0.313	0.313
Sows, farrow-to-nursery	0.250	--
Weanlings	0.033	--
Grower/finishers	0.143	0.143
Boars (artificial insemination operations)	0.200	0.200
Chickens		
Broilers	0.0050	0.0050
Roasters	0.0100	--
Layers	0.0083	0.0083
Pullets	0.0033	0.0033
Turkeys		
Broilers	0.010	\
Heavy Toms	0.020	} 0.014
Heavy Hens	0.010	/
Horses (PMU)		
Mares, including associated livestock	1.333	1.00
Sheep		
Ewes, including associated livestock	0.200	0.200
Feeder Lambs	0.063	--

Goats	0.143	0.143
Bison		
Cow	1.00	\
Bull	1.00	} 0.8875
Calf	0.25	/
Elk		
Cow	0.53	\
Bull	0.77	} 0.520
Calf	0.05	/

1. An Animal Unit is defined as the number of livestock required to excrete 73 kg (160 lbs) of nitrogen in a 12-month period (as defined in the Farm Practices Guidelines for Poultry Producers in Manitoba)

Summary of assumptions made in calculating Animal Units[1] from 2001 Agricultural Census Data

Livestock	Manitoba Animal Unit Category	Census Category	Assumptions Used for Animal Unit Calculations with census data
Dairy	Milking cows (including associated livestock)	Dairy cows	Assumed categories are equal.
Beef	Beef cows	Beef cows	Assumed number of beef cows reported in 2001 Census equal cow/calf pairs
	Backgrounder Summer pasture Feedlot cattle	Heifers and steers for slaughter or feeding 1 yr and older (combined categories)	Assumed steers and heifers reported in these census categories are split into the three categories (communication with MAFRI). Animal unit coefficient determined using this ratio.
Pigs	Sows, farrow–to-weanling	Sows	Assumed there are no farrow-to-finish operations and no weanling operations in Manitoba – only farrow-to-weanling and grower/finisher operations.
	Grower/finishers	Grower and finisher pigs	
	Boars (artificial insemination operations)	Boars	Assumed all boars reported in the 2001Census are from artificial inseminations.
Chickens	Broilers	Broilers and roasters	Assumed all birds reported in the census category are broilers (communication with MAFRI).
	Layers	Laying hens (19 weeks and older)	Assumed categories are equal.
	Pullets	Pullets (under 19 weeks)	Assumed categories are equal.
	Broiler breeding hens	Laying hens in hatcheries	Assumed all laying hens in hatchery supply flocks reported in Manitoba are broiler breeder hens.
Turkeys	Broiler, Heavy Toms, Heavy Hens	Turkeys	Assumed "turkeys" represents 20% boilers, 40% heavy toms, 40% heavy hens (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Sheep	Ewes, including associated livestock	Ewes	Assumed ewe/lamb pairs (communication with MAFRI).
	Feeder lambs	Lambs	Assumed no feeder lambs in province since numbers are very small and cannot be determined from census data (communication with MAFRI).
Horses	Horses	Total horses and ponies	Assumed each animal produces 1 Animal Unit – PMU farms not identified in Census (communication with MAFRI).
Bison	Bison	Bison	Assumed adults represent 85% and calves represent 15% of bison population in Manitoba (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Elk	Elk	Elk	Number of calves and sex of animals not identified in Census – assumed 45% cows, 35% bulls and 20% calves (communication with MAFRI). Animal unit coefficient is determined using this ratio.
Goats	Goats	Goats	Number of kids and sex of animals not identified in Census – assumed 7 goats make up one Animal Unit, irregardless of age and sex.

1. One Animal Unit is defined as the number of livestock required to excrete 73 kg (160 lbs) of nitrogen in a 12-month period (as defined in the Farm Practices Guidelines for Poultry Producers in Manitoba)

Appendix D: Land Cover Time Frame, Classifications, and Constraints

For the IWMP study area, imagery was available for the years of 1994, 2001-02, and most recently, 2006. Imagery was classified by the Manitoba Conservation - Manitoba Remote Sensing Centre into 16 unique land cover classes. To simplify the analysis, the 16 classes were aggregated into 7 basic land cover classes: annual cropland, forages, grasslands/pasture, trees, wetlands, water, and urban/transportation.

The 1994 land cover used satellite imagery that was captured on May 14th, 1993 for the western edge or the IWMP study area, and imagery from May 26th and October 26th for west central and eastern areas respectively. For the 2001-02 land cover data, the extreme western edge and was analyzed using imagery taken September 14th 2000, the west central area with imagery taken May 18th, 2000, and the eastern portion with imagery from September 3rd, 2001. The 2006 land cover data utilized satellite imagery that was captured on July 14th, 2006 for the majority of the watershed, with a sliver of the watershed that used imagery from June 16, 2005.

Data Constraints

It should be noted that the use of land cover data has limitations from a couple of perspectives. Weather patterns in years leading up to the imagery will impact the cover analysis and may be short term as opposed to a long term trend. Further, past image classifications were undertaken for specific purposes with standardization occurring between 2000-2001 and 2005-2006 as detailed below:

- Classification effort - the 1993 image classification concentrated specifically on annual cropland to aid in delivery of the Western Grains Transportation Payment Program. Greater attention was paid to all classification categories on the 1999-2000 image classification.
- The classification of forages and forages/grasslands - As the land cover classifications could be difficult to interpret given the age of the forage stand and the reflectance of the satellite imagery for classification.
- With respect to the increased level of forages, some of the forage conversion trends may be explained through the adoption of Permanent Cover Program offered by Agriculture Canada in the early 1990s. A program summary for the East Duck Mountain Sagemace Bay Watershed study area could provide more insight toward understanding the forage trends and if they were indeed related to the Permanent Cover Program, however, the data could not be made available in time for this report. There is some indication from local contacts that the program uptake by producers was low for this watershed, however, without an actual program summary, it cannot be quantified. This information will be available for future reports or for this watershed at a later date.

Classification Scheme: Land Cover Mapping of Manitoba

1. Agricultural Cropland; All lands dedicated to the production of annual cereal, oil seed and other specialty crops. This class can be further sub-divided into three crop residue classes; 0%-33%, 34%-66%, 67%-100%.

2. Deciduous Forest; 75%-100% of the forest canopy is deciduous. Dominant species include trembling aspen (Populus tremuloides), balsam poplar (Populus balsamifera), and white birch (Betula papyrifera). May include small patches of grassland, marsh or fens less than two hectares in size.

3. Water; Consists of all open water - lakes, rivers, streams, wetland ponds and lagoons.

4. Grassland/Rangeland; Lands of mixed native and/or tame prairie grasses and herbaceous vegetation. May also include scattered stands of associated shrubs such as willow, choke-cherry, saskatoon and pincherry. Areas may also be used for the cutting of hay while others are grazed. Both upland and lowland meadows fall into this class. Ther is normally less than 10% shrub or tree cover.

5. Mixedwood Forests; Forest lands where 25% to 75% of the canopy is coniferous. May inclue patches of treed bogs, marsh or fens less than two hectares.

6. Marsh*; Wetland vegetation of a multitude of different herbaceous species. These marshes range from intermittently inundated (temporary, seasonal, semi-permanent) to permanent depending on the current annual precipitation regime. Common vegetation species include; sedge (Carex spp.), whitetop (Scolochloa festucacea), giant reed grass (Phragmites australis), prairie cordgrass (Spartina pectinata), mannagrass (Glyceria spp.), spikerush (Eleocharis spp.), reedgrass (Calamagrotis spp.), wild barley (Hordeum jubatum), bluegrass (Poa spp.), cattail (Typha spp.), and bulrush (Scirpus spp.) depending on the depth of water. This zone can have a water tolerant shrub component (i.e. willow, Salix spp.) where the shrubs do not dominate the area, but ther is clear evidence of wetland indicators.

7. Treed and Open Bogs: Bogs are peatlands typically covered by peat mosses (Sphagnum spp.) and ericaceous shrubs (heath family; eg Labrador tea, Ledum spp.) although other mosses and lichens thrive here as well. Tamarack (Larix laricina) and black spruce (Picea mariana) are also found in boggy landscapes in the boreal forest, the transition zone and in agro-Manitoba.

8. Treed Rock: Lands of exposed bedrock with less than 50% tree cover. The dominant species is jack pine and/or black spruce and occasional areas of shrub.

9. Coniferous Forest: Forest lands where 75% to 100% of the canopy is coniferous. Jack pine and spruce are combined under this class. May include patches of treed bogs, marsh or fens less than two hectares in size.

10. Wildfire areas: Forest lands that have been recently burned (wildfires less than 5 years old) with sporadic regeneration and can include pockets of unburned trees.

11. Open Deciduous / Shrub: Lands characterised by shallow soils and/or poor drainage which supports primarily a cover of shrubs such as willow, alder, saskatoon and/or stunted trees such as trembling aspen, balsam poplar and
birch. An area could contain up to 50% scattered tree cover.

12. Forage Crops: Agricultural lands used in the production of forage such as alfalfa and clover or blends of these with tame species of grass. Fall seeded crops such as winter wheat or fall rye may be included here.

13. Cultural Features: Cities, towns, villages and communities with place names. Also includes peat farms, golf courses, cemeteries, shopping centres, large recreation sites, auto wreckyards, airports, cottage areas, race tracks and rural residential.

14. Forest Cutovers: Forest lands where commercial timber has been completely or partially removed by logging operations. Includes areas which have been replanted (plantations less than 10 years old).

15. Bare Rock, Sand and Gravel: Lands of exposed bedrock, gravel and/or sand, sand dunes and beaches with less than 10% vegetation. Also includes gravel quarry/pit operations, mine tailingsm, borrow pits and rock quarries.

16. Roads and Trails: Highways, secondary roads, trails and cut survey lines or right-of-ways such as railway lines and transmission lines.

17. Fen*: Fens are peatlands with nutrient-rich, minerotrophic water, and organic soils composed of the remains of sedges and/or moss, where sedges, grasses, reeds and moss predominate but could include shrubs and sparse tree cover of black spruce and/or tamarack. Much of the vegetative cover composition of fens would be similar to the vegetation zones of marshes.

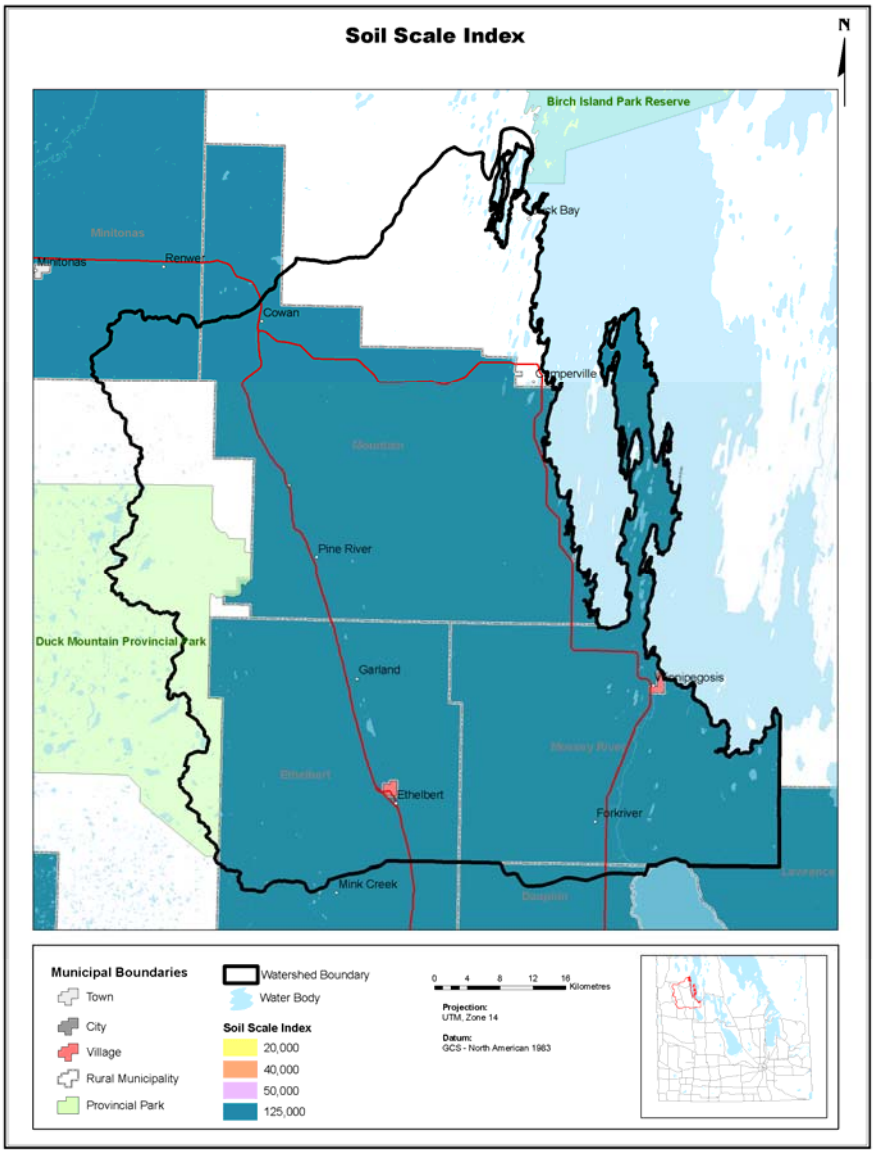
*Marsh and Fen can be rolled up into larger land use class of Wetlands.

