3.1.7. Wetlands

Wetlands are defined as:

> *"…land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic [water loving] vegetation and various kinds of biological activity which are adapted to a wet environment…" (National Wetlands Working Group 1988)*

Wetlands cover 25% of the area in Duck Mountain Provincial Forest, and are important ecosystems. Wetlands provide significant ecological goods and services such as water storage, moderation of flow, filtration, biodiversity, bird habitat, moose habitat, *etc*.

3.1.7.1 Wetlands Classification

The Canadian wetlands classification system (Warner and Rubec, 1997) has five major wetland types:

1. Bogs (organic soil)
2. Fens (organic soil)
3. Swamps (mineral soil)
4. Marshes (mineral soil)
5. Open Water (mineral soil)

Bogs are organic soil peatlands that are hydrologically isolated and stagnant, which means that they receive water only through precipitation or rainfall. There is no horizontal flow of water through a bog. The surface of a bog is typically very dry, but the thick peat below (average of 2.6 m, but ranging from 0.1 to 6 m deep in the Duck Mountain) is permanently saturated. Bogs are very nutrient poor. Sphagnum moss is always found on the surface of bogs. Stunted trees (black spruce and sometimes jack pine but rarely tamarack) are found on treed bogs (Figure 3.35). On shrubby bogs, shrubs include crowberry, Labrador tea, leatherleaf, and bog-laurel. There are also open bogs, with neither stunted trees, nor shrubs.

Fens are organic soil peatlands that do have a horizontal flow of water, often flowing slowly just below the surface. This earns fens the nickname of 'green rivers'. Fens have a wet surface, and average peat depths of 2.3 m in the Duck Mountain, but can range from 0.2 to 6.2 m in depth. Fens support tamarack trees on site (Figure 3.35), because of the nutrients in the flowing water. Indicator plants for fens include tamarack trees, birch shrubs, sweet gale, willow, buck bean, wire sedge, and brown moss.

Figure 3.37 Organic soil wetlands (bog-left; fen-right).

Swamps have mineral soil underneath some organic matter. Swamps are highly variable in their water flow, and fluctuate from dry to seasonally flooded. Water movement can be stagnant or dynamic. Swamps also have a hummocky surface (Figure 3.36) with windows or pools of water in between the hummocks.

Marshes are mineral soil wetlands with a shallow amount of organic soil over the mineral soil. Marshes dry out seasonally, and have variable dynamic water, depending on the upland and upstream runoff. In the forest, meadow marshes with sedges (Figure 3.36) commonly connect wetland areas. In the Parklands area, cattail marshes are common in low areas.

Shallow Open Water is also a mineral soil wetland, but is usually flooded with less than two meters of water. These look like shallow lakes (Figure 3.36) and often contain pond-lily and pond weed.

Figure 3.38 Mineral soil wetlands (swamp-left; marsh-middle; shallow open water –right).

The five major wetland types have been further sub-divided into 19 minor wetland classes (Figure 3.37). The minor wetland classes help reduce the significant amount of variability within a major wetland class. Common stratifiers of organic wetland types include treed, shrub, and open (*e.g.* bogs are stratified into treed bogs, shrubby bogs and open bogs). Fens are also further sub-divided into rich and poor. Swamps have the most variability of any wetland type, and are divided into five minor wetland classes.

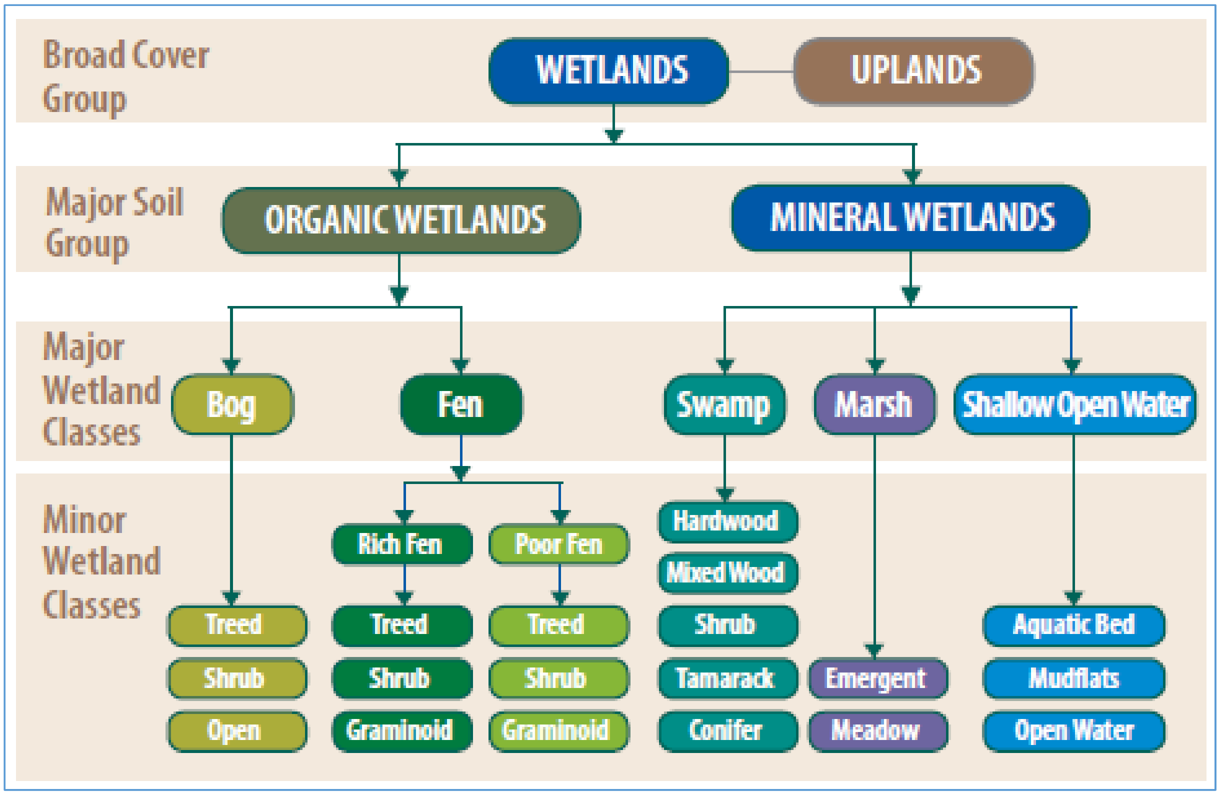


Figure 3.39 Major and minor wetland classes (Ducks Unlimited Canada 2014).

3.1.7.2 Wetlands Mapping

Wetlands mapping is a significant gap in Canada. However, there have been two wetlands mapping efforts FML #3.

In 2002, an ecosite key was developed for photo interpretation of non-forested wetlands, as part of the Forest Lands Inventory. The photo key used easily-observable and reliable features including:

- presence/absence of tall shrubs;
- amount of open water;
- amount of emergent vegetation;
- proportion of black spruce to tamarack;
- ground water movement patterns; and,
- shoreline sheltered vs. exposed.

The Forest Lands Inventory (2002) wetland mapping effort covers both the Duck and Porcupine Mountain Provincial Forests, an area of approximately 600,000 ha. The other portions of FML #3, such as the surrounding Parklands, were not mapped by this project.

The second wetlands mapping effort in FML #3 is the Ducks Unlimited Canada Enhanced Wetland Classification (Smith *et al.* 2007). This mapping effort used 30 X 30 m LANDSAT satellite imagery (Figure 3.38), and provided broad coverage across western Canada. A significant amount of ground-truthing guided the satellite classification.

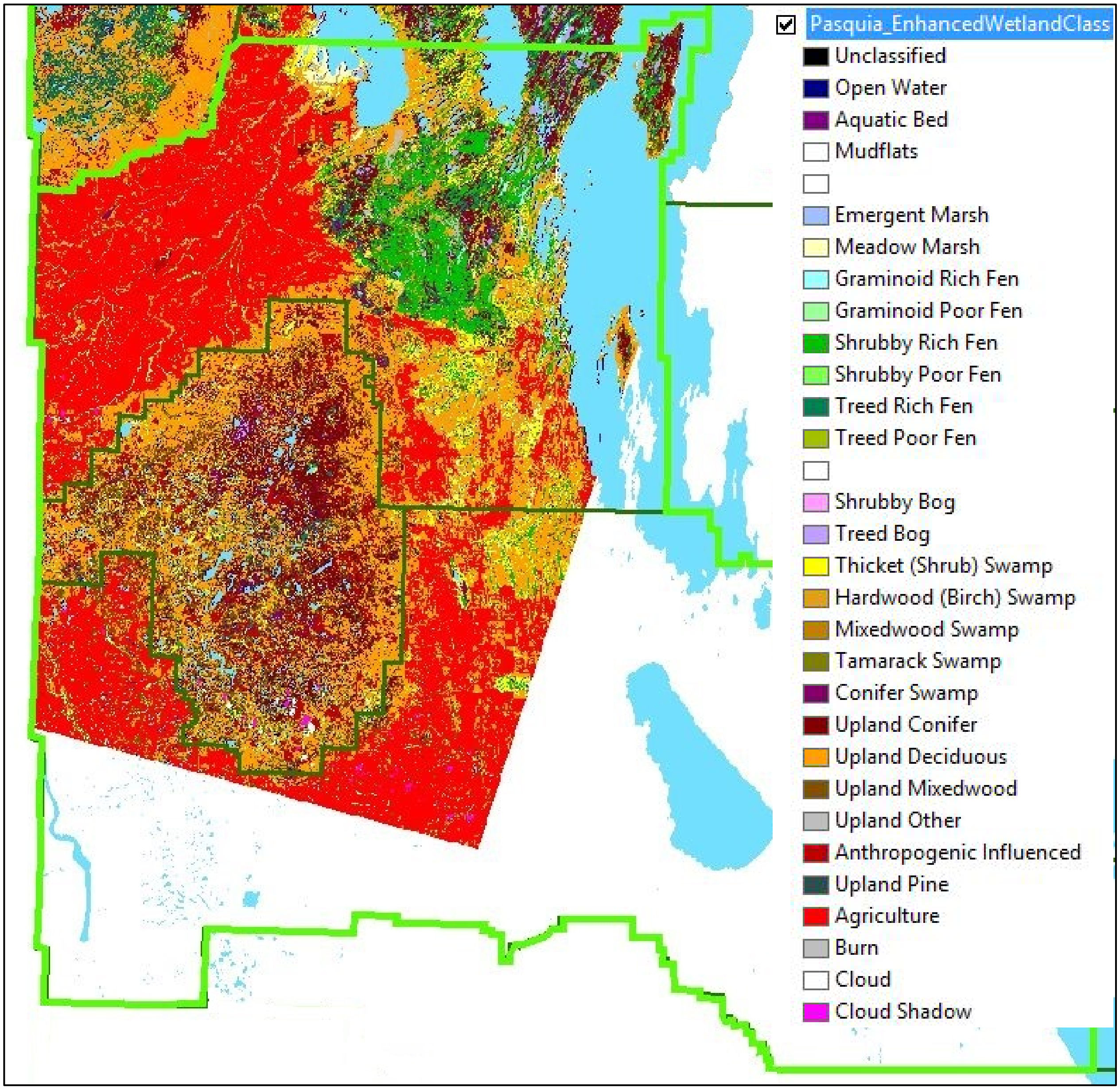


Figure 3.40 Enhanced Wetland Classification inventory in FML #3 (Smith *et al.* 2007).

3.1.8. Water

Water is important part of Forest Management Licence #3. Water forms many different kinds of features, including lakes, shallow open water, rivers, streams, wetlands, and ground water. The Duck Mountain and the Riding Mountain are the headwaters for many rivers. They start in the forested mountains, and then flow through agricultural land into Lake Winnipegosis.

Water features are important factors that contribute to the diversity and uniqueness of boreal plain ecosystems. The interspersion of both terrestrial and aquatic features on the landscape, and the riparian areas where they intersect, should be managed in a framework that recognizes the structural and process-based relationships between each element. These relationships in terms of biodiversity, the underlying processes involved in the hydrologic cycle, and maintenance of boreal forest ecosystems are related through time and space, and must be considered when planning.

The primary goal of many water conservation strategies is maintaining water quality and water quantity within and around forested ecosystems. Both natural disturbances and forest management activities may cause potential increases in water quantity, peak flows, dissolved nutrients in stream water, and increased siltation in aquatic environments. These potential changes can be mitigated through policies and implementation of best management practices and guidelines (*e.g.* buffer guidelines) around aquatic ecosystems.

3.1.8.1 *Watersheds*

Watersheds are defined topographically as areas of land where all water drains to a common point. Watersheds within Forest Management Licence #3 are shown in Figure 3.39. Watersheds often cross administrative and provincial boundaries. In Manitoba, Conservation Districts use watershed boundaries as their primary planning unit. This allows the Conservation Districts to address water quality and quantity issues in both the upstream and downstream portions of a watershed beyond the scope of single jurisdictions like towns or municipalities. FML #3 has five integrated management plans wholly or partially in its boundaries, as detailed in the land use section Integrated Watershed Management Plans.

