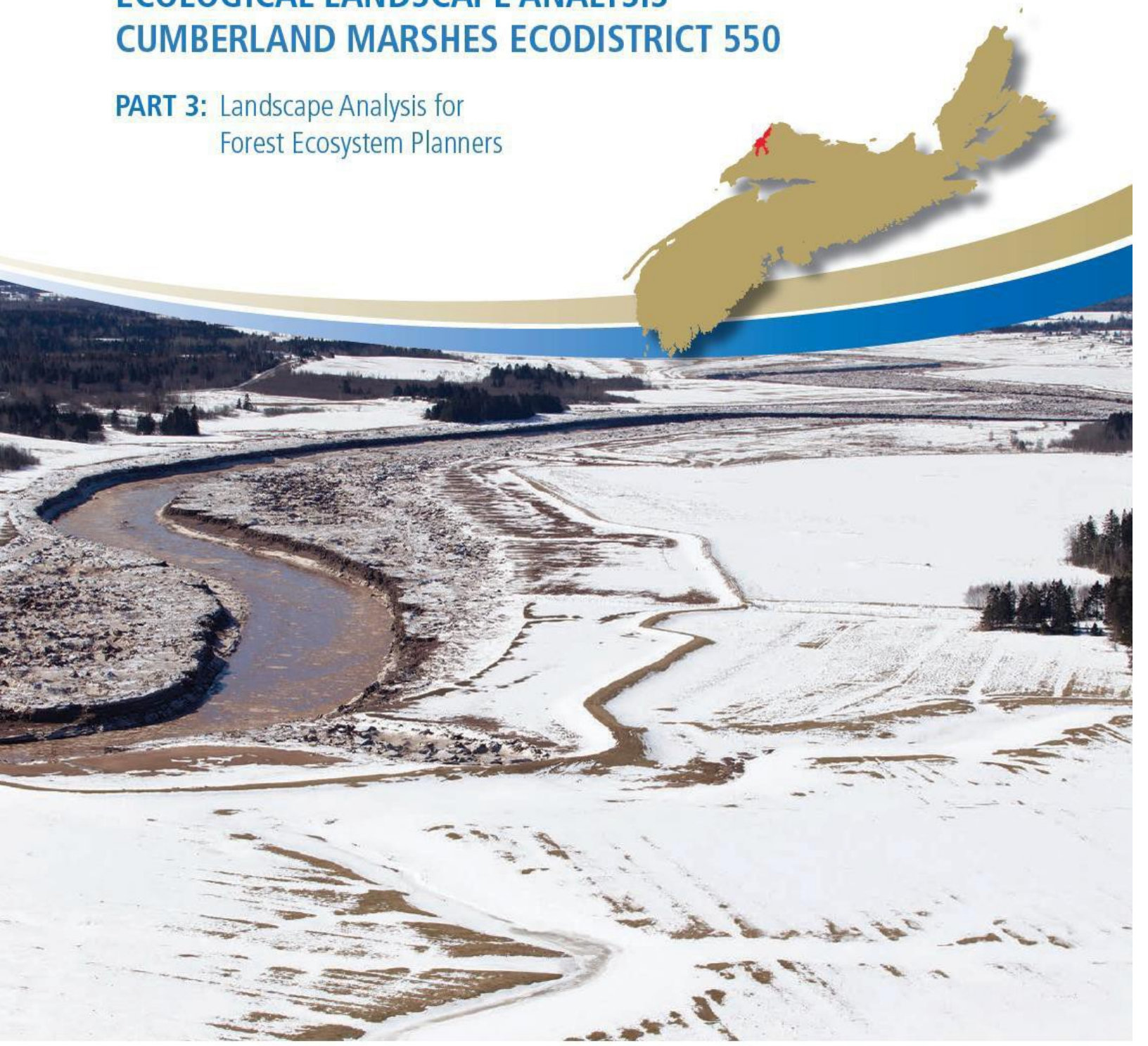
Department of Natural Resources

ECOLOGICAL LANDSCAPE ANALYSIS CUMBERLAND MARSHES ECODISTRICT 550

PART 3: Landscape Analysis for Forest Ecosystem Planners



ELA 2014-550

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 550: Cumberland Marshes

Prepared by the Nova Scotia Department of Natural Resources
Authors: Central Region DNR staff

ISBN 978-1-55457-591-6

This report, one of 38 for the province, provides descriptions, maps, analysis, photos and resources of the Cumberland Marshes Ecodistrict.

The Ecological Landscape Analyses (ELAs) were analyzed and written from 2005 – 2009. They provide baseline information for this period in a standardized format designed to support future data updates, forecasts and trends. The original documents are presented in three parts: Part 1 – *Learning About What Makes this Ecodistrict Distinctive* – and Part 2 – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland.* Part 3 – *Landscape Analysis for Forest Planners* – will be available as a separate document.

Information sources and statistics (benchmark dates) include:

- Forest Inventory (1995) – stand volume, species composition
- Crown Lands Forest Model landbase classification (2006) – provides forest inventory update for harvesting and silviculture from satellite photography (2005), silviculture treatment records (2006) and forest age increment (2006)
- Roads and Utility network – Service Nova Scotia and Municipal Relations (2006)
- Significant Habitat and Species Database (2007)
- Atlantic Canada Data Conservation Centre (2013)

Conventions

Where major changes have occurred since the original ELA report was written, the new information will be provided in *italics,* so that the reader can see how some conditions have changed since the benchmark date of the ELA.

REPORT FOR ELA 2014-550

Table of Contents – Part 3

Tables

Appendices

Theme Maps Available on Website

Part 3: Landscape Analysis of Cumberland Marshes – *For Forest Ecosystem Planners*

This in-depth Ecological Landscape Analysis (ELA) report is a lightly edited version of the original ELA produced by Department of Natural Resources (DNR) as an internal document to assist with Crown land planning. The report provides information for planners, forest managers, ecologists, technicians, and woodland owners seeking detailed planning resources. In coming years, the DNR will continue to develop landscape planning approaches and introduce additional tools to support sustainable management and biodiversity conservation. The Department is working with stakeholders to explore novel planning approaches using these methods.

The ELA provides tools to recognize and pursue common goals for sustaining ecosystem values across all ownerships within the province's diverse landscapes. The ELA is not a plan, but instead supports planning by providing a framework of ecosystem mapping, indicators, fine-scaled features, and landscape functions that help describe landscapes as ecological systems. The report comprises the four major sections outlined below, along with theme maps and appendices containing detailed data summaries:

Understanding the Landscape as an Ecological System

- Elements Within Landscapes
- Flow-Element Interactions
- Landscape Connectivity

Landscape Indicators

- Forest Composition Indicators
- Land Use Indicators

Fine Scale Features

- Priority Species and Other Special Occurrences
- Rare Ecosections
- Ecological Representivity

ELA Summary

- Element Interpretation
- Ecosystem Issues and Opportunities

Understanding the Landscape as an Ecological System

(Appendices 1, 2a, 2b; Map 2)

Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements, which were interpreted through analysis using the ecosection layer of the Ecological Land Classification (ELC) for Nova Scotia. Elements are described by their potential vegetation (e.g. climax forest type) and physical features (e.g. soil, landform). These characteristics help determine historical vegetation patterns and promote an understanding of present distributions and potential habitat

development. Across the province about three dozen elements were identified in the ELAs and mapped to show their distribution across ecodistricts and ecoregions.

Elements Within Landscapes (Map 2)

The landscape analysis identified and mapped seven distinctive elements in the Cumberland Marshes Ecodistrict – one matrix, five patches, and a corridor. A matrix is the dominant element. Patches are smaller yet still distinctive elements. Corridors are natural linear elements, such as river valleys, that extend across ecodistricts (see connectivity section for full discussion of matrix, patch and corridor concepts).

The matrix element **Marshes and Grasslands,** representing about one-third of the ecodistrict, has been extensively altered by human settlement, agriculture, wildlife management, roads, and utility corridors. The early settlers farmed the area up to about 1755 by cutting channels to the sea so the rich sediments of the waters of the bay would be deposited near the peat layers. This dyking controlled the natural siltation. The matrix is only about 9% forested with black and red spruce dominating.

Red and Black Spruce Hummocks is the largest patch element, representing more than one-quarter of the ecodistrict. This patch is the most intact element in the ecodistrict. The other patches, in order of size, are **Wetlands**, **Spruce Pine Flats**, **Tolerant Mixedwood Hills**, and **Red Spruce Hummocks.** Most of the patch elements are under heavy land use pressure.

Valley Corridors includes four main river systems – Hébert, Maccan, Missaguash, and LaPlanche – that provide linkages adjoining ecodistricts. The forests in these river corridors have been significantly altered by human land use.

Flow – Element Interactions (Appendix 1; Map 2)

Flow phenomena are the features that move across and through landscapes. They can be energy or material, living or non-living. Diaz and Apostol (1992) suggest that the most relevant flows for landscape analysis may include water, wind, fire, animals, plants, and humans. The following flows were considered in the analysis of this ecodistrict and are described in Appendix 1: people, water, deer, moose, furbearers (otter, fisher, beaver), wood turtle, osprey, eagle, rare plants, and fish.

The main purpose in describing flows, and their relationship to the elements, is to provide insight into the role of each element. This will inform understanding of each element's contribution to overall landscape function.

As an example of the flow – element interactions, it is thought that moose move to and from New Brunswick and Nova Scotia through this narrow track of land that separates the two provinces. It is thought that moose crossing into Nova Scotia move either through the Cumberland Marshes Ecodistrict 550 and down along the Northumberland Lowlands Ecodistrict 530 or toward Chignecto Ridges Ecodistrict 560.

Further studies are required to determine if there is movement across the border and, if so, what species are involved and when are these flows occurring.

Cumberland Marshes is under heavy land use pressures and major portions of forested land have been converted to other uses. The structure and habitat must be restored and protected to ensure the ecodistrict can function at an ecological level and also provide larger areas and interior conditions for species movement across borders.

Landscape Connectivity (Appendices 2a, 2b; Map 2)

Connectivity refers to the ease or difficulty that resources, such as water, animals, or even events, such as fires, can move within an area. As a basic ecological requirement, the ability to move without excessive risk is of critical importance for maintaining biodiversity at all levels, including genetic, individual, species, population, community, and ecosystem.

River corridors promote connectivity.

Connectivity takes many forms and operates at a wide range of scales. Among the structural ecosystem components that support movement, three major systems can be identified:

Matrix Ecosystems – Matrix implies large areas of broadly similar habitat in which movement is not constrained to particular routes. The slow spreading and mixing of species through the dominant community characterizes the ecosystem matrix. This "percolation" is dependent on the large patch conditions, which may be vulnerable to fragmentation. Interior habitat is often an important feature of matrix ecosystems.

Patch Ecosystems – The movement of species among patches of suitable habitat is dictated by the arrangement and size of patches and by a number of species' specific measures. Patches of suitable habitat must occur at acceptable distances over time. Some patch habitats have critical functions and must be continuously sustained, such as wetlands for migrating birds, feeding areas for deer, and calving grounds for moose. Other patches may be dynamic, shifting about the landscape as ecosystems evolve. Edge and interior habitat conditions are important features of patch ecosystems, as well as natural isolation.

Linear Corridor Ecosystems – Flow along popular routes is dictated by enduring physical features, such as river valleys. Linear flow often requires continuous connection, such as rivers. Breaks in the connection serve as obstacles. It is a characteristic of continuous linear features that they often serve as connective corridors for some species and barriers for others.

Cumberland Marshes is currently dominated by a much changed structure that does not represent the inherent natural conditions that once shaped this landscape. Human land use, transportation

systems and utility corridors have fragmented some of the element types, reducing the connective function of the corridors for some species. Human-caused changes may also increase the barrier effect of the corridors for species that must move across.

An additional concern inherent in all ecological planning is the maintenance of connectivity among conservation areas (including wilderness, old growth, provincial parks, ecological reserves, etc.) that are often not ecologically related. At the landscape scale of planning, connectivity among these areas is supported by the dominant forest structure. Connectivity will be sustained by applying the natural disturbance regime (NDR) guidelines for landscape composition and recognizing natural linkage opportunities.

The landscape design phase will address and consider, where possible, the recommendations and practices presented in Appendices 2a and 2b by:

- Mitigating the potentially negative barrier effects of concentrated land use in the Valley Corridors element by sustaining and restoring natural communities in key areas such as those identified during the landscape analysis.
- Enhancing connectivity among conservation areas by applying appropriate medium and high biodiversity emphasis standards when managing areas with natural linkage potential.
- Improving ecoregional connectivity by sustaining and restoring natural conditions at important linkage points among ecodistricts.

Links to Neighbouring Ecodistricts (Appendices 1, 2a; Map 2)

People, water, deer, moose, furbearers (muskrats, otter, mink, beaver), osprey, eagles, and fish are identified with linkages to the adjacent areas or ecodistricts.

The hydrological system provides the most obvious physical connection between Cumberland Marshes and its surroundings.

The major river corridors are the Hébert and Maccan rivers that dissect the southern sections of the ecodistrict. These rivers have tidal influences, numerous salt marshes, and intervale lands. Both of these rivers are important for migrating birds, salmon, and other wildlife species.

The Nappan River and the LaPlanche River are located in the northern section of the ecodistrict and are also important for anadromous fish – that migrate upriver from the sea to spawn – and nesting areas for eagles and ospreys.

People provide linkages among the neighbouring ecodistricts of Chignecto Ridges 560, Cumberland Hills 540 and Northumberland Lowlands 530 through their many activities (recreation, forest management, wildlife management, transportation, fishing, utilities, development, and settlements). The major linkages are at Amherst, River Hebert, Minudie, Warren, and Tidnish.

Highway 104 provides the main transportation linkage to and from Cumberland Marshes to New Brunswick. The highway brings national and international tourists to various locations throughout the province.

Landscape Indicators (Appendices 3, 6, 7, 8, 9, 10, 11; Maps 3, 4, 5, 9, 10)

Indicators provide standard measures for assessing landscape conditions. Indicators can be used to develop goals, identify priority actions, assess trends, and support the evaluation of scenarios.

Forest Composition Indicators (Appendices 8, 10; Maps 4, 9, 10)

Managing landscapes for biodiversity requires a variety of planning approaches and tools. Sustaining forest composition diversity by reflecting natural patterns of disturbance and succession is one approach that DNR is employing to try and realize this objective. A number of additional approaches and planning tools are being developed which will be integrated with objectives defined in the ELA protocol.

Human activities, such as forest harvesting, can shape the structure and composition of the forested landscape and should be planned to help support landscape composition goals.

At a landscape planning scale, the variety of habitats can be broadly described in terms of the composition of development classes, seral stages, and covertypes.

Development class indicators describe changes in structure and process as forests age and trees grow larger. For landscape management purposes, four development classes are recognized:

- $^{35}_{17}$ forest establishment (0 to 6 m height)
- $^{35}_{17}$ young competing forest (7 to 11 m height)
- $^{35}_{17}$ mature forest (> 11 m height; including multi-aged and old forest)
- $^{35}_{17}$ multi-aged / old forest (multiple layered / Old Forest Policy)

Seral stage indicators describe changes in species composition of forest communities as succession progresses from domination of early seral “pioneer” species following disturbance, toward late seral communities dominated by long-lived, shade-tolerant “climax” species. Seral stage is dependent on the composition of tree species of a forest, irrespective of age. For landscape management purposes, three seral stages are recognized:

- early (seral score 10 to 23)
- mid (seral score 24 to 37)
- late (seral score 38 to 50)

A look-up table (see Appendix 8) assigns each species in the forest inventory a value from one to five representing its position on the successional scale. These values are applied to the species composition data in the forest inventory to calculate a seral score, which may range from 10 to 50.

Covertype indicators further refine landscape composition by distinguishing forests of different community conditions. Management generally recognizes three forest covertypes:

- softwood (overstory cover of softwood species is 75% or more)
- hardwood (overstory cover of hardwood species is 75% or more)
- mixedwood (overstory cover of either softwood or hardwood is between 25% and 75%)

Target Ranges for Composition Indicators

Table 7 provides target ranges for development class and seral stage composition appropriate for different disturbance regimes. These ranges have been derived from the professional judgment of DNR forest ecologists to guide composition objectives for large landscape areas. This guidance can be used to assess how land holdings contribute to the overall ecodistrict structure by referring to the element analysis section which summarizes the levels of these indicators.

A full description of definitions and mapping of Nova Scotia's disturbance regimes is contained in the report "Mapping Nova Scotia's Natural Disturbance Regimes" available from the DNR website (http://novascotia.ca/natr/library/forestry/reports/NDRreport3.pdf).

Table 7 - Landscape Composition Target Ranges (by Development Class / Disturbance Regime)

Natural Disturbance Regime	Development Class			
	Forest Establishment	Young Competing Forest	Mature Forest (including multi-aged and old forest)	Multi-aged and Old Forest
Frequent Stand Initiating	5 - 30%	5 - 30%	>40% early, mid, and late seral representation	>8%
Infrequent Stand Initiating	5 - 20%	5 - 20%	>60% most in mid and late seral stages	>16%
Gap Replacement	0 - 15%	0 - 15%	>70% most in late seral stage	>24%

Forest Vegetation Types for Seral Stages in Each Element

Each element contains a number of forest stands that can be classified by vegetation, soil, and ecosites. The DNR publication ***Forest Ecosystem Classification for Nova Scotia, Part I: Vegetation Types (2010)*** (http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp) is helpful in identifying forest plant communities. Table 8 presents a description of the vegetation types likely to be found within elements, along with the current percentage of each seral stage.

Table 8 – Forest Vegetation Types[1] Within Elements in Cumberland Marshes

Element	Seral Stage					
	Early	% *	Middle	%	Late	%
Red Spruce Hummocks	IH4, IH5, IH6	14.0	MW4, MW5, SH5, SH6, SH7, SH8	34.0	**SH3**	52.0
Spruce Pine Flats	IH4, IH6, SP1	24.0		15.0	**SP7**	56.0
Tolerant Mixedwood Hills	IH5, IH6	13.0	IH7, MW4, MW5, SH5, SH6, SH8	46.0	**MW1**, MW2, SH3	30.0
Red and Black Spruce Hummocks	IH4, IH5, IH6	12.0	CE2, MW4, MW5, SH5, SH6, SH7, SH8	28.0	**SH3, SP7**	34.0
Marshes and Grasslands	Cultivated fields and freshwater wetlands (cattails, willows, alders)					
Salt Marsh	*Grasslands of* Spartina spp.					
Wetlands	CE1, WC1, WC2, WC3, WC5, WC6, WC7, WD2, WD3, WD5, WD6, WD8					

View forest groups and vegetation types at http://novascotia.ca/natr/forestry/veg-types/veg-navigation.asp

To help with identification of vegetation types, the 14 forest groups in Nova Scotia designated by DNR are: Cedar (CE), Coastal (CO), Flood Plain (FP), Highland (HL), Intolerant Hardwood (IH), Karst (KA), Mixedwood (MW), Old Field (OF), Open Woodland (OW), Spruce Hemlock (SH), Spruce Pine (SP), Tolerant Hardwood (TH), Wet Coniferous (WC), Wet Deciduous (WD)

Bolded vegetation types indicate typical late successional community

[1] Forest Ecosystem Classification for Nova Scotia (2010)

*Percentage of element in each successional stage. Percentages may not total 100 due to unclassified lands (such as clearcuts and regenerating stands) not being included.

Land Use Indicators (Appendices 3, 4, 5; Maps 6, 7)

Two indices (Ecological Emphasis Index and Road Index) have been developed to measure the relative pressure that current human land use exerts on ecosystems.

Ecological Emphasis Index (Appendices 11, 12; Map 3)

A variety of land management practices occur across landscapes, ranging from natural reserve areas to highly modified urban environments. Conserving biodiversity requires a balancing of land use practices to sustain ecological integrity.

To assist in assessing land use intensities and develop appropriate practices, four levels of ecological integrity are defined based on the degree that the conservation of natural conditions is emphasized in the management practices and policies applied to the land:

- Reserve, such as parks or wilderness areas
- Extensive, which are lands managed or restored for multiple values using ecosystem-based techniques
- Intensive, optimizing resource production by management techniques that may reduce biological diversity, such as plantations; but also meet the Wildlife Habitat and Watercourses Protection Regulations (NSDNR, 2002)
  (See http://www.gov.ns.ca/natr/wildlife/habitats/protection)

- Converted, lands altered for agriculture, roads, or other human activities

All lands within the ecodistrict are assessed at the stand level and assigned one of these four ecological emphasis classes (EEC) based on past practices. These classes are mapped over all areas of the landscape using a one hectare grid. The Ecological Emphasis Index (EEI) is determined by assigning a weighting value to each class: Reserve (100), Extensive (75), Intensive (25), and Converted (0). An overall index value may be calculated for any area of interest, such as element, ecosection, ecodistrict, or ecoregion, by averaging the index values within the area to provide a relative indication of land use pressure.

A summary of land use intensities provides an overall EEI of 41 to 45 for the ecodistrict (Appendices 12a and 12b). This would suggest that overall intensity of land use for Cumberland Marshes is currently at a changed state affecting both the structure and function to support habitat (for all species) and for biodiversity conservation.

The 18,979 hectares in the Cumberland Marshes Ecodistrict are presently supporting approximately 5,115 hectares of forest, with remaining lands being non-forest ecosystems such as lakes, wetlands, and dykelands.

A GIS-based classification of current land use employing the four ecosystem emphasis classes indicates that 46% of the land within the extensive EEC.

An additional 3% of these lands fall in the intensive EEC and are intensively managed to optimize resource production from sites maintained in a native state (e.g. forested). Despite intensive practices, these lands are an important component of landscape structure and composition. Management may eliminate or reduce the duration of some development processes, particularly mature old forest stages, and may result in non-natural succession, produce unnatural conditions such as plantations continuing exotic species, old field white spruce, and monoculture plantations, or reduce structure and composition below ecologically desirable levels. Forests are protected from fire, insects, and competing vegetation.

The remaining lands are split between the reserve class (4%) and the converted class (40%).

The reserve class is divided into two categories: legal reserves and policy reserves.

Legal reserves have legal status under the IUCN (The International Union for the Conservation of Nature) codes of I, II, or III, such as wilderness areas, protected beaches, or designated provincial parks.

Policy reserves are areas set aside under various provincial policies, such as the Old Forest Policy.

Representation of reserves in Cumberland Marshes is relatively low because of the small percentage (16%) of Crown land holdings. There is opportunity to add additional lands to the reserve class under various private land programs, such as Nova Scotia Nature Trust and Nature Conservancy of Canada by selecting ecosystem community types that presently have insufficient representation or community types that are rare within the ecodistrict or ecoregion.

Converted lands are areas that have been altered by human settlement, farming, urban development, and transportation and utility corridors. These converted lands are predominately located around the major river corridors, villages, and towns. These lands are given a 0 EEI value in their present state but some locations, especially along the river corridors, show opportunity for restorative measures to the predicted climax stands of spruce, elm, sugar maple, and white ash.

DNR will continue to develop and evaluate other measures of conservation risk.

Road Index (Appendices 6, 7; Map 5)

The GIS-based "Road Index" provides a standard assessment and mapping of road distributions across ecodistricts to assist planners to objectively explore options for managing road networks and assess the intersection of road affects with other features of the landscape. Density, distance, and type of linear feature (e.g. road types, power lines) are used to calculate index values that indicate relative road pressure. The index value is mapped over all areas of the landscape using a one hectare grid. The overall index may be calculated for any area of interest, such as element, ecosection, ecodistrict, or ecoregion, by averaging the index values within the area to provide a relative indication of land use pressure. The index provides a numerical indicator of road influence that can be used to monitor temporal changes and compare different landscapes.

In discussing road ecology, Forman (2004) describes five distinctive landscape types in North America: city-suburb, agricultural, forestry, arid-grassland, and natural landscape. Each landscape type has a characteristic pattern of road networks with distinctive ecological effects and planning considerations (Forman & Hersperger 1996). These were adapted in Nova Scotia to classify five Road Index Benchmark Ranges associated with particular land use settings:

- Remote Landscape (RI 0 to 6): Unpopulated with few roads, trails, or other linear features
- Forest Resource (RI 7 to 15: Forest access roads are the primary linear feature
- Mixed Rural (RI 16 to 24): Mixed land use of rural settlement, forestry, and agriculture
- Agriculture/Suburban (RI 25 to 39): Suburban settlement and/or open agricultural fields
- Urban (RI 40 to 100): Urban environment with high building densities, roads, and few tracts of undeveloped land outside municipal parks

Road, trail, and utility corridors are vital components of human land use. However, transportation systems are expensive and produce many undesirable environmental effects, such as chronic siltation, invasion routes for exotic species, fragmentation, loss of productive land, and increased human presence.

Low road density areas are important features for biodiversity conservation. Planning should consider block scheduling options, life expectancy, class requirements, decommissioning strategies, and overall landscape function, in order to develop efficient access systems designed to minimize environmental impacts.

Currently, Cumberland Marshes has an overall RI value of 15 (Appendix 7, Table 3). This value falls within the Forest Resource range of 7 to 15 (Appendix 7, Table 2). Twenty-two percent, or

3,959 hectares, has a Remote RI of 0 to 6 (Appendix 7, Table 2), while 23% is in the Mixed Resource and Rural Settlement class and 20% in the Agriculture and Suburban class.

The highest road densities occur around the settlements, town, and main transportation systems. Road indices of 37 in these areas place them in the Agriculture and Suburban category and are the highest in the entire ecoregion. These high road indexes bisect the ecodistrict in numerous areas because of the number of river corridors and human settlement, contributing to habitat fragmentation.

Opportunities for road and trail improvements include:

- Conserve the relatively low road densities within the matrix (RI of 4 and 9) through strategic scheduling of new access and decommissioning of roads where possible. Private woodland owners may be able to decommission some roads and share access.
- Access systems must be scheduled for regular maintenance or decommissioning, particularly where connectivity or additional reserves are to be established.
- Recreational trails should utilize old abandoned trails or logging roads before additional trails are established.
- Seek to improve the distribution and connectivity among the few low road density areas (Round Lake, Lusbys Marsh, Sand Lake, LaPlanche River, and Minudie Point) where this may improve connectivity among natural areas and linkages to neighbouring ecodistricts.

Fine Scale Features (Appendices 3, 4, 5; Maps 6, 7)

Data on the status and location of priority species, ecological land classification, representivity analysis, and other landscape characterization themes were used to identify special occurrences, rare ecosections, and ecological representivity. These fine scale features, which occur at a sub-landscape level, may require special management practices to conserve their uncommon characteristics.

Lindenmayer and Franklin (2002) refer to the importance of identifying “midspatial-scale” features and “patch-level habitats,” including: 1) aquatic ecosystems, such as streams, lakes, and ponds; 2) wildlife corridors; 3) specialized habitats, such as cliffs, caves, thermal habitats, meadows, and vernal pools; 4) biological hotspots or places of intense biological activity, such as calving sites, over wintering grounds, and spawning habitats; and 5) remnants of old forest.

Priority Species and Other Special Occurrences (Appendix 3; Map 6)

Landscapes and ecosystems comprise many species of plants, animals, and other organisms. Some of these species are given priority in planning, management, and stewardship because they are rare, and/or at risk of going extinct locally or on a larger scale. The status and location of these species are important and data are collected, compiled, and assessed on an ongoing basis.

The primary species data used in this report are from the Atlantic Canada Conservation Data Centre and DNR’s Significant Habitat Database. Efforts are made to ensure data are as accurate and up-to-date as possible. Lists and maps indicate what is currently known. Due diligence tied to

planning, management, and stewardship may require that surveys be carried out to update information or to fill gaps in our knowledge. Priority species may require special actions in terms of forest management and other activities that alter habitat and the landscape. If more information is required or if management specific to a priority species need to be developed, a regional biologist, Wildlife Division staff, or other species experts should be contacted.

This section includes species at risk (refer to Table 1a, Appendix 3), species of conservation concern (Table 1b, Appendix 3), other conservation features (Table 1c, Appendix 3), and heritage features (Table 1d, Appendix 3, where available). *The list of species at risk and species of conservation concern were obtained from the Atlantic Canada Conservation Data Centre (ACCDC) databases, current to 2013*.

Species at Risk

The term "species at risk" is generally used to describe those species that are, to some extent, protected under provincial or federal endangered species legislation. Usually these species are protected where they occur on provincial, federal, and private lands. In Nova Scotia, the two main pieces of endangered species legislation are the Nova Scotia Endangered Species Act (NSESA) and the federal Species at Risk Act (SARA). Species can be classified as "endangered," "threatened," "vulnerable/special concern," or as "extinct" or "extirpated." In most cases for species at risk, recovery planning and special management are in place, as well as legal protection (See http://novascotia.ca/natr/wildlife/biodiversity/at-risk-overview.asp).

Species of Conservation Concern

The term "species of conservation concern" refers to those species that are a high priority for conservation and special attention during planning, management, and stewardship. These species may be rare and/under a variety of threats but the threats do not currently warrant species at risk designation. In some cases these species could meet the criteria for a species at risk but a formal species at risk assessment has not been done. Species of conservation concern are a priority in landscape planning because a focus on them now can prevent these species from becoming species at risk later.

Species Ranking and Coding Systems

A number of ranking and coding systems identify and convey the status of species at risk and species of conservation concern. Some of this information is provided in Appendix 3 and Map 6 and is routinely used in planning, management, and stewardship activities.

Colour-coded "traffic light" systems are used provincially and nationally. These systems use "red to orange/yellow to green" categories to indicate the most at risk species (red) to the least at risk species (green). Details of these systems are available from the Wildlife Division.

A second system commonly used is NatureServe Conservation Data Centre system. This system uses numbers from one (extremely) to five (widespread, abundant) to denote the relative rarity and conservation concern for species. At the provincial scale numbers are prefixed with "S" to

indicate that this is a state/provincial level rank. Ranks at the National (N) and Global (G) levels are also available for all species. In Nova Scotia, the Atlantic Canada Conservation Data Centre (http://www.accdc.com/) works with partners to provide ranks and data on species' occurrence.


Canada geese in marshlands.

As of 2013 in the Cumberland Marshes Ecodistrict, there are documented occurrences (under the NSESA) of the following number of formally listed species: three endangered, three threatened, and two vulnerable. In addition to the listed species, the National General Status process also identified 12 orange species, 38 yellow species, 21 green species, and two undetermined species for a total of 73 other species of conservation concern in this ecodistrict.

Designated species at risk found within Cumberland Marshes include Atlantic salmon, mainland moose, black ash, and several bird species (red knot, common nighthawk, olive-sided flycatcher, bobolink, and Canada warbler).

Other species of conservation concern in the Cumberland Marshes Ecodistrict include spotted sandpiper and common loon (birds); Warnstorf's peat moss (bryophytes); bog willow, halberd-leaved tearthumb, cuckoo flower (plants); meadow horsetail (ferns and their allies); taiga bluet and ebony boghaunter (insects); eastern lampmussel and tidewater mucket (mollusks).

Birds

As of 2013, seven species of birds found to be present in the ecodistrict are designated at risk.

Five of these are listed under the NSESA: red knot and Canada warbler as endangered; common nighthawk and olive-sided flycatcher as threatened; and the bobolink as vulnerable. Nationally, four species are listed under SARA: common nighthawk, olive-sided flycatcher, and Canada warbler as threatened; and short-eared owl as special concern. COSEWIC has listed seven species: the red knot as endangered; common nighthawk, olive-sided flycatcher, bobolink, wood thrush, and Canada warbler as threatened; and short-eared owl as special concern.

Generally, there has been a nationwide decline in aerial insectivores, such as the olive-sided flycatcher and common nighthawk, which is commonly attributed to a decline in flying insects.

The bobolink is associated with large open grasslands and hayfields and declines are due to mortality from agricultural practices, habitat loss and fragmentation, and bird control methods. Habitat loss and land use practices, particularly on wintering grounds, are believed to have contributed to the widespread decline of Canada warbler, wood thrush, and olive-sided flycatcher. The common nighthawk prefers open habitats such as beaches, dunes, grasslands, barrens, pastures, recently cleared lands, and flat graveled roof tops in urban areas. The decline in the common nighthawk population is likely attributed to habitat loss and modifications along with reduced availability of flying insects.

The short-eared owl prefers large open habitats, such as coastal marshes and interior grasslands, and it is suggested that population declines are due to habitat loss and alteration.

The red knot was identified as endangered under NSESA in 2007 based on provincial surveys that showed a population decline. The primary cause of the decline is considered to be the depletion of horseshoe crabs whose eggs are a critical food source during the spring migration.

Plants

Two plant species listed at risk are documented for Cumberland Marshes.

In 2013, black ash was listed under the NSESA as threatened. There are an estimated 1,000 individuals and 12 mature trees in the province. There are only two documented locations in the ecodistrict, both on the fringe near Maccan and Fenwick.

In 2013, Eastern white cedar was listed under NSEA as vulnerable. Only 32 stands are identified provincially. The population is fragmented and comprises small stands that appear genetically separate from each other. This species is typically found in riparian areas, woodland forests, and old pastures, preferring nutrient rich, cool and moist habitats. In the Cumberland Marshes Ecodistrict, two locations are documented in the Amherst Point Migratory Bird Sanctuary.

Fish

The Maccan River and River Hébert are the two major rivers in the Cumberland Marshes Ecodistrict. Both are tidal rivers that flow north into Chignecto Bay.

Historically, Atlantic salmon have utilized these rivers for spawning and continue to make some use of the available habitat they present. The Inner Bay of Fundy salmon population has steadily declined over the last 20 years and has been designated as endangered by COSEWIC and protected under the federal Species at Risk Act. The decline in Atlantic salmon is not well understood but evidence suggests that low marine survival is a primary cause which may be due to ecological changes in the Bay of Fundy. Other threats to this species include environmental contaminants, habitat loss and degradation, lack of riparian buffers along waterways, water passage obstruction, and lack of pools.

Insects

Monarch butterflies are designated by COSEWIC and listed under SARA as special concern but have no provincial listing. They are grouped with the milkweed butterflies of the family Danaidae, which also includes the viceroy. The monarch is the most common of this group, occurring throughout the United States and southern Canada and it is also one of the few butterflies that are migratory.

Monarch habitat in Nova Scotia includes fields, meadows, abandoned farmland, and roadsides that have a presence of milkweed. Monarchs will only lay their eggs on the leaves of milkweed, which

is the primary food for the developing caterpillars. Adults may occasionally be observed after the breeding season in the Cumberland Marshes Ecodistrict as they may in other areas of the province.

Mammals

Moose on the mainland of Nova Scotia have been listed as endangered under the Nova Scotia Endangered Species Act (2003). Mainland moose are genetically distinct from those on Cape Breton Island, where moose populations are healthy. The Cumberland Marshes Ecodistrict has moose habitat mainly along the eastern boundary of the area. Moose are transient in this ecodistrict and likely move across the provincial boarder east of Fort Lawrence.

Moose are commonly associated with forested landscape habitats that have been altered or disturbed by an event such as fire, wind, disease, or timber harvesting. The habitat requirements of moose are largely dependent on successional forest stages. Early succession hardwood trees and shrubs provide important browse while mature conifer cover are valuable for shelter, thermal cover, and protection in winter and summer. Secluded wetland areas with and abundance of emergent vegetation are used for feeding and cooling during the summer. The availability of suitable habitat for endangered mainland moose is important in maintaining its future presence.

Special management practices for mainland moose are applied for forestry activities on Crown land in designated concentration areas
(See http://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_Mainland_Moose.pdf).

Application of these practices during forest management planning specifically aim to conserve calving areas, aquatic feeding areas, and thermal refugia. The Forest / Wildlife Guidelines and Standards provide minimal habitat specifications for moose on Crown land through the 8% retention for old growth and maintenance of reasonable age class distribution.

Old Forest

The Interim Old Forest Policy requires a minimum of 8% of Crown land within each ecodistrict be identified and protected. The stands are selected to provide representation of landscape elements with the best old forest and old forest restoration opportunities. *In 2012, DNR released an updated Old Forest Policy, containing new integrated resource management (IRM) decision-making procedures. (http://novascotia.ca/natr/library/forestry/reports/Old-Forest-Policy-2012.pdf).*

Rare Ecosections (Appendices 3, 12b; Map 7)

The Ecological Land Classification for Nova Scotia (Neily et al. 2003) classifies ecosections based on similar characteristics of landform, soils, and vegetation. These are the smallest mapped unit, and they repeat within ecodistricts. Ecosections have characteristic natural disturbance regimes and climax types.

Landscape elements were identified by combining ecosections with similar characteristics. Table 9 provides explanations of ecosections and their relationship to elements.

Ecosections that are rare (< 2% of ecodistrict area) or under high land use pressure (> 75% land conversion) are identified in Appendix 3.

Table 9 – Elements, Ecosections, Disturbance Regimes and Climax Types

550 Cumberland Marshes Ecodistrict			
Landscape Element and Type	**Ecosections***	**Dominant Natural Disturbance Regime**	**Dominant Climax Type**
Marshes and Grasslands (Matrix) *Includes small element Salt Marshes*	DKLD XXSM	Open Seral (Frequent)	
Red and Black Spruce Hummocks (Patch)	IMHO	Frequent	red Spruce (rS), black Spruce (bS), white Pine (wP)
Wetlands (Patch)	IFSM WTLD	Open Seral (Frequent)	
Spruce Pine Flats (Patch)	IMSM	Frequent	bS, wP, jack Pine (jP), red Pine (rP)
Tolerant Mixedwood Hills (Patch)	IMRD	Gap	rS, wP, sugar Maple (sM), yellow Birch (yB), Beech (Be)
Red Spruce Hummocks (Patch)	WMHO	Frequent	rS
Valley Corridors (Corridor)	Various	Various	Various

***Ecosection Explanations**: For example, in **WMHO**, **W** stands for Well-drained under Soil Drainage **M** stands for Medium-textured under Soil Texture and **HO** stands for Hummocky under Topographic Pattern

Soil Drainage: **W –** Well-drained **I –** Imperfectly drained **P** – Poorly drained **WTLD** – Wetland

Soil Texture: **C** – Coarse-textured soils (e.g. sands) **M** – Medium-textured soils (e.g. loams) **F** – Fine-textured soils (e.g. clays)

Topographic Pattern: **SM** – Smooth or flat **KK** – Hills **HO** – Hummocky **DM** – Drumlinoid **RD** – Ridges **DS** – Canyons and steep slopes

None of the seven ecosections within the ecodistrict represent less than 2% of the area. The IMRD, DKLD, WTLD, and IMSM ecosections represent 2% or less of the ecoregion.

The IMRD ecosection located within the mixedwood patch has the highest land use pressures

85% converted to agriculture, settlement, and other development activities. Old growth stands have been identified on 11 hectares, or 4.5% of Crown lands, under the Old Forest Policy (Appendix 5).

Practices or policies that might be implemented or devised to address conservation issues include:

- Recognition of uncommon forest species that may have their genetic viability threatened, as indicated by DNR's Endangered Species Rating System of yellow and red listed species.
- Fine filter management opportunities related to conservation of significant habits.
- Uncommon community conditions (e.g. old age, large live and dead trees, and species associations). Increased representivity in uncommon old forest communities.
- Implementation of restorative measures in community types such as red spruce, yellow birch, sugar maple, and beech stands or black spruce and red spruce communities where conversion to other uses is high.

Ecological Representivity (Appendices 4, 5)

Ecological representivity describes the degree that the range of natural ecosystem diversity (elements, ecosections) is secured within reserve systems (e.g. Parks, Wilderness, Old Growth Policy).

The overall goal is biodiversity conservation through protection of natural habitat diversity. Ecological representation is employed as a "coarse scale" ecosystem planning concept. The analysis evaluated and identified the reserve status of the ecosections and climax communities located within the ecodistrict where two levels of reserves were recognized: legally protected reserves, such as Wilderness Areas; and policy protected reserves under the IRM classification to include old forest, Eastern Habitat Joint Venture Sites, non-designated provincial park reserves and non-designated sites of ecological significance.

There are no legally protected reserves or wilderness areas in Cumberland Marshes. There are, however, 980 hectares under the policy reserves that include old forest sites set aside under the provincial Old Forest Policy, along with National Wildlife Management Areas, National Wildlife Sanctuaries, and two hectares of private lands under the Eastern Habitat Joint Venture Program.

The lands under the reserve classes account for about 5% of the area of the Cumberland Marshes.

Provincial Crown lands have approximately 33% of their lands under policy reserves. Opportunities to improve representation will have to be directed to private lands in the form of Eastern Habitat Joint Venture Programs, Nova Scotia Nature Trust, and Nature Conservancy of Canada. Strategies to improve representation should include:

- Enhancing connectivity among wetlands and river corridors.
- Recognizing importance of uncommon or rare climax community types: red spruce, sugar maple, yellow birch, and beech in the Tolerant Mixedwood Hills patch element, with the IMRD ecosection at 3% in the ecodistrict and 2% in the ecoregion; red spruce in the Red Spruce Hummocks patch element, representing 3% in the ecodistrict and 11% in the

ecoregion. Both community types under very heavy land use conversions and low EEI values.

ELA Summary

Element Interpretation (All appendices and maps)

Cumberland Marshes provides a natural boundary between Nova Scotia and New Brunswick at the Chignecto Isthmus. The level terrain, much of it underlain by tidal sediments deposited from Chignecto Bay and the Bay of Fundy, created extensive salt marshes of cordgrass.

Cumberland Marshes occupies a large area at the head of the Cumberland Basin where the flat imperfect to poorly drained terrain meets the sediment-loaded waters of the Bay of Fundy. The grasslands occupy much of the former salt marshes that have been dyked and are no longer exposed to siltation. Bogs, wetlands, lakes, and peat lands comprise a large portion of the ecodistrict. Most of the forested sections of the ecodistrict are frequently disturbed by stand-initiating events such as windstorms and insects (e.g. spruce budworm).

Early Acadian settlers to the area, around 1700, constructed dykes to keep out the saltwater and to develop fertile farmland. Dyke construction and maintenance has continued to reduce the area of natural salt marshes.

The ecodistrict receives strong winds and experiences cooler than normal temperatures than elsewhere in the ecoregion due to its proximity to the bay.

The ecodistrict predominantly comprises imperfectly drained to poorly drained soils. Approximately 52% of the ecodistrict occurs as peat lands and bogs. The peat lands are about one metre thick and have formed in the low lying depressions of the ecodistrict. The mineral soils reclaimed from the salt marshes are mainly silty clay loams showing minimal horizon development because of the continuous deposition of marine sediments prior to dyke construction. The mineral soils adjacent to the peat lands are usually poorly drained sandy loams.

The Fort Lawrence ridge is the only portion of the ecodistrict where a shade-tolerant mixedwood forest occurs. Inland ecosections often favour black, red or hybrid spruce, red maple, and tamarack.

Marshlands and Grasslands
(Matrix) (DKLD) ecosections) (6,061 ha)

The matrix has been extensively altered through agriculture, wildlife management, human settlement, roads, and utility corridors.

The early settlers farmed the area by cutting channels to the sea through which the sediment-rich waters of Chignecto Bay flowed to deposit silts above the peat. This dyking controlled the natural siltation.

In the past, the Cumberland Marshes and the Tantramar Marshes in New Brunswick were called the "World's Largest Hayfield." Hay was shipped to customers along the Eastern Seaboard and Europe as late as the 1930s. The hay was rich in iodine, making it a valuable source of healthy, high quality fodder. The John Lusby Marsh is the only remaining salt marsh in the area that is still subject to siltation. The Acadians dyked the marshland until 1955.

In the 1800s, a system of tide channels and ditches transformed more of the marshland to fertile pastures. Where the dykelands have been maintained for agricultural use they are covered by a variety of forage, grain, and introduced plants. Many of the farms on the Cumberland Marshes were later abandoned.

Extensive development on both sides of the marshes in New Brunswick and Nova Scotia may be threatening species' movement and flows from one province to another.

The matrix element is only 9% forested. There is a good distribution of the amount of forest in each of the development classes. Sixty-two percent of the forest is in the late seral stage with black spruce and red spruce dominating.

The EEC indicates that the index of DKLD is 27, indicating an extensive conversion to non-forest uses.

Flows

People (agriculture, transportation, pipeline, power line); water (catchment, wildlife habitat, filtering); deer (travel, general percolation); moose (travel, general percolation); furbearers (muskrats, mink, beaver, otter); osprey (food, habitat); eagle (food, habitat); rare plants (small white leek, blue cohort, yellow Canada lily); fish (salmon, eels, trout).

Composition

Cumberland Marshes Ecodistrict 550 (based on statisticsup to 2006)

Composition of Marshes and Grasslands

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	31%	24%	45% (37 Mat + 8 OF)	8%
Seral Stage	Early	Mid	Late	Unclassified
	9%	14%	62%	15%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	71%	15%	13%	1%

Desired Condition

A series of undisturbed saltwater and freshwater marshes and grasslands with inclusions of lakes, bogs, and peat lands.

Issues

- Matrix element of ecodistrict has some of the highest conversions and lowest Ecological Emphasis Indices in the province.
- Additional development may threaten species' movement and flows from New Brunswick and Nova Scotia.
- Only 2% representation of reserve lands within the dykeland ecosection (Appendix 4).

Red and Black Spruce Hummocks
(Patch) (IMHO ecosection) (4,856 ha)

The red and black spruce patch element comprises three main areas at Barronsfield / Minudie, Lower Maccan, and Amherst Marsh / Fort Lawrence Ridge. Smaller sections of this patch type occur between Goose Lake and Round Lake.

This element is still predominately softwood (65%) but the mixedwood and hardwood makes up 19% and 14% respectively. The development classes are fairly well-balanced with a slight over-abundance in the establishment class. Mid-seral species of red maple, white birch, balsam fir, and spruce dominate the mixedwood and hardwood covertypes. Only 36% of the forest is in the late seral stages while 40% is in the early and mid-seral stages with aspen, red maple, grey birch, and balsam fir dominating (Appendix 10). White spruce comprises 11% of early successional species. The IMHO ecosection has 761 hectares, or 16% of the total patch element, converted to a non-forest condition.

The EEC range is 49 to 59, indicating relatively high land use pressures for this patch element. The Road Index value is 9, which places the patch element in the Forest Resource class.

Flows

People (forestry, agriculture); water (catchment, drainage, filter); deer (seasonal habitat).

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)
Composition of Red and Black Spruce Hummocks

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	35%	19%	46% (39 Mat + 7 OF)	7%
Seral Stage	Early	Mid	Late	Unclassified
	12%	28%	36%	24%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	65%	14%	19%	2%

Desired Condition

A softwood dominated patch type of red and black spruce with a mixture of development classes and seral stages consistent with frequent stand-initiating disturbances.

Issues

- Mid-seral species of white birch, red maple, and balsam fir dominate the mixedwood and hardwood covertypes.
- White spruce comprises 11% of early successional species.
- IMHO ecosection (bS) has 761 hectares, or 16% of the total patch element, converted to a non-forest condition.
- Relatively high land use pressures are associated with the entire element with human settlement, urban development, and road construction.
- No reserve lands associated with the IMHO ecosection and the black spruce community are within this element type.

Wetlands

(Patch) (IFSM and WTLD ecosections) (2,289 ha)

A series of medium and large wetland patches that are found throughout the ecodisctrict. These wetland patches and marsh areas are some of the most important and valuable waterfowl habitat in the province. The Missaguash Bog, Lusbys Marsh, and the area around the Minudie Marsh are the larger wetland complexes.

Only 24% of these wetlands are forested with red spruce, black spruce, scattered red pine, red maple, and eastern larch, with sphagnum and sedges on the imperfectly drained areas. Poorer stunted black spruce, red maple, larch, and shrubs are found on the poorly drained areas (Appendix 10, Table 2).

Flows

People (recreation, water supply for Amherst); water (catchment, filtering, wildlife habitat); deer (seasonal habitat); furbearers (habitat - muskrats, otter, mink, beaver); osprey (food); eagle (food); rare plants (blunt-leaf roundweed, whorled water milfoil).

Composition

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)

Composition of Wetlands

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	36%	21%	43% (35 Mat + 8 OF)	8%
Seral Stage	Early	Mid	Late	Unclassified
	5%	20%	70%	25%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	68%	6%	26%	0%

Desired Condition

A variety of wetland types and complexes that are interconnected to the hydrological system.

Issues

- Urban sprawl and infilling of important productive ecosystems continues.
- Approximately 15% of this element type and community has been placed in policy reserves.

Spruce Pine Flats
(Patch) (IMSM ecosection) (698 ha)

The patch type is inherently imperfectly drained, medium-textured with a smooth topography of black spruce. Almost 80% of the forest within the element is classified as a softwood covertype.

The development classes are slightly unbalanced with only 11% of the forest in the establishment class and 24% in the mature development class. Fifty-five percent of the forest is still in a late seral stage with red spruce, black spruce, and white pine dominating. Twenty-four percent of the forest is in the early successional stage with aspen, white birch, white spruce, and balsam fir dominating.

The black spruce community type is under heavy land use pressures by agriculture, forestry, settlement, and development as indicated by the EEI range of 22 to 23. Sixty-six percent of these lands have been converted (Appendix 12a).

Flows

People (forestry, agriculture, recreation); water (catchment, drainage, filter); deer (seasonal habitat); moose (habitat).

Composition

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)
Composition of Spruce Pine Flats

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	12%	40%	48% (24 Mat + 24 OF)	24%
Seral Stage	Early	Mid	Late	Unclassified
	24%	15%	56%	5%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	79%	6%	14%	1%

Desired Condition

Late seral softwood stands and softwood-dominated mixedwoods with a variety of development classes and seral stages appropriate for the disturbance regime.

Issues

- Black spruce within this ecosection represents 4% of the ecodistrict but only 1% of the ecoregion.
- Road Index of 25 places this element type in the Agriculture and Suburban class.
- Possibility exists of decommissioning roads where applicable.
- Total of 6% of the black spruce within Spruce Pine Flats has been set aside as Old Forest under the departments Interim Old Forest Policy.

Tolerant Mixedwood Hills
(Patch) (IMRD ecosection) (543 ha)

The mixedwood patch occurs as a single patch in the Fort Lawrence Ridge area. Historically this patch type was a mixedwood covertype of red spruce, sugar maple, yellow birch, and beech located on an imperfectly drained medium-textured soil. The present area is only 11% forested with red and black spruce, white spruce, balsam fir, red maple, aspen, and white birch.

Only 40% of the forest is in the mature development class. Fifty-nine percent of the forest is in the early and mid-seral stages. The IMRD ecosection only represents 3% of the ecodistrict and 2% of the ecoregion. Almost the entire area has been converted to non-forest use. The EEI range is 9 to 10, the lowest EEI within the entire ecoregion.

The Road Index is 28, placing the element in the Agriculture and Suburban class.

Flows

People (agriculture); deer (seasonal habitat); osprey (hunting, food); eagle (hunting, food); rare plants (northern white cedar, Downey willow herb, Adders tongue, purple clematis).

Composition

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)
Composition of Tolerant Mixedwood Hills

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	16%	35%	49% (40 Mat + 9 OF)	9%
Seral Stage	Early	Mid	Late	Unclassified
	13%	46%	30%	11%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	81%	5%	14%	0%

Desired Condition

A mixedwood community type of red spruce, sugar maple, yellow birch, and beech with at least 60% of the forest in the mature, multi-aged, and old growth development classes. Most of this forest should be in the mid and late seral stages.

Issues

- Small element has a lack of representation.
- Conversion rates in element exceed 80% (Appendix 3, Table 2).
- An extremely low EEI (9 to 10) is a result of conversion.
- There is no representation of the rSsMyB and Be community type.

Red Spruce Hummocks

(Patch) (WMHO ecosection) (358 ha)

The Red Spruce Hummocks patch type occurs as very small fragmented patches in the Amherst Point and Nappan River area. Sixty-eight percent of the forest is still softwood with mixedwood and hardwood comprising 13% and 17% respectively. One percent of the forest land is not classified. Fifty-two percent of the forest is in the late successional stage with red and black spruce dominating.

Early and mid-successional species of red maple, aspen, white spruce, white birch, and balsam fir comprise 48% of the forested land. Only 5% of the forest in this patch type is in the establishment development class (Appendix 10). This patch type has very high land use pressures as indicated by the very low EEI of 28. Sixty-four percent of the patch type has been converted to a non-forest use (Appendix 12a).

The Road Index is 27, which places this element type in the Agriculture and Suburban class.

Flows

People (transportation, forestry, recreation); deer (habitat); moose (general percolation); rare plants (Fries Pondweed, Hickeys clubmoss).

Composition

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)
Composition of Red Spruce Hummocks

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	5%	21%	74% (60 Mat + 14 OF)	14%
Seral Stage	Early	Mid	Late	Unclassified
	14%	34%	52%	0%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	69%	17%	13%	1%

Desired Condition

A softwood-dominated patch type of red spruce with small inclusions of mixedwoods and hardwoods. A variety of development classes for the frequent disturbance regime and at least 40% of the forest in the mature development class is desired.

Issues

- Element has a low EEI of 49 to 59 with very high conversions within the ecodistrict (Appendix 12a).
- Only 16% of Red Spruce Hummocks is now forested (Appendix 3, Table 2).
- Road index of 27 places the element type in the Agriculture and Suburban class.
- Thirty-four percent of the forest has mid-seral species associations.
- Red spruce element occurs as relatively small (358 ha) fragmented patches in Amherst Point and Nappan.
- Only 2.7% of this element and community type has reserve status.

Valley Corridors

(Corridor) (Various ecosections) (2,103 ha)

These main river corridors are the Lower River Hébert and the Maccan, Nappan, and LaPlanche rivers. These corridors inherently contained late seral softwoods of red and black spruce. However, the forests within these systems have been significantly altered by concentrated human activity that has created settlements, agricultural fields, intersecting roads, power lines, and other linear features. Forty-seven percent of the corridors have been converted to other land uses. The remaining forests along these corridors have fairly balanced development classes but only 31% of the forest is in the late successional stage (Appendix 10, Table 1). Fifty-six percent of the forest is dominated by white spruce, red maple, balsam fir, larch, and white birch (Appendix 10, Table 2).

Flows

People (farming, canoeing, fishing, settlement, roads, forestry); water (major drainage - permanent and secondary); deer (travel); furbearers (travel, food shelter); osprey (food, habitat); eagle (food, habitat); fish (Atlantic Salmon, gaspereau, shad, mussels, eels).

Composition

Cumberland Marshes Ecodistrict 550 (based on statistics up to 2006)

Composition of Valley Corridors

Development Class	Establishment	Young Competing	Mature (incl. multi-aged and old forest)	Multi-aged and Old Forest
	15%	21%	64% (56 Mat + 8 OF)	8%
Seral Stage	Early	Mid	Late	Unclassified
	37%	19%	31%	13%
Covertype	Softwood	Hardwood	Mixedwood	Unclassified
	47%	35%	13%	5%

Desired Condition

A series of slopes and intervales in a natural forest condition with some inclusions of altered land use features is desired.

Issues

- Forty-seven percent of these corridor systems have been altered by human activity, such as settlements, agriculture, power lines, roads, and other linear features.
- Functional integrity of the river systems and the flows and linkages provided to various species are important.
- Only 2% representation is found within Valley Corridors.

Ecosystem Issues and Opportunities (All appendices and maps)

Management of the forest resource in the Cumberland Marshes Ecodistrict should focus on forest biodiversity conservation across the range of spatial scales. General principles could include maintenance of connectivity, maintenance of landscape heterogeneity, maintenance of stand structural complexity, and maintenance of the integrity of aquatic systems (Lindenmayer and Franklin 2002). Actions taken toward these principles could consider:

- High conversion within the DKLD, IMRD, IMSM, and WMHO ecosections.
- Additional development that may reduce or eliminate species movement between Nova Scotia and New Brunswick.
- Early and mid-seral species dominate some of the element types.
- Low EEI for the ecodistrict.
- Rare ecosections within the ecodistrict and ecoregion.
- High road indices throughout the ecodistrict.
- Quantity of natural or artificial regeneration in white spruce.
- Insufficient representation within many of the element types.

Appendix 1: Flow - Element Interactions

Element	People	Water	Deer	Moose	Furbearers	Wood Turtle	Osprey	Eagle	Rare Plants	Fish
Matrix										
Marshes and Grasslands (DKLD)	Agriculture, transportation pipeline, power line	Catchment, wildlife habitat, filtering	travel (general percolation)	travel (general percolation)	Habitat - rat, mink, otter, beaver		Food, habitat	Food, habitat	- small white leek, blue cohort, yellow Canada lily	Trout, eels, salmon
Patches										
Red and Black Spruce Hummocks (IMHO)	Forestry, Agriculture	Catchment, drainage, filtering	Seasonal habitat	habitat						
Wetlands (WTLD)	Recreation - water supply for Amherst	catchment - filtering - wildlife habitat	Seasonal habitat		Habitat for muskrats, otter, mink, beaver		Food	Food	Blunt-leaf Roundweed, whorled water milfoil	
Spruce Pine Flats (IMSM)	Forestry, Agriculture Recreation	Catchment, drainage, filtering	Seasonal habitat	habitat						
Tolerant Mixedwood Hills (IMRD)	Largely converted to agriculture		seasonal habitat				Hunting -food	Hunting - food	Northern white cedar - Downy willow herb, adders tongue, purple clematis	
Red Spruce Hummocks (WMHO)	Transportation, Forestry Recreation		habitat	Movement (general percolation)					Fries Pondweed, Hickeys Clubmoss	

Appendix 1: Flow - Element Interactions

Element	People	Water	Deer	Moose	Furbearers	Wood Turtle	Osprey	Eagle	Rare Plants	Fish
Valley Corridors	———	———	———	———	———	———	———	———	———	———
River Hébert	farming, canoeing, roads, fishing, settlement	major drainage, permanent and secondary	travel summer habitat	summer travel	travel, food, shelter	habitat	food, habitat	food, habitat	triangle floater, halberd-leaf tear thumb	Atlantic salmon gaspereau, shad, mussels eels
Maccan River	farming, canoeing, roads, fishing, settlement	major drainage, permanent and secondary	travel summer habitat	summer travel	travel, food, shelter	habitat	food, habitat	food, habitat	yellow Canada lily, blue Cohort	Atlantic salmon trout
LaPlanche River	roads, settlement, forestry, canoeing, boating, camping	major drainage, permanent and secondary	travel	———	travel, food, shelter	———	food, habitat - Blue Heron habitat	food, habitat	———	- trout - eels, perch
Nappan River	settlement forestry	major drainage, permanent and secondary	travel	———	travel, food, shelter	———	food, habitat	food, habitat	yellow Canada lily	Atlantic salmon

Appendix 2a: Landscape Connectivity Worksheet

Feature	Structure Type (corridor, matrix, patch, island)	Importance in Ecodistrict (high, moderate, low)	Significant Cases (species, ecosections, specific rivers)	Scale and Pattern of Operation (local, landscape)	Associated Natural Disturbance Regime	Characteristic Community	Characteristic Neighbour(s)	Barriers - Impediments to Functionality	Significant Issues	Management Strategy
Marshes and Grasslands	Matrix	High	- Minudie Marsh, - LaPlanche River area	Large prominent matrix occurring in three large patches	Non-forest	Grassland farmland	Chignecto Bay, wetlands and patches of rS and bS	Extensive road network - development urban sprawl	wildlife conservation	Maintain this important ecosystem for wildlife habitat - add additional Eastern Habitat Joint Venture lands - acquisitions
Red and Black Spruce Hummocks	Patch	Moderate to High	Barronsfield - Lower Maccan	Large fragmented patches	Frequent (fire/wind)	rS bS	- wetlands - dykelands	change of land use - conversion	wildlife connectivity to New Brunswick - well fields - water quality	Manage for climax community type - restore converted lands where possible - manage for water quality
Wetlands	Patch	High	Chignecto Bird Sanctuary - Lusbys Marsh	numerous wetlands large and small over entire ecodistrict	Open Seral	open bogs, partially treed stunted bS and ericaceous vegetation	rS bS patches - grasslands agricultural lands	roads	potential infilling/urban sprawl	- reduce human footprint - eliminate infilling - freshwater and saltwater wetlands are extremely important in this ecodistrict.
Spruce Pine Flats	Patch	Moderate	West Amherst	small fragmented patches - heavy land use pressures	Frequent	bS	wetlands, dykelands, grasslands	- roads - development	conversion to other uses	restore converted lands
Tolerant Mixedwood Hills	Patch	Moderate	Fort Lawrence Ridge	Small single patch	Infrequent	rSsMyBBe	- rSbS - dykeland	extensive road network - conversion to agriculture	wildlife conversion	restore forest community
Red Spruce Hummocks	Patch	Moderate	Nappan River area	very small fragmented patches	Frequent	rS	bS dykelands	road systems - conversion	wildlife connectivity to New Brunswick	restore climax community - reduce conversion
Valley Corridors	River Corridors	High	River Hébert - Maccan River - LaPlanche River	large significant rivers that dissect southern sections of the ecodistrict	Frequent	rS bS interval lands	dykeland, wetlands, saltmarshes	settlement development	discontinuous forest cover - settlement - agriculture - forestry	Maintain and/or restore continuity

Appendix 2b: Connective Management Strategies

Structure Type	Attributes	Conditions of Concern	Management Strategies
Matrix	percolation, large patch, interior habitat	fragmentation, excessive edge	1. Promote contiguous forest structure using strategies such as patch aggregation and overstory-sustaining selection cutting 2. Promote large patch structure and interior conditions 3. Mitigate large scale, long term, fragmentation of the matrix that could impede percolation 4. Manage age and structure appropriate to NDR. For gap and infrequently disturbed ecosections maintain 60% mature cover
Patch Ecosystems	patch size, nearest neighbour, edge / interior, intervening habitat condition	undesirable connections, internal composition, excessive separations, threats to key patch	1. Identify and map key patch representatives (high quality, or critical link/distance) 2. Maintain natural isolations, as well as necessary "nearest neighbour" distances 3. Identify potential metapopulation habitat dynamics (if applicable)
Linear Corridors	continuous connection	barriers, interruptions, excessive edge	1. Mitigate unnatural barriers 2. Map and Manage along natural boundaries 3. Conserve "interior" conditions where appropriate through strategic management of neighbouring ecosystems 4. Sustain continuity, through management of overstory and interior structure appropriate to NDR 5. Follow habitat regulations for buffer management. Establish wider buffers with natural boundaries along major waterways

Appendix 3: Special Occurrences (Ecodistrict 550)

Table 1a: Species at Risk (species protected by endangered species legislation on all lands)

SPECIES		DESIGNATION		
Common Name	**Scientific Name**	**Provincial**	**Federal**	**COSEWIC**
BIRDS	-			
Short-eared Owl	*Asio flammeus*	N/A	Special Concern	Special Concern
Red Knot	*Calidris canutus rufa*	Endangered	N/A	Endangered
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened
Bobolink	*Dolichonyx oryzivorus*	Vulnerable	N/A	Threatened
Wood Thrush	*Hylocichla mustelina*	N/A	N/A	Threatened
Canada Warbler	*Wilsonia canadensis*	Endangered	Threatened	Threatened
DICOTS	-			
Black Ash	*Fraxinus nigra*	Threatened	N/A	N/A
FISH	-			
Atlantic Salmon - Inner Bay of Fundy population	*Salmo salar pop. 1*	N/A	Endangered	Endangered
GYMNOSPERMS				
Eastern White Cedar	Thuja occidentalis	Vulnerable	N/A	N/A
INSECTS	-			
Monarch	*Danaus plexippus*	N/A	Special Concern	Special Concern
MAMMALS	-			
Moose	*Alces americanus*	Endangered	N/A	N/A

Appendix 3: Special Occurrences (Ecodistrict 550)

Table 1b: Other Species of Conservation Concern (other species that are a priority for planning, management, and stewardship action)

SPECIES		DESIGNATION	
Common Name	**Scientific Name**	**Provincial General Status Rank**	**ACCDC S-Rank***
BIRDS	-		
Spotted Sandpiper	*Actitis macularius*	Sensitive (Yellow)	S3S4B
American Bittern	*Botaurus lentiginosus*	Sensitive (Yellow)	S3S4B
Least Sandpiper	*Calidris minutilla*	Secure (Green)	S1B,S5M
Semipalmated Sandpiper	*Calidris pusilla*	Sensitive (Yellow)	S3M
Semipalmated Plover	*Charadrius semipalmatus*	Secure (Green)	S1S2B,S5M
Killdeer	*Charadrius vociferus*	Sensitive (Yellow)	S3S4B
Black Tern	*Chlidonias niger*	May Be At Risk (Orange)	S1B
Blackpoll Warbler	*Dendroica striata*	Sensitive (Yellow)	S3S4B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Sensitive (Yellow)	S3S4B
Willow Flycatcher	*Empidonax traillii*	Sensitive (Yellow)	S2B
American Coot	*Fulica americana*	Undetermined (Undetermined)	S1B
Wilson's Snipe	*Gallinago delicata*	Sensitive (Yellow)	S3S4B
Common Loon	*Gavia immer*	May Be At Risk (Orange)	S3B,S4N
Hudsonian Godwit	*Limosa haemastica*	Sensitive (Yellow)	S3M
Gray Jay	*Perisoreus canadensis*	Sensitive (Yellow)	S3S4
Black-backed Woodpecker	*Picoides arcticus*	Sensitive (Yellow)	S3S4
Virginia Rail	*Rallus limicola*	Undetermined (Undetermined)	S2B S3B,S5M
Greater Yellowlegs	*Tringa melanoleuca*	Sensitive (Yellow)	S2S3B
Willet	*Tringa semipalmata*	May Be At Risk (Orange)	S1?B,S4S5M
Solitary Sandpiper	*Tringa solitaria*	Secure (Green) Sensitive	S3S4B
Wilson's Warbler	*Wilsonia pusilla*	(Yellow)	
BRYOPHYTES			
a Moss	*Leucodon andrewsianus*	Sensitive (Yellow)	S2S3
Warnstorf's Peat Moss	*Sphagnum warnstorfii*	Sensitive (Yellow)	S2S3
DICOTS			
Cuckoo Flower	*Cardamine pratensis var. pratensis*	May Be At Risk (Orange)	S1
Prickly Hornwort	*Ceratophyllum echinatum*	May Be At Risk (Orange)	S2?
Purple Clematis	*Clematis occidentalis*	May Be At Risk (Orange)	S1
Purple-veined Willowherb	*Epilobium coloratum*	Sensitive (Yellow)	S2?
Downy Willowherb	*Epilobium strictum*	Sensitive (Yellow)	S3
Philadelphia Fleabane	*Erigeron philadelphicus*	Sensitive (Yellow)	S2
Yellow-seeded False Pimperel	*Lindernia dubia*	Secure (Green)	S3S4

Appendix 3: Special Occurrences (Ecodistrict 550)

Table 1b: Other Species of Conservation Concern (other species that are a priority for planning, management, and stewardship action)

SPECIES		DESIGNATION	
Common Name	**Scientific Name**	**Provincial General Status Rank**	**ACCDC S-Rank***
Water Beggarticks Farwell's	*Megalodonta beckii*	Sensitive (Yellow)	S3
Water Milfoil Whorled	*Myriophyllum farwellii*	Sensitive (Yellow)	S2
Water Milfoil Halberd-	*Myriophyllum verticillatum*	Sensitive (Yellow)	S2
leaved Tearthumb	*Polygonum arifolium*	Sensitive (Yellow)	S2
Pennsylvania Smartweed	*Polygonum pensylvanicum*	Secure (Green)	S3
Gmelin's Water Buttercup	*Ranunculus gmelinii*	Secure (Green)	S3
Alder-leaved Buckthorn	*Rhamnus alnifolia*	Sensitive (Yellow)	S3
Bog Willow Meadow	*Salix pedicellaris*	Sensitive (Yellow)	S2
Willow Horned Sea-	*Salix petiolaris*	Secure (Green)	S3
blite Humped	*Suaeda calceoliformis*	Secure (Green)	S2S3
Bladderwort	*Utricularia gibba*	Secure (Green)	S3S4
FERNS AND THEIR ALLIES			
Meadow Horsetail	*Equisetum pratense*	Sensitive (Yellow)	S2
Variegated Horsetail	*Equisetum variegatum*	Secure (Green)	S3
Northern Adder's-tongue	*Ophioglossum pusillum*	Sensitive (Yellow)	S2S3
INSECTS			
Lance-Tipped Darner	*Aeshna constricta*	Secure (Green)	S3
Common Roadside-Skipper	*Amblyscirtes vialis*	Secure (Green)	S2
Taiga Bluet	*Coenagrion resolutum*	May Be At Risk (Orange)	S1
Harvester	*Feniseca tarquinius*	Secure (Green) Secure	S3S4
Northern Pearly-Eye	*Lethe anthedon*	(Green) Secure (Green)	S3
Bronze Copper	*Lycaena hyllus*	Secure (Green) Secure	S1
Little Wood-satyr	*Megisto cymela*	(Green) Sensitive	S3S4
Elfin Skimmer	*Nannothemis bella*	(Yellow) Secure (Green)	S3
Mustard White	*Pieris oleracea*	May Be At Risk (Orange)	S2
Question Mark	*Polygonia interrogationis*	May Be At Risk (Orange)	S3B
Williamson's Emerald	*Somatochlora williamsoni*		S1
Ebony Boghaunter	*Williamsonia fletcheri*		S1
MOLLUSKS			
Eastern Lampmussel	*Lampsilis radiata*	Sensitive (Yellow)	S2
Tidewater Mucket	*Leptodea ochracea*	Sensitive (Yellow)	S1
MONOCOTS			
Slim-stemmed Reed Grass	*Calamagrostis stricta*	Sensitive (Yellow)	S1S2
Slim-stemmed Reed Grass	*Calamagrostis stricta ssp. stricta*	Sensitive (Yellow)	S1S2

Appendix 3: Special Occurrences (Ecodistrict 550)

Table 1b: Other Species of Conservation Concern (other species that are a priority for planning, management, and stewardship action)

SPECIES		DESIGNATION	
Common Name	**Scientific Name**	**Provincial General Status Rank**	**ACCDC S-Rank***
Hairlike Sedge	*Carex capillaris*	Sensitive (Yellow) May	S2
Creeping Sedge	*Carex chordorrhiza*	Be At Risk (Orange)	S1
Bearded Sedge	*Carex comosa*	Sensitive (Yellow)	S2
Livid Sedge	*Carex livida var. radicaulis*	May Be At Risk (Orange)	S1
Early Coralroot	*Corallorhiza trifida*	Secure (Green) Sensitive	S3
Ovate Spikerush	*Eleocharis ovata*	(Yellow) Secure (Green)	S2?
Canada Waterweed	*Elodea canadensis*	Secure (Green) Sensitive	S3?
Russet Cotton-Grass	*Eriophorum chamissonis*	(Yellow) Sensitive	S3S4
Slender Cottongrass	*Eriophorum gracile*	(Yellow) Sensitive	S2
Lesser Rattlesnake-plantain	*Goodyera repens*	(Yellow) Sensitive	S3
Moor Rush	*Juncus stygius ssp. americanus*	(Yellow)	S1S2
Canada Lily	*Lilium canadense*	May Be At Risk (Orange)	S2S3
Fries' Pondweed	*Potamogeton friesii*		S2

*Atlantic Canada Conservation Data Centre S-Ranks, where S1: extremely rare; S2: rare; S3: uncommon; S4: usually widespread, fairly common; S5: widespread, abundant; S#S#: A range between two consecutive ranks for a species/community denotes uncertainty about the exact rarity (e.g. S1S2); Consult http://www.accdc.com/en/ranks.html for descriptions of other ranks.

Provincial General Status Ranks as assessed in 2010 (http://www.wildspecies.ca/wildspecies2010).

Appendix 3: Special Occurrences (Ecodistrict 550)
Table 1c – Other Conservation Features

Feature	Type	Information Source	Legislation or Status Ranking System
Amherst Marsh	Ecosystems	Ducks Unlimited	Nova Scotia Environment Act Nova Scotia Forest Act(Wildlife Habitat and Watercourse Protection Regulations)
Amherst Point Migratory Bird Sanctuary (part of Chignecto RAMSAR Site, overlaps with Chignecto National Wildlife Area)	Ecosystems	Significant Species and Habitats Database	Migratory Birds Convention Act Canada Wildlife Act
Ducks Unlimited Project	Ecosystems	Significant Species and Habitats Database	Nova Scotia Environment Act
John Lusby Saltmarsh (Chignecto National Wildlife Area, part of Chignecto RAMSAR Site)	Ecosystems	Significant Species and Habitats Database	Migratory Birds Convention Act Canada Wildlife Act
Bald Eagle	Species	Significant Species and Habitats Database	Nova Scotia Wildlife Act
Maccan River Wildlife Management Area	Ecosystems	Source	Nova Scotia Wildlife Act
Salt Marshes	Ecosystems	Significant Species and Habitats Database	Nova Scotia Environment Act

Appendix 3: Special Occurrences (Ecodistrict 550)
Table 1d – Heritage Features

Feature	Type	Information Source
Acadian Settlement	Heritage	Source
Amherst Well Field		Source
Ships Railway	Heritage	Source

Appendix 3: Special Occurrences

Table 2: Comparison of Ecological Emphasis Classification Index by Ecosection (Within Ecodistrict and Ecoregion)

Ecosections that form 2% or less of the ecodistrict and/or ecoregion area or are more than 75% converted are highlighted. The table provides a sense of how unique or uncommon an ecosection and its associated climax communities are within the ecodistrict and across the ecoregion. The EEC Index value conveys an indication of relative land use pressure on the ecosection.

Ecosection	Climax Type	Ecodistrict Occurrence						Ecoregion Occurrence					
		Area of Ecosection		Area of Climax Type (1, 2, 3) *		EEC Index ecosection	% Converted	Area of Ecosection		Area of Climax Type (1, 2, 3) *		EEC Index ecosection	% Converted
		Ha	%	Ha	%			Ha	%	Ha	%		
DKLD	dykeland	7,399	39.0	0	0.0	27	63.0	7,399	2.0	0	0.0	27	63.0
IMHO	bS	4,872	26.0	4,139	22.0	50 to 60	16.0	111,432	24.0	71,985	15.0	55 to 64	12.0
IMRD	rS sM yB Be	543	3.0	543	3.0	9 to 10	85.0	11,467	2.0	31,820	7.0	52 to 58	18.0
IMSM	bS	698	4.0	4,139	22.0	39 to 40	67.0	6,672	1.0	71,985	15.0	51 to 55	29.0
WMHO	rS	518	3.0	2,954	16.0	26	66.0	51,448	11.0	133,552	28.0	41 to 47	34.0
WTLD	wetlands	2,289	12.0	0	0.0	56 to 59	0.0	7,234	2.0	0	0.0	51 to 53	1.0

*Area of Climax Type refers to the total area of the climax community in the ecodistrict and in the ecoregion.

Appendix 4: Ecological Representivity Worksheet

Ecosystem			Crown Responsibility	Legal Reserves		Policy Reserves (including unproclaimed legal reserve proposals)		Ecological Emphasis Classification "Reserve Class"					
Ecosection	Climax Type	Area (ha)	Percent of Area on Crown (%)	Crown Area (ha)	Private Area (ha)	Crown Area (ha)	Private Area (ha)	Crown		Private		Total Reserve	
								ha	% (EcoS)	ha	% (EcoS)	ha	% (EcoS)
DKLD	dykeland	7,399	18.0	0	0	122	2	122	2.0	2	0.0	124	2.0
IMHO	bS	4,872	4.0	0	0	0	0	0	0.0	0	0.0	0	0.0
WTLD	wetlands	2,289	62.0	0	0	0	0	0	0.0	0	0.0	0	0.0
XXWA		1,516	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0
XXMS	salt marsh	1,147	48.0	0	0	536	0	536	47.0	0	0.0	536	47.0
IMSM	bS	698	10.0	0	0	43	0	43	6.0	0	0.0	43	6.0
IMRD	rS sM yB Be	543	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0
WMHO	rS	518	20.0	0	0	55	0	55	11.0	0	0.0	55	11.0
Total		**18,983**		**0**	**0**	**756**	**2**	**756**		**2**		**758**	

See Appendix 12b for full Ecological Emphasis worksheet.

Appendix 5: Ecodistrict Reserves and Protected Areas Summary

Legal Reserves			Policy Reserves (including unproclaimed legal proposals)		
Act Designation	Area by Ownership		Policy Program	Area by Ownership	
	Crown (ha)	Private (ha)		Crown (ha)	Private (ha)
Wilderness Areas	0	0	Eastern Habitat Joint Venture		2
National Historic Sites and Parks	0	0	National Wildlife Management Areas	757	0
			Old Forest	11	0
			National Wildlife Sanctuaries	210	0

Source: Crown Lands Forest Model Landbase Classification
Some of these programs may occur in the same area. For example, much of the Old Forest Policy forests are located in the Wilderness Areas.

Appendix 6: Description of Road Density Index

Road, trail, and utility corridors provide the background structure for transporting people and goods and are integral components of human land use. However, transportation systems are expensive and have a wide range of negative environmental impacts including watercourse siltation, habitat fragmentation, dispersal obstruction, plant and animal mortality, exotic species invasion, loss of productive land, and an overall increase in human presence (Forman & Deblinger 2000, Reed et. al. 1996, Lindenmayer & Franklin 2002).

In order to reduce conflicts with natural systems and improve transportation safety there is clearly a need to incorporate landscape ecology into the planning of transportation networks (Forman 2004, Forman & Hersperger 1996, Spellerberg 1998). The emerging science of road ecology advocates integrating spatial analysis of the transportation system with ecological landscape analysis as a fundamental step in transportation system planning (Forman 1999, Lindenmayer & Franklin 2002, Diaz & Apostol 1992).

Efficient access systems can be strategically designed to minimize environmental impacts by incorporating factors such as harvest scheduling, life expectancy, location, road class requirements, decommissioning, and mitigation measures (Lindenmayer & Franklin 2002, Forman, 2004). Selection of transportation routes should incorporate knowledge of landscape functions to improve compatibility with natural ecosystem flows and connectivity (Forman & Hersperger, 1996). Furthermore, areas without roads and/or few roads are important for biodiversity conservation and should be considered during planning (USDA Forest Service 1999).

The GIS-based “Road Index” procedure calculates and maps the spatial influence of the transportation network. It is a management tool designed to help planners gauge the relative influence of man-made linear features within landscapes. It was designed to help integrate the transportation system into an ecological landscape analysis process. In addition to mapping, the index provides a numerical indicator of road influence that can be used to monitor temporal changes and compare different landscapes.

Main Concepts

The influence of the transportation network on the ecological landscape varies with three main factors: 1) the type of transportation feature (e.g. highway, power line, trail, etc.); 2) the density of linear features in a given area; and 3) the distance of an area from transportation features (Forman 2004, Lindenmayer & Franklin 2002, Forman & Deblinger 2000). The Road Index is a weighting of these three factors reflecting their relative influence on ecosystem function.

Road density has a well-documented influence on many factors, including wildlife movements, fragmentation, human access, hydrology, and fire patterns (Forman and Hersperger, 1996). Forman & Deblinger (2000) report great variance in road effect zones, with average cumulative effects extending 300 metres from road edges and some impacts penetrating up to a kilometre. Consequently, Index values are determined by assessing the transportation network within a one kilometre radius. The Index algorithm is applied to a grid of one hectare squares representing the landscape in question. The calculation provides a measure of the density of the transportation network and the specific distance to the transportation features.

The resulting index values are scaled to provide a potential range of 0 to 100. For the purpose of map interpretation, these values have been grouped into benchmark ranges that reflect characteristic patterns of land use in Nova Scotia.

In Nova Scotia, as in most populated jurisdictions, transportation networks are continuously changing as new roads and utilities are constructed and unused roads and trails deteriorate. As such, any analysis of the current state of these features must be based on reasonably up to date data. In this province, the Geomatics Centre, administered by Service Nova Scotia and Municipal Relations, is responsible for mapping transportation features which they include in their 1:10000 topographic series mapping.

On a provincial level, this work is updated on a ten-year repeat cycle and includes changes to existing features and the delineation of new features. Before undertaking road analysis, the Geomatics Centre should be contacted to ensure that the most current data is used to calculate the Road Index values. This data should be further updated using Landsat satellite imagery to add significant new roads and utilities that are over 500 metres in length on lands currently with a remote or forest resource index value.

DNR Forestry Branch maintains a table relating the topographic series attribute coding used by the Geomatics Centre to the feature categories used in the Road Index calculations, along with ArcView programs allowing the data to be formatted correctly. An inventory of recent Landsat satellite images is also available.

Full report contained in the Ecological Landscape Analysis Guidebook
http://www.gov.ns.ca/natr/library/forestry/reports/Procedural%20Guide%20For%20Ecological%20Landscape%20Analysis.pdf

Appendix 7: Road Density Index Worksheets

Road index values for all tables are benchmarks that will be monitored over time to evaluate trends.

Table 1: Length of Access Systems and Index Weighting for Different Road Types

Road Type	Road Index Weighting	Length (km)
Trails, tracks, abandoned roads, and railways	1	162
Utility corridors	3	23
Gravel roads and active railways	6	74
Paved streets and roads collectors	10	64
Highways	15	6

Table 2: Distribution of Road Index Classes

Road Index Value		Area of Ecodistrict Affected	
Indication	Range	Hectares	Percent
Remote	0 to 6	3,959	22
Forest Resource	7 to 15	5,869	31
Mixed Rural	16 to 24	4,446	23
Agriculture Suburban	25 to 39	3,861	20
Urban	40 to 100	809	4
Total		**18,944**	**100**

Table 3: Road Index Values for Each Landscape Element Type

Landscape Element	Area (ha)	Road Index
Marshes and Grasslands	6,061	16
Spruce Pine Flats	698	25
Spruce Hummocks	4,856	9
Red and Black Spruce Hummocks	359	28
Mixedwood Ridges	543	28
Valley Corridors	2,103	38
Wetlands	2,289	3
Salt Marsh	*1,076*	*8*
Total	**17,985**	**15**

*Water is excluded from this table. Rounding, overlapping, and averaging of figures may lead to small differences in tables.

Appendix 8: Development Classes and Seral Stages

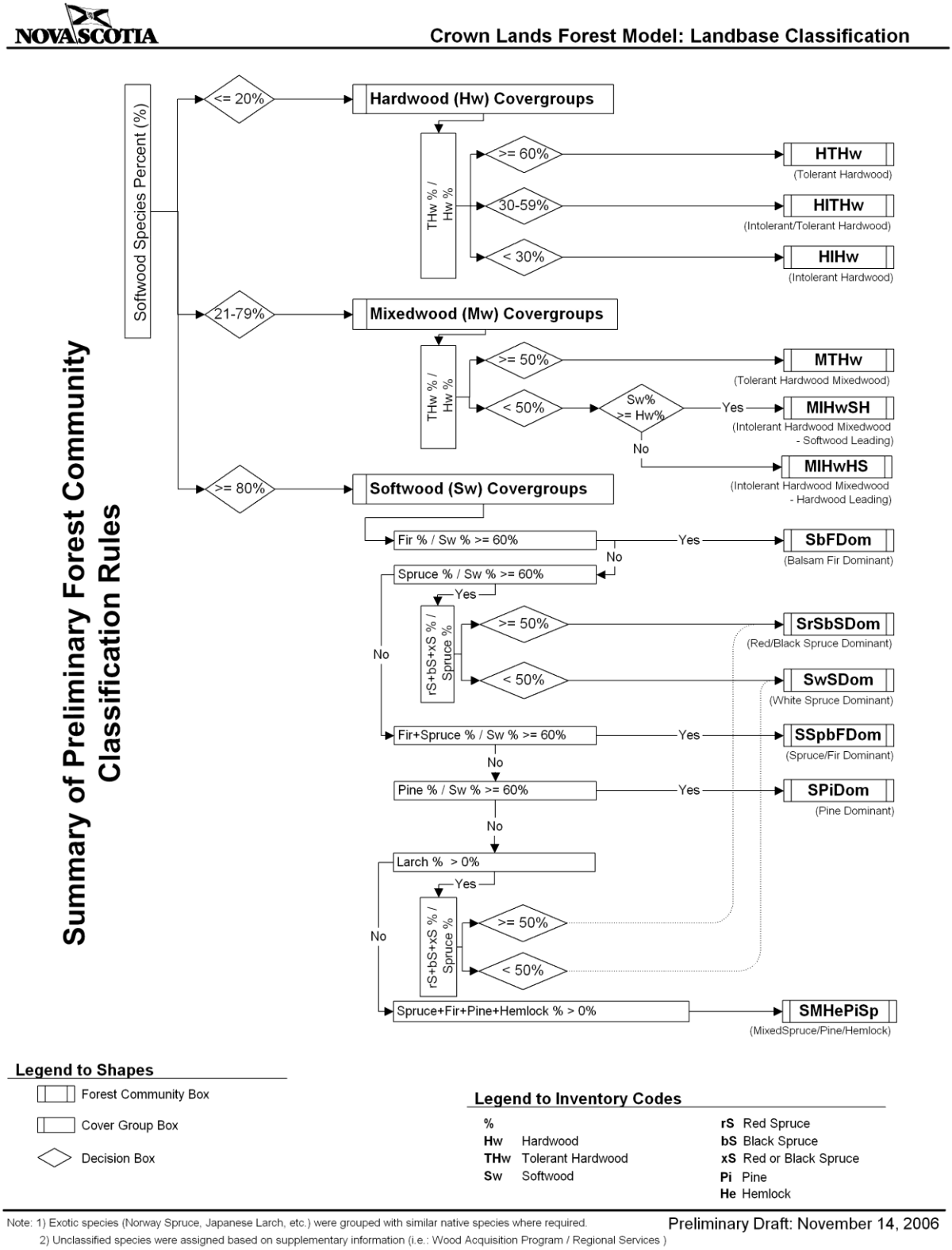
Development Class	Seral Stage
1. Forest Establishment (Height 0 to 6 m) • establishment of new growth following a stand-initiating disturbance • high diversity of forbs, shrubs, and tree regeneration, many of which are short-live shade intolerant "pioneer" species • peak seed production by forbs and shrubs • approximate age 0 to 25 years	Early Seral Species (Score 10 to 23) • new growth dominated by pioneer tree species or unclassified regeneration Mid Seral Species (Score 24 to 37) • regeneration composed of a mixture of pioneer, mid-climax, and climax species Late Seral Species (Score 38 to 50) • regeneration dominated by climax species
2. Young Forest (Height 7 to 11 m) • young forests with developing tree canopies characterized by vigorous self-thinning and crown differentiation • early tree seed production, no understory development • approximate age 25 to 40 years	Early Seral Species (Score 10 to 23) • canopy dominated by pioneer tree species Mid Seral Species (Score 24 to 37) • canopy composed of a mixture of pioneer, mid-climax, and climax species Late Seral Species (Score 38 to 50) • canopy dominated by climax species
3. Mature Forest (Height > 11 m) • stands dominated by upper canopy with full differentiation into dominance classes • self-thinning process reduced • tree seed production prominent and regular • individual tree mortality creates canopy gaps that are soon closed by neighbouring tree growth • increased light initiates regeneration and early understory development • approximate age 40 to 125 years	Early Seral Species (Score 10 to 23) • canopy dominated by pioneer species • over maturity initiates canopy breakup and understory development Mid Seral Species (Score 24 to 37) • climax species in mixture with pioneers in the overstory • often reflecting a transition to climax domination following a period of sub canopy development Late Seral Species (Score 38 to 50) • canopy dominated by climax species • over maturity initiates gap dynamic processes leading to multi-aged and old growth conditions
4. Multi-aged and old growth forest (Varying height and age and Old Growth ID) • dominant overstory exhibiting a variety of crown sizes and canopy densities • canopy gaps promote development of multi-layered understory and recruitment to overstory	Early Seral Species (Score 10 to 23) • canopy likely to break up and be replaced by developing understory Mid Seral Species (Score 24 to 37) • pioneer-dominated overstory with canopy recruitment from a climax species-dominated understory Late Seral Species (Score 38 to 50) • climax species-dominated overstory maintained through gap dynamic processes

Summary of species-level seral score values by ecodistrict (Source: NSDNR - January 2014 revision)

Species		Ecodistrict																																						
Code	**Name**	**100**	**210**	**220**	**310**	**320**	**330**	**340**	**350**	**360**	**370**	**380**	**410**	**420**	**430**	**440**	**450**	**510**	**520**	**530**	**540**	**550**	**560**	**610**	**620**	**630**	**710**	**720**	**730**	**740**	**750**	**760**	**770**	**780**	**810**	**820**	**830**	**840**	**910**	**...**
AS	ash	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
BA	black ash	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BC	black cherry	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
BE	beech	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
BF	balsam fir	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	1	1
BP	balsam poplar	1	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	3	1
BS	black spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
EC	eastern cedar	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
EH	eastern hemlock	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	exotic species	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GB	grey birch	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IH	intolerant hardwood	3	2	4	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	4	3	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
IW	ironwood	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
JP	jack pine	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
LA	largetooth aspen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OH	other hardwood	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
OS	other softwood	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PC	pin cherry	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RM	red maple	3	2	4	2	2	2	2	2	4	2	5	2	2	2	2	2	2	2	2	2	5	3	2	2	2	2	2	2	2	2	2	3	2	3	3	2	2	2	2
RO	oak	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
RP	red pine	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	3	4	4	4	4	4	4	4	3	4	3	3	3	4	4	3	4	4	3	3	3	3
RS	red spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
SM	sugar maple	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ST	striped maple	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
TA	aspen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TH	tolerant hardwood	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TL	eastern larch	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
UC	unclassified	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WA	white ash	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
WB	white birch	3	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
WE	white elm	2	2	4	2	4	2	2	2	2	2	2	2	2	2	2	2	4	4	4	2	2	2	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2
WP	white pine	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
WS	white spruce	4	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	4	1	1
XS	red and black spruce	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
YB	yellow birch	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

A look-up table assigns each species in the forest inventory a value from 1 to 5 for its position on the successional scale. The look-up table may change by ecodistrict since climax on the coast or the Cape Breton Highlands differs from inland and lowland districts. This successional value is multiplied by the species' percent in the stand to give a stand successional score. Each stand may have up to four species, and the four percentages add to 10, so the stand successional scores range from 10 to 50. These scores are subdivided into three successional categories: 10 to 23 early, 24 to 37 mid, and 38 to 50 late.

Appendix 9: Vegetation Community Classification – Forest Model



Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Marshes and Grasslands (Matrix)	DKLD XXSM	Softwood				Early	2	1	15	4	22	369; 71.0	EARLY	45; 9.0
						Mid	1	2	12	1	16			
						Late	75	93	75	17	260			
						Uncl	71	0	0	0	71			
		Mixedwood				Early	0	2	2	2	6	68; 13.0	MID	71; 14.0
						Mid	2	8	2	2	14			
						Late	1	8	28	8	45			
						Uncl	4	0	0	0	4			
		Hardwood				Early	0	7	9	1	17	77; 15.0	LATE	324; 62.0
						Mid	0	2	33	6	41			
						Late	0	1	19	0	20			
						Uncl	0	0	0	0	0			
		Unclassified				Early	1	0	0	0	1	4; 1.0	UNCL	78; 15.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	4	0	0	0	4			
Total					**6,061***	**# ha**	**161**	**124**	**195**	**41**	**521**			
						%	**30.9%**	**23.8%**	**37.4%**	**7.9%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Red and Black Spruce Hummocks (Patch)	IMHO	Softwood	rS bS	Frequent	4,856; 100.0	Early	68	59	157	8	292	2,377; 65.0	EARLY	424; 12.0
						Mid	77	97	127	42	343			
						Late	94	303	520	83	1,000			
						Uncl	741	0	0	0	741			
		Mixedwood				Early	47	6	10	6	69	703; 19.0	MID	1,015; 28.0
						Mid	75	60	176	50	361			
						Late	4	20	105	54	183			
						Uncl	90	0	0	0	90			
		Hardwood				Early	0	0	23	3	26	495; 14.0	LATE	1,333; 37.0
						Mid	5	107	180	18	310			
						Late	4	44	100	2	150			
						Uncl	7	0	0	0	7			
		Unclassified				Early	36	0	0	0	36	61; 2.0	UNCL	864; 24.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	25	0	0	0	25			
Total					**4,856***	**# ha**	**1,273**	**696**	**1,398**	**266**	**3,633**			
						%	**35.0%**	**19.2%**	**38.5%**	**7.3%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Wetlands (Patch)	WTLD IFSM	Softwood	bS	Open Seral	1,145; 50.0	Early	5	0	4	1	10	357; 68.0	EARLY	5; 1.0
						Mid	0	8	9	0	17			
						Late	53	101	69	19	242			
						Uncl	109	0	0	0	109			
		Mixedwood				Early	0	0	0	0	0	136; 26.0	MID	20; 4.0
						Mid	0	4	2	4	10			
						Late	0	7	87	12	106			
						Uncl	23	0	0	0	23			
		Hardwood				Early	0	0	0	0	0	33; 6.0	LATE	368; 70.0
						Mid	0	1	0	0	1			
						Late	0	2	17	8	27			
						Uncl	5	0	0	0	5			
		Unclassified				Early	0	0	0	0	0	0; 0.0	UNCL	130; 25.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**2,289***	**# ha**	**195**	**123**	**188**	**44**	**550**			
						%	**35.5%**	**22.4%**	**34.2%**	**8.0%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Spruce Pine Flats (Patch)	IMSM	Softwood	bS	Frequent	558; 80.0	Early	0	12	10	12	34	128; 79.0	EARLY	40; 24.0
						Mid	0	5	5	0	10			
						Late	9	35	11	23	78			
						Uncl	6	0	0	0	6			
		Mixedwood				Early	0	0	0	0	0	23; 14.0	MID	25; 15.0
						Mid	0	4	4	3	11			
						Late	0	4	6	2	12			
						Uncl	2	0	0	0	2			
		Hardwood				Early	0	2	2	0	4	10; 6.0	LATE	90; 55.0
						Mid	0	3	3	0	6			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
		Unclassified				Early	2	0	0	0	2	2; 1.0	UNCL	8; 5.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**698***	**# ha**	**19**	**65**	**41**	**40**	**165**			
						%	**11.5**	**39.4**	**24.8**	**24.2**	**100.0**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Tolerant Mixedwood Hills (Patch)	IMRD	Softwood	rS sM yB Be	Infrequent	534; 98.0	Early	1	3	2	1	7	48; 81.0	EARLY	8; 13.0
						Mid	1	15	7	0	23			
						Late	1	3	10	2	16			
						Uncl	2	0	0	0	2			
		Mixedwood				Early	0	0	0	0	0	8; 14.0	MID	27; 46.0
						Mid	0	1	2	0	3			
						Late	0	0	0	2	2			
						Uncl	4	0	0	0	4			
		Hardwood				Early	0	0	0	0	0	3; 5.0	LATE	18; 30.0
						Mid	0	0	3	0	3			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
		Unclassified				Early	0	0	0	0	0	0; 0.0	UNCL	6; 11.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**543***	**# ha**	**9**	**22**	**24**	**5**	**60**			
						%	**15.0%**	**36.7%**	**40.0%**	**8.3%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Red Spruce Hummocks (Patch)	WMHO	Softwood	rS	Frequent	359; 100.0	Early	0	2	4	1	7	40; 68.0	EARLY	8; 14.0
						Mid	0	0	5	3	8			
						Late	2	4	18	0	24			
						Uncl	0	0	0	0	0			
		Mixedwood				Early	0	0	0	0	0	8; 13.0	MID	20; 34.0
						Mid	0	0	0	2	2			
						Late	0	0	5	1	6			
						Uncl	0	0	0	0	0			
		Hardwood				Early	0	0	0	0	0	10; 17.0	LATE	31; 52.0
						Mid	0	6	3	1	10			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
		Unclassified				Early	1	0	0	0	1	1; 1.0	UNCL	0; 0.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	0	0	0	0	0			
Total					**359***	**# ha**	**3**	**12**	**35**	**8**	**58**			
						%	**5.2%**	**20.7%**	**60.3%**	**13.8%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 1: Forest Landscape Composition Worksheet (Cumberland Marshes 550)

Element	Ecosection (% land area)	Covertype	Climax Species (M=Mid; L=Late Seral)	Natural Disturbance Regime	Total Land Area of Potential Forest* (ha; %)	Seral Stage	Current Forest - GIS Inventory							
							Development Class (ha)				Total Forested Area (ha)	Covertype (ha; %)	Seral Stage Summary (ha; %)	
							Establish-ment (1)	Young Forest (2)	Mature Forest (3)	Multi-aged (4)				
Valley Corridors (Corridor)	DKLD WMHO IMHO	Softwood	rS bS	Frequent	176; 8.0	Early	0	3	14	3	20	55; 47.0	EARLY	44; 37.0
						Mid	0	0	5	0	5			
						Late	0	6	14	0	20			
						Uncl	10	0	0	0	10			
		Mixedwood				Early	0	2	1	1	4	16; 13.0	MID	22; 19.0
						Mid	0	0	0	2	2			
						Late	0	1	8	0	9			
						Uncl	0	0	0	0	0			
		Hardwood				Early	0	10	9	0	19	42; 35.0	LATE	37; 31.0
						Mid	2	3	8	2	15			
						Late	0	0	7	1	8			
						Uncl	0	0	0	0	0			
		Unclassified				Early	0	0	0	0	0	5; 5.0	UNCL	16; 13.0
						Mid	0	0	0	0	0			
						Late	0	0	0	0	0			
						Uncl	5	0	0	0	5			
Total					**2,103***	**# ha**	**17**	**25**	**66**	**9**	**117**			
						%	**14.5%**	**21.4%**	**56.4**	**7.7%**	**100.0%**			

Left side of table refers to "potential" forest, interpreted from the Ecological Land Classification. Right side refers to "current" forest condition, summarized from inventory in the Forest Model. All multi-aged stands can be considered mature and added to mature totals. *Total area of element.

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Marshes and Grasslands	DKLD XXSM	N/A	dykeland	S	SrSbSDom	331	64.9%	Late (L)	Non-forested
				S	SwSDom	35	6.8%	Early (E)	
				M	MIHwSH	40	7.9%	E / Mid (M)	
				M	MIHwHS	28	5.5%	E / M	
				H	HIHw	76	15.0%	E / M	
Total						**510**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Red and Black Spruce Hummocks	IMHO	Frequent	bS	S	SrSbSDom	1,614	45.1%	L	**Well-drained** Early : Aspen, gB, pin cherry honeysuckle, wood aster Mid: red spruce, balsam fir, stair-step moss Late: Red spruce, hemlock, starflower **Imperfect drainage** - bS, cinnamon fern, sphagnum - bS, false holly, wild raisin - rM,bF, sensitive fern, tamarack, black spruce, sedge **Poorly drained** scrubby wetlands of shrubs and stunted trees
				S	SwSDom	538	15.0%	E	
				S	SspbFDom	117	3.3%	M	
				S	SbFDom	102	2.9%	E/M	
				S	SpiDom	7	0.2%	L	
				M	MIHwSH	401	11.2%	E/M	
				M	MIHwHS	302	8.4%	E/M	
				H	HIHw	493	13.4%	E/M	
				H	HTHw	2	0.1%	L	
Total						**3,576**	**100.0%**		

*Forest Community Codes:	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Wetlands	WTLD	Frequent / Open seral	bS	S	SrSbSDom	336	63.9%	L	**Well-drained** Early : alders/shrubs Mid black cherry, wS Late: wA, sM - ostrich fern **Well to imperfectly drained** - bS,cinnamon fern-sphagnum / bS, false holly, wild raisin / rP, bS sphagnum / rM, bf - sensitive fern / eL, bS - sedge (jp and wP) **Poorly drained** scrubby wetlands of shrubs and stunted trees.
				S	SspbFDom	5	0.9%	L	
				S	SwSDom	16	3.1%	E	
				M	MIHwSH	88	16.8%	M	
				M	MIHwHS	48	9.1%	M	
				H	HIHw	33	6.2%	M	
Total						**526**	**100.0%**		

*Forest Community Codes:	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Spruce Pine Flats	IMSM	Frequent	bS	S	SrSbSDom	81	50.3%	L	**Well-drained** Early: tA, honeysuckle - wood star -rM, tA – bunchberry, rM, wB, sarsaparilla Mid: rS, bF, stair-step moss - rM, hay-scented fern - wood sorrel Late: sM, yB new york fern - sM, wA - christmas fern - sM yB - hay scented fern - rS eH – starflower -eH, rS- wild lily-of-the-valley yB, rS - wood fern **Well to imperfectly drained** - bS,cinnamon, fern-sphagnum / bS, false holly, wild raisin / rP, bS sphagnum / rM, bf - sensitive fern / eL, bS, sedge (jp and wP) **Poorly drained** scrubby wetlands of shrubs and stunted trees
				S	SwSDom	39	24.3%	E	
				S	SpiDom	6	3.9%	L	
				S	SbFDom	1	0.9%	E/M	
				M	MIHwSH	14	8.4%	E/M	
				M	MIHwHS	10	6.1%	E/M	
				H	HIHw	10	6.1%	E/M	
Total						**161**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Tolerant Mixedwood Hills	IMRD	Infrequent	rS sM yB Be	S	SrSbSDom	23	39.5%	L	**Well-drained** Early :tA, honeysuckle - wood star - rM, tA - bunchberry - rM, wB, sarsaparilla Mid - rS, bF, stair-step moss - rM, hay-scented fern - wood sorrel Late :sM, yB new york fern - sM, wA - christmas fern - sM yB - hay scented fern - rS eH - starflower - eH, rS- wild lily-of-the-valley yB, rS - wood fern
				S	SwSDom	14	23.9%	E	
				S	SbFDom	9	14.7%	E/M	
				S	SspbFDom	2	3.1%	L	
				M	MIHwHS	6	9.6%	E/M	
				M	MIHwSH	3	4.2%	E/M	
				H	HIHw	3	4.8%	E/M	
Total						**60**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Red Spruce Hummocks	WMHO	Frequent	rS	S	SrSbSDom	27	46.9%	L	**Well-drained** Early: gB, pincherry, aspen, honeysuckle - wood star - rM, tA - bunchberry Mid rS, bF, stair-step moss Late: rS, eH, starflower, yB, rS - yellow birch, red spruce, wood fern **Imperfectly drained** - bS, cinnamon fern, sphagnum - bS, false holly, wild raisin - rM, bF, sensitive fern tamarack, bS, sedge
				S	SwSDom	13	22.3%	E	
				M	MIHwHS	6	10.4%	E/M	
				M	MIHwSH	2	3.3%	E/M	
				H	HIHw	10	17.1%	E/M	
Total						**58**	**100.0%**		

*Forest Community Codes:	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10: Table 2: Composition of Forest Communities (in Cumberland Marshes Grouped by Landscape Element)

Element	Ecosections	Dominant NDR	Dominant Climax Type	Covertype	Forest* Community (Crown Model)	Area (ha)	Percent of Forest Community	Successional Stage	Successional Types
Valley Corridors	IMSM WCHO ICHO WCKK WTLD XXWA ICSM IMHO WCDS WMKK	Frequent Infrequent Frequent Gap Open seral Frequent Frequent Infrequent Gap	bS rS eH wP bS sM yB Be rS eH wP bS rS eH wP sM yB Be	S	SrSbSDom	23	20.4%	L	Corridors cut through different element types - see other elements for successional types
				S	SbFDom	3	2.6%	E	
				S	SwSDom	28	25.0%	E	
				S	SpiDom	1	1.2%	L	
				M	MIHwSH	11	9.5%	M	
				M	MIHwHS	5	4.3%	M	
				H	HIHw	42	36.9%	M	
Total						**113**	**100.0%**		

*Forest Community Codes:			
	SrSbSDom-Red Black Spruce Dominant SwSDom-White Spruce Dominant SspbFDom-Spruce Fir Dominant SbFDom-Balsam Fir Dominant	SpiDom-Pine Dominant SMHePiSp-Mixed Spruce Pine Hemlock MIHwSH-Intolerant Hardwood Mixedwood S MIHwHS-Intolerant Hardwood Mixedwood H	MTHw-Tolerant Hardwood Mixedwood HIHw-Intolerant Hardwood HTHw-Tolerant Hardwood HITHw-Intolerant Tolerant Hardwood

Appendix 10:
Table 3: Summary of "Potential Climax" Forest Abundance
(Based on ELC Interpretations)

Climax Type	Ecodistrict		Ecoregion	
	Hectares	Percent	Hectares	Percent
rS	2,954	16.0%	133,552	28.0%
rS, sM, yB, bE	543	3.0%	31,820	7.0%
bS	4,139	22.0%	71,985	15.0%
Total	**7,636**	**41.0%***	**237,357**	**50.0%****

*Total does not add up to 100% because wetlands not added.
**Total does not add up to 100% because not all climax vegetation types in region are found in this ecodistrict
Source: Crown Lands Forest Model Landbase Classification.

Appendix 11: Ecological Emphasis Classes and Index Values

The classification includes all upland conditions, both forested and non-forested, under all types of administration and land use practices. It does not include water or other non-terrestrial conditions.

Ecological Emphasis Class	Conservation Factor	Description
Reserve	**1**	• Reserved lands which meet biodiversity conservation goals through preservation of natural conditions and processes. Resource management activities are not usually permitted except where required to perpetuate desired natural conditions. This class is assigned based on the types of laws and policies governing the management (for example: Wilderness, Parks, Conservation Easement, Old Forest Policy).
Extensive	**0.75**	• Lands managed for multiple values using ecosystem-based techniques that conserve biodiversity, and natural ecosystem conditions and processes. • Forestry practices employ ecosystem-based prescriptions which consider natural disturbance regimes, successional trends, structure, and composition. Natural regeneration is favoured to provide the next forest. Practices may include protection from fire and insects. • Management complies with the Forest Code of Practice, and excludes the use of herbicides, exotic tree species, off-site native species, genetically modified organisms, and stand conversion.
Intensive	**0.25**	• Lands managed intensively to optimize resource production from sites maintained in a native state (e.g. forested). Despite intensive practices these lands are an important component of landscape structure and composition. • Management may eliminate or reduce the duration of some development processes, particularly mature old forest stages, and may result in non-natural succession. Practices may produce unnatural conditions such as exotic species, old field spruce, and monoculture plantations, or reduce structure and composition below ecologically desirable levels. Forests are protected from fire, insects, and competing vegetation. • Management adheres to environmental regulations and policies such as the Wildlife Habitat and Watercourse Protection Regulations and Forest Code of Practice.
Converted	**0**	• Land converted to an unnatural state for human use or areas where practices have significantly degraded site productivity (e.g. agriculture, urban development roads, Christmas trees, seed orchards, forest soil compaction).

Appendix 12a: Ecological Emphasis Index Worksheet – Elements

Landscape Element	Total Land Area (ha)	Ecological Emphasis Classes					Ecological Emphasis Index	
		Reserve Area (ha)	Extensive Forest Management Area (ha)	Intensive Forest Management Area (ha)	Conversion to Non-Forest Area (ha)	Unclassified Land Use Area (ha)	Effective Area Range (ha)	EEC Index Range
Marshes and Grasslands	6,049	123	1,997	30	3,816	81	1,650 to 1,690	27 to 28
Red and Black Spruce Hummocks	4,851	0	2,723	417	761	951	2,384 to 2,860	49 to 59
Spruce Pine Flats	698	43	129	49	464	13	155 to 161	22 to 23
Red Spruce Hummocks	358	56	57	12	233	1.00	102.00	28
Salt Marsh	*1,074*	*494*	*440*	*10*	*124*	*6*	*828 to 831*	*77*
Wetlands	2,291	0	2,141	11	1	137	1,643 to 1,712	72 to 75
Tolerant Mixedwood Hills	543	0	61	14	462	7	51 to 54	9 to 10
Valley Corridors	1,579	42	487	27	1,007	16	418 to 426	26 to 27
Total	**17,443**	**758**	**8,035**	**570**	**6,868**	**1,212**	**7,231 to 7,837**	**41 to 45**

These classes have been given a weighting percentage representing their ecological emphasis level: Reserve (100), Extensive (75), Intensive (25), and Converted (0). These percentages are applied to the area of land in each class to determine the "effective area" which is divided by "total area" to calculate the index.

The Unclassified land is too young to determine if it is being managed extensively or intensively. Therefore, an EEI range is reported based on it being all one or the other.

Water was not included as an element type. Areas were rounded to the nearest hectare.

EEI values are benchmarks that will be monitored over time.

Appendix 12b: Ecological Emphasis Index Worksheet – Ecosections

Ecosection	Total Land Area (ha)	Ecological Emphasis Classes					Ecological Emphasis Index	
		Reserve Area (ha)	Extensive Forest Management Area (ha)	Intensive Forest Management Area (ha)	Conversion to Non-Forest Area (ha)	Unclassified Land Use Area (ha)	Effective Area Range (ha)	EEC Index Range
DKLD	7,399	124	2,425	55	4,695	97	1,980 to 2,029	27
IMHO	4,872	0	2,782	418	777	955	2,430 to 2,908	50 to 60
IMRD	543	0	61	14	461	6	51 to 54	9 to 10
IMSM	698	43	280	54	465	18	271 to 280	39 to 40
WMHO	518	55	103	16	340	1	137	26
WTLD	2,289	0	1,669	4	1	126	1,284 to 1,347	56 to 59
XXMS	1,147	536	461	10	131	6	886 to 889	77 to 78
Total	**17,191**	**758**	**7,781**	**572**	**6,871**	**1,209**	**7,039 to 7,644**	**41 to 45**

For an explanation of calculations and other information to help better understand this table, please refer to the bottom of Appendix 12a.

Appendix 13:

Glossary B: Terms in Parts 1, 2, and 3

Aspect	The direction of a downhill slope expressed in degrees or as a compass point.
Atlantic Coastal Plain Flora (ACPF)	A group of 90 species of taxonomically unrelated wetland plants that inhabit lake and river shores, bogs, fens, and estuaries and which are found primarily in southwestern Nova Scotia. The distribution of this group of plants extends down the eastern coast of the USA with isolated populations in Nova Scotia and along the Great Lakes.
Biodiversity	The diversity of plants, animals, and other living organisms, in all their forms and level of organization, including genes, species, ecosystems, and the evolutionary and functional process that link them.
Canopy	The uppermost continuous layer of branches and foliage in a stand of trees.
Climax forest community	A relatively stable and self-perpetuating forest community condition that maintains itself (more or less) until stand-level disturbance causes a return to an earlier successional stage. The final stage of natural succession for its environment.
Climax vegetation	A forest or non-forest community that represents the final stage of natural succession for its environment.
Coarse filter approach	A habitat-based approach to conserving biodiversity by maintaining a natural diversity of structures within stands, and representation of ecosystems across landscapes. The intent is to meet the habitat requirements of most native species over time. Usually combined with a fine filter approach to conserve specific rare species and ecosystems.
Coarse Woody Debris (CWD)	Dead tree stems greater than 7.5 centimetres in diameter and laying horizontally at 45 degrees or less. Provides habitat for many species and is a source of nutrients for soil development.
Commercial thinning	Silviculture treatment that “thins” out an overstocked stand by removing trees that are large enough to be sold as products, such as poles or fence posts. This treatment is carried out to improve the health and growth rate of the remaining crop trees.

Composition	The proportion of biological components within a specified unit such as a stand or landscape: **Stand or Species Composition.** The proportion of each plant species in a community or stand. May be expressed as a percentage of the total number, basal area, or volume of all species in that community. **Landscape Composition.** The proportion of each community type within a landscape. Community type may be defined by vegetation type, covertype, seral stage, or development class (age).
Connectivity	The way a landscape enables or impedes movement of resources, such as water and animals.
Converted	Lands removed from a natural state (e.g. forest) and changed to other uses (e.g. agriculture, urban, settlement, road).
Corridor	Corridors are natural linear communities or elements, such as river valleys, that link parts of the ecodistrict. They are a fundamental feature of the "matrix, patch, corridor" concept of landscape structure.
Crown land and Provincial Crown land	Used in the Ecological Landscape Analysis to include all land under the administration and control of the Minister of Natural Resources under the Forests Act, Section 3; as well as the lands under the administration and control of the Minister of Environment under the Wilderness Areas Protection Act. Also includes Federal Parks in the accounting of protected area representation.
Covertype	Refers to the relative percentage of softwood versus hardwood species in the overstory of a stand. In this guide, covertype classes are: **Softwood:** softwood species compose 75% or more of overstory **Hardwood:** hardwood species compose 75% or more of overstory **Mixedwood:** softwood species composition is between 25% and 75%
Development class	The description of the structure of forests as they age and grow (e.g. establishment forest, young forest, mature forest, multi-aged / old forest).
Disturbance	An event, either natural or human-induced, that causes a change in the existing condition of an ecological system.
Ecodistrict	The third of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecoregions. Characterized by distinctive assemblages of relief, geology, landform, and vegetation. Used to define the landscape unit for these Ecological Landscape Analysis reports.

Ecological land classification	A classification of lands from an ecological perspective based on factors such as climate, physiography, and site conditions. The Ecological Land Classification for Nova Scotia Volume 1 delineates ecosystems at five hierarchical scales: ecozone, ecoregion, ecodistrict, ecosection, and ecosite.
Ecological integrity	The quality of a natural unmanaged or managed ecosystem in which the natural ecological processes are sustained, with genetic, species, and ecosystem diversity assured for the future.
Ecoregion	The second level of the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecozone. Used to characterize distinctive regional climate as expressed by vegetation. There are nine ecoregions identified in Nova Scotia.
Ecosection	The fourth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecodistricts. An ecological land unit with a repeating pattern of landform, soils, and vegetation throughout an ecodistrict.
Ecosite	The fifth of five levels in the Ecological Land Classification for Nova Scotia Volume 1, and a subdivision of ecosections. Characterized by conditions of soil moisture and nutrient regimes. Although not mapped, the Acadian and Maritime Boreal ecosites of the province are fully described in the Forest Ecosystem Classification for Nova Scotia (2010).
Ecosystem	A functional unit consisting of all the living organisms (plants, animals, and microbes) in a given area, and all the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size – a log, pond, field, forest, or the Earth's biosphere – but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation, such as a forest ecosystem, old-growth ecosystem, or range ecosystem. Can also refer to units mapped in the DNR Ecological Land Classification system.
Ecozone	The first of five levels in the Ecological Land Classification for Nova Scotia Volume 1. Ecozones are continental ecosystems characterized by the interactions of macroclimate, soils, geographic, and physiographic features. The entire province is contained within the Acadian ecozone, one of 15 terrestrial ecozones in Canada.
Edge effect	Habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the more-or-less well-defined boundary between ecosystems, as, for example, between open areas and adjacent forest.

Element	A landscape ecosystem containing characteristic site conditions that support similar potential vegetation and successional processes. Elements were mapped by combining ecosections with similar climax vegetation and natural disturbance interpretations. Depending on their role in the ecosystem, elements may be described as matrix, patch or corridor.
Endangered species	A wildlife species facing imminent extirpation or extinction. A species listed as endangered under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal Species at Risk Act).
Even-aged	A forest, stand, or vegetation type in which relatively small age differences exist between individual trees. Typically results from stand-initiating disturbance.
Extensive land use	Lands managed for multiple values using ecosystem-based techniques that conserve biodiversity and natural ecosystem conditions and processes.
Extinct species	A species that no longer exists. A species declared extinct under federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA).
Extirpated species	A species that no longer exists in the wild in Nova Scotia but exists in the wild outside the province. A species declared extirpated under federal or Nova Scotia endangered species legislation (Nova Scotia Species at Risk Act or federal SARA).
Fine filter approach	An approach to conserving biodiversity that is directed toward individual species and critical ecosystems that are typically rare or threatened. This approach is usually combined with the coarse filter approach to conserving natural ranges of habitat.
Forest management	The practical application of scientific, economic, and social principles to the administration and working of a forest for specified objectives. Particularly, that branch of forestry concerned with the overall administrative, economic, legal, and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection, and forest regulation.
Frequent stand initiating	Disturbances usually occur more frequently than the average lifespan of the dominant species and are of sufficient intensity to destroy most of the existing trees, promoting a new forest within relatively short periods of time.

Gap replacement	An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to periodic gap formation events that are rarely of a stand-initiating intensity.
Habitat	The place where an organism lives and/or the conditions of that environment including the soil, vegetation, water, and food.
Infrequent stand initiating	The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests.
Inherent conditions	Refers to the natural condition of ecosystems based on their enduring physical features. This is the potential condition expected in the absence of human influence.
Integrated Resource Management (IRM)	A decision-making process whereby all resources are identified, assessed, and compared before land use or resource management decisions are made. The decisions themselves, whether to approve a plan or carry out an action on the ground, may be either multiple or single use in a given area. The application of integrated resource management results in a regional mosaic of land uses and resource priorities which reflect the optimal allocation and scheduling of resource uses.
Intensive land use	Lands managed intensively to optimize resource production from sites maintained in a forested state.
Land capability (LC)	LC values represent the maximum potential stand productivity (m^3/ha/yr) under natural conditions.
Landform	A landscape unit that denotes origin and shape, such as a floodplain, river terrace, or drumlin.
Landscape	An expanse of natural area, comprising landforms, land cover, habitats, and natural and human-made features that, taken together, form a composite. May range in scale from a few hectares to large tracts of many square kilometres in extent.
Long range management frameworks	A strategic, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource uses and values, consensus-based decision making, and resource sustainability.

Matrix	A widespread vegetation forest community which dominates the landscape and forms the background in which other smaller scale communities (patches) occur. The most connected or continuous vegetation type within the landscape, typically the dominant element. (Matrix is a fundamental feature of the "matrix, patch, corridor" concept of landscape structure).
Mature forest	A development class within the sequence of: 1) forest establishment; 2) young forest; 3) mature forest; and 4) multi-aged and old growth. Mature forests include multi-aged and old growth. Forests are typically taller than 11 metres, have an upper canopy fully differentiated into dominance classes, and regularly produce seed crops. Mature forests may develop over long periods, transitioning from early competitive stages where canopy gaps from tree mortality soon close, to later stages where openings persist and understories develop to produce multi-aged and old growth.
Memorandum of understanding (MOU)	An agreement between ministers defining the roles and responsibilities of each ministry in relation to the other or others with respect to an issue over which the ministers have concurrent jurisdiction.
Mixed stand	A stand composed of two or more tree species.
Multiple use	A system of resource use where the resources in a given land unit serve more than one user.
Natural disturbance	A natural force that causes significant change in forest stand structure and/or composition such as fire, wind, flood, insect damage, or disease.

Natural disturbance regimes	The patterns (frequency, intensity, and extent) of fire, insects, wind, landslides, and other natural processes in an area. Natural disturbances inherently influence the arrangement of forested ecosystems and their biodiversity on a given landscape. Three disturbance regimes recognized in Nova Scotia are: **Frequent:** Disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even age. The time interval between stand-initiating events typically occurs more frequently than the longevity of the climax species that would occupy the site – therefore, evidence of gap dynamics and understory recruitment is usually absent. This regime results in the establishment and perpetuation of early to mid-successional vegetation types. **Infrequent:** Stand-initiating disturbances which result in the rapid mortality of an existing stand and the establishment of a new stand of relatively even-age, but the time interval between disturbance events is normally longer than the average longevity of the dominant species – allowing gap dynamics and understory recruitment to evolve and become evident (eventually creating uneven-aged stands). This regime generally leads to the establishment and/or perpetuation of mid to late successional vegetation types. **Gap replacement:** Stand-initiating disturbances are rare. Instead, disturbances are characterized by gap and small patch mortality, followed by understory recruitment, resulting in stands with multiple age classes. This regime generally leads to the establishment and/or perpetuation of late successional vegetation types.
Old growth	Climax forests in the late stage of natural succession, the shifting mosaic phase, marked by mature canopy processes of gap formation and recruitment from a developed understory. Typical characteristics include a multi-layered canopy of climax species containing large old trees, decadent wolf trees, and abundant snags and coarse woody debris. In Nova Scotia, stands older than 125 years are classed as old growth.
Patch	A discrete community or element nested within a surrounding landscape, which is often a matrix forest. (Patch is a fundamental feature of the “matrix, patch, corridor” concept of landscape structure.)
Pre-commercial thinning	A silviculture treatment to reduce the number of trees in young stands before the stems are large enough to be removed as a forest product. Provides increased growing space and species selection opportunities to improve future crop tree growth.

Reserve	An area of forest land that, by law or policy, is usually not available for resource extraction. Areas of land and water set aside for ecosystem protection, outdoor and tourism values, preservation of rare species, gene pool and wildlife protection (e.g. wilderness areas, parks).
Riparian	Refers to area adjacent to or associated with a stream, floodplain, or standing water body.
Road deactivation	Measures taken to stabilize roads and logging trails during periods of inactivity, including the control of drainage, the removal of sidecast where necessary, and the re-establishment of vegetation for permanent deactivation.
Seral stage	Any stage of succession of an ecosystem from a disturbed, unvegetated state to a climax plant community. Seral stage describes the tree species composition of a forest within the context of successional development.
Species	A group of closely related organisms which are capable of interbreeding, and which are reproductively isolated from other groups of organisms; the basic unit of biological classification.
Species at risk	Legally recognized designation for species at federal and/or provincial levels that reflects varying levels of threats to wildlife populations. The four categories of risk are extirpated, endangered, threatened, and species of special concern.
Succession	An orderly process of vegetation community development that over time involves changes in species structure and processes.
Threatened species	A species that is likely to become endangered if the factors affecting its vulnerability are not reversed. A species declared as threatened under the federal or Nova Scotia species at risk legislation (NS Endangered Species Act or federal SARA).
Tolerance	The ability of an organism or biological process to subsist under a given set of environmental conditions. The range of these conditions, representing its limits of tolerance, is termed its ecological amplitude. For trees, the tolerance of most practical importance is their ability to grow satisfactorily in the shade of, and in competition with, other trees.
Vernal pool	A seasonal body of standing water that typically forms in the spring from melting snow and other runoff, dries out in the hotter months of summer, and often refills in the autumn.

Vulnerable species	A species of special concern due to characteristics that make it particularly sensitive to human activities or natural activities or natural events. May also be referred to as “species of special concern.” A species declared vulnerable under the federal or Nova Scotia endangered species legislation (NS Endangered Species Act or federal SARA).
Wilderness area	A part of the provincial landbase designated under the Wilderness Areas Protection Act (e.g. Canso Barrens).

Literature Referenced

Bruce, J. and B. Stewart. 2005. Development of a "road index" for landscape level assessment of linear transportation features using density, distance, and class measures. Unpublished report.

Diaz, N. and D. Apostol. 1992. Forest landscape analysis and design: a process for developing and implementing land management objectives for landscape patterns. R6 ECO-TP-043-92. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

Duke, T. and L. Benjamin. 2005. Forest / wildlife habitat and management guide, 560 – Chignecto Ridges. Department of Natural Resources, Kentville. Internal report. 15pp.

Dunster, J. and K., Dunster. 1996. Dictionary of natural resource management. UBC Press. 363 pp.

Fenow, B.E. 1912. Forest Conditions of Nova Scotia. 93 pp.

Forman, R.T.T. 2004. Road ecology's promise: what's around the bend? Environment 46(4):8-21.

Forman, R.T.T. and R.D. Deblinger. 2000. The ecological road-effect zone of a Massachusetts (USA) suburban highway. Conservation Biology 14: 36-46.

Forman, R.T.T. 1999. Spatial models as an emerging foundation of road system ecology, and a handle for transportation planning and policy. In Proceeding of the Third International Conference on Wildlife Ecology and Transportation, edited by G.L.Evink, P.Garrett, and D.Zeigler, 118-123. Tallahassee, Florida: Florida DOT.

Lindenmayer, D. B. and J. F. Franklin. 2002. Conserving forest biodiversity: a comprehensive multi-scaled approach. Island Press. ISBN 1-55963-935-0. 351 pp.

Methven, I. and M. Kendrick. 1995. A Disturbance History Analysis of the Fundy Model Forest Area. 16pp.

Mailman, G. E. 1975. Tobeatic Resource Management Area Land Inventory. Nova Scotia Department of Natural Resources.

Neily, P. and E. Quigley. 2005. Natural disturbance ecology in the forests of Nova Scotia. Ecosystem Management Group, Department of Natural Resources, Truro. Unpublished report.

Neily, P., E. Quigley, L. Benjamin, B. Stewart, and T. Duke. 2003. Ecological land classification for Nova Scotia. Vol. 1 - mapping Nova Scotia's terrestrial ecosystems. Nova Scotia Dept. of Natural Resources, Forestry Division, Truro. 83 pp.

Nova Scotia Department of Natural Resources. 2006. Guidelines for the development of long range management frameworks. Nova Scotia Department of Natural Resources, Regional Services, Halifax. 33 pp.

Nova Scotia Department of Natural Resources. 2002. Wildlife Habitat and Watercourses Protection Regulations. Section 40 of the Forests Act R.S.N.S. 1989, c. 179 O.I.C. 2001-528 (November 15, 2001, effective January 14, 2002), N.S. Reg. 138/2001 as amended by O.I.C. 2002-609 (December 20, 2002), N.S. Reg. 166/2002
http://www.gov.ns.ca/natr/wildlife/habitats/protection/

Reed, R.A., J.Johnson-Barnard, and W.L. Baker. 1996. Contribution of roads to forest fragmentation in the Rocky Mountains. Conservation Biology 10:1098-1106.

Seymour, R. S. and M. L. Hunter, Jr. 1999. Principles of Forest Ecology. Chapter 2. In: M.L. Hunter Jr. Ed. Maintaining Biodiversity in Forest Ecosystems. 698 pp.

Spellerberg, I.F. 1998. Ecological effects of roads and traffic: a literature review. Global Ecology & Biogeography Letters 7, 317-333.

Stewart, B. and P. Neily. 2008. A procedural guide for ecological landscape analysis. Department of Natural Resources, Truro. Report for 2008-2.

Strang, R. M. 1972. