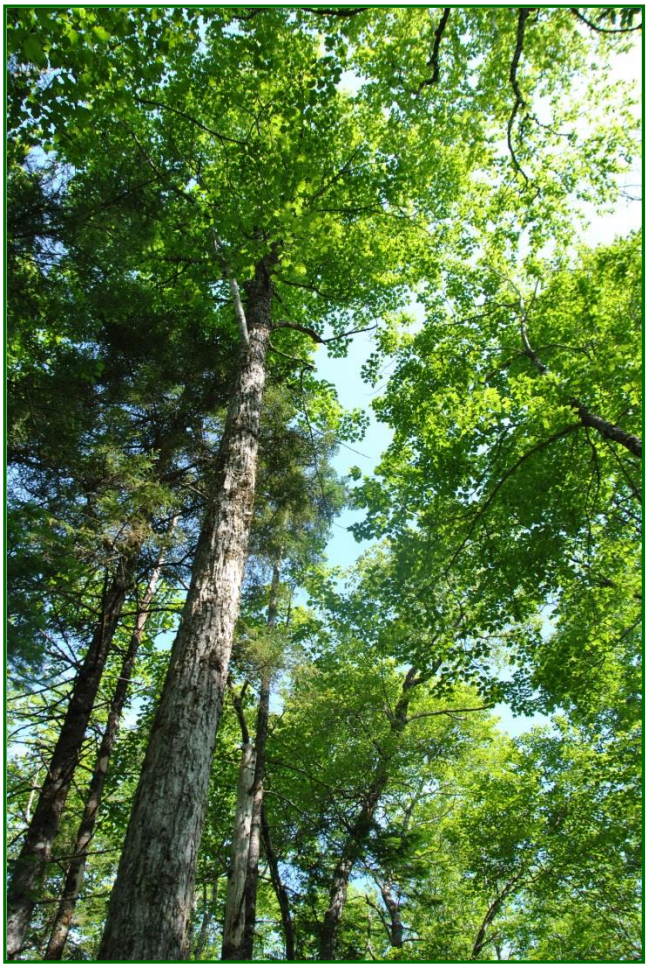
# Otter Ponds Demonstration Forest

## Forest Management Plan

**Location:** Mooseland, Halifax Count East, NS

**Property Identification Numbers:** 41019322, 40793457 and 4109324

**Geographic Position Coordinates:** UTM Zone 20north NAD 83 of 517,970 meters easting and 4,976,374 meters northing



**Total Forest Area = 485.6 hectares**

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## Introduction

In September 2010 an agreement was signed between the Nova Scotia Department of Natural Resources (NSDNR) and Nova Scotia Woodlot Owners and Operators Association (NSWOOA) to manage a tract of Crown land for demonstration purposes of Acadian forest restoration, known as the Otter Ponds Demonstration Forest (OPDF). The OPDF is a project division of NSWOOA ran by a board of directors involving community groups on the Eastern Shore of Nova Scotia which includes government and industrial stakeholders.

## Mission statement

The OPDF will be a working demonstration forest which adheres to the principle that gradual restoration of ecosystem structure and function of the natural Acadian Forest is an option for sustainable forest use in the Eastern Shore area of Nova Scotia.

## Objectives

1. To manage and operate the OPDF as a working woodlot that produces annual or periodic yield of timber, forest values, and ecosystem services.
2. To certify the OPDF to the Forest Stewardship Council® (FSC®) Maritime Region standard, and to promote, through demonstration, the benefits of woodlot certification to the forest, to landowners, and to society as a whole.
3. To demonstrate the philosophy, science, and practice of uneven aged forest management in the Acadian Forest
4. To carry out uneven aged silviculture treatments, to develop and field test technical criteria for existing and new treatments, to develop techniques for forest restoration.
5. To demonstrate that timber production is compatible with protection (conservation) of other forest values and provision of ecosystem services by providing opportunities for woodlot owners, school children, public organizations, and individuals to experience a working woodlot situation.

## Purpose of management plan

This management plan is to serve as a framework to help the OPDF board of directors meet their set objectives and to practice responsible stewardship of restoring the natural Acadian Forest. This management plan provides the means to meet the Forest Stewardship Council certification standards for Small and Low Intensity Forests in the Maritime Region. This document is to be considered a continual working document that serves as an educational tool. As more knowledge and information becomes available this will especially aid with future management decisions to develop appropriate restoration strategies and implementation plans. Also, this management plan is meant to encourage discussions amongst interested parties involved of the wide range of opportunities and challenges of restoration and how they can be achieved and overcome. Finally, the OPDF board of directors are encouraged to continually work along with the Ecosystem management group of NSDNR to develop appropriate methods and tools to implement sound ecosystem based restoration strategies.

This approach will help define appropriate methods for Acadian Forest restoration for other forest owners in the Eastern shore area; as well as help ensure multiple values and associated benefits of the OPDF are maintained for future generations.

## Silent season

A designation of silent season, a period of time during the year, is recommended to encourage landowners / managers to take time separate from work to observe and appreciate the natural forest and the life forms within. It can be any time of year to walk the forest individually and/or with others interested as well as a time to talk to adjoining landowners and people in the community about plans, sightings and other observations. This can provide important insight when it is time to plan and implement work activities in certain areas.

Silent Season is particular to each FSC Group Member and can vary per forest type and area of the province. A few suggestions of best times to establish a Silent Season would be during the time of year when the ground is wet and vulnerable to damage, and when forest dependent wildlife are susceptible to disturbance while raising young (for instance, various birds nesting period which can extend from late April to June). The designation of Silent Season can be made flexible to address variability of weather that affect site conditions. It is recommended for the OPDF board of directors to further discuss and explore what they like to see as the Silent Season and develop policies to follow during management.

## General forest description

Location and area

The Otter Ponds Demonstration Forest (OPDF) is located in the community of Mooseland, Halifax County, Nova Scotia on the east side of the Mooseland Road. The Tangier River divides this forest into west and east sections with the bulk of OPDF area located on the east side of the River. Currently the OPDF is accessed from a woods road that is approximately 3 kilometers east from the Mooseland Road. The east entrance into OPDF can be found using geographical positioning coordinates in UTM Zone 20north NAD 83 of 517,970.1 meters easting and 4,976,373.9 meters northing.

The total area of OPDF comprises of approximately 645.5 hectares, which includes 171.4 hectares of water and wetlands and 28 hectares of area classed as industrial (the main old mining site area). Total forest area of OPDF is approximately 485.6 hectares, which excludes water and the area classed as industrial. The water and wetland includes parts of River Lake, German Lake, the Tangier River, part of Capes Lake, multiple brooks, various sized ponds including the larger Otter Ponds located in the northeast section, and various seepages and small creeks that flow into these larger watercourses. The OPDF is part of the greater Tangier River watershed.

Land use history

The Mooseland area, particularly along the Tangier River, is known for being one of the earliest and more successful gold mining locations in Nova Scotia with heaviest activity occurring during the mid-1800's. During the late 1800's Alfred Dickie was one of the first known 'lumber barons' of the area who had a sawmill in Tangier near the coast. Alfred purchased lands surrounding the Tangier River, logged during winter and conducted log drives down the River in spring to log his sawmill. Therefore, many of the areas in fairly close proximity to the Tangier River and River Lake would have been heavily logged at that time. Prior to Alfred and the gold rush little is known regarding the possibilities of Europeans that may have traveled up the Rivers to look for trees suitable for ship masts and other building materials in demand in Europe and the extent such trees may have been harvested.

There is no known settlement by the Mi'kmaq or extensive use for fishing or hunting of the Tangier River area. However it is known by the locals that Ship Harbour Long Lake and Lake Charlotte to the west offered a wider variety of such activities and more favourable areas for settlement; thus is a known area inhabited by the Mi'kmaq.

During the 1940's – 1960's the Crown began purchasing land in this area to increase land holdings. In the 1940's there was the 'yellow birch dieback' where numerous yellow birch were affected and died. Extensive harvesting occurred at this time in attempt to salvage and utilize the material before totally lost to mortality. It was after World War Two the Musquodoboit Lumber Company sawmill was running at the southwest corner of River Lake. The Prest family began logging areas for the Crown on what is now the OPDF, as well as surrounding areas.

The only activities that have occurred since the 1960's took place during the 1980's when a few areas in the northwest sections were harvested. In the last 20 years a small harvest occurred near the 3rd drumlin (east of the River), and a larger harvest occurred on the most eastern drumlin and was planted with a mix of spruce.

The OPDF has not been used extensively for some time now and many areas are isolated.

## Relationship to surrounding lands

All properties surrounding the OPDF are privately owned except for the farthest southeast section and the Tangier Grand Lake Wilderness Area west of the Mooseland road which are both Crown land.

## Boundary lines

During the field reconnaissance, portions of the northeast, south, and east boundary lines were relatively good-fair and corner posts located in the south adjacent to private land were readily identifiable and easy to find. The south corner posts were dated 2003, thus it is presumed this when most if not all of the boundary lines and corner pins may have been upgraded. However, there are areas along eastern and northern sections that were not readily identifiable and may require further investigation to determine need for upgrading.

South sections along River Lake serve as a natural boundary for the OPDF, and the Mooseland Road serves as the west boundary. Therefore, upgrading is not necessary in these areas.

## Access

Much of the OPDF is currently isolated and only accessible by foot. There are 3 current access points into the OPDF from the community of Mooseland, of varying conditions, that travel south from the River road which is a privately owned road. The closest road into the OPDF is 3 kilometers from Mooseland off of the River road and accesses the 1st drumlin on the east side of the River (locally known as German Lake hill), which the condition of the road is considered good and only travels through one adjacent private land owner. The next road is over 6 kilometers from Mooseland and reaches a small section of a drumlin situated in the eastern section of OPDF, this drumlin is locally known as River Lake hill. This road requires a considerable amount of upgrading in terms of ditching, culvert replacement, two watercourse crossings, brushing out the sides, and resurfacing and recrowning the roadbed in order to be travelable with a tractor trailer; and also crosses several

parcels of privately owned land. The third road is the farthest away at 11+ kilometers from Mooseland Road and accesses the large plantation in the most eastern section atop a large drumlin locally known as Powder horn hill. This road is in very rough shape, is slow to travel by vehicle, and thus also requires a considerable amount of upgrading.

In order to implement any activities within the OPDF additional access is required to be established with the long term goal to develop an efficient network of trails. To minimize costs and future maintenance responsibilities, in terms of utilizing access of adjacent landowners, the best scenario is to extend the existing road east of German Lake hill beyond the brook to efficiently access areas to salvage some windfallen trees as well as begin selection harvest trials. This road would require a proper watercourse crossing and would fork just beyond this crossing to access mid-sections and the other, large drumlin (locally known as Hawboldt's farm hill) to the south (refer to Figure 1). Also, for purposes of holding education and demonstration field days, school trips, and workshops having the main access point into OPDF at German Lake hill will be very convenient and allow for more time in the forest. There is also a security component of having the main access point only 3 kilometers away from Mooseland since many people use the River road for work and recreational purposes. Thus, allows the community to 'keep an eye' on the property.

Over time access could extend to eastern sections. However once the large plantation on Powder horn hill becomes merchantable in about 10-15 years' time the OPDF board of directors will have to determine the best options for access to shorten extraction distance.

Basically this all comes down to minimizing costs, if money is going to be spent on road access it may as well be on your own land versus someone else's. This will allow the OPDF board of directors to have better control of where dollars are best spent that will offer the most benefits and opportunities.

## Ecological Land Classification

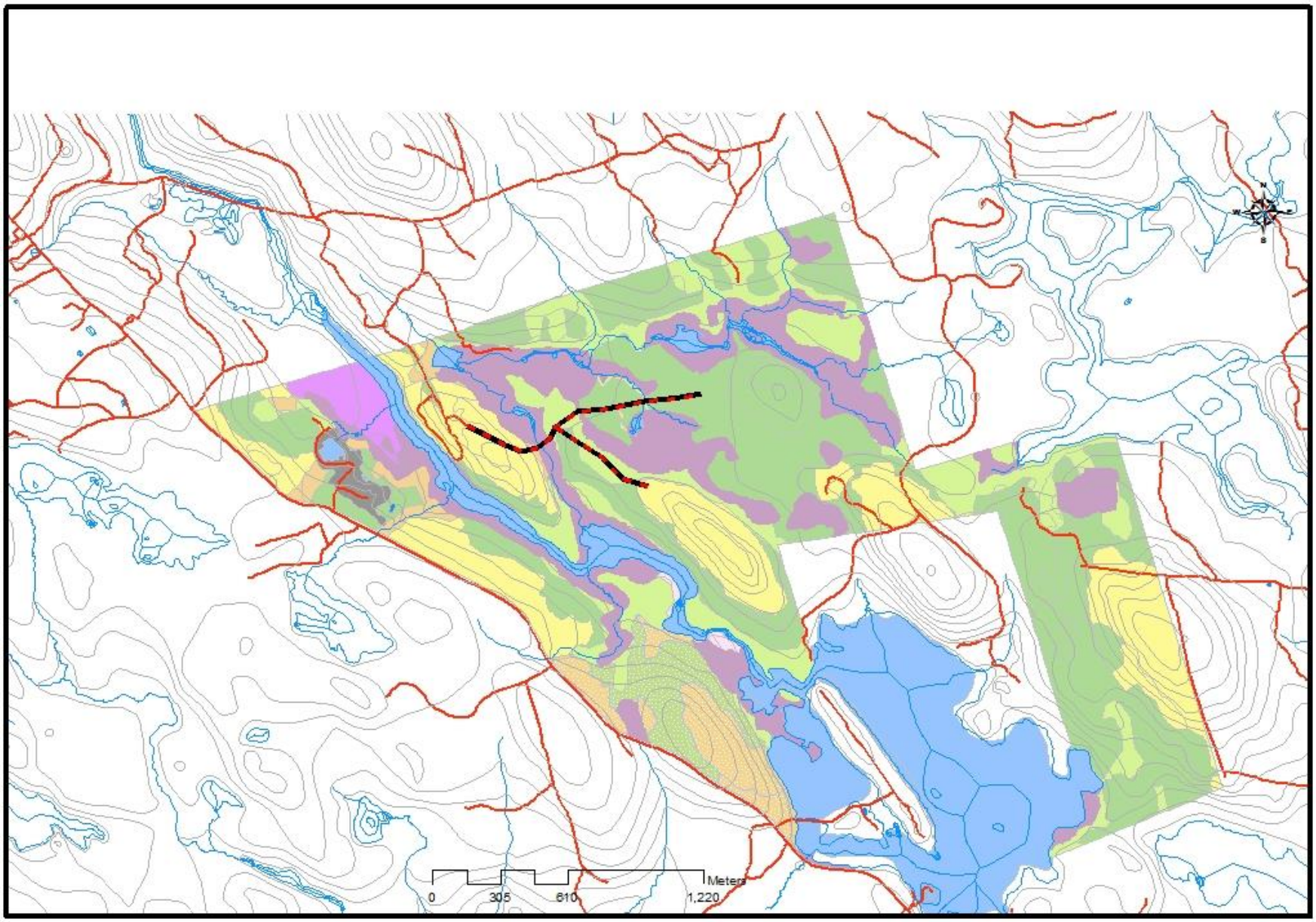
### *Acadian Forest*

The OPDF is a part of the Acadian Forest, which is a transitional forest between the deciduous dominated Carolinian Forest in the south and the conifer dominated Boreal Forest in the north as a result of our temperate climate. As such the Acadian Forest contains a diverse range of both coniferous and deciduous species with mix of species dependent on geological features, glacial history, site and soil conditions, environmental and micro-climatic factors as well as type and degree of past disturbances. The most distinguishing feature is the abundance of Red spruce, which is particularly unique, within the Acadian Forest. This Forest region encompasses all of Nova Scotia, Prince Edward Island, New Brunswick and portion of the New England States.

### *Ecoregion and Ecodistricts*

Within the Acadian Forest of Nova Scotia there are 9 defined ecoregions (NSDNR Ecological Land Classification for Nova Scotia, 2005). The OPDF is situated entirely within the Eastern ecoregion (400) and includes parts of the Eastern Interior (420) and the Eastern Granite Uplands (430) ecodistricts (refer to Figure 2, and the Forest Ecosystem Classification for OPDF report completed by Keys et al., June 2011, of the NSDNR Ecosystem management group in Appendix A).

Figure 1.  Access and proposed road and trails map



The common physical features, in terms of topographical pattern, soil texture and soil drainage, (referred to as ecosections as outlined in Figure 2) that are characteristic of the ecodistricts found within OPDF include:

WFDM = well drained soil, fine textured soil (sandy clay loam), with drumlin landforms
WMDM = well drained soil, medium textured soil (loam, sandy loam), with drumlin landforms
WMHO = well drained soil, medium textured soil (loam, sandy loam), with hummocks (series of small rounded hills with gentle slope)
IMHO = imperfectly drained soil, medium textured soil (loam, sandy loam), with hummocks
WCKK = well drained soil, coarse textured soil (coarse sandy loam, excessively stony or gravelly), with hills (series of knolls and knobs with moderate to steep slopes)
ICHO = imperfectly drained soil, coarse textured soil (coarse sandy loam, excessively stony or gravelly), with hummocks.

As outlined in Appendix A, the majority of the OPDF is situated in the Eastern Interior ecodistrict which constitutes approximately 92% of the total area and includes 5 drumlins associated with the Tangier River drumlin field. On the east side of the River the first drumlin is locally known as German Lake hill, the 2nd drumlin is known as Hawboldt farm hill, the 3rd drumlin, of which the north section is part of the OPDF is referred to as River Lake hill, and the 4th most eastern drumlin is known as Powerhorn hill . The remaining area of OPDF is associated with the Eastern Granite Uplands ecodistrict located in the southeast corner next to River Lake.

*Terrain and Soil*

The landforms of OPDF include small rolling hills or knolls, low lying areas and wetlands between drumlins and areas of rockland. The elevation ranges from 90 meters above sea level (ASL) in the wet, low lying areas to upwards of 150 meters ASL on top of the largest drumlin referred to as Powder horn hill. The other drumlins reach elevations of 125-130 meters ASL. The drumlins are deposits of glacial till and characterized by well drained, deep loamy soil while areas between these drumlins contain more variable drainage ranging from rapid – well - moderately well – imperfectly and coarser soil that is often quite stony and has variable depth. These landforms are part of the Eastern Interior ecodistrict and soil is derived from quartzite (greywacke) dominated glacial till. The southeast corner of OPDF is considered rockland since this area is dominated by coarse, stony, shallow, rapidly drained soils derived from granite glacial till with large granite boulders and ridges situated across the landscape. This landform is part of the Eastern Granite Uplands ecodistrict and in flatter areas of shallow soil to underlying bedrock where there is severely impeded drainage frequent wet areas or bogs occur.