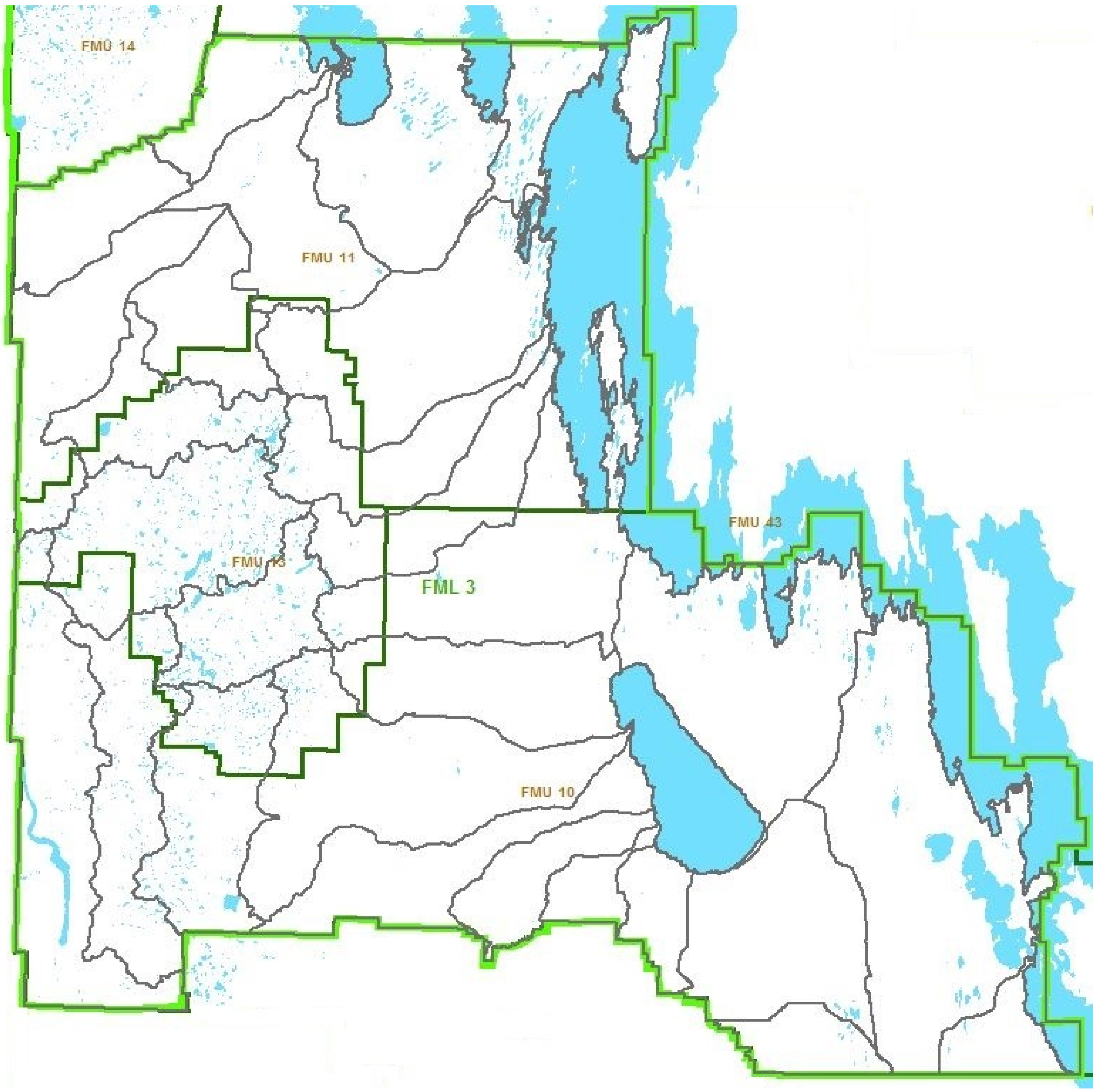


Figure 3.41 Watersheds in Forest Management Licence #3.

The Duck Mountain Provincial Forest has an Environment Act Licence condition of 30% maximum of a watershed in a harvested state. Cut blocks were considered to be in a 'harvested state' for five years following harvest for hardwood species, and 10 years post-harvest for softwood species. After successful regeneration, cut blocks were considered forested and no longer in a 'harvested state'. This 30% upper limit is meant to limit the risk of very rapid snow melt due to young forest not shading the ground and moderating the spring snow melt. The current condition of all watersheds in a harvested state (Figure 3.40) is well below the 30% maximum threshold.

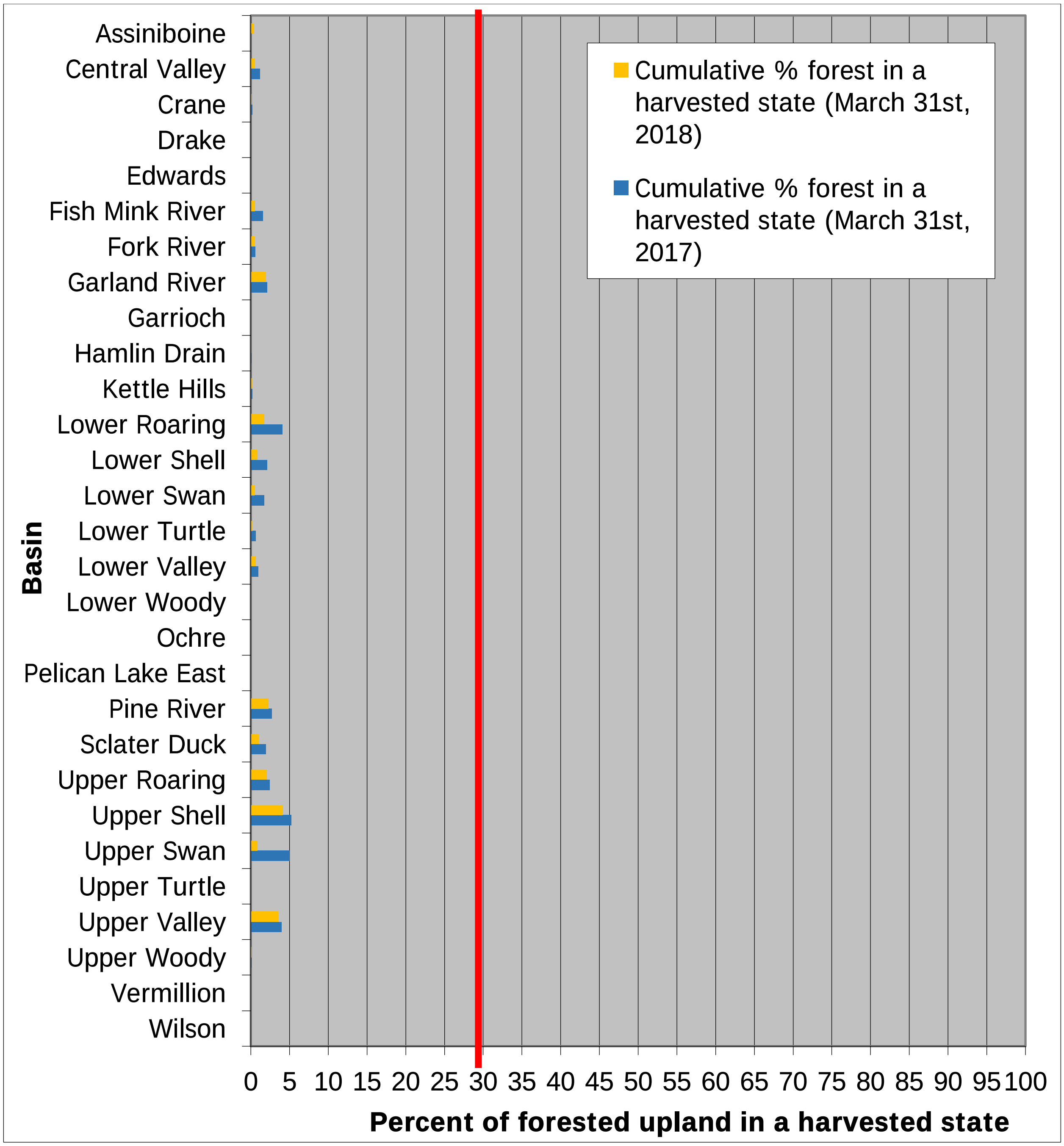


Figure 3.42 Percent of forested upland in the Duck Mountain Provincial Forest in a harvested state as of Mar. 31, 2018.

3.1.8.2 *Rivers*

The Duck and Riding Mountains are the headwaters of many rivers in FML #3 (Figure 3.41). In the Swan Valley, the Woody River flows north-east into Swan Lake. The Swan River also flows north-east into Swan Lake, but the Roaring, East Favel, West Favel, and Sinclair Rivers flow first into the Swan River.

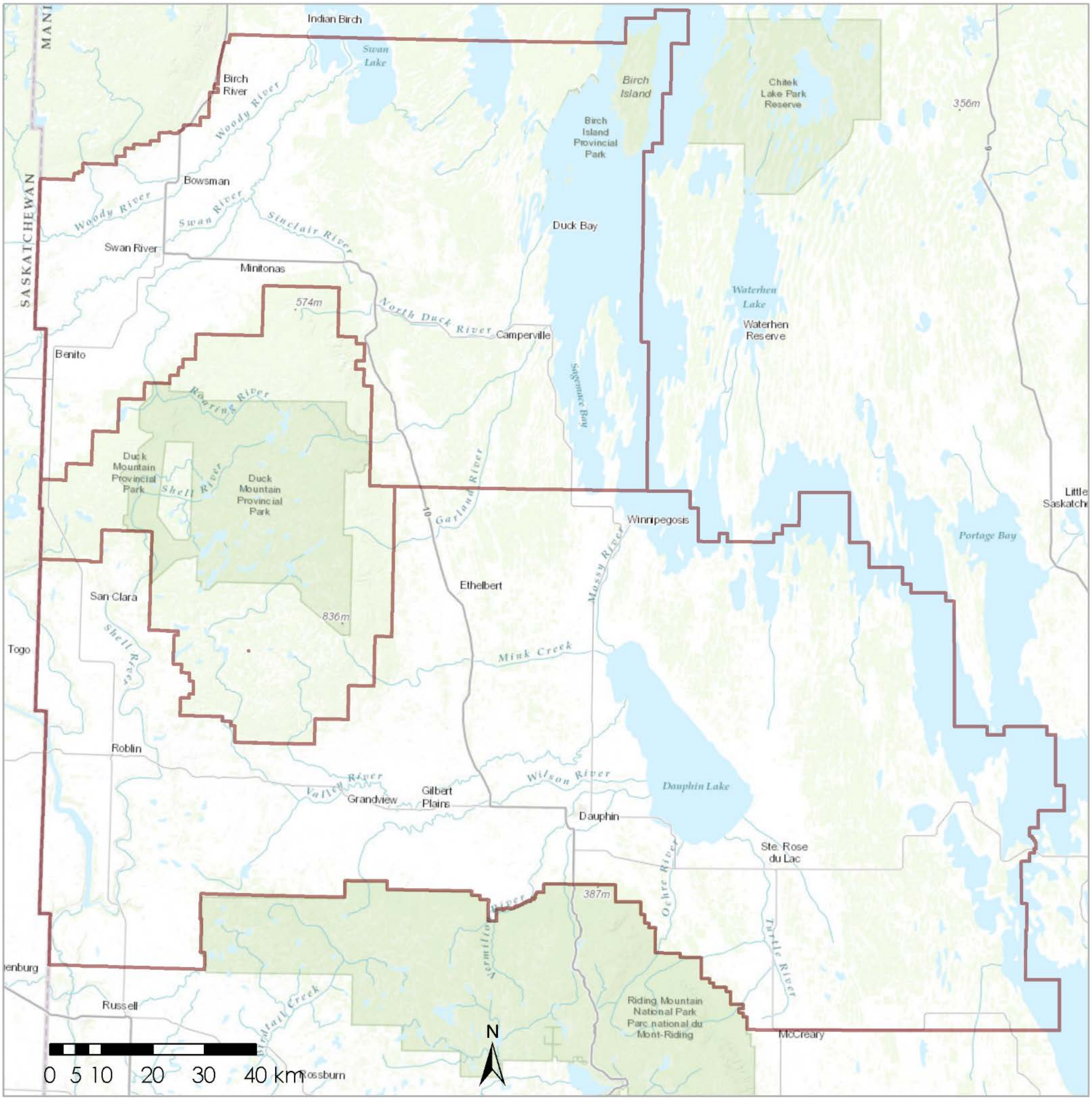


Figure 3.43 Rivers in the Forest Management Licence area (ForSite consulting).

There are many rivers on the east side of the Duck Mountain. Most of these rivers begin in the Duck Mountain and flow east into Lake Winnipegosis. This includes the following rivers (in order of north to south):

- North Duck River (hydrometric gauge station 05LG004 at Cowan)
- Sclater River
- South Duck River
- North Pine River (hydrometric gauge station 05LG001)
- South Pine River
- Garland River (hydrometric gauge station 05LG006)
- Point River
- Fork River
- Fishing River
- Mink Creek
- Drifting River

Rivers on the east side of the Duck Mountain that flow in Lake Dauphin include:

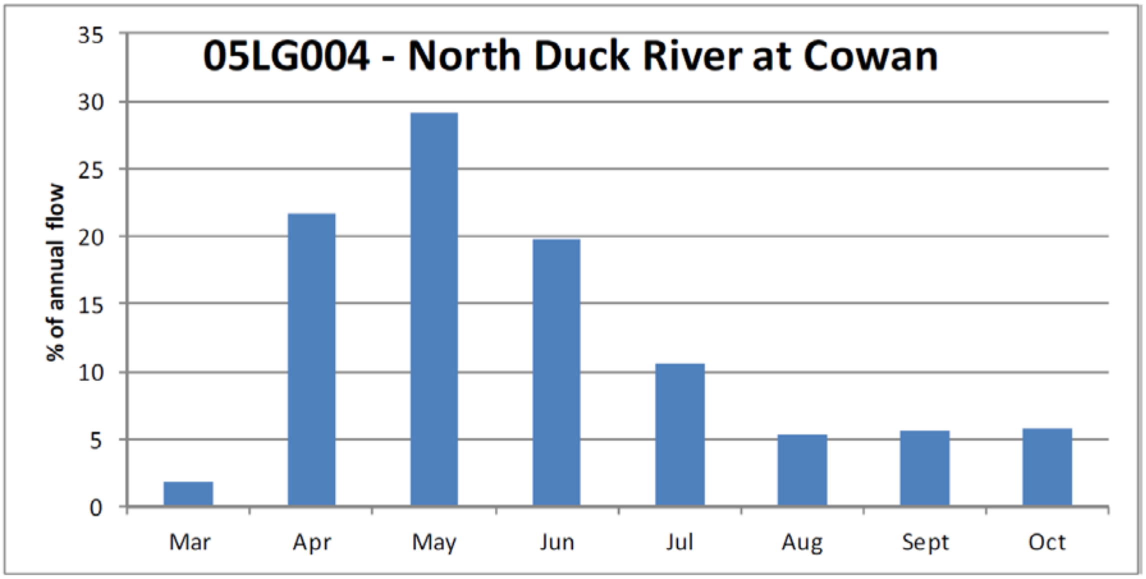
- Valley River
- Wilson River

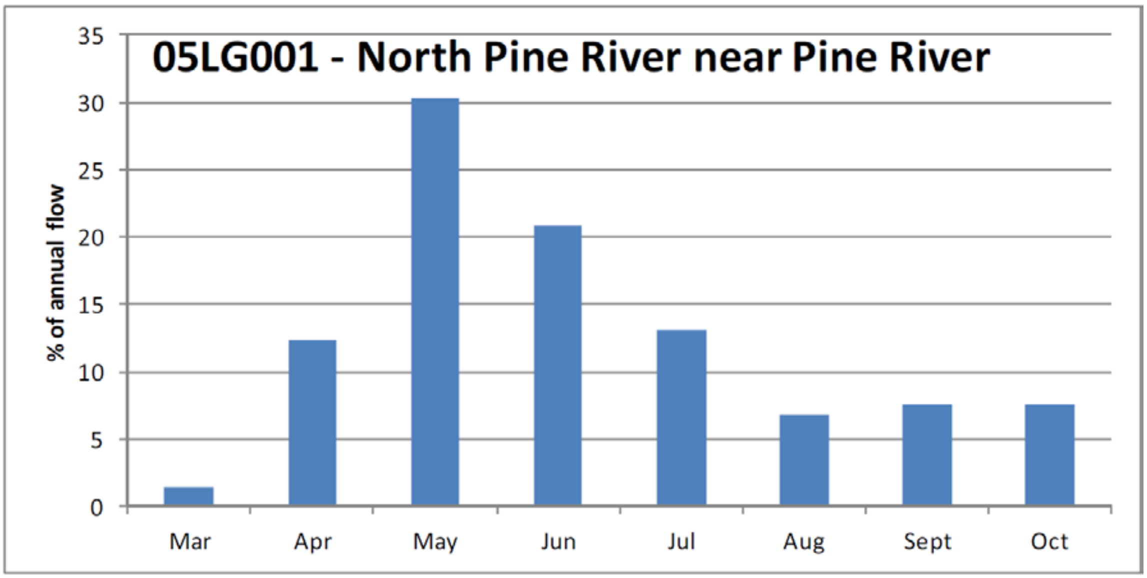
The Mossy River flows out of Lake Dauphin and into Lake Winnipegosis. The Shell River starts in the Duck Mountain glacial spillway and flows south into the Assiniboine River.

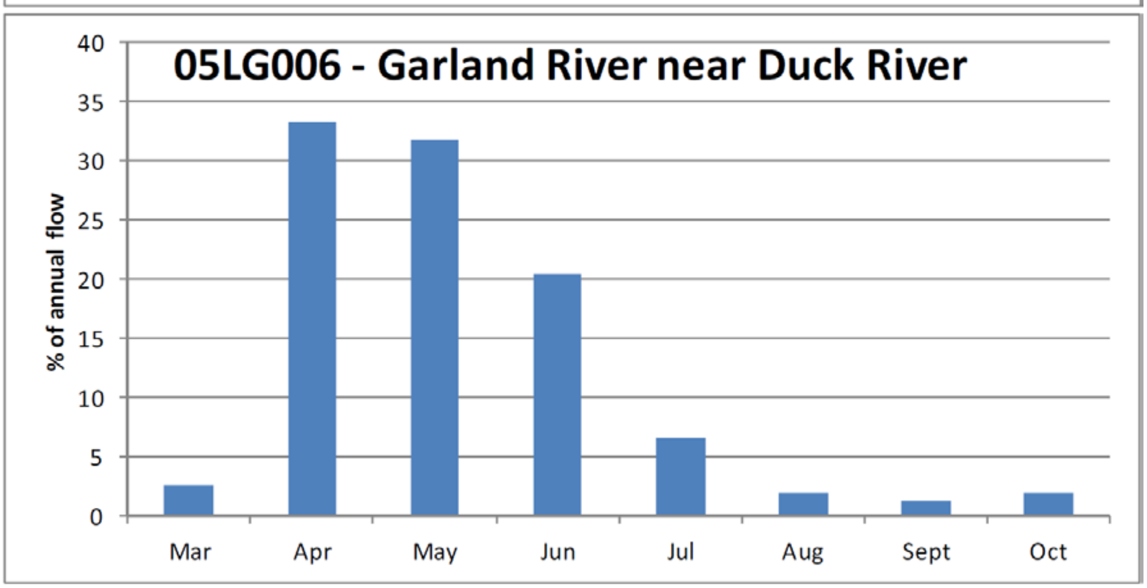
Riding Mountain is the headwaters for:

- Vermillion River
- Ochre River
- Turtle River

The local rivers have significant water flow in the spring months, due to both snow melt and rain contribute to spring runoff in the months of April and May (Figure 3.42). Flow reduces over the summer, and usually reduces even further in fall and winter. Extreme rain events with heavy precipitation can dramatically, but temporarily, increase river flow volume. Percent of annual flow by month are shown for rivers with a gauge station (Figure 3.42).


05LG004 - North Duck River at Cowan
% of annual flow
35
30
25
20
15
10
5
0
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct


05LG001 - North Pine River near Pine River
% of annual flow
35
30
25
20
15
10
5
0
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct


05LG006 - Garland River near Duck River
% of annual flow
40
35
30
25
20
15
10
5
0
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct

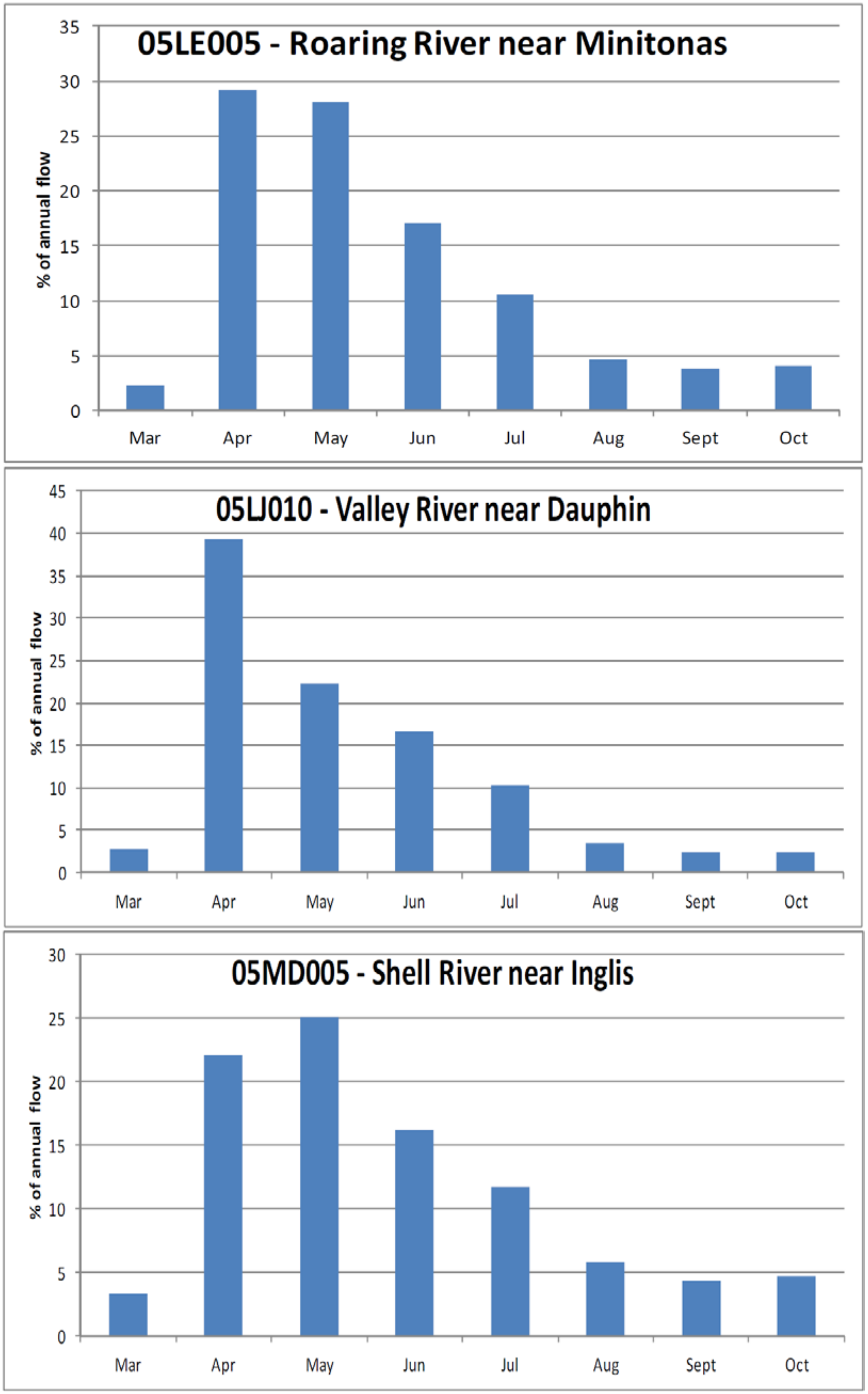


Figure 3.44 Percent of annual flow by month for rivers with hydrometric gauges (Lee 2014).

3.1.8.3 Streams and Stream Classification

Streams are smaller than rivers, but often flow into rivers. For planning purposes within Forest Management Licence #3, there are two kinds of steams: 1) mapped streams; and 2) unmapped streams. Unmapped streams cannot be seen through leaf cover in summer imagery, and cannot be seen in leaf-off imagery in the fall, because they are often dry. Whether mapped or unmapped, streams will have defined or undefined channels.

Streams with a channel
Streams with a defined channel are either permanent streams with a year-round flow (Figure 3.43) or intermittent streams with intermittent flow (*i.e.* are dry and have no water for part of the year).

Figure 3.45 Example of a permanent stream with a defined channel (left - EAF-C19) and an intermittent stream with a defined channel (right- CWC-C04)

Streams without a channel
Many of the water courses or small streams in FML #3 are undefined, meaning they are not mapped in a GIS system, and are not visible from aerial imagery. These features are usually found during field surveys. Most of these features have no defined channels or banks (Figure 3.44). These features typically have very little flow, and have organic substrate and alder/willow vegetation associated with them. Some of these features are the result of overland flooding. In some cases, the flow goes underground and resurfaces downstream. Some are also sedge meadows, beaver floods, or old roads that have become water courses.

Figure 3.46 Small watercourse not mapped (top left CWC-C45); small watercourse, not mapped (top right TEL-C21); no channel, water intermittent (middle left ARL-C07); overland flow from flood (middle right DFR-C10); black spruce, alder - small watercourse (bottom left VMR-C16); Old road which is now a watercourse (bottom right RTH-C07).

3.1.8.4 Waterbodies

There are many waterbodies within Forest Management Licence #3. The largest waterbody is Lake Winnipegosis, which is on the eastern edge of FML #3 (Figure 3.45). Other significant waterbodies include Swan Lake and Pelican Lake to the north, Lake Dauphin in the south, and Lake of the Prairies to the west. All of these lakes have significant commercial fishing and/or recreational angling.

Smaller lakes occur in the Duck Mountain, but the recreational potential of these lakes are not limited by their size. Wellman/Glad Lakes, Child's Lake, and Singush Lake are all part of the Duck Mountain Provincial Park Recreation Zone. Other lakes in the Duck Mountain, such as Burrows Lake, are not in the park. Many small lakes exist in the Duck Mountain, because the clay soils and hummocky terrain form lakes at low spots in the terrain.

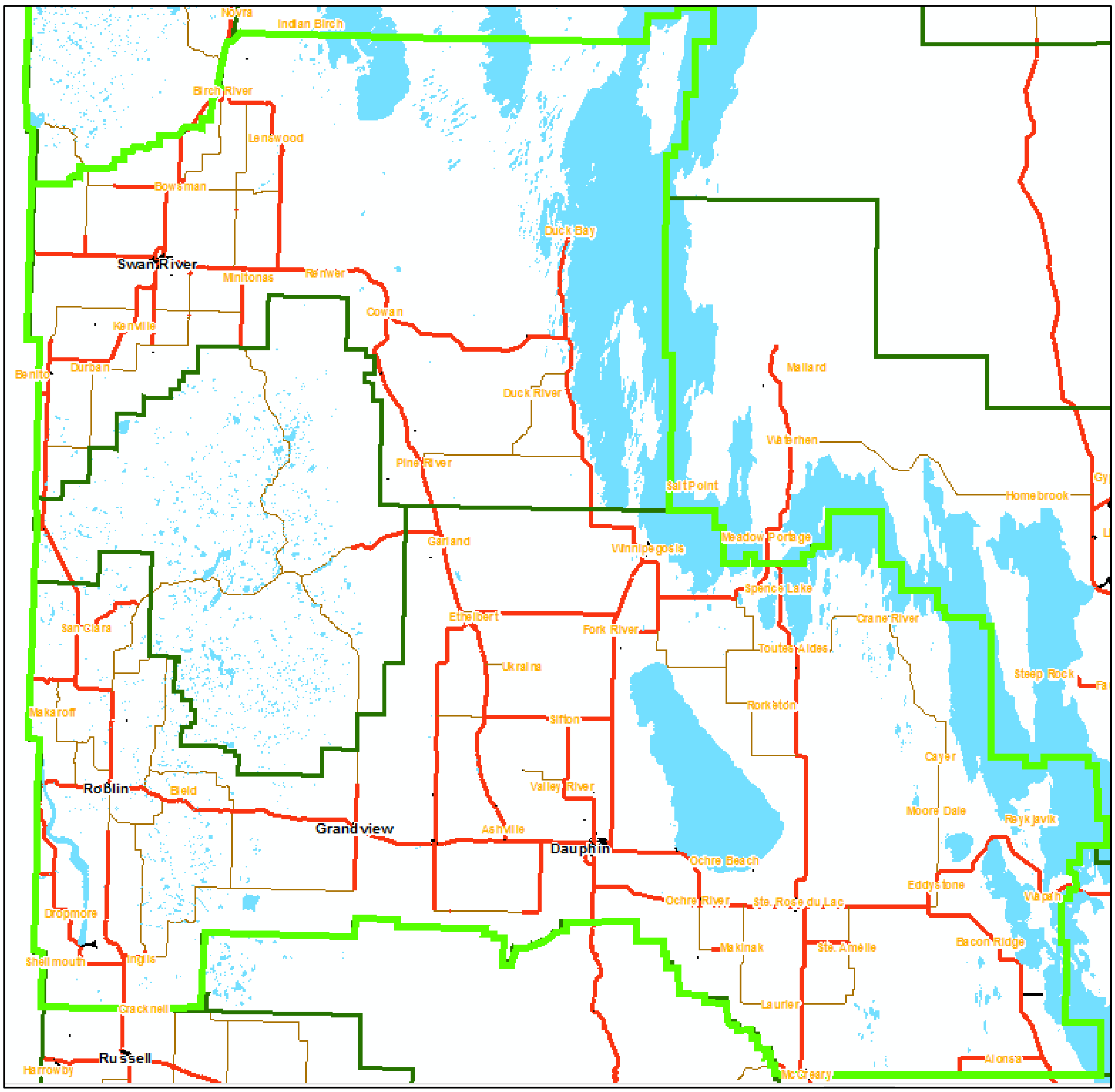


Figure 3.47 Waterbodies in the Forest Management Licence #3 area.

A summary of the hydrometric data available in the watershed shows that the area surrounding the East Duck Mountain has been experiencing wetter than normal conditions in the last 10 years. This has resulted in Lake Winnipegosis reaching record high levels in 2010 and 2011 (Figure 3.46), approximately 1.0 m higher water levels than average.

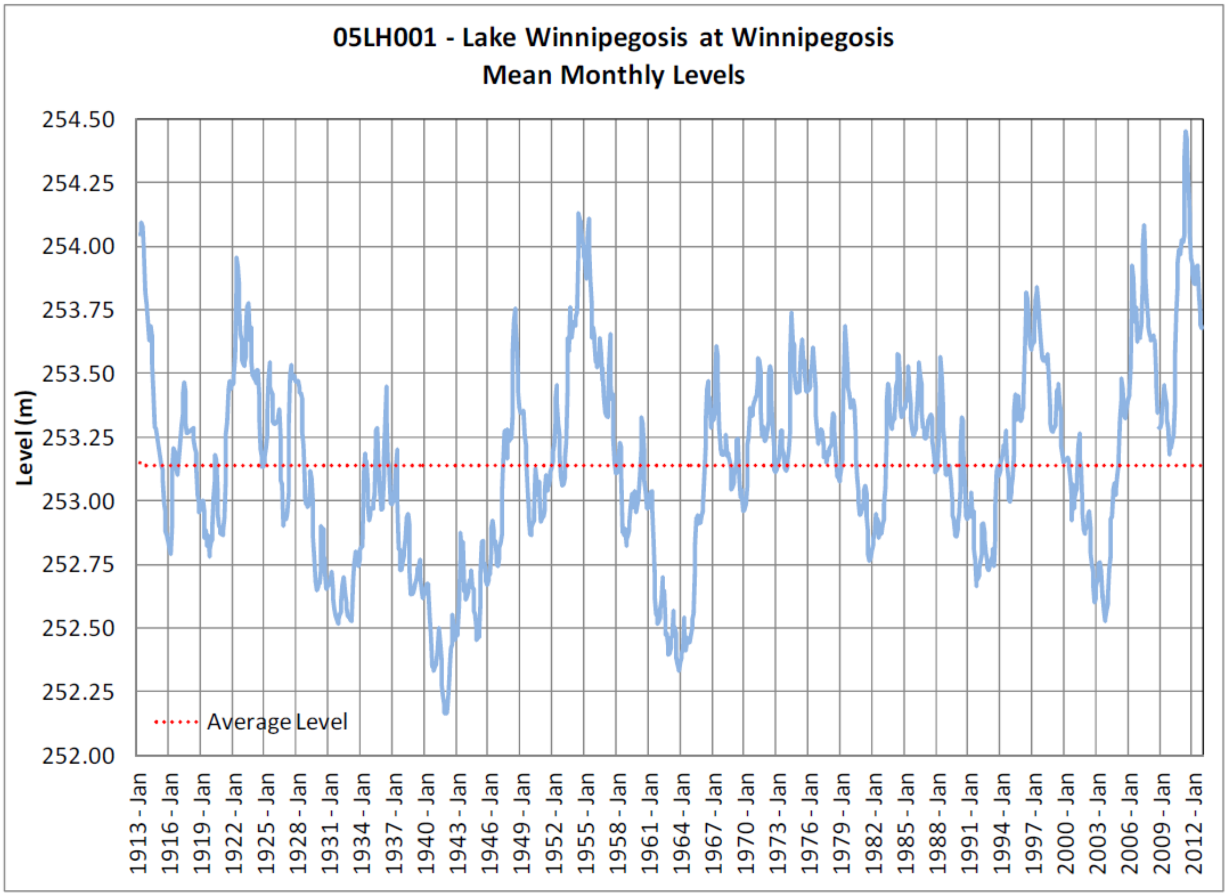


Figure 3.48 East Duck Mountain Hydrology report (Lee 2014).

Waterbodies can be generally categorized as large lakes, small lakes, and beaver floods (Figure 3.47). All of these waterbodies are usually 2 m deep or deeper.

Figure 3.49 Loons on East Blue Lake (top left) and Swan Lake (top right); small lakes (middle row); and beaver ponds (bottom row).

Shallow open water (Figure 3.48) is a wetland and a waterbody less than 2 m deep. The shallow water often freezes near the bottom, killing any fish that may be present.

Figure 3.50 Shallow open water in the Duck Mountain.

Oligotrophic Lakes
An oligotrophic lake is a lake with low primary productivity as a result of low nutrient content. These lakes have low algal production and consequently, often have very clear waters with high drinking-water quality. The bottom of such lakes typically have ample oxygen and so support many fish species such as lake trout, which require cold, well-oxygenated waters. The oxygen content is likely to be higher in deep lakes, owing to their larger hypolimnetic volume. Oligotrophic lakes are most common in cold regions that are underlain by igneous rocks, especially granitic bedrock or sterile sand.

Mesotrophic Lakes
Mesotrophic lakes are lakes with an intermediate level of productivity. These lakes are commonly clear water lakes and ponds with beds of submerged aquatic plants and moderate levels of nutrients.

Eutrophic Lakes
A eutrophic body of water, commonly a lake or pond, has high biological productivity. Due to excessive nutrients, especially nitrogen and phosphorus, these water bodies are able to support an abundance of aquatic plants. Usually, the water body will be dominated either by aquatic plants or algae. When aquatic plants dominate, the water tends to be clear. When algae dominate, the water tends to be darker. Photosynthesizing algae supplies oxygen to the fish and biota which inhabit these waters. Occasionally, an excessive algal bloom will occur and can result in fish death because the decomposition of the algae reduces the amount of oxygen available to fish.

Hypereutrophic
Hypereutrophic lakes are very nutrient-rich and are characterized by frequent and severe nuisance algal blooms and low transparency. Hypereutrophic lakes have a visibility depth of less than one meter, and have high chlorophyll and phosphorus concentrations. The excessive algal blooms can also significantly reduce oxygen levels and prevent life from functioning at lower depths, creating dead zones beneath the lake surface.

3.1.8.5 Water Quality

Water quality is important to the health of ecosystems (*e.g.* rivers, streams, and waterbodies), safety (recreational water quality), and drinking water (town, municipal, and private well water). However, there is no single indicator of water quality. Water quality is a combination of physical indicators (*e.g.* sediment, odour, colour, taste), chemical indicators (*e.g.* pH, hardness), and biological indicators (*e.g.* algae, pathogens, diseases, *etc.*).

Natural water bodies vary in water quality as environmental conditions change. Nutrient input, (especially nitrogen and phosphorus), organic carbon, and sediment load affect natural water systems. Beaver dams impede water flow and generally have a negative effect on water quality.

Water Quality Index (WQI) is an index that ranges from 0 to 100, based on 25 variables, including pH, dissolved oxygen, total phosphorus, and nitrate-nitrite. The higher the score, the better the quality of water. WQI can be put into classes (*i.e.* excellent, good, fair, marginal, and poor). The WQI for both the Swan River and Woody River ranged between 'fair' to 'good' from 1992 to 2008 (Figure 3.49).

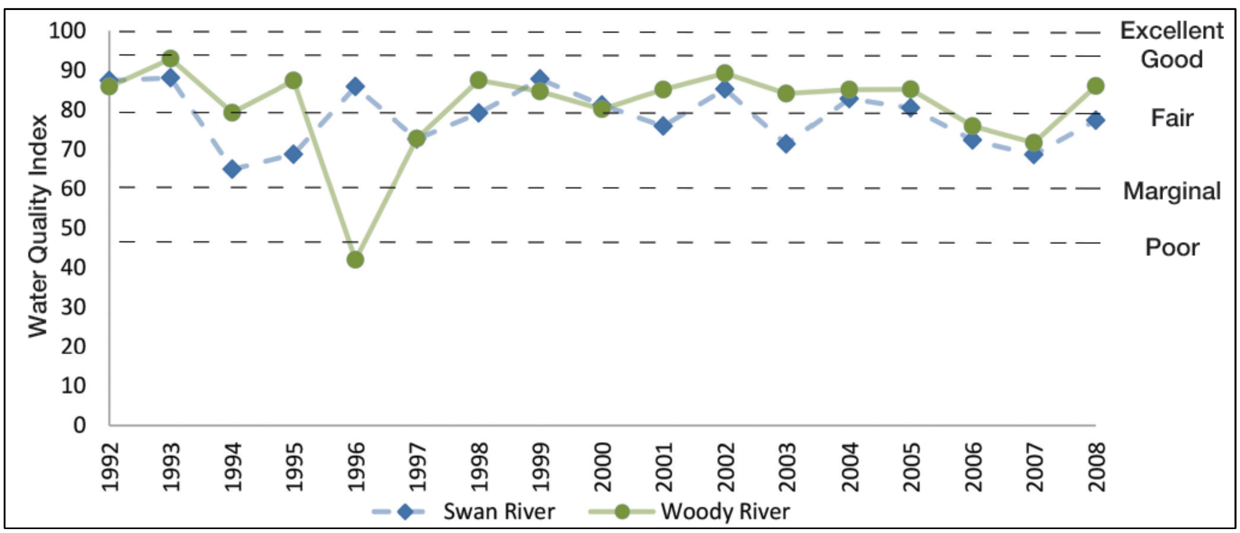


Figure 3.51 Water Quality Index for the Swan and Woody Rivers 1992 to 2008 (Swan Lake Watershed Conservation District).

The WQI was developed by the Canadian Council of the Ministers of the Environment, and is calculated by comparing the water quality data to "Guidelines for Canadian Drinking Water Quality". The WQI measures the scope, frequency, and amplitude of water quality exceedances and then combines the three measures into one score between 0 and 100. The higher the score, the better the quality of water. The scores are then ranked into one of the categories described below:

1. Excellent: (WQI Value 95-100) - Water quality is protected with a virtual absence of impairment; conditions are very close to pristine levels. These index values can only be obtained if all measurements meet recommended guidelines virtually all of the time.
2. Very Good: (WQI Value 89-94) - Water quality is protected with a slight presence of impairment; conditions are close to pristine levels.
3. Good: (WQI Value 80-88) - Water quality is protected with only a minor degree of impairment; conditions rarely depart from desirable levels.
4. Fair: (WQI Value 65-79) - Water quality is usually protected but occasionally impaired; conditions sometimes depart from desirable levels.
5. Marginal: (WQI Value 45-64) - Water quality is frequently impaired; conditions often depart from desirable levels.
6. Poor: (WQI Value 0-44) - Water quality is almost always impaired; conditions usually depart from desirable levels.

3.1.8.6 Groundwater

Sources, Distribution, and Quality
Surface and subsurface geological characteristics affect each other. Therefore, groundwater sources and distribution are described in three subregions: Swan River Valley, Duck Mountain, and Riding Mountain. The quality of the groundwater varies considerably over FML #3.

Swan River Valley Subregion
The Swan River Valley subregion is the lowland area between the Porcupine Hills and Duck Mountain and extends toward Swan Lake. This area lacks Jurassic formations, which means the salty water from the Palaeozoic rocks can filter into the Cretaceous Swan River Formation. Thus, highly mineralized water is common within the regional Swan River sandstone and sand aquifers.

Localized surface sand and gravel aquifers are common throughout the mainly heterogeneous surface glacial deposits. Water quality varies. For example, near Bowsman, potable groundwater is difficult or impossible to find. However, near the Town of Swan River, fresh water is in sandstone aquifers at depths of more than 60 m.

Duck Mountain Subregion
The Duck Mountain subregion includes Duck Mountain and goes east to Lake Winnipegosis , and includes Dauphin Lake. This subregion contains the Manitoba Escarpment, nearly flat lowlands, numerous streams in the northern lowland, and a few streams in many parts of the south. The depth to the Palaeozoic includes a gently eastward sloping transition zone between the carbonate rock, and is greater here than in the other subregions. The southern part of this subregion has Jurassic shale and limestone beds that separate the Swan River Formation from the Palaeozoic carbonate rocks. This slows the movement of salty water from the Palaeozoic rocks into the Cretaceous Swan River Formation.

Overlaying the Swan River Formation are Cretaceous soft shale formations that usually prevent water movement to the overlying till. Sand and gravel lenses interbedded in the thick upland till are fairly common. In the northern lowland complex area, extensive surface sand and gravel deposits are common. Relatively fresh water in deep wells of this area indicates significant local recharge.

Several salt springs exist near Lake Winnipegosis where water from the Palaeozoic carbonates reaches the surface.

Low mineral concentrations in the Swan River Formation aquifer systems indicate good local recharge conditions in the Ethelbert area and along the north-eastern side of Duck Mountain. Extensive surface sand and gravel deposits are also common in the northern part of the lowland. Because fairly deep wells in bedrock in this area have fresh water, significant local recharge likely takes place.

However, several brine springs exist along Lake Winnipegosis where the Palaeozoic carbonate rocks lie under the surface. Along the Valley River, the soft clay shale bedrock acts as a barrier to recharge. This results in salty Swan River Formation water and a lack of fresh groundwater in the Grandview, Gilbert Plains, and Ashville area.

Riding Mountain Subregion

An extensive sand and gravel aquifer exists in the Timberton area south of Duck Mountain at the base of the upland area. Along the Valley River, the bedrock consists of soft clayey shale, with minor sand and gravel lenses. This means limited groundwater recharge. Water from the underlying Swan River Formation is salty. Fresh groundwater is often difficult to find in the areas of Grandview, Ashville, and Gilbert Plains.

Highly mineralized and salty water is common in the lowland area because the Palaeozoic rocks transmit salty water and local recharge is slowed by the shale beds and till.

Alluvial fans at the base of the northeastern slopes of the Escarpment are recharged mainly from precipitation over the alluvial fans and by infiltration from streams that cross them. As a result, the aquifers are a significant source of good quality groundwater.

In a belt up to five km wide east of these alluvial fans, the subsurface is soft clay shale with no aquifers. In deeper water bearing zones, the water is highly mineralized. Drinkable water in this area is rare.

3.1.8.7 Groundwater Wells

Ground water wells are in towns (Figure 3.50 and are surrounded by agricultural land – Swan River, Minitonas, Bowsman, Benito, and Birch River.

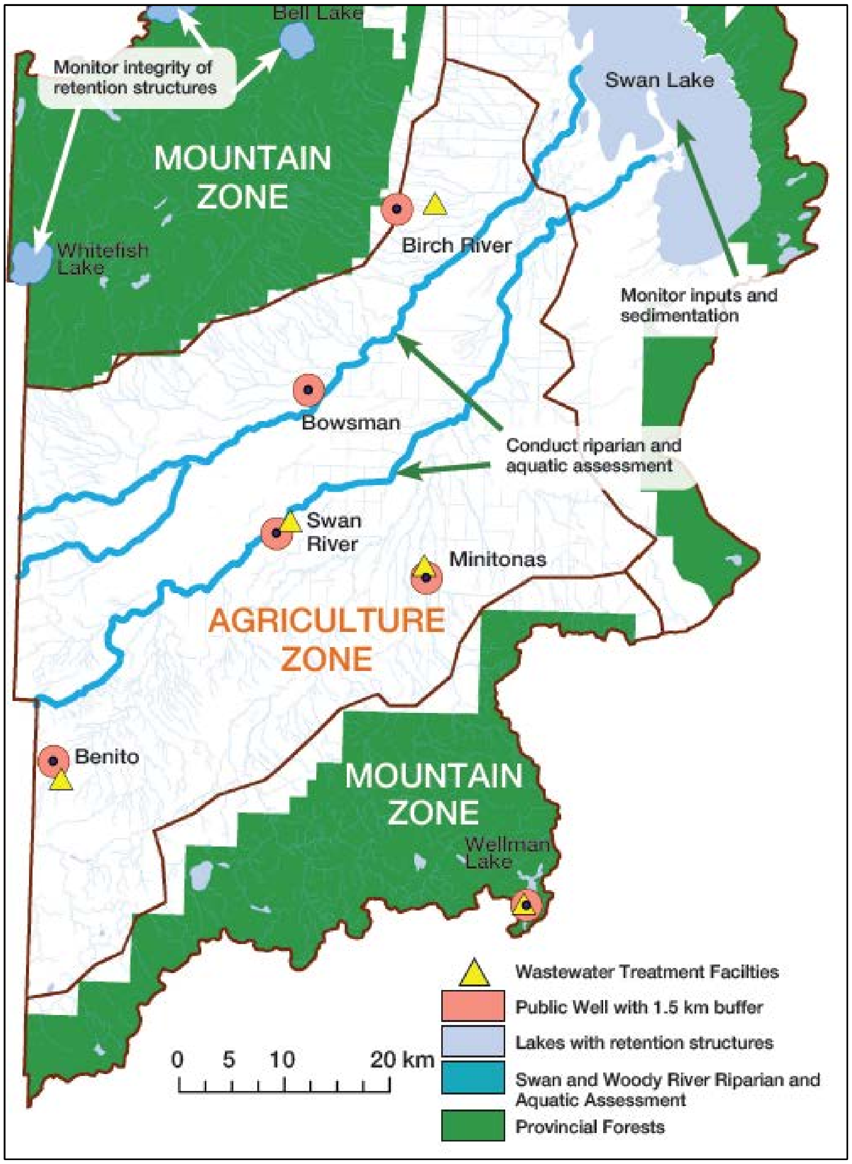


Figure 3.52 Ground water wells in the FML #3 area (Swan Lake Watershed Conservation District)

Public drinking water wells have a protection zone of 1.5 km around each well. Intensive and high pollution risk development activities, such as chemical or fertilizer storage facilities, disposal fields, fuel tanks, waste disposal grounds, or wastewater treatment facilities are restricted in public drinking water source zones.

Rural residents use private wells as their drinking water supply. Nitrates and coliform are the main dangers for contaminating drinking water in private wells.

3.1.8.8 Shallow Aquifers

Aquifers are an underground layer of water-bearing permeable gravel, sand, silt, or fractured rock. Aquifers or layers of water occur at various depths, often in multiple layers, depending on the permeability of the sub-surface layers.

Shallow aquifers are close to the surface, and are likely to be topped up by the local rainfall. The groundwater in these aquifers have a seasonally high water table one to several meters from the ground's surface. These are often used for shallow well water supply.

Water-bearing layers below an impermeable layer are a confined aquifer, and are not directly influenced by precipitation. Confined aquifers are deeper than shallow aquifers and far less sensitive to surface-induced contaminants, such as organic matter.

3.1.8.9 Runoff and infiltration regimes

Precipitation that falls to the ground either runs off the ground surface, or infiltrates the ground and becomes groundwater. Runoff of precipitation depends upon many factors. Clay soils absorb less water than sandy soils, resulting in more overland runoff of water into streams. Likewise, soil already saturated from previous rainfall can't absorb much more water, increasing the amount of surface runoff. Vegetation slows the movement of runoff, allowing more time for precipitation to seep into the ground. Agriculture and the tillage of land also changes the infiltration patterns of a landscape.
Water falling on steeply-sloped land, like the Manitoba Escarpment, runs off more quickly and infiltrates less than water falling on flat land.

Precipitation that falls to the ground surface and infiltrates the ground becomes groundwater. Some water infiltration stays in the rooting zone of the soil and plant roots draw upon this shallow groundwater. The process of evapotranspiration moves water back into the atmosphere. Infiltration replenishes aquifers by filling openings and pore spaces in soil or rock layers. Below the ground surface is an unsaturated zone, which water travels through to reach lower zones. The water table is the point at which the ground is completely saturated. Below this level, the pore spaces between every grain of soil and rock crevice is completely filled with water.

3.1.9. Vegetation

Vegetation is a significant component of ecosystems. Vegetation is highly influenced by the underlying soil texture, nutrient status, and the soil moisture regime. The strong relationship between vegetation and soil is reflected in ecosites, which are used for the planning strata.

Various ecosystems are often described based on their dominant vegetation, including uplands, wetlands, grasslands, shrub lands, and aquatic areas. Examples of these include aspen-hazel forest, black spruce swamp, cattail marsh, alder thicket,

Ecosystems contain many vegetation elements including tree canopies, tall shrub, small shrub, herbs, forbs, mosses, and lichen layers. The average occurrence and percent cover of these vegetation elements are quantified by Arnup *et al.* 2006 (Figure 3.51).

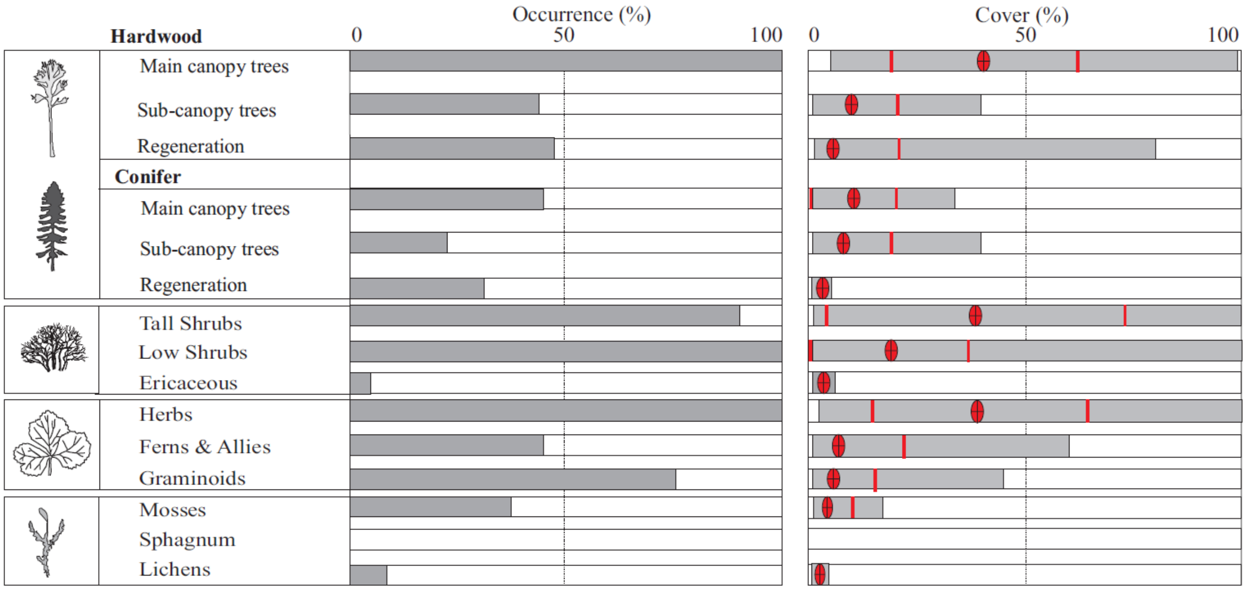


Figure 3.53 Ecosystem elements including trees, shrubs, forbs, mosses, and lichens on aspen–hazel mesic clay ecosite (Arnup *et al*. 2006).

Scale is very relevant and important when managing vegetation. Trees for example can be described at many different scales: a single individual tree; a clump of trees; a stand of trees; aggregates of stands; or a forest at the landscape scale.

3.1.9.1 Vegetation Inventories

To quantify diversity of vegetation, and to implement Ecosystem-Based Management (EBM) as defined in the Manitoba Forest Plan (2002), an ecologically-based vegetation inventory was needed. In 1982, the provincial government created the Forest Resources Inventory (FRI), which was a timber inventory. The FRI timber inventory met its intended needs as a regional-level inventory for broad planning and calculation of Annual Allowable Cut. However, the timber-focused FRI was not suitable for EBM planning, since only the merchantable trees were inventoried, and other ecosystem components such as shrubs, snags, coarse woody debris, soils, wetlands, and understory vegetation were unknown.

Louisiana-Pacific Canada Ltd. initiated or were partners in a series of inventory projects, that eventually culminated in the creation of the Forest Lands Inventory (FLI, 2002), an ecological inventory capable of providing ecological information to implement Ecosystem-Based Management planning. A summary of inventory projects are listed in Table 3.17.

Table 3.17 Summary of Vegetation Inventory Projects.

Year	Project Name and Summary
1982	Forest Resources Inventory – Province of Manitoba inventory
1997	Ecosystem Resource Inventory & Landscape Analysis
1998	Wetland inventory & multiple scale approach (Dave Locky, U of Alberta PhD research, 2005).
1999	LP field test of Wetland Ecological Classification system from Ontario. LP biologists field-tested the Northwestern Ontario wetland ecosite guide (Racey *et al.* 1996) in the Duck Mountain. Wetlands were field surveyed for a 'goodness of fit' with the Ontario Classification.
2001-2006	Ecosite Decision Support System (Baydack 2006). An attempt to create (but not map) ecosites and standardize them across Manitoba.
2002	Forest Lands Inventory. Joint effort between LP and Manitoba Conservation to create an ecological inventory for FMUs 13 and 14 and map at the ecosite level.
2006	Ecosites of the Mid-Boreal Upland Ecoregion of Manitoba (Arnup *et al.* 2006). An ecosite classification system, complete with field guide and ecosite maps for the Duck and Porcupine Mountain Provincial Forests. Built on the 2002 Forest Lands Inventory.
2007	Ducks Unlimited – Land cover classification. Ducks Unlimited completed a satellite image classification of a large portion of FML#3, as part of the Pasquia project.
2013	Provincial inventory for wooded portion of FMUs 11 and 12 - developed from aerial photography flown in 2001 and 1980s but updated to 2013

Vascular Flora of Manitoba has an online list of species, but no pictures, keys, text, or identifying features.

Vascular plants vascular plant flora of Manitoba

https://home.cc.umanitoba.ca/~burchil/plants/

Non-Vascular plants of Manitoba

Bryophytes - mosses and liverworts

https://home.cc.umanitoba.ca/~burchil/plants/mosses/index.html

Lichens – online lists of lichens for Manitoba include:

https://home.cc.umanitoba.ca/~burchil/plants/lichens/index.html

Cryptogamic Herbarium (UofM WIN)

3.1.9.2 Forest Lands Inventory

The inventory used to create the modeling landbase for this Forest Management Plan (2020 to 2040) is the Forest lands Inventory (2002). It was jointly created by LP and Manitoba Conservation. This detailed ecological inventory stratified multiple tree layers to describe vegetation at different heights, which is especially common in aspen-spruce mixedwood forests. In addition, an ecosite classification system (Table 3.18) was developed (Arnup *et al*. 2006) to facilitate a biodiversity conservation strategy. The inventory and its' ecosite classification provide ecosystem information, which is used to help Ecosystem-Based Management.

Table 3.18 Ecosite classification system for the Forest Lands Inventory.

	Ecosite Number	Soil Moisture Class	Soil Texture Class	Vegetation
non-forested wetlands	**W1**	wet	n/a	Open Bog (low shrub)
	W2	wet	n/a	Open Poor Fen (low shrub)
	W3	wet	n/a	Open Rich Fen
	W4	wet	n/a	Thicket Swamp
	W5	wet	n/a	Shore Fen
	W6	wet	n/a	Meadow Marsh
	W7	wet	n/a	Sheltered Marsh
	W8	wet	n/a	Exposed Marsh
	W9	wet	n/a	Open Water Marsh (floating leaf - peat substrate)
	W10	wet	n/a	Open Water Marsh (submergent - mineral substrate)
forested uplands	**11**	Dry-Fresh	sandy	TA-BA hardwood
	12	Dry-Fresh	sandy	TA-JP-Spruce mixedwood
	13	Dry-Fresh	sandy	JP-BS feathermoss
	21	Fresh	coarse loamy-silty	WB mixedwood

	Ecosite Number	Soil Moisture Class	Soil Texture Class	Vegetation
	22	Fresh	coarse loamy-silty	TA hardwood
	23	Fresh	coarse loamy-silty	TA-WS mixedwood
	24	Fresh	coarse loamy-silty	JP-BS mixedwood
	31	Fresh	Clayey (lacustrine)	TA-BA hardwood / mixedwood
	32	Fresh	fine loamy (till or stratified)	TA-BA hardwood
	33	Fresh	fine loamy (till or stratified)	TA-BA mixedwood
	34	Fresh	fine loamy (till or stratified)	WS-BF mixedwood
	35	Fresh	fine loamy (till or stratified)	JP-BS mixedwood
	36	Fresh	fine loamy (till or stratified)	BS-JP-(WS-BF) Labrador tea-feathermoss
	41	Moist	sandy to silty	TA-BA hardwood
	42	Moist	sandy to silty	WS (BF) mixedwood
	43	Moist	sandy to silty	BS-JP-feathermoss
	44	Moist	coarse loamy to clayey	Other hardwoods (AG-AE-MM)
	51	Moist	fine loamy to clayey	TA-BA hardwood
	52	Moist	fine loamy to clayey	TA-WS-JP mixedwood
	53	Moist	fine loamy to clayey	BS-feathermoss-Labrador-tea
forested wetlands	**61**	Wet	fibric-mesic organic	BS-(WS) -Lab tea - Fmoss - Sphagnum
	62	Wet	mesic organic	BS-Alder-Herb Rich
	63	Wet	fibric organic	TL-BS-Sedge (Treed Fen)
	64	Wet	fibric organic	BS-(JP)-Ericaceous-Sphagnum
non-forested uplands	**71**	Dry - Moist	any mineral soil texture	Open Shrub
	72	Dry - Moist	any mineral soil texture	Closed Shrub
	73	Dry - Moist	any mineral soil texture	Grassland

To implement Ecosystem Based Management at the landscape-level, the ecosystems in the Duck Mountain and Porcupine Mountain Provincial Forests needed to be mapped (and classified. Therefore, LP and Manitoba Conservation-Forestry Branch created a pilot ecological inventory of Forest Management Units 13 and 14, Duck Mountain Provincial Forest and Porcupine Mountain Provincial Forest, respectively. LP and MC managed the project, while the consulting firm The Forestry Corp. was contracted to do the inventory work. The entire project area was approximately 600,000 hectares.

The new Forest Lands Inventory (FLI) is an operational inventory, which has a high level of ground-level accuracy, versus a regional inventory, which has a coarse level of accuracy at the landscape-level. The FLI is also ecologically-based and is designed to accurately map the location and characteristics of ecologically important forest components, such as soil moisture, soil textures, and topography.

100% of the landbase was photo-interpreted, regardless of administration boundaries such as parks, protected area, Treaty Land Entitlement, *etc*. In addition, all land, including forested uplands, forested wetlands, non-forested uplands, and non-forested wetlands were inventoried.

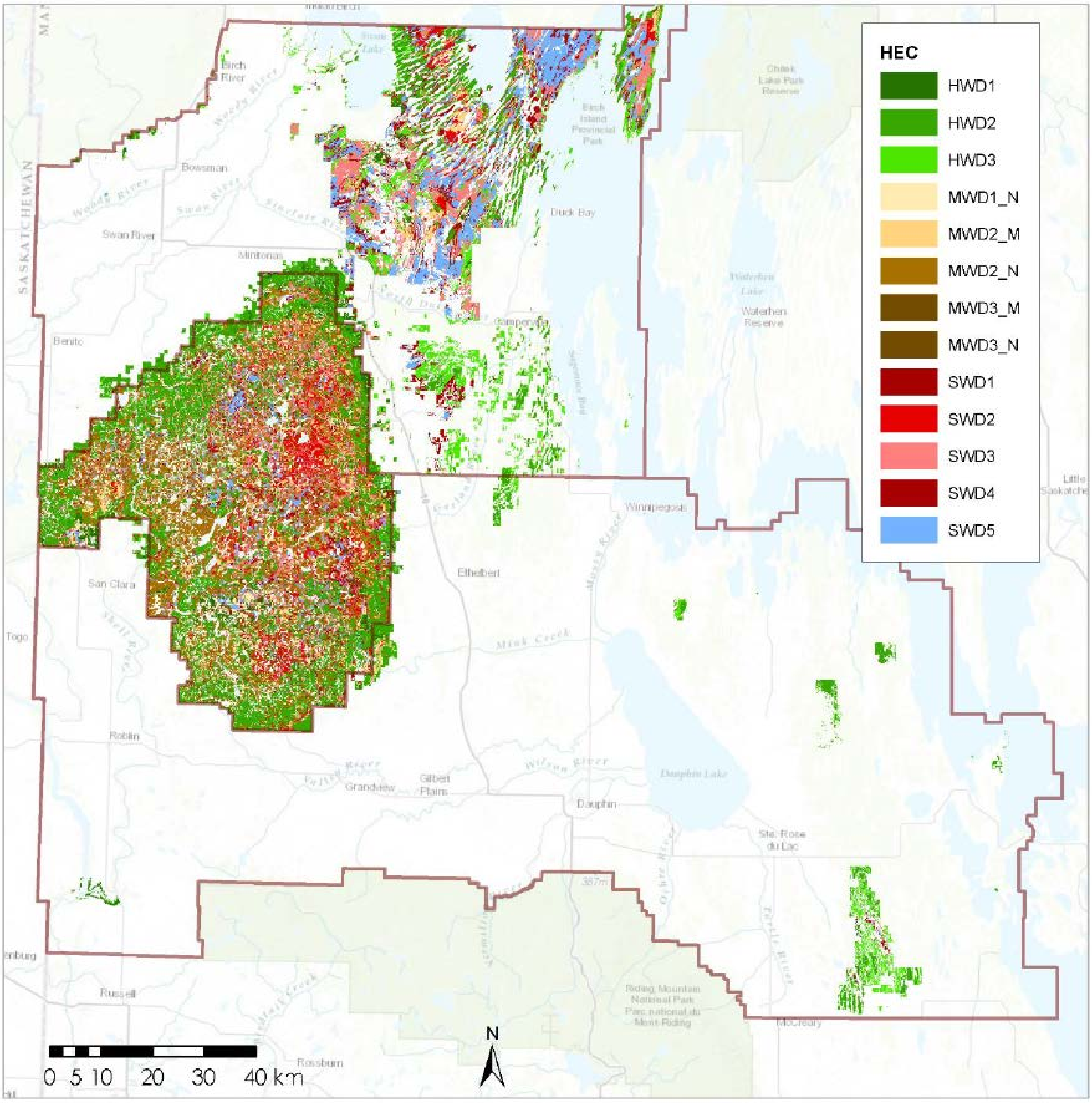


Figure 3.54 Map of Habitat Element Curve strata in FML #3 (ForSite Consulting, 2018) for open crown land.

Landform and soil mapping was completed first. Soils polygons were delineated on 1:60,000 photos, and soils and landform attributes interpreted within each polygon. 282 polygons were field checked for quality control. Primary landform and soils mapping attributes include:

mode of deposition (e.g. glacio-fluvial, morainal);
soil texture (e.g. coarse-textured soil (Silty Sand));
landscape modifiers (e.g. Organic flat, bowl, ribbed, sloping, or level with hummocky mineral soils);
drainage (e.g. I-imperfectly drained);
soil order, great group, & subgroup (e.g. D.GL dark gray luvisol); and

soil subgroup modifiers (e.g. calcareous, Bt clay layer, rich Ah horizon).

Two sets of aerial photography, black and white near-infrared photos and colour infrared leaf-off photos, both at a scale of 1:15,000 were utilized. The colour infrared photos show conifer understory, tamarack, and terrain that would normally be masked by the leaves of the hardwoods. Stratification of ecological boundaries into polygons was determined first. Stand attributes were then determined within each polygon.

Forested stands attributes include:

- cover
- cover class
- arrangement
- Canopy (# layers, type, rank)
- % species
- age of origin
- ecological data
- stand conditions (modifiers)
- wetland info

Topographic stand attributes include:

- soil model & number (same as 1:60,000 soils/landform effort)
- parent material / mode of deposition
- parent material texture
- topographic form (e.g. SC side slope concave)
- slope position (1-7)
- slope percent class
- aspect
- soil moisture regime (classes)

Due to the many mixedwood stands in the project area, the FLI was designed to be a multi-layer inventory. Therefore, stands were photo interpreted with several canopy layers (if they have different heights), as well as a conifer understorey, if present.

Quality control (QC) procedures were utilized at each stage of the inventory development. Photo interpretation had QC by having 40 stand-height helicopter observations per 10 km X 10 km map sheet, in addition to 10 ground visits by the photo interpreter. The interpreters did internal QC on their photo interpretation work, and then submitted the line work to provincial photo interpreters, who did additional external quality control.

1,429 ecosystem sampling plots were measured across the project area, in a statistically rigorous sampling design. The ecological plots characterized the forest resource in terms ecological characteristics of the sites, including live trees, snags, coarse woody debris, soils, vegetation, and wildlife observations.

Ecosite primary data (*e.g.* soil moisture, soil texture, vegetation) were mapped by photo interpretation. Ecosite plot data on 536 forested wetland and forested upland plots were collected and used to create 24 distinct and unique forested ecosites. A field key was created, based on the classification results. The forested ecosites were summarized in factsheets.

An ecosite field key was created, based on the ecosite classification results. The forested upland and forested wetland ecosites were summarized in factsheets. Ecosite assignments were made for all forested polygons in the FLI, by using the ecosite primary data and the ecosite key. Through this effort, an ecosite was assigned to every forested upland and forested wetland stand in the landbase. Fact sheets were created for each ecosite, complete with stand structure summaries, vegetation features, and colour photos of average soil conditions, understory vegetation, and tree canopy.

All of the above-mentioned innovations have created an exceptional inventory, with a great depth of 'ecological resolution' and detail. Unfortunately, the ecological depth and detail also make the FLI harder to use. Therefore, a 'User Guide' was created to assist inventory users with correctly using the tabular and spatial data in the FLI (The Forestry Corp. 2004).

3.1.9.3 Previous Forest Resource Inventory

Prior to the creation of the Forest Lands Inventory (2002), the previous forest resource inventory was the 1982 Forest Resource Inventory. Characteristics of this inventory included the following hierarchy of classification:

- Land and water were divided first
- forested and non-forested land (*i.e.* barren-bare rock, fields, meadow, marsh muskeg, and unclassified)
- productive forested (cover groups H, N, M, and S) versus 'non-productive' forested land (*i.e.* treed muskeg, treed rock, willow-alder, and protection forest)

Three digit codes were assigned to each category listed above.

The 1982 FRI had no stand ages. Instead of age, cutting class was assigned, based on size, vigour, state of development and maturity of a stand for harvesting purposes. In general the 1982 FRI had a strong merchantable conifer focus. Significant detail and effort was put into delineating the merchantable conifer stands. Conversely, the hardwoods were all lumped and little effort or detail were put into the non-merchantable hardwoods.

Wetlands were considered 'non-productive' and lumped into muskeg and treed muskeg categories, ignoring the Canadian Wetland Classification system. Ecological information such as landforms and soils were purposefully absent.

3.1.9.4 Forest Stand Age

Forest age is an important consideration, since forest ecosystems are very dynamic. An ecosystem will have different characteristics and habitat values when young, old, or very old. There are different ways and different metrics to measure and estimate stand ages across an entire forest. Two methods utilized in the Duck Mountain include ‘Time Since Fire’, and inventory age. The metric and methodology of ‘Time Since Fire’ focuses on the previous stand-replacing event, usually a fire. Results from Tardif 2004 document stands that have not had a fire for 300 years or since the 1720’s. Forest inventory ages focus on individual trees by counting their annual growth rings, then estimating stand age. This methodology showed a maximum stand age of 160 years old in the Duck Mountain. Note that rot in aspen prevents counting rings in very old aspen trees.

3.1.9.4.1 Time Since Fire

The importance of understanding natural disturbances has increased as society desires a more natural approach to forest management. The idea behind “natural disturbance pattern emulation” is that forest management strategies that feature retention of natural species composition, stand structures, and landscape patterns similar to those of natural disturbances that will likely promote the conservation of biodiversity.

Little research has been conducted in Manitoba with regards to natural disturbances. One of the principle natural disturbance agents in Manitoba is forest fire. For these reasons and to better understand the dynamics of the Duck Mountain ecosystems, Tardif (2004) developed a 300-year fire history reconstruction for the Duck Mountain Provincial Forest (DMPF).

Standard dendrochronological methods were used to determine the time-since-fire distribution of forest stands within the DMPF (Tardif, 2004). The study results indicated that the fire cycle in the DMPF has dramatically changed since the early 1700s, as mapped in Figure 3.25. In the pre-settlement period (1700-1880), which corresponded to the late portion of the Little Ice Age, the fire cycle may have been around 55 years with an average of 1.8% of the area burning each year. Throughout that period, it is speculated that large, infrequent fires have occurred in conjunction with prolonged droughts. For example, an extreme drought was observed from 1885 to 1895 and coincided with about 83% (283,580 ha) of the DMPF burning.

Time-since-fire dates were obtained for each fire-site by aging dominant trees/species known to regenerate well after fire. The post-fire colonization mechanisms of trembling aspen-balsam poplar-white birch (asexual reproduction within the burn) and, jack pine-black spruce (aerial seed banks within the burn) served to date stand origin. Priority was given to shade-intolerant species like jack pine and trembling aspen, which form even-aged cohorts following forest fires. Other species like white birch, tamarack, black spruce, and white spruce were also used because of their greater longevity. At each site, 8-10 trees were sampled and two cores were extracted from opposite direction and close to the ground level using an increment borer. In young site (less than 80 years) only one core per tree was extracted. Four cores were systematically extracted from white birch, a species characterized by numerous missing rings. No attempt to determine the actual position of the root collar was done.

In addition to time-since-last-fire, indicators of previous fire were looked for. Each site was searched for fire-scarred trees, snags and down woody debris that were charred or not. Many cross-sections were collected. Snags are often the result of past fire and they can be used to extend back in time both the fire history and reference chronologies (Payette et al. 1989). Priority was given to jack pine snags, which may stand for over 100 years. In many sites, it was thus possible to determine both time-since-last-fire and the time to the previous fire. To characterize each fire-site, ten modified Point Centre Quadrat separated by a pacing distance of 10 m were sampled and at each point, the species and diameter of the closest tree in each quadrant was recorded. The data was used to calculate both relative frequency and dominance and to develop an importance value for each species. In addition to the 263 fire-sites, 96 checkpoint-sites were sampled to assess the continuity of the time-since-fire across the landscape and/or to locate fire scarred trees and/or other indicators of past fire activity. These were done when a change in stand structure was observed. In these sites, usually three living trees and/or a few snags were sampled.

Despite these frequent fires, the length of the fire cycle has increased to about 200 years. On average, about 0.5% of the landscape was burning every year. Since the last major fire that occurred in 1961, the length of the fire cycle has been estimated to be 15,000 years. The year 1961 coincided with the most severe drought in the 20th century for that region of Manitoba. Part of this extraordinarily long fire cycle is an artifact of a 40 year data set, which is small for these landscape-level, long time horizon events. Another part of the long fire cycle may also be a reflection of fire detection and control practices that have improved in the last few decades.

At no other time in the 300 year record was there a 40 year period with so little area burned. The impact of fire suppression needs to be further investigated, as it is speculated to play a major role in the lengthening of the fire cycle. The current time-since-fire distribution and age structure observed in the landscape are probably unprecedented. The imprint of the late 19th century fires coupled with settlement and fire suppression have been the dominant forces structuring the ecological processes of today. This study questions the use of the current state of the DMPF, and provides a benchmark on which to evaluate future anthropogenic impacts. It also emphasizes the need to re-introduce larger scale disturbances in the DMPF and questions our ability to cope with potential risks associated with large, infrequent disturbances.

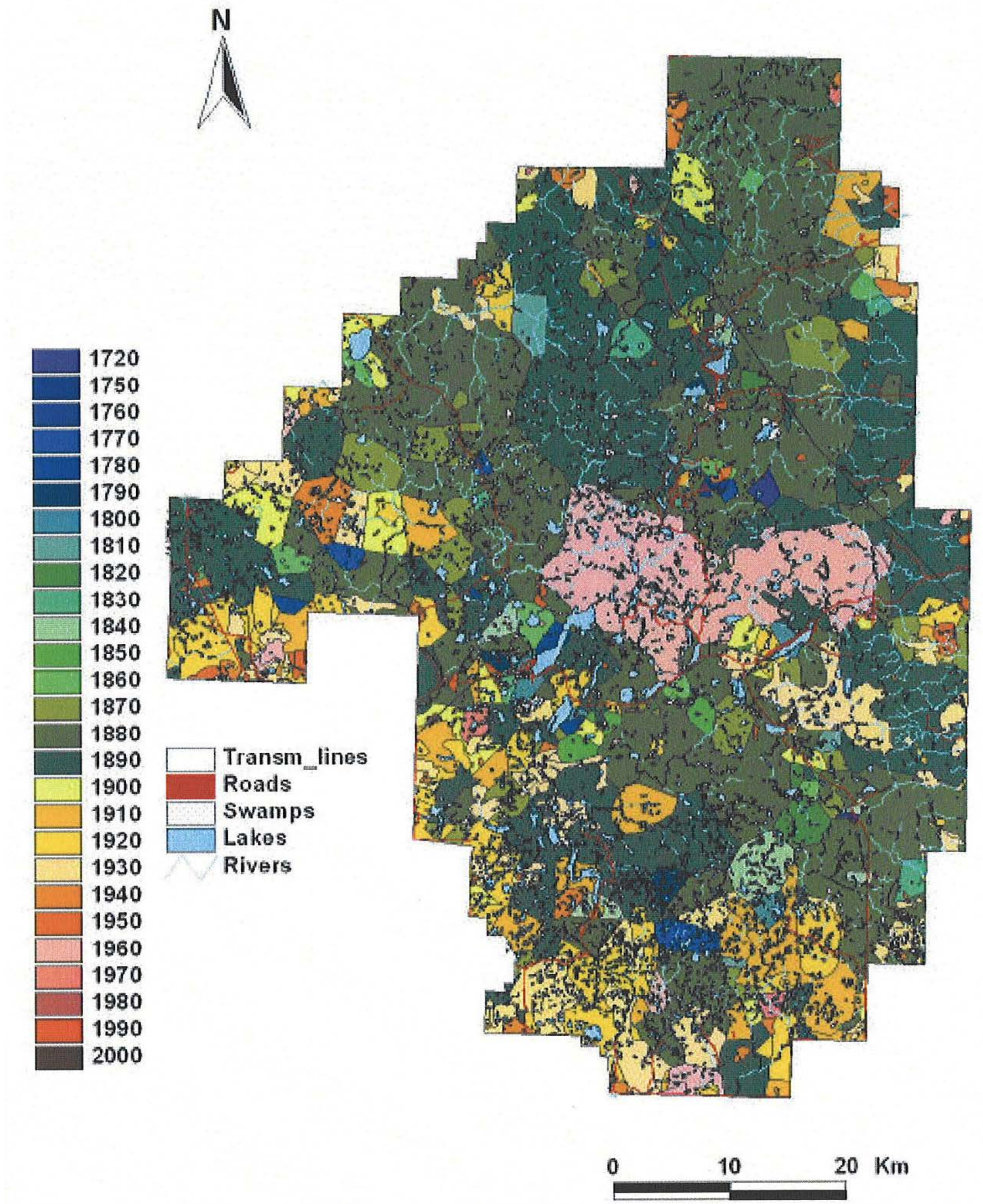


Figure 3.55 Time-since-last-fire map for the Duck Mountain (Tardif, 2004).

The Duck Mountain Provincial Forest (DMPF) is unique with respect to:

- Its' isolated nature along the Manitoba escarpment; and
- The existence of a provincial park within its' boundaries.

Tardif further suggests that with the increased risks or uncertainties associated with global warming and fire suppression, managers should explicitly incorporate the risk of large, infrequent catastrophic fires in their long-term management plan. For the DMPF, this may mean establishing firebreaks or controlling fuel build-up.

There are several additional implications for forest management. Harvesting has replaced fire as the main stand-replacing disturbance agent. The author recommends that the harvest should be dispersed to create a variety of age classes that exist in different areas, similar to a large fire that will leave a forest with diverse age classes intact. This dispersal of disturbances is counterbalanced by a need to develop larger cut blocks or a larger range of cut block sizes than is currently permitted by government guidelines, to create a landscape pattern that maintains some natural characteristics.

3.1.9.4.2 Inventory Age

A standard method of populating a forest inventory with an age for every stand is a combination of measuring individual trees within a stand, then estimating the age of nearby stands that appear to be similar. However, age cannot be directed determined from aerial photos or aerial imagery.

The current age class distribution of all forest stands across FML #3 is shown in Figure 3.54. The age class graph is divided into contributing forest, and non-contributing forest (*i.e.* no harvest areas such as parks or buffers). There is a significant age class imbalance, since the majority of the forest is either mature, over mature, or very over mature. The age class 1-20 years are recent stand-replacing disturbances, including softwood harvesting by Quota Holders, hardwood harvesting by LP and Quota Holders, as well as 14,300 ha of blow down that occurred in 2012, and finally a few small fires. The age class structure of the Duck Mountain (FMU 13) has been heavily influenced by the 1890's fire events, where the majority of the Duck Mountain burned all at once 130 years ago.

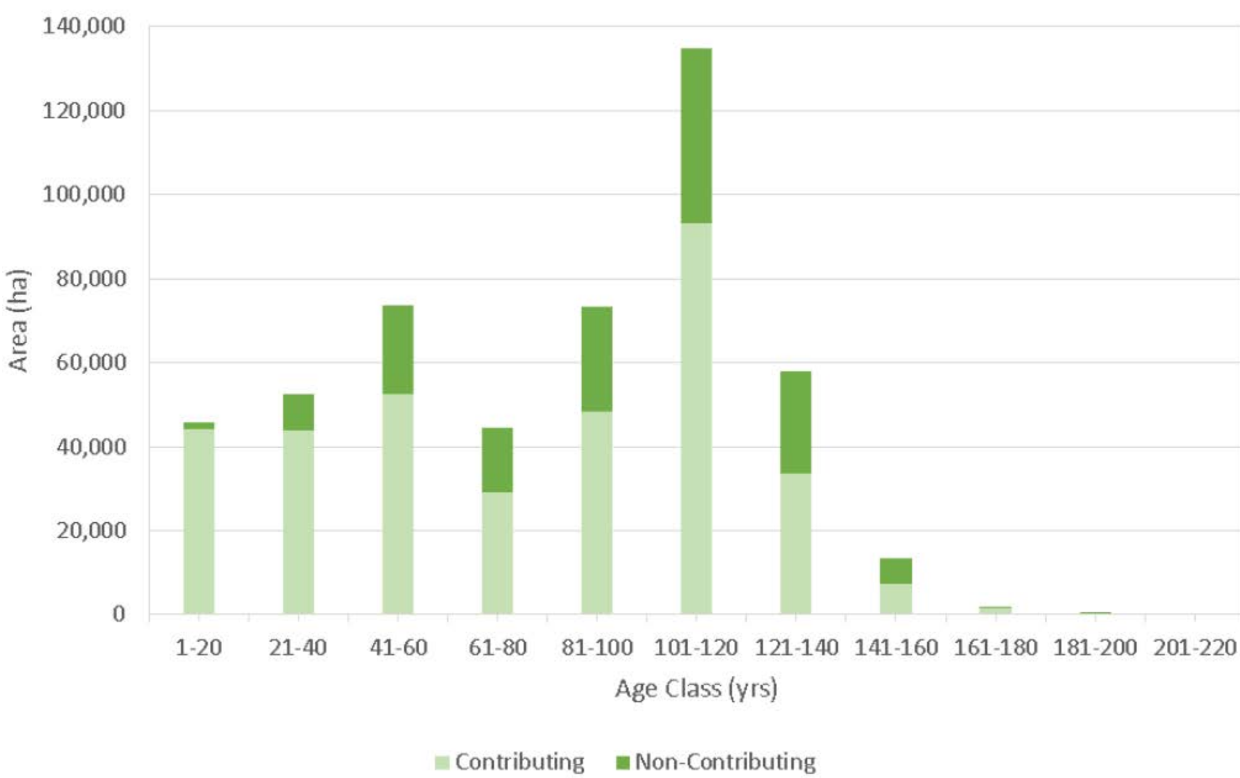


Figure 3.56 Forest age class distribution of FML #3 (ForSite consultants).

3.1.9.5 Vegetation Biodiversity

Vegetation biodiversity is both the number and variety of plants found in an area. Biodiversity is important to having robust and resilient ecosystems. In addition, higher biodiversity provides more habitat opportunities and life requirements for wildlife species.

The baseline diversity of plant species within FML #3 is described by the various vegetation ground sampling efforts have been done in and around FML #3 (Table 3.19).

Table 3.19 Vegetative ground sampling summary in and around FML #3.

Inventory Name	Reference	Location	Findings	Description
Duck Mountain Resource Inventory	MNR 1980	Duck Mountain Provincial Park	300 species of plants	
Riding Mountain National Park Resource Description and Analysis	Briscoe *et al.* 1979	Riding Mountain National Park	nearly 500 species	
Canadian Historical Information Network (CHIN)		Manitoba	over 900 species	a database containing a listing of the herbarium collections of the University of Winnipeg, Manitoba Museum of Man and Nature and other Canadian Institutions.
Ecosites of the Mid-Boreal Upland Ecoregion of Manitoba	Arnup *et al.* 2006	Duck and Porcupine Mountain Provincial Forests	393 species total trees - 12 spp. shrubs - 60 spp. semi-shrubs – 8 spp. herbs – 215 spp. mosses and liverworts – 83 spp. lichens – 15 spp.	Ecosite plot data collected on 536 forested wetland and forested upland plots as part of the Forest Lands Inventory (2002) yielded a vegetation list by life form

The current condition of biodiversity in FML #3 is best quantified by the three biodiversity indices that were measured and calculated for forested ecosites (Figure 3.19) as part of the Arnup *et al.* 2006 ecosite guide. Note that non-forested ecosites were photo-interpreted only, and without field sampling biodiversity indices could not be calculated for non-forested uplands and non-forested wetlands. The three biodiversity metrics are:

i) **Average No. of Species**: The mean number of plant species per sample.

ii) **Total No. of Species**: The total number of plant species encountered in all the samples.

iii) **Shannon-Weiner Index**: A value for the Shannon-Weiner Index calculated from the vegetation samples.

A higher index number means higher biodiversity, while a lower index number means lower biodiversity. Generally, the ecosites with the highest biodiversity are the forested wetlands (ecosites 61 to 64), and the mixedwood ecosites on average to moist conditions (ecosites 31, 33, 34, 35, 42 & 52). The least amount of biodiversity is found in dry sites (ecosites 11 to 24).

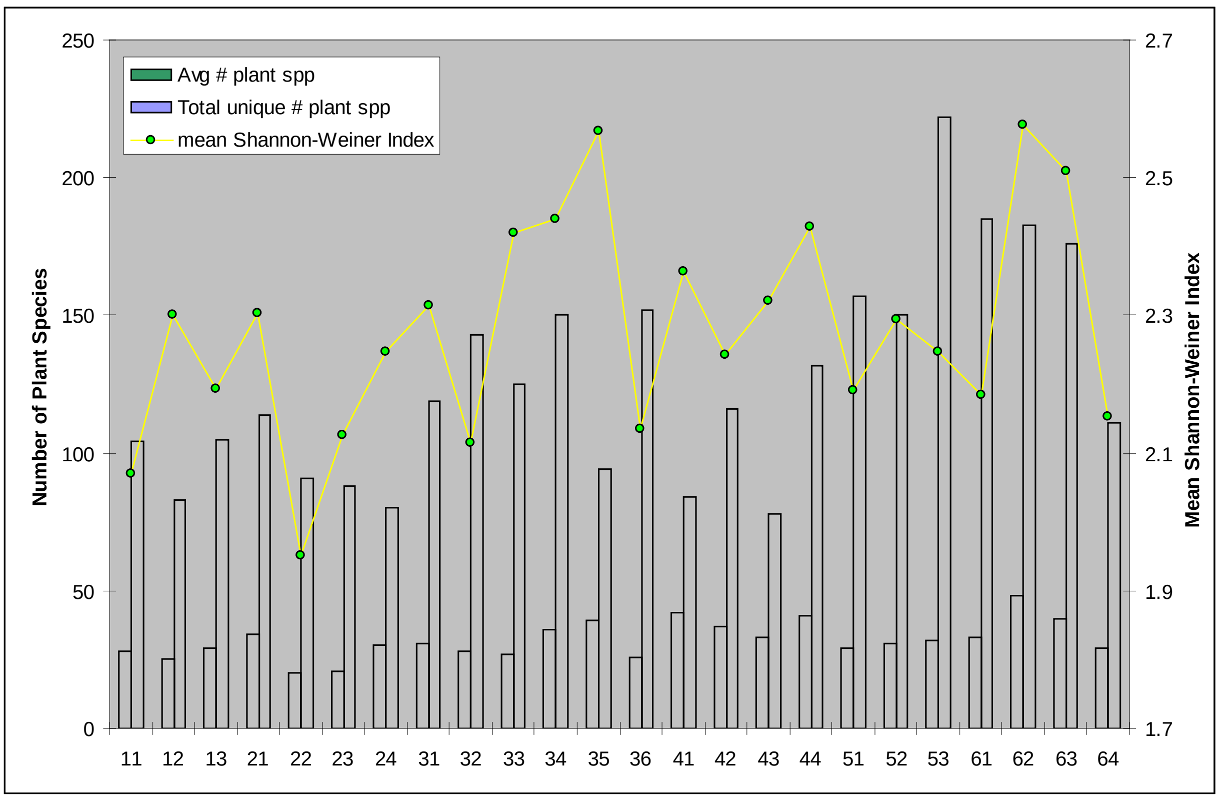


Figure 3.57 Biodiversity indices for forested upland and forested wetland ecosites.

Additionally, soil moisture is an environmental gradient that correlates with vegetative biodiversity. Dry sites have the least biodiversity, and wet sites have the most biodiversity, irrespective of stand cover type (Figure 3.56).

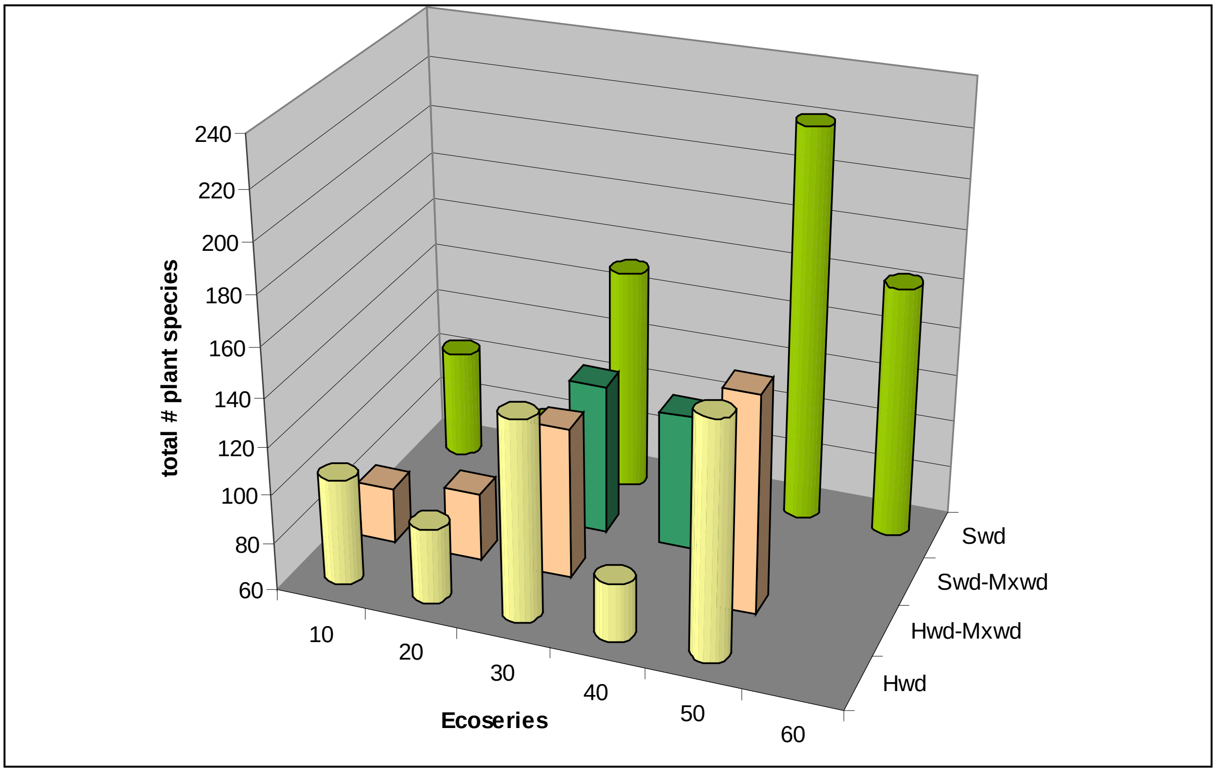


Figure 3.58 Biodiversity index (total number of plant species) increases with soil moisture class (Ecoseries 10=dry; Ecoseries 60=wet).

3.1.9.6 Landscape Diversity

Landscape diversity refers to forest vegetation patterns and structural features of the forest landscape, originally derived from a combination of natural processes and disturbances that are influenced by activities associated with forest management. Landscape diversity, and its ongoing maintenance, is an important element of a desired future forest in order to preserve species diversity in the future.

Three landscape diversity metrics used to define the current landscape diversity are:

1. Hardwood percentage, which is an easily interpreted indictor of diversity;
2. Forest age, which is an easily interpreted indictor of diversity; and
3. Age edge density which measure of the interspersion of habitat that is also commonly used as coarse filter indicator of biodiversity. Forest with the same age over a large area have an age edge density of zero. Forest with many different stand ages over a small area have a high age edge density (measured in metres of edge per hectare). Age edge density is a useful biodiversity metric since some generalist wildlife species prefer abundant edge and diverse cover types within their ranges, whereas other forest interior dependent species require large areas of contiguous forest habitat.

3.1.9.7 Endangered Ecosystems

Manitoba's Endangered Species and Ecosystems Act lists two endangered ecosystems:

1) **Alvar** - thin (usually 10 cm or less) or absent layer of soil over a limestone or dolomite bedrock pavement. Alvars are often very wet in the spring, then very dry in the summer. Manitoba alvars have variable features, including open perennial grassland, shrub land, savannah, and limestone/dolomite flat-rock substrate dominated by lichens.

2) **Tall Grass Prairie** – originally occurred in Manitoba's Red River Valley in south-central Manitoba, but has mostly been converted to farm land.

Neither alvars nor tall grass prairie endangered ecosystems occur in FML #3.

3.1.9.8 Species at Risk - Vegetation

The Manitoba Wildlife and Fisheries Branch is responsible for the administration of Manitoba's Endangered Species and Ecosystems Act. Plant species classified as Endangered and Threatened (as of Oct. 23rd, 2018) are shown in Table 3.20:
https://www.gov.mb.ca/sd/wildlife/sar/sarlist.html
Note that the provincial government does not stratified the location of these species at risk by Forest Management Licence boundaries. To date, none of these species have been found by the Pre-Harvest Survey program.

Table 3.20 Manitoba listed Endangered and Threatened plant species.

Common Name	Scientific Name	*EcoRegion
ENDANGERED PLANTS		
Gastony's Cliffbrake	*Pellaea gastonyi*	
Gattinger's Agalinis	*Agalinis gattingeri*	
Great Plains Ladies'-Tresses	*Spiranthes magnicamporum*	
Rough Agalinis	*Agalinis aspera*	
Smooth Goosefoot	*Chenopodium subglabrum*	
Small White Lady's-slipper	*Cypripedium candidum*	
Western Ironweed	*Vernonia fasciculata*	
Western Prairie Fringed-orchid	*Platanthera praeclara*	
THREATENED PLANTS		
Buffalo grass	*Buchloë dactyloides*	
Culver's-root	*Veronicastrum virginicum*	
Hackberry	*Celtis occidentalis*	
Hairy Prairie-Clover	*Dalea villosa*	
Riddell's Goldenrod	*Solidago riddellii*	
Western Silvery Aster	*Symphyotrichum sericeum*	
Western Spiderwort	*Tradescantia occidentalis*	

*Ecoregion acronyms: MBU-Mid-Boreal Upland; IP-Interlake Plain; AP-Aspen Parklands; LMP-Lake Manitoba Plain; BT-Boreal Transition

Please note that this list of endangered and threatened species is for the entire Province of Manitoba, and likely includes plant species not found in FML #3.

Manitoba's Conservation Data Center ranks approximately 2,000 plant species in the Province. A ranked list (i.e. S1-extremely rare to S5-very common) of aquatic and upland plants and includes many agricultural weeds is provided at:
https://www.gov.mb.ca/sd/cdc/pdf/plant_rank.pdf

The Manitoba ranking (Province-wide) system is:

S1 Very rare throughout its range or in the Province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

S2 Rare throughout its range or in the Province (6 to 20 occurrences). May be vulnerable to extirpation.

S3 Uncommon throughout its range or in the Province (21 to 100 occurrences).

S4 Widespread, abundant, and apparently secure throughout its range or in the Province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

S5 Demonstrably widespread, abundant, and secure throughout its range or in the Province, and essentially impossible to eradicate under present conditions.

The Conservation Data Center also provides lists of species of conservation concern. These species lists are far more than just plants, but also include amphibians, animal assemblages, birds, fish, invertebrates, mammals, and reptiles by ecoregion: https://www.gov.mb.ca/sd/cdc/ecoregions.html

FML #3 spans portions of five different ecoregions:

1) Mid-Boreal Upland
2) Interlake Plain
3) Aspen Parklands
4) Lake Manitoba Plain
5) Boreal Transition