Appendix E: Soil Information and Background

Soils data within the watershed can be used to provide information on various soil characteristics as well as interpretative ratings such as agriculture capability, water and wind erosion risk. Used in conjunction with the land cover data from 1994-2006, observations about temporal land use trends can be made and used to explain any changes in land management practices.

Soils data within the Manitoba has been mapped at different scales of accuracy, the East Duck study area being available only at a 1:125 000 accuracy scale (reconnaissance level) of across the entire watershed (see figure below).

Reconnaissance soils data is more suitable for broader landscape based analysis and regional planning purposes. This information is not suitable for the development of municipal development plans/zoning by-laws, agronomic assessment for irrigation and other site specific land use activities. Analysis of this nature requires more detailed soils information for assessments and management considerations. Soil information provided in this report is based on the characteristics of the dominant soil series within the various soils polygons



Appendix F: Canada Land Inventory System Land Classes

Agricultural Capability for Manitoba

Agriculture capability is a 7 class rating of mineral soils based on the severity of limitations for dryland farming. This system does not rate the productivity of the soil, but rather its capability to sustain agricultural crops based on limitations due to soil properties and landscape features and climate. This system is usually applied on a soil polygon basis and the individual soil series are assessed and maps portray the condition represented by the dominant soil in the polygon. Class 1 soils have no limitations, whereas Class 7 soils have such severe limitations that they are not suitable for agricultural purposes. In general, it takes about 2 acres (0.8 hectares) of Class 4 land to equal production from 1 acre (0.4 hectares) of prime (Class 1) land. (From *Land: The Threatened Resource*).

Class 1: Soils in this class have no important limitations for crop use. The soils have level to nearly level topography; they are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility; soils are moderately high to high in productivity for a wide range of cereal and special crops (field crops).

Class 2: Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of field crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3: Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. Under good management, these soils are fair to moderate in productivity for a fairly wide range of field crops.

Class 4: Soils in this class have significant limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few field crops, the yield for a range of crops may be low or the risk of crop failure is high. These soils are low to moderate in productivity for a narrow range of field crops but may have higher productivity for a specially adapted crop or perennial forage.

Class 5: Soils in this class have severe limitations that restrict their capability to producing perennial forage crops and improvement practices are feasible. These soils have such serious soil, climatic or other limitations that they are not capable of use for sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants.

Class 6: Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery or because the soils are not responsive to improvement practices.

Class 7: Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

Agriculture capability subclasses identify the soil properties or landscape conditions that may limit use. A capital letter immediately following the class number identifies the limitation (eg. 2W, 3N, etc.).

Subclasses:
C - adverse climate (outside the boundaries of agro-Manitoba)
D - undesirable soil structure and/or low permeability
E - erosion damage
I - inundation (flooding) by streams and lakes
M - moisture (droughtiness) or low water holding capacity
N - salinity
P - stoniness
R - consolidated bedrock
T - topography (slopes)
W - excess water other than flooding (inadequate soil drainage or high water table)
X - two or more minor limitations

Appendix G: Water Erosion Risk

Water erosion information is available as part of the provincial soil survey data that has been compiled from reconnaissance (1:125000 scale) and detailed (1:50000 & 1:20000 scale) soil survey reports. The Universal Soil Loss Equation (USLE) that was developed by Wischmeier and Smith (1965) was used to provide information on water erosion as part of the provincial soils data. The USLE provides a quantitative estimate on the amount of soil that is displaced due to water erosion (either tonne/ha or ton/ac) on an annual basis due to soil, climatic, landscape and management factors that influence the rate of erosion. The USLE can be written as:

A = RKLSCP

Where:

A = Predicted water erosion rate
R = Erosivity of rainfall and snowmelt factor
K = Soil erodibility factor
L = Slope length factor
S = Slope steepness factor
C = Crop cover and management factor (set at 1.0 - assuming bare, unprotected soil)
P = Conservation practice factor (set at 1.0 - assuming no conservation practices)

Due to limitations that are inherent in the model, the lack of the inclusion of conservation management practices and crop cover factors, the numbers that are generated from the USLE should not be used as a value for actual soil loss due to water erosion. However, the USLE is useful in comparing water erosion risk between soils based on their soil/landscape properties and climatic conditions. To accomplish this, the computed USLE values have been compiled into the following 5 group risk classes:

N = Negligible	< 2.7 ton/ac/yr (< 6 tonne/ha)
L = Low	2.7 – 4.9 ton/ac/yr (6 – 11 tonne/ha)
M = Moderate	4.9 – 9.8 ton/ac/yr (11 – 22 tonne/ha)
H = High	9.8 – 14.7 ton/ac/yr (22 – 33 tonne/ha)
S = Severe	> 14.7 ton/ac/yr (> 33 tonne/ha)

By using the risk class groupings, soils can be compared on the basis of their soil physical properties, landscape and climate for resource analysis and targeting of soil conservation programming.

Appendix H: Wind Erosion Risk

Wind erosion information in Manitoba has been developed from the provincial soil survey data and the Soil Landscapes of Canada (SLC Ver 1.0). A geographic information system (GIS) was used to combine both spatial datasets, creating a derived product upon which wind erosion was calculated.