As Appendix A indicates and completed field checks revealed the common soil types for OPDF are medium to coarse textured loams – sandy loams with varying drainage capabilities due to the rolling terrain, degree of stoniness, and depth to underlying bedrock. Figure 3 outlines the various soil types that most likely occur within OPDF. Soil type 2 is fresh and well drained, Soil type 3 is more wet and imperfectly drained, while Soil type 4 is organic or peat and is saturated with water year round, the soil type 14 is shallow over rock ledge, and soil type 8 has more organic matter enrichment, is well drained and is usually found as inclusions on the drumlins. The field checks also revealed little to no clay in soil samples on the drumlins and slopes to classify it as sandy clay loams. However, a loamy phase of soil type 2 (Soil type 2L) was found along the slopes of the drumlins and at their base which becomes prominent with inclusions of soil type 8 (more rich) on the west facing slope of the most eastern drumlin. It is presumed soil on the west side of the Tangier River may contain a more noticeable presence of clay, which tends to have higher nutrient holding capacities thus more fertile. Such verifications can be made prior to commencing activity in these areas. The field reconnaissance also identified areas in the most south easterly section near River Lake have the granite phase of

fresh to medium fertility soils (ST2G) since they are located within the Eastern Granite uplands ecodistrict.

The soil types of OPDF offer similar growth capabilities for the most part however differences occur with increased moisture, shallowness to underlying bedrock, degree of rockiness, coarser textures (high sand component), and increased rates of drainage. However, the most influential is the amount of downed woody material (organic matter) on the forest floor and impacts of past disturbances namely from intense harvesting and machinery used. All these factors directly affect soil productivity in terms of nutrient flow and availability for tree growth over time. Downed woody material on the forest floor, standing deadwood that will eventually fall and serve as a steady replacement, as well as yearly leaf fall from deciduous trees is essential to maintain a continuous replenishment of nutrients and moisture holding capacities of organic matter thus site productivity.

During the field reconnaissance some areas within OPDF have sufficient levels of downed woody material due to the amount of windfalls that have occurred mainly from Hurricane Juan and subsequent storms. Other areas that are dominated by 40-60 year old trees and 70-90 year old trees tend to lack down woody material components. This is of particular concern since observations from these areas particularly 70-90 year old coniferous trees, which tend to have long life spans, indicate a beginning of loss of vigor as exhibited by thinning crowns of some trees. These areas tend to occur on medium-coarse textured (loam-sandy loam) well drained soils, soil type 2 and 2L, which have a high forest floor loss hazard. This hazard refers to high potential for serious decreases in site fertility (nutrient and moisture availability) when surface organic layers are removed or redistributed over the site and especially when the site is fully exposed to full sunlight; the main factors influencing sensitivity to forest floor loss are soil moisture content, soil texture (coarseness), stoniness and overall soil depth (NSDNR, Ecosystem management group, forest ecosystem classification manual, part 2, 2011). Therefore, with repeated removal of all or most of the biomass on site, which has occurred in many areas of OPDF, it has been concluded that variable degrees of soil degradation has occurred resulting in declining vigor with each rotation. Declining vigor was also observed on the drumlins of portion of the 50 – 80+ year old deciduous trees particularly the red maple which otherwise should be healthy and growing vigorously because they are known to live at least 100 years of age on good sites. Thus, an important conclusion of such observations, which requires further investigation, is it will be of utmost importance to maintain partial shaded conditions and build up organic matter (biomass) on sites that are lacking. This can be accomplished by supplying increasing levels of various sized woody material over the forest floor during restoration activities within OPDF to help moisture holding capacities and nutrient enrichment.

*Land use classification*

There were 10 main classifications that occupy the land of OPDF, as outlined in Figure 4 and in the table below:

Table 1. Land Classification of the OPDF

| Land classification | Area (ha) |
|---|---|
| MW Forest Group | 51.17 |
| SH Forest Group | 245.47 |
| TH Forest Group | 62.03 |
| IH Forest Group | 1.13 |
| CC/Plantation | 28.77 |
| WC Forest Group | 56.06 |
| WD Forest Group | 1.43 |
| Wetlands | 39.57 |
| Water | 131.85 |
| Industrial (non-forest) | 28.0 |
| Total | 645.5 |
| Total wetlands & water | 171.4 |
| Total forest land | 485.6 |
| Total wet forest groups | 57.5 |
| Total operable* forest land | 388.6 |

MW = Mixedwood

SH = Spruce / Hemlock

TH = Shade tolerant hardwoods
(i.e., sugar maple and yellow birch)

IH = Shade intolerant hardwood
(i.e., white birch, trembling aspen (poplar)

WC = Wet coniferous
(i.e., black spruce, balsam fir, tamarack larch)

WD = Wet deciduous (i.e., red maple)

CC/Plantation = Clear cut harvest followed up with an established spruce plantation

* also refers to productive land

As outlined in Table 1, 388.6 hectares is classified as operable forest land which equates to 80% of the total forest land occupied by the OPDF. Operable land refers to forest land that is workable and productive enough to receive benefits from efforts. Five forest cover type groups constitute this operable area- the Mixedwood (MW) forest group, the Spruce Hemlock (SH) forest group, the tolerant hardwood (TH) forest group, the Intolerant hardwood (IH) forest group and the previous clear cut / established plantation group (CC/Planatation).

The industrial (non-forest) classification refers to the area in the northwest corner of OPDF on the west side of the River. This area as identified on Figure 4 contains infrastructure associated with mining and has been expanded from the classification completed by the Ecosystem management group of NSDNR of 5.7 hectares to include an additional 22.3 hectares for a total of 28.0 hectares. The reasoning is to incorporate all mining works since 1860 such as old shafts and pits that are frequently distributed in the area that were most active. Since it is very unlikely these geological hazards can be fully remediated we will assume this area will never be used as part of the OPDF project. Therefore, this is not considered forest land and will not be part of this management plan nor the forest land certified to the Maritime Standard of the Forest Stewardship Council.

Due to the various geological hazards associated with the northwest section of the OPDF an agreement was developed between NSDNR and the OPDF board of directors to indicate a reserved portion of land, Appendix B, with restrictions that forest activities cannot commence in such areas until the old shafts and pits have been remediated and are no longer a hazard. The reserved land portion comprises a total of 110 hectares, which 28.0 hectares as mentioned above is classed as industrial or non-forest, leaving 82 hectares classed as forest where remediation plans are to begin.

The agreement also states no wood volume is to be harvested or extracted from this area without NSDNR's permission unless these geological hazards have been remediated and approved. During the next few years NSDNR and the OPDF board of directors will work together to identify these hazards and get necessary actions underway. Once hazards are remediated and NSDNR's approval is issued the restriction area boundaries may be adjusted and forest activities can commence.

Out of the 82 hectares of the reserved portion land 48.2 hectares is considered operable since the remaining areas are classed as wetlands and wet coniferous groups. Therefore, until restrictions are released, the total operable forest land will exclude the 48.2 hectares giving a total of 339.24 hectares. This area will be considered the operable land base for the first 5 years and used as the main reference for recommended activities and to calculate annual harvest levels.

These 82 hectares of reserved land for remediation will be part of the FSC certified area as long as the agreement with NSDNR and the FSC Principles and Criteria are adhered to. Therefore, the FSC certified forest land will include the 5 forest groups listed above in addition to the Wet Coniferous (WC) forest group, the Wet Deciduous (WD) forest group and the wetlands, for a total of 485.6 hectares.

*Forest cover type groups*

The spatial representation of each of the forest groups can be viewed in Figure 4, as provided by the Ecosytem management group of NSDNR. As outlined in the table, and Appendix A, there were 6 forest groups delineated within the OPDF which were based on forest cover data provided by NSDNR. The 2003 forest cover data had 321 stands for the OPDF area. Therefore to simplify units and for purposes of restoration forest groups were assigned to the 2003 units based on dominant species present and other similarities of site conditions. As information becomes available it will be added to the management plan and used to more accurately represent specific site and soil conditions and develop appropriate restoration strategies.

Each of the forest groups have various dominant vegetation types, as outlined in NSDNR's Forest Ecosystem Classification manual, Part 1. The following is a description of each of the forest groups with dominant vegetation types and common species found on the OPDF.

Tolerant hardwood forest group (TH):

This forest group comprises of areas where shade tolerant hardwood species comprise 50% or more of the overstory, and primarily occupy the drumlins, upper slopes and the crests of steeper hills. These areas tend to thrive with yellow birch, sugar maple and scattered beech. In many of these areas red maple has replaced sugar maple in the overstory thus areas of red maple and yellow birch is currently the dominant mix. However, sugar maple can occasionally be found in the understory of many of the drumlins. As per the field assessment, an exception may be on Hawboldt's farm hill) where sugar maple component in the overstory was more notable, as well as a few large healthy beech.

In all areas of this forest group large diameter yellow birch were very common. There were a few large white and red spruce found scattered amongst the dominant hardwoods in the upper canopy as well as sparse white spruce regeneration in the understory. Yellow birch, balsam fir, some sugar maple and red spruce were the most common species of regeneration and intermediate stage trees. Much, if not all, of these areas that constitute this forest group are uneven-aged (contain multiple age classes), which is reflective of past wind related disturbances (as indicated by the mound and pit formations) and previous high grading that most likely has repeatedly occurred. The field

assessments revealed German Lake hill contains more of a mixedwood condition as evident by the component of red and white spruce amongst the dominant hardwood. The proximity to the River, amongst other access points, suggests more disturbance (in terms of harvesting) took place in this area that has altered the forest condition to presently contain more red spruce despite the similarities in soil types with other drumlins that lack much of a red spruce component.

Overall, these areas contain a high component of poor quality and form trees, increasing components of maturing red maple exhibit crown dieback (or thinning crowns) which are signs of stress and loss of vigor, and various distributions of regeneration and intermediate stage trees that show signs of varying potential. However Hawboldt's farm hill in particular contains varying ranges of fair-good quality and form trees including undergrowth that exhibit good signs for potential growth and development into high value products. Dominant tree heights in these areas tend to range from 14 - 17 meters, while diameters are more variable but tend to range anywhere from 18 – 60+cm.

The exception of conditions is on the most eastern drumlin, Powder horn hill, where a spruce plantation, primarily Norway and Black spruce, was established approximately 15- 20 years ago. It was quickly obvious this area is meant to grow tolerant hardwoods of yellow birch and sugar maple since a fair portion of the plantation has been over grown with natural yellow birch, some sugar maple, along with some red maple and few white birch even after herbicide control treatments. Red spruce and balsam fir seemed to have filled in naturally in a few areas particularly in northwest sections (surrounding the main landing area). Dominant heights of the hardwood range from 5 – 9 meters with average diameters approximately 5 – 10 cm. Dominant heights of the softwood range considerably depending on extent of hardwood competition, which tends to be greater along the southwest facing slope of the drumlin. On the slope softwood heights range from 3 – 6 meters while in other areas they extend upwards of 8 meters. The diameters also vary considerably ranging from 8 – 15 cm. There are portions of the planted spruce under hardwood canopy that are severely stressed thus are beginning to die out, as well as evident porcupine damage that is contributing to the stress level thus slow mortality. Overall stem density is rather high with a range of approximately 15,000 – 25,000 stems per hectare. A fair amount of this area is surpassing the maximum recommended heights to perform the traditional pre commercial thinning treatment to receive subsidy from available silviculture programs. However, certainly warrants more investigation to conduct trials on density control to determine the most appropriate means to promote growth and quality development of the best trees at this stage of development while not increasing vulnerability to weather related damage, or increasing degree of branchiness that will negatively affect quality.

The common vegetation types within this forest group, as per Appendix A and as described in detail in NSDNR's FEC, Part 1, 2010, include:

> TH1: Sugar maple / Hay scented fern
> TH2: Sugar maple / New York fern – Northern beech fern
> TH8: Red maple – Yellow birch / Striped maple

There are varying inclusions of mixedwood vegetation types that occur within this tolerant hardwood forest group, most likely the result of natural or human caused disturbance. These mixedwood types include:

> MW1: Red spruce – Yellow birch / Evergreen wood fern
> MW4: Balsam fir – Red maple / Wood sorrel – goldthread

As concluded from the field reconnaissance, both of these MW vegetation types are prominent on much of German Lake Hill. Also, MW1 tends to have a higher occurrence on the mid slopes that ring around the drumlins.

The prominence of both Hay scented fern and New York fern, as observed in many areas of the drumlins, poses potentially serious problems as heavy competition for light in terms of the extreme shaded conditions. Such conditions are created by the dense continuous cover that in turn prevents desired regeneration to adequately establish after germination. These ferns, as well as bracken fern, are spreading species that proliferate as dense beds of individual stalks that arise from rapidly spreading rhizomes, and have a wide tolerance of site conditions (Nyland and Engelman, 2006). Hay scented fern does best on well drained soils and dense colonies tend to be facilitated where deer browsing prevents development of other understory plants and where other overstory disturbances (i.e., thinning) have increased light to the forest floor (Nyland and Engelman, 2006) and in cases where machinery have spread rhizomes over more area of the forest floor. When conditions are suitable this fern can spread rapidly as well as readily germinate on moist seed beds exposed to light and can negatively affect regeneration establishment. New York fern does best on moist sites in full – partial shade and is very hardy; however this fern spreads more slowly than hay scented fern posing less of a problem in forest regeneration efforts (Nyland and Engelman, 2006). The extent of hay scented fern, in particular, will be challenging to control in order to help ensure adequate regeneration can establish and grow taller than fern height. In some areas, Blackberry, scatterings of yellow birch, red and white spruce were observed growing through the dense fern canopy. Maintaining at least partial shaded conditions during management activity will be important to help limit the spread of this fern.

Intolerant hardwood forest group (IH):

This forest group constitutes a small area of OPDF where the composition of red maple, white birch and trembling aspen was greater than 50% of the overstory species. This area is concentrated on both sides of the woods road leading to a drumlin (German Lake hill) of the OPDF and is the result of past harvesting.

There is variable stem density, dominant height and diameter within this forest group as well as stem quality and potential. Dominant heights range from 10-14 meters and diameter (at breast height) range from 4 – 16 cm. Red spruce, balsam fir and a few white pine can be found scattered in the mix of the hardwoods.

The common vegetation types within this forest group, as per Appendix A and as described in detail in NSDNR's FEC manual, Part 1, 2010, include:

> IH6: White birch – Red maple / Sarsaparilla – Braken

Spruce Hemlock forest group (SH):

There are two main softwood forest groups listed in NSDNR's FEC manual, Part 1: Vegetation types, which are Spruce Hemlock and Spruce Pine. The main difference between these two forest groups is nutrient regimes. The Spruce Pine forest group has a limiting range of nutrients and nutrient availability as compared to the Spruce Hemlock forest group which extends from the high end of poor to the low end of rich (compare pages 136 & 158 in the FEC manual, Part 1.). Spruce Pine forest groups have a relatively poor nutrient regime due to their association with shallow, coarse soils on bedrock ridges and outcrops (NSDNR FEC, Part 1, 2010). The softwood dominated areas of the OPDF have been classed entirely in the Spruce Hemlock Forest Group (SH) despite the absence of Hemlock throughout. Rather they are in this class because soil types revealed a medium nutrient

regime. Hemlock would certainly have thrived as a dominant mix particularly along watercourses where there was increased moisture however changes in climate and site factors have created a vast absence of this species.

In the southeast corner within the Eastern Granite Uplands ecodistrict there are small occurrences of SP forest groups since this area is rockier, drier and there is a noticeable presence of black spruce, balsam fir, and white pine.

This Spruce Hemlock Forest Group comprises a range of areas where softwood species, namely red spruce and balsam fir, make up more than 50% of the overstory species. This forest group encompasses the lower slopes that ring around the drumlins where pure stands of red spruce with sparsely scattered large yellow birch can be found. The various ridges that transect through OPDF tend to have white pine, black spruce and balsam fir on the poorer sites on top of the ridges, while red spruce, balsam fir with some red maple and yellow birch occupy the mid and lower slopes of these ridges. On the imperfectly drained sites between the drumlins black spruce, balsam fir and tamarack larch are the dominant species.

During the field assessment, some of the forest group areas located on the mid and lower slopes of the ridges and drumlins contained large residual yellow birch as well as some red maple that were scattered. This suggests such areas may have the potential to eventually succeed to a mixedwood condition and should be a consideration during management activities.

This forest group contains a varied range of development stages. For instance, there are at least 8 known areas of 40 - 50 year old red spruce growing in dense conditions with basal areas of upwards 40m2/ha and dominant heights of 16 meters. Trees within these areas are showing signs of vigorous growth, dominant trees are becoming obvious, natural thinning is occurring, and there is a high component of good quality and form growing stock. These areas have much potential if tended in a way that will not jeopardize stand structure or stability.

There are also areas of 70 – 90 year old red spruce scattered in mid sections of the OPDF that are relatively dense with basal areas in the 32m2/ha range, dominant heights of 17-18 meters and diameters (at breast height) in the 30 cm range. Core samples of some of these trees revealed good growth until approximately 25 years ago as crowns filled in and as competition for nutrients increased. Some trees in these areas are showing signs of loss vigor as apparent by thinning crowns, and the few windfalls that are occurring particularly along the edges. Tree quality and future potential varies considerably dependent on site conditions and previous disturbance. Most of these areas contain minimal to no advanced regeneration except in areas where openings in canopy have occurred and along open edges where a mix of red spruce, balsam fir, white pine and some red maple have filled in and are continuing to do so.

There were multiple areas in this forest group affected by Hurricane Juan and subsequent storms, most recently the December 2010 storm that packed high winds while the soil was over saturated. The result is multiple areas of old and more recent windfallen trees especially on the ridges and upper slopes in the mid-section of the OPDF as well as the south end of the two drumlins east of the River that contain. Windfallen trees from Hurricane Juan are past commercial value and are now worth more ecologically. These windfallen trees are mostly surrounded and hidden by the natural regeneration that has emerged and is reaching heights of 3-4 meters. The main species of regeneration include a mix of red spruce, balsam fir, yellow birch, red maple, few white birch and white pine. During the field assessment, it was noted areas dominated by balsam fir that have matured, died and had fallen to the forest floor also have regenerated well with a mix of species. There were areas of recent windfallen trees that were noted west of German Lake Hill and the brook and remain feasible to salvage if access can be achieved in the near future.

In the most easterly section of OPDF north of the road there are spruce plantations that were established in the 1980s. These areas are growing well with some areas of high stem density due to naturals that have filled in. In areas of imperfect to poor drainage trees appear to have stunted growth.
Along the top of the ridge, south of Otter Ponds, there are areas that contain a mix of residual large spruce and yellow birch with an abundance of various aged balsam fir, with scatterings of red spruce, yellow birch and white pine under canopy. In areas where windfalls occurred the emerging regeneration is having a difficult time to establish through the thick duff.

Collectively this forest group can be considered uneven – aged since there are various sized areas containing similar aged trees but over the entire area a wide range of tree ages are present.

The biggest challenge to help restore areas in this forest group pertain to sensitivities to forest floor loss due to the coarse, stony soil and the increased risk to windfall and ice/snow damage if trees are thinned too much too soon particularly with heavy machinery. To limit forest floor loss partial shade is especially important on these soil types in order to maintain moisture and nutrient availability for regeneration to establish and for trees to properly grow through development stages. If these areas were entirely harvested the likelihood of regeneration survival would be low due to moisture and nutrient deficits. The soil would most likely be further degraded and unable to support desired species to a commercial size.

The common vegetation types within this forest group, as per Appendix A and as described in detail in NSDNR's FEC, Part 1, 2010, include:

> SH4: Red spruce – White pine / Lambkill / Bracken
> SH5: Red spruce – Balsam fir / Schreber's moss
> SH6: Red spruce – Balsam fir / Stair-step moss – Sphagnum
> SH8: Balsam fir / Wood fern / Schreber's moss
> SH9: Balsam fir – Black spruce / Blueberry

The most common vegetation types found in this forest group were SH5 and SH6. Similar mixedwood inclusions, MW1 and MW4, were found in this forest group as was in the tolerant hardwood forest group. As mentioned, such inclusions are usually the result of natural or human caused disturbances.

Mixedwood forest group (MW):

This Mixedwood forest group comprises of areas where both softwood and hardwood species were dominant and there was a lack of black spruce or tamarack in the overstory. The forest group usually encompasses mid to lower slopes of the drumlins and some ridges. Red maple and yellow birch are commonly the dominant hardwood with red spruce and/or balsam fir the dominant softwood.

There are various stages of growth, stem density, dominant height and diameter within this forest group as well as varying stem quality and potential. Many areas contain standing dead and fallen balsam fir, which serve as coarse woody material, with hardwoods of red maple and yellow birch remaining in the upper canopy. Spruce tends to be scattered in the upper canopy of varying quality and vigor. Regeneration and species distribution is also quite variable usually comprising of balsam fir, red maple, yellow birch and spruce. This forest group tends to contain areas of trees that are two – aged or uneven-aged.

There is an area of extensive windfalls along the west and south side of German Lake hill that has regenerated well with a mix of yellow birch, balsam fir, red spruce, red maple, and to some degree sugar maple. During the field reconnaissance the effects of how opening sizes influence the composition and distribution of regenerating species became apparent. This is based on tree silvics and stresses the need for managers to understand what conditions the desired species needs to grow. For instance, in areas that had a relatively open canopy (basal area >10m2/ha) balsam fir and red maple were the prominent species regenerating as compared to areas with partially open canopy (basal area 12-16m2/ha) where red spruce and yellow birch were the prominent regeneration; however basal area ranges from 10-14m2/ha tend to favour more yellow birch. Under closed canopy balsam fir and beech appear to be more prominent than yellow birch and red spruce.

The common vegetation types within this forest group, as per Appendix A and as described in detail in NSDNR's FEC, Part 1, 2010, include:

> MW1: Red spruce – Yellow birch / Evergreen wood fern
> MW4: Red maple – Balsam fir / Wood sorrel – Goldthread

After the first few years of management there most likely will be more area of other forest groups identified as mixedwood and switched to the MW forest group.

Wet coniferous and Wet deciduous (WC and WD) forest groups:

These forest groups are associated with low lying areas of wet soils and peat usually surrounding wetlands and watercourses. The Wet Coniferous (WC) forest group comprises of areas where black spruce and tamarack larch were more than 50% of the overstory species while the Wet Deciduous (WD) forest group comprised a greater component of red maple.

The common vegetation types within this forest group, as per Appendix A and as described in detail in NSDNR's FEC, Part 1, 2010, include:

> WD6: Red maple – Balsam fir / Wood aster / Sphagnum
> WD8: Red spruce – Red maple / Wood sorrel – Sensitive fern / Sphagnum
> WC5: Red spruce – Balsam fir / Cinnamon fern / Sphagum
> WC6: Balsam fir / Cinnamon fern – Three seeded sedge / Sphagnum

The WD forest groups were very limited as small inclusions on the edges of the west side of Tangier River. The WC forest group was much more common on poorly drained, wet forested sites.

These forest groups are not part of the operable or workable area of the OPDF as they are highly sensitive to ground disturbance.

*Ecosites and productivity*

Ecosites are basically productivity units for tree growth based on similar moisture and nutrient regimes of the identified vegetation and soil types. The Nova Scotia Acadian Forest has a total of 17 ecosites, as outlined in NSDNR's FEC manual, Part 3, of which the OPDF contains 8 (Figure 5). These 8 ecosites have a moisture regime that ranges from fresh to wet and a nutrient regime that ranges from very poor to rich. This provides a wide range of productive capabilities; from an ecosite 4 indicating poor growth capability to an ecosite of 13 and 14 that most likely has high growth capabilities. The drumlins are pockets of glacial till therefore have better soil drainage and textures

for tree growth so these areas are mainly associated with medium to rich ecosites. The ecosites associated with the drumlins comprise 24% of the OPDF, while the non-drumlin uplands make up 55% of the area and are mainly associated with medium fertility ecosites (NSDNR, Ecosystem management group Otter Ponds report, 2011). The remaining 20%, excluding industrial of 1%, is associated with wet, very poor to poor sites and includes treed and non-treed wetlands.

The land (growth) capabilities (LC), as outlined in Table 22 of NSDNR's FEC manual, Part 3, for operable forest groups within the OPDF range from 5.0 – 6.0 m3/ha/year for softwood and 2.25 – 3.0 m3/ha/year for hardwood. As mentioned in this manual, LC values represent fully stocked, even aged stands at peak mean annual increment (MAI) when left to grow without silviculture treatments thus they serve as an indication of maximum potential of stand productivity under natural conditions. Therefore, it is unknown if such LC values are appropriate for uneven aged conditions that are within the OPDF. Also, it is suspected soil degradation has occurred in the last few rotations due to the amount of intense harvesting that took place since there is a high forest floor loss hazard associated with the most common soil type on the OPDF. It is highly recommended for the OPDF board of directors to consider establishing permanent sample plots to begin recording data to measure growth and yield. This will enable the OPDF board of directors to determine more representative LC values to base harvesting activity on.

*Natural succession and disturbance patterns*

Natural succession is a fundamental concept in ecology that refers to more or less predictable and orderly changes in the composition or structure of an ecological community. In forest ecosystems, succession is typically initiated by some form of disturbance (e.g. logging, severe windthrow, fire) of an existing community.
The trajectory of ecological change can be influenced by site conditions (e.g., geology/soil, landforms, topography, drainage, and surface materials), interactions of the species present, and other factors such as availability of seed trees, or weather conditions at the time of disturbance.
In general, early successional forests will be dominated by fast-growing, light-loving (i.e. shade-intolerant), well-dispersed 'pioneer' species. In the forests of northeastern North America trees such as grey and white birch, poplar, balsam fir, red maple, white spruce, and white pine are particularly well-adapted to quickly invade and establish within large-sized gaps in forest canopies.

The early successional, pioneer tree species that are first to grow back after a large disturbance in the Mooseland area include balsam fir, red maple, and white birch. Due to the presence of seed trees in the overstory or in adjacent stands, red spruce, yellow birch and a few white pine have recolonized medium-to-large sized gaps. As succession proceeds, these shade- intolerant species will tend to be replaced by more long-lived, slower-growing, shade-tolerant species like yellow birch, sugar maple, red spruce, hemlock and white pine (Table 2). Late-successional species require some level of shade, moisture, and soil fertility to germinate and establish.

Table 2 Shade tolerance ranking of common eastern Canadian tree species (Harrison, 2006).

| Very Intolerant | Intolerant | ← → | Intermediate | ← → | Tolerant | ← → | Very Tolerant |
|---|---|---|---|---|---|---|---|
| Larch | Red pine | White ash | White pine | Red maple | Black spruce | Red spruce | Balsam fir |
| Poplar | White birch | | Yellow birch | Norway spruce | Cedar | | Eastern hemlock |
| Grey birch | Jack pine | | Red oak | | | | Sugar maple |
| Pin cherry | | | White spruce | | | | Beech |
| Willow | | | | | | | |

The shade-tolerant, long-lived tree species for the OPDF area include red spruce, yellow birch and possibly hemlock in lower areas, white pine in some coarse-textured, well-drained areas, and sugar maple, yellow birch and beech on drumlins. Beech, because of an introduced disease, is no longer a significant component of the forest. Several medium-sized and a few large sized beech have persisted nonetheless.

As forests and soils develop over time, organic matter is generated by living organisms and decomposed and cycled through the soils, increasing fertility and moisture retention. Downed woody material created by fallen trees and limbs decomposing on the forest floor contributes to both nutrient cycling and increased soil moisture providing conditions conducive for many species to germinate and establish.

Most of Nova Scotia's pre-colonial forests consisted of longer-lived species that survive well in partially shaded conditions, such as sugar maple, yellow birch, American beech, white pine, red spruce, and eastern hemlock. Large old trees were a major component of the forests. As old trees died and fell over, gaps were created in the canopy which allowed sunlight to reach the forest floor, enabling the germination of seeds and growth of saplings. The continual formation of gaps was the most common means of forest renewal. Nova Scotia's forests had a multilayered appearance, with a variety of live, dying, and dead trees, and accumulations of dead wood on the ground. These forests were certainly not just trees. They included all the animals, plants, mosses, lichens and a myriad other organisms that depended on the live and dead trees for food, reproduction, and cover. The diversity of organisms contributed to a healthy forest both resistant and resilient to outside influences, such as storms, insect attacks and drought.

Most of Nova Scotia's forests are now in early stages of succession (less than 60 years old); growing back from previous harvetss or from land cleared for agriculture, and may contain only a few remnant long-lived trees. Our forests are generally young, and lack many of the features of the original Acadian Forest. Furthermore, species like beech and elm have been severely affected by introduced diseases, and make up a much smaller portion of today's forests.

From the perspective of forest restoration – whereby land managers are attempting to speed up the restoration of late successional tree species - early successional, pioneer species can serve as a nurse crop for longer-lived, late successional trees (if present as seeds or seedlings) to germinate, establish and grow. Once the pioneer trees fall to the forest floor, openings in the canopy permit the climax species to be released and flourish, becoming the dominant species in the stand. Therefore, harvest activities should mimic our natural disturbance patterns both in scale and frequency.

Common natural disturbances in the province include weather related events and to some extent insect infestations. Insect infestations tend to be patchy in their impacts, and their severity and frequency are often influenced and exacerbated by land use practices that result in an abundance of even-aged balsam fir or white spruce forests.

Strong winds, heavy snow and ice can have moderate to severe impacts on Nova Scotia's forests. They may cause large and often shallow-rooted trees and snags to fall and cause damage and/or breakage to other trees. Commonly, small-scale weather events create gaps in the forest canopy. Sunlight reaches the forest floor, enabling the regeneration of tree seedlings. This 'gap' formation is the major type of regeneration in the Acadian Forest of Nova Scotia. Over time, a multilayered forest develops, with a variety of live, dying, and dead trees, and accumulations of dead wood on the ground.

Occasionally Nova Scotia is hit by hurricane-force winds. Hurricanes are not unusual, though most hurricanes are relatively weak by the time they reach the east coast of Canada. Notable exceptions include Hurricane Edna in 1954 (a category 3 Hurricane), and Hurricane Juan in 2003 (a category 1-2 hurricane). Weaker than Edna, Juan passed over central Nova Scotia on September 28th 2003.

The impacts of hurricanes are typically uneven and patchy in distribution. Hurricane Juan resulted in moderate to severe blowdown (30-100% stems downed) across 5% of the hurricane's swath. Mooseland was directly in Juan's path and the topography of the area directly influenced Juan's impact on the forest particularly in narrow valleys along Rivers and other watercourses and on the tops of ridges and southern faced slopes.

Maintaining multiple age classes and tree species diversity is the best insurance against the potential impacts of large-scale natural and anthropogenic disturbances.

## Wildlife

There is a diversity of forest types, site conditions and land features that suggest the OPDF hosts or can inhabit a range of wildlife species. In particular such areas would most likely include near the Tangier River and along the north ridge where the Otter Ponds are located which are linked to adjacent wetlands by seepages.

Though a comprehensive inventory of wildlife has not been carried out for the OPDF field observations were noted during the reconnaissance of wildlife signs, existing habitat features or potential habitats. Wildlife or signs of wildlife that were observed include black bear, white tailed deer, snowshoe hare, red tail hawk, spruce grouse, porcupine, squirrel, numerous songbirds; as well as a few snakes and common amphibians. Songbirds were more prevalent in areas that offered multiple structures in terms of uneven forest layers (or canopies). A few stick nests were observed on top of German Lake hill and Hawbolt's farm hill. Stick nests are considered a critical habitat feature which are platforms of sticks and twigs used by large birds for nesting. Eagles, osprey, herons, owls and hawks all use stick nests. Nests are often used repeatedly by the birds that build them. It is important not to disturb sticks nests especially since harvesting near an active stick nest may result in abandonment of young.

Numerous cavity trees were also observed on and surrounding areas of these drumlin areas. Cavity trees are dead or dying trees that have one or more holes on the trunk or main branches. Occasionally, cavities can be found in healthy trees. They are either excavated by woodpeckers, or created by decay and broken branches. For more than 50 wildlife species in the Maritime Provinces, cavity trees are vital for nesting, rearing young, roosting, feeding, storing food, escaping and/or hunting predators, and hibernating. Some of these species require large cavities, like wood ducks, insect-eating bats, the endangered American marten, as well as larger mammals such as the black bear. Other species, like the black-capped chickadee, and the redbacked vole, can make use of cavities in smaller-sized trees. To ensure that high priority cavity trees are maintained, or recruited, all trees with well-rounded, deep holes should be kept. In addition to nesting cavities, attention should be paid to maintaining feeding and escape cavities.

Mast trees are trees whose fruit (seeds) are important sources of food for wildlife. Cherry, oak, beech and ironwood are important mast species. There was very few mast trees observed in the OPDF, especially as there are very few healthy good-sized beech left in the Maritimes. There were few mature large, relatively clear of canker disease, healthy crown beech trees located on both the German Lake hill and Hawbolt's farm hill. Thus it is critical that any remaining mast trees be left. Beaked hazelnut and Serviceberry are also considered mast trees, of which few Serviceberry trees were found but not beaked hazelnut.

Various sized deadwood on the forest floor provides habitat for a variety of small, medium and large-sized mammals, insects, amphibians, etc. Large-sized trees are particularly important – and increasingly rare in some areas. As restoration activities commence it will be essential to continually allow some larger trees to fall to the forest floor and rot – contributing to wildlife habitat, as well as moisture retention and nutrient enrichment. In some areas where windfalls have occurred the amount of deadwood is sufficient however in other areas particularly even aged sites larger sized deadwood is lacking.

The OPDF board of directors are encouraged to approach the Wetlands and Wildlife division of NSDNR to help with a comprehensive assessment of wildlife, wildlife habitat features and potential habitat. Such information will be invaluable during prescription development and especially on the ground implementation.

Protected species

The Nova Scotia Endangered Species Act protects species categorized as either endangered, threatened, vulnerable, extirpated (no longer exists), or extinct. More information regarding the Nova Scotia Endangered Species Act and an updated listing can be found using the website: http://www.gov.ns.ca/natr/wildlife/biodiversity/species-list.asp. During the forest inventory assessment none of these species were observed, though Common nighthawks were seen nearby in the village of Mooseland. From this list the species most likely to potentially live or that once lived in this area include moose, Chimney swift, lynx, Wood turtle, Olive-sided flycatcher, Rusty blackbird, Eastern ribbonsnake, and the American marten (see more information about each of these species in Appendix C).

Many other species are considered to be in decline, but are not listed under the Act. For example, the Monarch butterfly, fisher, southern flying squirrel, and black ash are all "yellow listed" - recognized as being sensitive to human activities - under NSDNR's general status ranking system. Species status can be queried using their website: http://www.gov.ns.ca/natr/wildlife/genstatus/ranks.asp.

To find out more information regarding the identification of species at risk and their associated habitats the newly available booklet "Species at Risk in Nova Scotia – Identification and Information Guide" can be viewed or downloaded online from the website: www.speciesatrisk.ca or by contacting a wildlife biologist specializing in stewardship of species at risk with Nova Scotia's Department of Natural Resources.
It is each forest owner's responsibility as a steward of the land to adopt a precautionary approach to protect life and habitat if any of the species do exist or have the potential to exist on your property. To that end, measures should be adopted to:

- Maintain or recruit large-sized snags for nesting and roosting chimney swifts
- Minimize forest fragmentation and edge effects created by roads and large openings in the canopy, and maintain large-sized trees and remnant older forest stands. Moose, fisher and

marten are negatively affected by forest fragmentation and conversion of older forests to young forests.
- Take measures not to disturb wet areas to protect habitat of flycatchers, black ash, rusty blackbird and turtles.

Strengths and weaknesses of the OPDF

The strengths that will assist the board of director to achieve management objectives are:

1. Large land base with a diversity of forest cover types, in addition to water resources, provides a range of opportunities for restoration trials, research, education, demonstration and recreation.
2. An existing entrance to the east section of OPDF within 3 kilometers from the Mooseland road.
3. The range of skill and knowledge of the OPDF board of directors, and their keen interest and involvement with this forest.
4. The involvement of a wide range of interests.

Weaknesses that may create challenges to achieve management objectives include:

1. Isolation of most of the OPDF area
2. Intense harvests that have occurred in the past including forest conversion from hardwood to softwood and high grading hardwood stands
3. The most common soil type within OPDF is associated with a high forest floor loss hazard
4. Number of watercourses and seepages
5. Costs associated with implementing restoration strategies. The board of directors are dealing with a deficit since much of the value has already been taken by previous generations.
6. Locating experienced and willing contractors to carry out harvest and silviculture activities

## Annual growth and Annual Allowable Harvest

Annual growth refers to yearly volume growth increments of tree species as a function of land capability, which is based on site and soil conditions, topographical and climatic factors. The annual growth rate of softwoods and hardwoods provide a basis to establish a reasonable harvest level that will serve as a guide when planning and implementing forest management activities. We must harvest less than what the forest is growing in order to truly sustain all of nature's functions and processes, particularly the role of standing deadwood and coarse woody material. This will ensure a long-term balance of all forest values.

The determination of annual growth to establish a reasonable harvest level of both softwoods and hardwoods will be based on land capability values as discussed above in the Ecosite Section. The harvest levels will pertain only to the operable forest area and does not include the operable area within the reserved land portion that is possible to remediate (as discussed in the Land classification section above). This relates to a total of 339.24 hectares that is actually operable and will be used to determine annual harvest levels for the first 5 years. However, as remediation work is complete within this reserved land portion and restrictions of forest activity are released the approved area will then be added to the operable land base thus will contribute to future annual allowable harvest levels. Table 3 below outlines the current operable forest groups, associated ranges of growth capabilities for softwood and/or hardwood and the resulting harvest levels with a 30% reduction applied.

Harvest levels incorporate a 30% precautionary reduction to allow for the ongoing recruitment of deadwood. This recognizes the critical role of dead and dying wood in forest ecosystems. Firstly,

dying and dead wood provide one of the greatest resources for animal species in a natural forest. If fallen timber and slightly decayed trees are removed the whole system is seriously impoverished of perhaps more than one fifth of its wildlife component. Secondly, dead organic matter, in the form of trunks, limbs and branches, contain large amounts of nutrients and carbon, which are then slowly released during decomposition. In this way, dead wood acts as a slow-release fertilizer, and plays an important role in maintaining forest health and quality. A 30% reduction was chosen because coarse woody material and standing deadwood remains lacking in many areas of the OPDF. These areas would certainly benefit from increasing levels of coarse woody material and maintenance of partial shade due to the well - rapid drainage and coarse - medium textured characteristics of the soil.

Table 3. Annual growth and harvest levels

| | | Growth capability (LC) ranges (m3/ha/yr) | | Total SWD Annual growth | Total HWD Annual growth | SWD AAC* | HWD AAC* |
|---|---|---|---|---|---|---|---|
| Forest Groups | Area (ha) | SWD | HWD | (m3/yr) | (m3/yr) | (m3/yr) | (m3/yr) |
| MW Forest Group | 26.47 | 5.0 - 6.0 | 2.75 - 3.0 | 70.2 | 57.9 | 49.1 | 40.5 |
| SH Forest Group | 227.97 | 5.0 - 5.5 | | 1168.8 | | 818.2 | |
| TH Forest Group | 56.03 | | 2.75 - 3.0 | | 166.6 | | 116.6 |
| CC/Plantation | 28.77 | 5.0 - 5.5 | 2.75 - 3.0 | 76.7 | 41.9 | 53.7 | 29.4 |
| Totals | 339.24 | | | 1315.7 | 266.4 | 921.0 | 186.5 |

* 30% precautionary reduction applied.

These calculated harvest levels serve as a reasonable guide and starting point to begin harvest activities within the OPDF. These levels are recommended during the first 3 – 5 years since there is a surplus of volume in the form of windfallen trees that remain ‘green’ and red maple that is surpassing maturity on areas of the drumlins. As harvest activity takes place during these first few years a better understanding of present volume, growth capabilities as well as age class distributions will become known which will help re-assess / re-evaluate these harvest levels to ensure they are fully representing the range of growing conditions. We may very well find an adjustment to these levels necessary to better reflect growth and to ensure adequate levels of deadwood is maintained. Such an evaluation is necessary to ensure levels remain appropriate, reflect the growing characteristics and conditions of the forest, and to meet the objectives of the OPDF board of directors.

Harvest volumes do not have to be cut each and every year as long as an average harvest is maintained over a specified period and does not negatively impact ecological health or site productivity.

All activity and wood harvested must be justified, well documented and account for the full range of economic versus ecological costs and benefits of pursuing such activities and actions.

**Wood volumes**

Total merchantable wood volumes including a breakdown of total softwood and hardwood merchantable wood volumes was included in the 2003 forest inventory information provided by NSDNR. NSDNR’s Ecosystem management group had organized the information of the various 321 stands or polygons into one of the forest groups for the entire forest area of the OPDF. The following table outlines the 2003 merchantable wood volume information per forest group. The total operable

area outlined here includes the wet forest groups as well as the operable areas within the Reserved Land Portion.

Table 4. 2003 merchantable wood volume information per forest group for the OPDF.

| Forest Group | Area (ha) | SWD VOL (m3) | HWD VOL (m3) | Total Swd + Hwd (m3) |
|---|---|---|---|---|
| MW Forest Group | 64.87 | 4,900.6 | 2,790.5 | 7,691.1 |
| SH Forest Group | 245.47 | 23,116.5 | 1,072.6 | 24,189.1 |
| TH Forest Group | 62.03 | 1,073.0 | 5,890.9 | 6,963.9 |
| IH Forest Group | 1.13 | 0.0 | 0.0 | 0.0 |
| CC/Plantation | 28.77 | 0.0 | 0.0 | 0.0 |
| WC Forest Group | 61.06 | 5,067.2 | 222.0 | 5,289.2 |
| WD Forest Group | 1.43 | 0.0 | 0.0 | 0.0 |
| Total | 464.76 | 34,157.3 | 9,976.0 | 44,133.3 |
| Total Operable | 402.27 | 29,090.1 | 9,754.0 | 38,844.1 |

Please note this inventory was derived from 2003 aerial photography interpretations before Hurricane Juan and subsequent storms that have caused various degrees of damage in terms of extent of windfallen trees. Thus, the volumes outlined in this table are not fully representative of present 'on the ground' conditions but growth has occurred during the last 8 years.

Conclusions from the field assessment estimated approximately 30% of the 2003 volume was affected by Hurricane Juan and subsequent storms that affected weakened trees. As mentioned previously, much of this volume has lost commercial value and is worth more ecologically. This would relate to a reduction in total volume to approximately 30,900 m3. According to growth capabilities as outlined in the ecosite information for the OPDF the estimated softwood growth per year is approximately 1479 m3/year and for hardwood growth is approximately 303 m3/year. So extrapolated over 8 years would equate growth in the vicinity of 12,000 m3 for softwood and 2400 m3 for hardwood, for total estimated growth of 14,400 m3. Added to the estimated volume after Hurricane Juan and other storms this equates to an approximation of 45,300 m3 at present, which is similar to the 2003 total volume outlined above. However please keep in mind these values serve as a reference and may be more or less of the actual since there are many assumptions made here and uncertainties involved. Ground truthing of these volumes should be completed as pre-treatment assessments and harvest activity is completed to determine how they compare with the 2003 and forecasted values. Such ground truthing and comparisons will also allow a better understanding of potential growth and how the growth capabilities as outlined in the FEC manual compare with actual conditions of the OPDF.

**Generalized Recommendations**

Silviculture prescriptions and restoration strategies

Traditional silvicultural systems and their application need to be adapted to address the ecological complexities and associated hazards of restoring the Acadian Forest. Restoration strategies must be developed and applied that will help build up soil health to in turn be able to support a diverse range

of suitable species. The more species and structural diversity there is in the forest the more habitats are available for a variety of life forms. The more life there is in the forest the more biomass will accumulate thus building soil health and overall forest health.

The OPDF provides an ideal means to develop and test various restoration strategies to determine what activity and methods are most appropriate and yield the best results to restore forest health while being economically feasible and viable. This would include expanding on traditional silviculture treatments to be more wholistic in approach and to focus more on quality development of trees. The OPDF is an ideal area to pursue various trials due to the wide array of forest conditions and development stages within each forest group that has resulted from previous disturbances, which is characteristic of many woodlots in Nova Scotia.

The principles of maintaining shade (for moisture), shelter (for support and stability) and seed (for natural regeneration) should be the underlying basis of all harvest activity that occurs within the OPDF.

As such, restoration strategies will focus on:

> Tending (thinning) and regenerating activities dependent on stages of development and site conditions within each operable forest group.
> Promoting growth and quality development of the best trees to increase end value.
> Manage the best, most dominant trees to maintain stand structure thus stability. If all the best, dominant trees were taken leaving the weak and suppressed the stand would become very vulnerable to weather related damage thus increasing risks to negative effects. This is particularly crucial when moving even (single) aged stands to contain more uneven (multiple) aged conditions.
> Maintaining some degree of canopy cover to in turn maintain partial shade thus soil moisture and limiting forest floor loss.
> Managing the sunlight through manipulating canopy cover to create conditions favourable to encourage desired species and help control competition.
> Favouring any species that are lacking or known to be rare within OPDF, for instance healthy beech, any hemlock or white ash; even sugar maple on some of the heavily disturbed drumlins.
> Considering fill planting tree species in areas worked that lack diversity.
> Increasing components of downed woody material and leaving standing deadwood in areas that are lacking.
> Minimizing ground disturbance. This is key to limiting negative effects to site productivity.
> Minimizing the number of main trails and extraction trails through the OPDF.
> Balancing economic and ecological values. There should be reasonable value for effort involved.
> Utilizing available silviculture subsidies to help offset cost involved with implementing proper tending and regenerating activities.

An understanding of tree silvics and specific site conditions is crucial in order to develop appropriate prescriptions and operating plans that will help best achieve management objectives.

The following are some examples of possible initial restoration activities that could be completed once access is established:

TH forest group, German Lake Hill (1st drumlin east of Tangier River):–

- Group and individual tree selection of poor form, less vigorous trees particularly portion of the mature red maple to gradually begin opening the canopy to provide growing space for more vigorous trees and to release young stems of yellow birch, sugar maple and spruce under canopy. Concentrate activities in the southern half of the drumlin.

- It is important not to reduce basal area by more than 30% during the first entry and attempt to maintain a residual average basal area of at least 16m2/ha, not to create conditions favourable for hay scented fern to proliferate, which will negatively influence regeneration establishment unless regeneration is already firmly established. Also, this will help limit possible weather damage of trees from wind and ice that may occur.
- The size and distribution of group selection (patch) cuts should be no more than 1 – 2 tree lengths in size and should be distributed alternatively in the area where there are concentrations of poor quality, less vigorous trees and where there is already sufficient levels of regeneration.
- In areas where patches of windfallen trees have occurred consider salvaging any spruce that remains commercial and harvesting mature spruce with thinning crowns that surround the patches. This will have to be done carefully to limit damage to regeneration that has already established. The young growth has not reached a sufficient height to be ready for thinning, even so thinning activities would be very difficult and quite hazardous due to the number of windfalls hidden amongst the flourishing regeneration.
- It is of utmost importance to identify and note stick nest sites and not operate in the areas where these occur during mid-spring – early summer to avoid nesting periods, particularly of active nests. This will require further assessment and periodic monitoring to identify active nesting sites.
- Various trials of basal area reductions, size of patch cuts, methods of harvest as well as control areas should be established, monitored and documented in order to help determine best strategies of how to obtain desired results as well as to minimize costs involved.

TH forest group, extensive spruce plantation on Powder horn hill:-

- Intermediate thinning, since the present height and diameter of trees age of development is between the traditional pre commercial thinning stage and commercial thinning or crop tree release stage, consider completing various spacing (density control) trials to determine what method will yield the best quality stems while not increasing risk to damage caused by weather. It is important, as in any trials conducted, to leave various areas untreated, to allow to develop naturally, to serve as a benchmark to measure treated areas against.
- Good quality, form and vigorous yellow birch, sugar maple, and red spruce should be favoured as the crop trees.

TH forest group, young hardwood north of road on Powder horn hill:-

- Crop tree release and pruning of the best yellow birch and single stem maple in the stand.
- Conduct various crown thinning trials to determine the extent crop trees crowns can be released without becoming vulnerable to weather damage.

SH forest group, south of German Lake Hill, east of German Lake hill, and beyond wet areas extending to southeast area of the Otter Ponds:-

Areas with recent windfalls-
- Selection harvest activities to salvage windfallen spruce that remains commercial and feasible to extract. Also, select portion of the standing trees that may not last until the next cutting cycle such as trees exhibiting thinning crowns, loss of vigor, scarring or other damage, particularly those trees that are hindering the growth of more promising, vigorous trees.

- The cutting and extraction of recent windfallen trees and some declining overstory trees surrounding regeneration must be completed carefully with caution to minimize damage as much as possible. The young growth has not reached a sufficient height to be ready for thinning, even so thinning activities would be very difficult and quite hazardous due to the number of windfalls hidden amongst the flourishing regeneration.

Areas of 40-50 year old red spruce-
- Crop tree release of light removal. Concentrate releasing the crowns of the best, most dominant 125 trees per hectare by removing less vigorous and poor form trees on at least 2 – 3 sides that are directly interfering with the development of crop trees. This is basically a non-uniform crown thinning concentrating only on promoting growth of the best trees within the stand.
- These areas could also benefit from a light commercial thinning however since these areas are dense and are underlain by stony soil of variable depth in either case this poses serious challenges due to the high risks to damage involved when machinery is used and large size extraction trails are needed.
- During activities various levels of coarse woody material must remain on site to maintain moisture and replenish soil of nutrients.
- There are several areas of this condition of which various trials of removal and methods of extraction can be tested.

Areas of 70-90 year old spruce-
- Due to high hazards of forest floor loss and insufficient regeneration on such areas, an entire harvest of these areas will only set back these sites many years since they most likely will not adequately regenerate to desired species or would planted seedlings survive.
- A shelterwood type harvest of 30% basal area is recommended to encourage natural regeneration. By maintaining dominant structure of the stand and limiting ground disturbance during harvest activity windfall risk can be significantly decreased. In addition, harvest activity should focus removal of trees that will not remain through to the next cutting cycle.
- Another option may be to periodically implement group selection or patch cuts targeting 2 – 3 trees in a group to open the canopy and encourage regeneration in patches. Thinning between patch cuts are also an option to consider.
- During any activity in this condition various levels of coarse woody material must remain on site to maintain moisture and replenish soil of nutrients.

For all the conditions within this forest group, amongst other groups, various trials of removal by varying methods would be appropriate to determine effects of basal area reduction on stand stability, growth response, and regeneration response, as well as economics to complete such tasks.

Tree marking in some selection harvest situations particularly with a high component of acceptable growing stock (good quality trees) is highly recommended. In terms of restoration, tree marking is particularly important to maintain stand structure and stability especially in even aged conditions. Tree marking is a separate action from the actual operation thus allows the landowners objectives and the residual forest to be the main focus; basically to determine how to make the harvest activity most successful. The underlying focus is not to jeopardize the health or structure of the forest stand. Tree marking also considers economics; however such economics is based more on growing the trees, the longer term, and not so much cutting them. Tree marking identifies either the trees to cut or to leave keeping in mind how cutting and extraction will take place. A tree marking scheme is developed based on present forest stand conditions and management objectives. This helps ensure a desired outcome will be achieved and most importantly prevent further high grading of the stand.

As possible work sites are identified pre assessments will be completed prior to any activity occurring within the OPDF. Pre-treatment assessments will collect detailed information and verify soil and vegetation type classifications which will provide an informed basis to develop appropriate site specific silviculture prescriptions, restoration strategies and implementation plans. Pre-treatment assessments will gather site information such as species composition, growth potential, wood product volumes (if desired), acceptable growing stock versus unacceptable growing stock, operational issues, identify unique and sensitive areas; and will also identify opportunities to conduct trials that use different methods and degrees of regenerating and tending in various forest development stages and condition. From the pre-assessment information a pre intervention (or pre-operating) plan is completed to outline the approximate treatment area, site specific silviculture prescriptions including basal area (or stem density) residual targets and estimated amount of removal, the tree marking scheme (if applicable) and operational hazards if any.
Once the pre-intervention plan is complete, assuming access is already established, the next step is implementation on the ground beginning with laying out the treatment boundaries, machine exclusion zones (i.e., seepages) of the site and tree marking. The next step, assuming a contractor is available, is to begin cutting and extracting trees harvested based on the completed marking scheme. Once the work is complete a post treatment assessment will be completed to gather information for future reference. This information will be incorporated into the management plan and a database of work sites continually compiled in spatial software for mapping and future planning purposes.
The various tools available from NSDNR such as the tolerant hardwood and tolerant mixedwood and softwood management guides and the newly published forest ecosystem manuals will continually be used to help develop appropriate restoration strategies. This provides excellent opportunity for the OPDF board of directors to demonstrate the practical use of these guides in terms of how the information derived can help with management planning and help achieve desired outcomes.
There are also opportunities to continually work with the Ecosystem management group at NSDNR to develop and test various restoration strategies and help determine appropriate management interpretations for the guides.

Riparian area, machine exclusion zones and special management zones

This entire OPDF sits within the Tangier River watershed with various watercourses and seepages therefore the entire area should be considered a riparian area. Selection harvest and tending activities must be completed during the appropriate time of year, with proper equipment of low impact and great care not to disrupt the natural flows of surface and sub-surface water. By applying an uneven-aged, ecosystem-based approach to forest management continuous forest cover will be maintained. However, the standards as outlined for the Watercourse Protection and Wildlife Habitat regulations must be followed. A buffer width of minimum 20 meters width from all watercourses is required as per Nova Scotia's Watercourse Protection and Wildlife Habitat regulations. A 7 meter machine exclusion zone is required from the shore's edge. Harvesting is permitted within the buffer zone as long as a basal area of 20m2/ha is maintained and there is no disturbance within the 7 meter machine exclusion zone.

The area where land meets water particularly along the Lakes, the Tangier River, various brooks and wetlands should be designated as special management zones (SMZs) due to the greatest range / opportunity for species diversity and wildlife habitat, degree of sensitivities associated with such sites, and the high recreational use of such areas for instance fishing. Therefore the zones should be approximately 50 – 100 meters wide from the high water mark of the watercourses. These areas, including wetlands and bogs, serve critical ecological roles and functions of the greater forest ecosystems. Activities within SMZs should be limited, of low impact and well planned not to disrupt ecological processes and jeopardize ecosystem health which could in turn jeopardize the uses and benefits offered such as recreational fishing.

Education and demonstration opportunities

For the most part, education and demonstration activities must be in close proximity to existing (and future) access to ease the movement of people. There are many aspects of the forest and of activities that could take place and serve as the focus of interpretive hikes, demonstration sites of both active and non-active areas, workshops and school trips. For instance, identification of tree and ground vegetation, soil types and wildlife habitat, comparison of silviculture treatments and methods used, map and compass use, GPS use, and so on.

Research trials and studies could certainly be incorporated into education and demonstration activities. Gathering up volunteers to collect information on wildlife sightings, for instance, may be a fun idea particularly for school children and families.

Research opportunities

There are many opportunities to conduct research that will help future management decisions and implementation plans. Some examples include:
> Establishment of various permanent sample plots to measure growth and yield of uneven aged conditions, and possible soil degradation of soil types.
> Assessing present components of downed woody material and the effects on regeneration in terms of species, rates, and distribution, soil carbon and health, wildlife diversity, etc.
> Density control and release trials in young, even aged stands.
> Monitoring and measurement of various restoration strategies and silvicultural methods in terms of achieving desired results.

Recreation opportunities

There is a wide range of recreational opportunities within the OPDF. Especially fishing, canoeing, kayaking and camping; as well as swimming, hiking, bird watching, exploring, and overall observing and being one with nature through the seasons that could be encouraged, enhanced including possibilities of deriving income from users such as for camping. As access increases so will the opportunities for these activities.

However, a common issue in Nova Scotia with the creation of roads, trails, etc is the potentially high usage of such access by all-terrain vehicle (ATV) users. Thus it is important to monitor this situation and work with ATV users to ensure they are aware of the detrimental effects that could be caused if not responsibly used. The working relationship should also involve placing proper signage of designated trails and encourage them to help with maintaining proper infrastructure such as trails and bridges in order to use the trails within the OPDF. In the event ATV traffic increases with increasing access these measures will limit possible damage caused and the usage by ATVers may also help “keep an eye” on the property to report any irresponsible use and/or illegal activity.

The OPDF board of directors are encouraged to discuss what and how they would like to proceed with these various recommendations, and how information that is currently available including resources of inkind support may be able to help them achieve management objectives.

**Monitoring and record keeping**

Monitoring sites, maintaining and compiling records of activities by operating year, including practicing the silent season to monitor forest conditions, are a crucial part of management planning and the overall learning process. These records will help improve future management decisions and result in optimizing growth of forest stands. We also encourage the recording of natural history observations, like sightings of particular bird nests, bear or other activity or any wildlife signs including amphibians. This will increase the OPDF board of directors' familiarity with the forest and identify areas where special precautions need to be made when implementing various activities.

We can all learn from monitoring growth response and natural processes and functions of the forest, which will help us in ensuring ecological health and long term site productivity is maintained for future generations.

A pre-intervention and monitoring plan must be developed when planning to conduct regeneration and tending activities, and it is part of record keeping tasks. Refer to Appendix D for pre-intervention considerations for volume removal and ecosystem disturbance or the monitoring plan. This pre-intervention plan is required as per the Acadian Forest Keepers standards for the FSC Maritimes certification.

## Concluding comments

This management plan will allow the OPDF board of directors to become more familiar with the forest and serves as a guide as to what actions to consider to improve forest conditions that will restore ecosystem structure and function, and offers possibilities of where to start. It should also provide direction for things to think about and take note of prior to, during and after harvest/silviculture activities that will help achieve management goals and objectives for the short and long term.

If you have any questions at any time while reviewing this document, when you are considering implementing activities, and/or during implementation stages, please let us know.

Sincerely,

Patricia Amero, RPF
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Resource manager, Acadian Forest Keepers