The wind erosion model that is used for the Agriculture Canada Wind Erosion Risk Maps (1989) was applied to the derived dataset. The model was developed from the works of Chepil (1945, 1956) and Chepil and Woodruff (1963) and derives an index value *E* for wind erosion risk (Coote, Eilers & Langman, 1989). The model is stated as:

$$E = kC(V_*^2 - \gamma W^2)^{1.5}$$

Where:

E = maximum instantaneous soil movement by wind (dimensionless)
k = surface roughness and aggregation factor (dimensionless)
C = factor representing soil; resistance to movement by wind (dimensionless)
V_* = drag velocity of wind at soil surface ($cm \cdot s^{-1}$)
γ = soil moisture shear resistance (dimensionless), a value of 5000 was used
W = available moisture of the surface soil ($m^3 water \cdot m^{-3} soil$)

For the analysis, the V_* and *W* values were used from the Soil Landscapes of Canada series. These values are listed for each polygon in the Wind Erosion Risk publication. A listing of *k* and *C* values are also listed in the report and are based on soil surface texture. The values were entered into the database based on soil surface texture types taken from the provincial soil survey data.

Following entering of values for *K*, *C*, *W* and calculating values for V_*, the dimensionless wind erosion index values (*E)* were calculated for each polygon. These values were rated as per the rating system in the Wind Erosion Risk publication.

Class	**E Value**
Negligible	< 100
Low	101 - 250
Moderate	251 - 400
High	401 - 700
Severe	> 700

The ratings are for bare soil and do not consider land use and crop management factors. *E* values were calculated only for those soils within the seamless soil layer that had a mineral soil surface texture rating. Polygons that were rated as being organic soils, bare rock and water in either the seamless soil data or the SLC data did not have *E* values calculated.

For those polygons that have secondary and/or tertiary soils listed within the map unit, a weighted calculation was done based on the percent of occurrence. If organic soils existed in any combination (primary, secondary, tertiary) with mineral soils, weightings were based on mineral soils only.

Appendix I: Soil Drainage Classes

Soil Drainage Class	Description
Very Poor	Water is removed from the soil so slowly that the water table remains at or on the soil surface for the greater part of the time the soil is not frozen. Excess water is present in the soil throughout most of the year
Poor	Water is removed so slowly in relation to supply that the soil remains wet for a large part of the time the soil is not frozen. Excess water is available within the soil for a large part of the time.
Imperfect	Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly down the profile if precipitation is the major source
Well	Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying materials or laterally as subsurface flow
Rapid	Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep slopes during heavy rainfall.
Source: *System of Soil Classification of Canada – Canada-Manitoba Soil Survey Reports*	

Drainage classification is based on the dominant soil series within each individual soil polygon

Appendix J: Crown Lands Component for East Duck IWMP

History

The area that we know as Manitoba was originally owned by the Crown. The Crown gave tenure to much of Canada, including parts of Manitoba, to a private company, the Hudson's Bay Company (HBC) which from 1670 to 1870 had a legal and economic monopoly on much of this land. In 1870, Canada acquired the HBC land and used it as an economic tool to promote development. It was at this time that the province of ***Manitoba*** was founded. Its ***crown lands*** remained under the jurisdiction of the federal Department of Agriculture (which handled immigration matters) and the Department of the Interior (in charge of ***Crown lands)*.**

Under the Dominion Lands Act system of 1871, huge areas of crown land were given to the Canadian Pacific Railway to fund its transcontinental line. Certain sections were reserved for schools and other areas were reserved for school boards to be sold to fund education. The rest of the land was distributed to settlers for agriculture. Settlers paid a $10 fee and agreed to make some improvements within a specified time (usually over 3 years) for 180 acres (73 ha) of land. Since there was an extreme shortage of agricultural lands in Europe at this time, this venture aided in the rapid settlement of the Prairie provinces. Land that was not claimed during settlement remained Crown Land. In addition, land on which settlers could not meet the agreement specified under the Dominion Land Act was also returned to the Crown.

At the same time, a total of ten numbered treaties were signed between the ***Crown*** and various native bands in Manitoba. The first, being 'Treaty One' was signed at Lower Fort Garry in ***1871***. The treaties guaranteed First Nations annual payments, support for education, health, ***land*** reserves and other economic incentives in exchange for the government's access to their territories as a means to encourage settlement, farming and economic development by non-First Nations people.

In ***1930***, responsibility for ***Crown Lands*** was transferred to the provincial government of ***Manitoba.*** Virtually all of Northern ***Manitoba***, beyond the Department of Aboriginal and Northern Affairs boundary, is what they called "unorganized territory" and is also ***Crown land*.**

Today, Manitoba's Crown Lands are used for varying purposes, including agriculture, mining, and cottages. Other areas are set aside for research, environmental protection, public recreation, and resource management. Approximately 95% of the province's forests sit within provincial Crown land.

Operations

The planning and classification of Crown land in agro-Manitoba is the ultimate responsibility of the Crown Lands Assistant Deputy Minister's Committee (CLADMC), previously known as the Crown Land Classification Committee (CLCC). The CLCC was created in 1975 by the Premier of Manitoba for the specific purpose of Crown land use planning and resolution of land and resource use conflicts between departments of government. It is an interdepartmental committee with representation from Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Conservation, Water Stewardship, Aboriginal and Northern Affairs, Science Technology Energy & Mines (STEM) and Intergovernmental Affairs (IAF). The committee reports to cabinet.

The CLCC determined that to achieve its objectives, there was a need for on-the-ground planning and resource management expertise. This was obtained by creating local Block Planning Committees (BPC's), comprised of regional specialists from those departments on CLADMC. Eight BPCs were

created in 1976. The BPC's meet every two months or as needed to discuss issues related to crown lands in their respective regions. Minutes are then forwarded to CLADMC for final approval.

The overall objective of CLADMC and the BPC's is to provide a systematic and integrated approach to planning and development of Crown land, its allocation and use, integration of uses and the protection, conservation and sustainability of provincial resources.

Multi-Use Concept

The Provincial Crown Land Planning Process is strongly guided by the concept of multiple resource use whereby Crown Lands may be used by both competing and complementary users.

Complementary use of Crown land requires special consideration be given to management in order to ensure that one resource use does not compromise the other. One such example is timber harvesting/livestock grazing, where a project initiated by MAFRI (Garland Project) is showing that proper management (of livestock grazing and forestry practices) can result in long term benefits to both resource users. The science and research from this project will be very beneficial in resolving a longstanding land use issue, and ultimately make more land available for complementary use. The information from this project will also assist private landowners in terms of managing their resources (e.g.; in instances where the land management objective is to enhance both forestry potential and livestock grazing).

Classification System

Crown lands are classified using an open-ended, comprehensive coding system which, on a quarter section basis, dictates land use(s), permissible level of development, length of commitment, requirements for multiple uses and natural of permissions required. Application of the codes is conducted within a planning framework consistent with approved procedures. Each proposal for a use different than that allowed by the code must be considered individually, observing policies and procedures. Changes to plans are reviewed and revised annually.

Management and Administration

Management and administration of Crown land is shared by Manitoba Conservation, Manitoba Agriculture, Food and Rural Initiatives (MAFRI), Aboriginal and Northern Affairs and Manitoba Infrastructure and Transportation (MIT). The Crown Lands and Property Agency of MIT is responsible for the administration of Crown land issues leases and permits upon the direction of MAFRI with regard to Crown lands classified for agricultural uses and issues leases and permits for all other Crown lands as directed by Manitoba Conservation. Manitoba Aboriginal and Northern Affairs maintain authority equivalent to that of local government for Crown land dispositions in the Northern Affairs area.

Manitoba Agricultural Crown Lands

Agricultural Crown Lands in Manitoba are managed by the Agriculture Crown Lands section of the Land Use Branch of Manitoba Agriculture, Food and Rural Initiatives. This section issues agricultural leases and permits on those lands which are designated as primarily agricultural as well as multi-use lands which may be used for agricultural purposes on a secondary or interim use-basis, subject to specific conditions and covenants required by other resource users. The section also advertises available agricultural Crown lands for lease and ensures equitable allocation.

Agriculture Crown Lands Leasing Program

The purpose of the program is to assist Manitoba agricultural producers with additional land base to complement their operation and to improve the productivity of agricultural Crown lands by applying the principles of sustainable management.

Applicants wishing to apply to lease agricultural Crown lands must be 18 years of age, Canadian citizens or have landed immigrant status and be residents of Manitoba actively involved in the management of a farm or ranch. Information and direction of all aspects of agricultural Crown land use in Manitoba as well as extension information with regard to livestock, forages and land management are the main services associated with the program.

Fees for the leasing of agricultural crown lands are different depending on the use of the land. Pasture lands are leased at comparable market value using a formula which is reviewed in years divisible by five while cropping lands are tendered to highest bidder. Development (land improvements) is done at lessee cost and rental rates are not increased for an agreed-upon number of years, depending on the extent of the development.

Successful applicants are required to sign a multi-page detailed lease which clearly outlines what they can and cannot do on the leased land as well as their responsibility to maintain lands in the state they were received. Penalties ensue where these responsibilities are not met and repeated offenses can result in cancellation of the lease.

There are a variety of different functions associated with agricultural crown lands under the program. Advertising and allocation of available lands (vacant or surrendered) occurs 3 times per year. Applicants may enter into forage leases for a period of time equal to the difference in the lessee's age and 65 OR if the lessee is 60 years of age or older, for 5 years. Cropping leases are generally issued for a 5 year term with no right of renewal. Casual hay and/or grazing permits are issued on an annual basis. There are also renewable hay leases and renewable grazing permits.

An Agricultural Crown land Sales policy has been in place since 1989 to assist in the growth of the agricultural industry while protecting provincial, municipal or other public interested in land which may be required for alternate purposes. This policy enables lessees who have held the land under a long-term lease for at least 2 consecutive years to apply to purchase the land if the land meets specific suitability requirements. The proposed sale is then circulated amongst the various interested government agencies for comment, then approved or rejected. Sales that are rejected may be appealed.

The Crown Lands Improvement Program (CLIP)

In the 70's and early 80's, the province introduced the Crown Lands Improvement Program (CLIP) in an effort to provide farmers and ranchers with a better forage base. Under this program, the province paid for clearing, breaking and seeding tame forage to Crown lands, relieving many clients from relying solely on lakeshores and meadows for hay and contributing to better animal health. The forage production capacity of the field is then reassessed on the lease according to soil type and it was the obligation of the lessee to maintain the developed field to produce tame forage at the rate specified until it was transferred or surrendered.

Unfortunately, many of the CLIP-subsidized fields have not been maintained and have reverted back to native-type species in combination with distinct poplar encroachment. When a lessee surrenders his lease on a CLIP field and he has not maintained the CLIP development, he will be charged back the depreciated % loss and have to repay to the province.

Appendix K: Nutrient Management Regulations

Section G. Recent Federal and provincial POLICIES, LEGISLATION AND Activities Affecting Agricultural Land use and Management

Nutrient Management Regulations: The Nutrient Management Regulation is the first regulation to be passed under *The Water Protection Act*. The purpose is to protect water quality by encouraging nutrient management planning, regulating the application of nitrogen and phosphorus and restricting development within environmentally sensitive areas, especially along natural water systems.

The regulation sets out Nutrient Management Zones based on Canada Land Inventory (CLI) agriculture capability ratings. The various Nutrient Management Zones contain maximum nitrate-nitrogen limits and maximum allowable phosphorus application rates. These can be found on the provincial website: http://www.gov.mb.ca/waterstewardship/wqmz/limitsandthresholds.pdf

Under the regulation, some agricultural operations may be required to file a Nutrient Management Plan (NMP) with Manitoba Water Stewardship.

Effective January 1, 2009, a Nutrient Management Plan must be registered if:

- Nutrients are mechanically applied within Nutrient Management Zone N4 for those agricultural operations in existence prior to November 8, 2006. Nutrient Management Zone N4 consists of CLI class 6 and 7 lands and unimproved organic soils.

Effective January 1, 2011, a Nutrient Management Plan must be registered if:

- Nutrients will be applied to any field that exceeds the residual soil nitrate-nitrogen limits listed in Table 1 for Nutrient Management Zones N1, N2 and N3.
- Nutrients will be applied to any field resulting in soil test phosphorus measuring 60 ppm or more within Nutrient Management Zones N1, N2 and N3 and the phosphorus application rates listed in Table 2 cannot be met.

Table 1. Soil Nitrate-Nitrogen Limits

Nutrient Management Zone	Agriculture Capability Soil Class	Residual Soil Nitrate-Nitrogen Limits within 60 cm (24") of soil
N1	Class 1, 2 and 3 except any 3M subclass	157 kg/ha (140 lb/ac)
N2	Any 3M subclass, class 4 and 5M subclass if it is being irrigated	101 kg/ha (90 lb/ac)
N3	Class 5 except 5M under irrigation	33.6 kg/ha (30 lb/ac)
N4	Class 6, 7 and unimproved organic	No Nitrogen Applications
Nutrient Buffer Zone	Not Applicable	No Nitrogen Applications

Table 2. Soil Test Phosphorus Thresholds and Maximum P Application Rates

Nutrient Management Zone	Soil Test Phosphorus (P) Thresholds within 15 cm (6") of soil (ppm)	Allowable Application Rate of P expressed as P_2O_5 (kg/ha (lb/ac)
N1,N2 and N3	< 60	No restriction
	Between 60 and < 120	Two times crop removal rate
	Between 120 and < 180	One time crop removal rate
	180 or more	No application without approval by the director
N4	No Phosphorus Applications	
Nutrient Buffer Zone	No Phosphorus Applications	

Parcels of land included in a Manure Management Plan registered with Manitoba Conservation do not need to be included in a Nutrient Management Plan submitted to Manitoba Water Stewardship.

Nutrient Buffer Zones apply to all water bodies and groundwater features located across Manitoba. As of January 1, 2009, nutrients containing nitrogen or phosphorus cannot be applied to areas within Nutrient Buffer Zones. The width of the Nutrient Buffer Zone varies depending on the nature of the body of water (Table 3).

Table 3: Nutrient Buffer Zones under the Nutrient Management Regulation

Width* of Nutrient Buffer Zones

Water Body	Setback if Nutrient Buffer Zone IS covered with permanent vegetation	Setback if Nutrient Buffer Zone IS NOT covered with permanent vegetation
• a roadside ditch or an Order 1 or 2 drain†	No direct application to ditches and Order 1 and 2 drains	
• a groundwater feature	15 m (49 feet)	20 m (66 feet)
• a wetland, bog, marsh or swamp other than a major wetland, bog, marsh or swamp‡	Distance between the water's edge and the high water mark	
• a lake or reservoir designated as vulnerable**	30 m (98 feet)	35 m (115 feet)
• a lake or reservoir (not including a constructed stormwater retention pond) not designated as vulnerable** • a river, creek or stream designated as vulnerable**	15 m (49 feet)	20 m (66 feet)
• a river, creek or stream not designated as vulnerable** • an Order 3 or higher drain† • a major wetland, bog, marsh or swamp‡ • a constructed stormwater retention pond	3 m (10 feet)	8 m (26 feet)

* ***The Nutrient Buffer Zone is measured out from the water body's high water mark or the top of the outermost bank on that side of the water body, whichever is further from the water.***

† Designated on a Manitoba Water Stewardship plan that shows the designation of drains.

‡ As defined in 1(2) in the Nutrient Management Regulation under the *Water Protection Act.*
"For the purposes of this regulation, a wetland, bog, marsh or swamp is major if
(a) it has an area greater than 2 ha (4.94 acres)
(b) it is connected to one or more downstream water bodies or groundwater features; and
(c) it contains standing water or saturated soils for periods of time sufficient to support the development of hydrophytic vegetation."

** Designated as vulnerable if listed in the Schedule in the Nutrient Management Regulation under the *Water Protection Act.*

Appendix L: Livestock Manure and Mortalities Management Regulation

An important regulation for agriculture is the **Livestock Manure and Mortalities Management Regulation (LMMMR)**, administered by Manitoba Conservation under the Provincial Environment Act. Details can be found at the provincial government website:

http://www.gov.mb.ca/conservation/envprograms/livestock/index.html

The main points of the legislation are:

- Annual *manure management plans* are required for operations of *300 animal units or more* and cover the storage, handling, disposal and application. These need to be submitted to the department before Feb 10 (for spring application) or July 10 (fall application).
- Manure application is regulated on the basis of residual nitrogen in soil; application rates cannot result in more than 140lbs/acre for Class 1, 2 and 3 (see exception); 90lbs/acre for Class 3M, 3MW and 4; and no more than 30lbs/acre for Class 5 soils.
- Annual water analysis is required by all livestock operations with greater than 300 animal units.
- Winter spreading is prohibited between November 10 and April 10 (with exceptions for operations under 300 Animal Units, pre-1998 operations and applications within defined setback distances)
- Permits are required for the construction of a manure storage facility as well as for a confined livestock facility.

Recent Revisions to LMMMR

1. **Phosphorus.**

   As a result of increasing concerns of rising phosphorus levels in Manitoba, the provincial government has amended the LMMR regulation to include phosphorus as criteria in manure application as of November 2008.

Soil phosphorus (P) thresholds for regulating manure management application:

   1. If soil test P threshold is 60ppm or less, no restriction on P application (use N-based application)
   2. If soil P threshold is between 60-119ppm, apply P4 up to 2 times crop removal rate
   3. If soil P threshold is between 120-179ppm, apply P4 at 1 times crop removal rate
   4. If soil P threshold is at or above 180ppm, no manure application is allowed without written consent by the Department

2. **Special Management Areas (SMA's)**

   Special management areas have designated that include lakes and other watercourses as well as the Red River Valley and other floodplains. Within these areas special manure management practices are required. Examples include no winter application in floodplains and the use of buffer strips along waterways.

SMA's require special consideration when implementing management strategies to mitigate the risk of phosphorus loss. They have certain properties of location, soil, climate and landscape (topography) that cause them to be likely sources of phosphorus loss to surface water. The attributes of SMA's provide only limited opportunity for natural attenuation of phosphorus movement before it is transported to surface water. In light of this elevated risk, adoption of beneficial management practices (BMPs) to influence the processes involved in phosphorus transfer to surface water is more critical than on the

rest of the landscape. BMPs that inhibit phosphorus mobilization and delivery in particular will be important in SMAs.

SMA's in Manitoba have been identified as those areas that are:
• subject to regular inundation, or
• immediately adjacent to surface water (lakes, rivers, creeks, large unbermed drains, or other watercouses and roadside ditches)

a. Regularly inundated lands (Red River Valley and Floodplains)
Lands that are subject to regular inundation, whether by overflow from a water body or precipitation and impeded drainage, require special management because of the prolonged contact between water and the soil surface (and particularly exposed manure). Under these conditions, manure could be directly transferred to surface water, especially if the manure has been deposited on frozen ground or on top of the snow. There is also a potential for transfer of dissolved phosphorus, and to a lesser degree particulate phosphorus, to overlying floodwaters.

The criterion for designating regularly inundated lands as SMAs is high risk of connectivity between these lands and surface water via surface drainage, whether natural or artificial. Practices such as the elimination of manure applications in winter will reduce the exposure of applied manure at the soil surface prior to inundation, should reduce the risk of phosphorus transfer to floodwaters and ultimately to downstream drains and surface water bodies. Large livestock operations are already prohibited from spreading manure during the winter. Another practice that should reduce the risk of phosphorus transfer to floodwaters is subsurface placement of manure by injection or incorporation following broadcast application. Injection or incorporation of manure is most critical in the fall on regularly inundated lands so that there is minimal or no exposure at the soil surface prior to spring snowmelt. The adoption of this practice is limited by the cropping system (*i.e.,* limited feasibility for perennial forage or reduced-till systems). Special consideration should be given to low or zero disturbance systems that receive manure where full injection or incorporation is not feasible. In these situations, the risk posed by surface application of manure may be partially offset by reduced risk of erosion and runoff, compared to cultivated annual cropland.

b. Lands immediately adjacent to surface water or watercourses
Lands immediately adjacent to surface water or watercourses are at an elevated risk of contributing phosphorus simply due to their physical proximity. Maintaining narrow strips of perennial vegetation on the edges of cultivated fields reduces the direct deposition of manure phosphorus into surface water and watercourses. Direct deposition could also occur via the actual entry of tillage equipment or the movement of soil due to tillage as the equipment passes very near to the waterway. Wider buffer strips along more significant waterbodies help to filter
sediment from runoff before it enters the waterbody.

Harvesting of the perennial vegetation in the buffer strip serves as a means to remove accumulated phosphorus in plant tissue and potentially provides a source of livestock feed.

No manure phosphorus should be applied to the permanently vegetated buffer strips.

3. Point Sources
Agricultural point sources or "end of pipe" sources include confined livestock areas, manure storage structures or field storage sites, grazing livestock access to watercourses for drinking water and seasonal feeding areas. The Livestock Manure and Mortalities Management Regulation already requires a 100 metre setback from watercourses for any manure storage structures or field storage sites, as well as confined livestock areas. In addition, livestock in confined areas are prohibited from having direct access to surface watercourses.

While direct access to watercourses by grazing livestock is not specifically prohibited by the *Livestock Manure and Mortalities Management Regulation*, direct discharge of manure in surface water is prohibited. The *Protection of Water Sources Regulation* is used to protect surface water sources of community drinking water.

Application Forms & Reports Relating to the LMMMR

Here are some practical links regarding application forms and other information on manure management (also found on Manitoba Conservation's website)
http://www.manitoba.ca/conservation/envprograms/livestock/index.html

- Application for Registration of a Manure Storage Facility Without a Permit (française)
- Application for Permit to Construct, Modify or Expand a Manure Storage Facility *(134 Kb pdf file)*
- Construction Requirements for Confined Livestock Areas and Collection Basins
- Application for Permit to Construct, Modify or Expand a Confined Livestock Area
- Obtaining a permit to construct, modify or expand a manure storage facility
- Manure Management Plan Form *(230 Kb DOC file)*
- Manure Management Plan Form *(32 Kb PDF file)*
- MMP Detailed Instructions and Schedules *(104 Kb PDF file)*
- Spreading Confirmation Sheet *(32 Kb PDF file)*
- Manure Management Plan Filer Software
- Nutrient Status Report *(18 Kb PDF file)*
  http://www.gov.mb.ca/conservation/envprograms/livestock/pdf/nutrient_status_report.pdf

Appendix M: Beneficial Management Practices offered under the Canada Manitoba Farm Stewardship Program 2003-2008

NFSP System Development
BMP Category Code/Practice Code Assignment

NOTE 1: The units of measurement are: distance = kilometers (km), area = acres, volume = cubic meters (m3)

NOTE 2: Funding is expressed as thousands of $ = K (eg. $4K = $4,000)

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
01	Improved Manure Storage and Handling	0101	increased storage to meet winter spreading restrictions (including satellite storage)	volume (m^3)	30%	$30K
		0102	improved features to prevent risks of water contamination (leaks, spills)	N/A		
		0103	slurry storage covers to reduce odours and GHG emissions	N/A		
		0104	containment systems for solid manure (includes covers)	N/A		
		0105	assessment and monitoring of existing manure storage infrastructure	N/A		
		0106	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)	N/A		
02	Manure Treatment	0201	dewatering systems, nutrient recovery systems	N/A	30%	$30K
		0202	composting of manure			
		0203	anaerobic biodigestors			
		0204	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
03	Manure Land Application	0301	specialized/modification to equipment for improved manure application	N/A	30%	$10K
04	In Barn Improvements	0401	more efficient livestock watering devices and cleanout systems to reduce water use and decrease manure volumes	N/A	30%	$20K
		0402	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
05	Farmyard Runoff Control	0501	upstream diversion around farmyards ;downstream protection (eg. catch basins, retention ponds, constructed wetlands)	N/A	50%	

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
		0502	construction of impermeable base and roof for minimizing runoff from livestock pen areas and confinement areas (feed bunks, water infrastructure, walls and electrical costs are not eligible)			$20K
		0503	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
06	Relocation of Livestock Confinement and Horticultural Facilities	0601	relocation of livestock facilities such as corrals, paddocks and wintering sites away from riparian areas	N/A	50%	$30K
		0602	relocation of horticultural facilities such as greenhouses and container nurseries from riparian areas			
		0603	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
07	Wintering Site Management	0701	shelterbelt establishment	# kms	50%	$15K
		0702	portable shelters and windbreaks	# kms		
		0703	alternative watering systems (ie: solar, wind or grid power)	N/A		
		0704	field access improvements: alleyway/access lane upgrades	# kms		
		0705	fence modifications	# kms		
08	Product and Waste Management	0801	improved on-farm storage and handling of agricultural products (eg. fertilizer, silage, petroleum products, and pesticides)	N/A	30%	$15K
		0802	improved on-farm storage, handling, and disposal of agricultural waste (eg. livestock mortalities, fruit and vegetable cull piles, wood waste)			
		0803	composting of agricultural waste (eg. Livestock mortalities fruit, vegetable, wood, straw residue)			
		0804	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
09	Water Well Management	0901	sealing & capping old water wells	N/A	50%	$6K
		0902	protecting existing water wells from surface contamination			
10		1001	alternative watering systems (ie: solar, wind or grid power)to manage livestock:	N/A	50%	$20K

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
10	Riparian Area Management (GREENCOVER)	1002	buffer establishment and planting of forages (planting and establishment costs for trees and shrubs for the year of planting and one year after the planting year, or the termination of the NFSP funding, whichever comes first)	# acres		
	Riparian Area Management (GREENCOVER)	1003	fencing to manage grazing and improve riparian condition/function	# kms		
		1004	native rangeland restoration or establishment: native species of forages, shrubs, and trees	# acres		
		1005	grazing management in surrounding uplands: alternative watering systems (ie: solar, wind or grid power) and cross fencing	# kms offence		
		1006	improved stream crossings	N/A		
11	Erosion Control Structures(Riparian) (GREENCOVER)	1101	constructed works in riparian areas: contour terraces, gully stabilization, bank stabilization, erosion control matting, silt fencing, drop inlet and enhanced infiltration systems, in-channel control, retention ponds and erosion control dams	N/A	50%	$20K
		1102	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
12	Erosion Control Structures(Non Riparian)	1201	constructed works in non riparian areas: contour terraces, gully stabilization, bank stabilization, erosion control matting, silt fencing, drop inlet systems and enhanced infiltration systems, in-channel control, retention ponds and erosion control dams, mechanical wind screens	N/A	50%	$20K
		1202	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
13	Land Management for Soils at Risk	1301	forage or annual barrier establishment for soils at risk (eg. stripcropping, grassed waterways, perennial forages on severely erodible or saline soils)	# acres	50%	$5K
		1302	straw mulching	# acres		
		1303	grazing management in critical erosion areas not associated with riparian zones: alternative watering systems (ie: solar, wind or grid power), crossfencing	# kms offence		
14	Improved Cropping Systems	1401	equipment modification on pre-seeding implements for restricted zone tillage for row crops, seeding and post seeding implements for low disturbance placement of seed and fertilizer	N/A	30%	$15K
		1402	chaff collectors and chaff spreaders installed on combines			

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
		1403	precision farming applications: GPS information collection, GPS guidance (ie: autosteer, lightbars, software) , manual and variable rate controllers for variable fertilizer application			
15	Cover Crops	1501	establishment of non-economic cover crop	# acres	30%	$5K
		1502	equipment modification for inter row seeding of cover crops (eg. relay crops)	N/A		
16	Improved Pest Management	1601	equipment modification for improved application	N/A	30%	$5K
		1602	information collection and monitoring			
		1603	biological control agents			
		1604	cultural control practices			
		1605	mobile water tanks			
17	Nutrient Recovery from Waste Water	1701	recycling of waste water streams from milkhouses, fruit and vegetable washing facilities, and greenhouses in order to recover nutrients	N/A	30%	$20K
		1702	engineering design work (this practice code will stand alone if project does not proceed for economic, technical or environmental reasons (CEAA)			
18	Irrigation Management	1801	irrigation equipment modification/improvement to increase water or nutrient use efficiency	N/A	30%	$10K
		1802	equipment to prevent backflow of altered irrigation water into water sources			
		1803	improved infiltration galleries and irrigation intake systems			
19	Shelterbelt Establishment (GREENCOVER)	1901	establishment of shelterbelts for farmyard, live stock facilities, dugout snowtrap, wildlife habitat enhancement, field (planting and establishment costs for trees and shrubs for the year of planting and one year after the planting year, or the termination of the NFSP funding, whichever comes first)	# kms	50%	$10K
		1902	tree materials required for shelterbelt establishment	N/A		
20	Invasive Alien Plant Species Control	2001	integrated approaches (cultural, mechanical, and biological) for control of invasive plant species (eg. leafy spurge, purple loosestrife, scentless chamomile)	N/A	50%	$5K
		2101	buffer strips: native vegetation	# acres	50%	

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
21	Enhancing Wildlife Habitat and Biodiversity	2102	alternative watering systems (ie: solar, wind or grid power)	N/A		$10K
		2103	improved grazing systems: crossfencing	# kms		
21		2104	wildlife shelterbelt establishment	# kms		
	Enhancing Wildlife Habitat and Biodiversity	2105	improved stream crossings	N/A		
		2106	hayland management to enhance wildlife survival	N/A		
		2107	wetland restoration	acres		
22	Species at Risk	2201	alternative watering systems (ie: solar, wind or grid power)	N/A	50%	$10K
		2202	improved grazing systems: crossfencing	# kms		
		2203	plant species establishment	# acres		
		2204	infrastructure development and relocation	N/A		
23	Preventing Wildlife Damage	2301	forage buffer strips	# acres	30%	$10K
		2302	fencing or netting to protect stored feed, concentrated livestock, high value crops, drip irrigation systems, and other ag. activities	# km offence		
		2303	scaring and repellant systems and devices	N/A		
24	Nutrient Management Planning	2401	consultative services to develop nutrient management plans, planning and decision support tools	# acres	50%	$4K
25	Integrated Pest Management Planning	2501	consultative services to develop integrated pest management plans, planning and decision support tools	# acres	50%	$2K
26	Grazing Management Planning (GREENCOVER)	2601	consultative services to develop range and grazing management plans, planning and decision support tools	# acres	50%	$2K
27	Soil Erosion and Salinity Control Planning	2701	consultative services to develop soil erosion and salinity control plans, planning and decision support tools	# acres	50%	$2K
28	Biodiversity	2801	consultative services to plan habitat enhancement, wetland restoration,	# acres	50%	$2K

BMP Category Code	BMP Category Description	BMP Practice Code	BMP Practice Description	BMP Practice Unit Type	Cost Share	Caps
	Enhancement Planning		stewardship for species at risk and/or wildlife damage prevention within agricultural land base; planning and decision support tools			
29	Irrigation Management Planning	2901	consultative services for planning improved water use efficiency and reduced environmental risk of existing irrigation systems, planning and decision support tools	# acres	50%	$2K
30	Riparian Health Assessment (GREENCOVER)	3001	consultative services for assessing riparian health, planning and decision support tools	# acres	50%	$2K

Appendix N: Environmental Farm Plan Workshops and EFP Statement of Completions in Manitoba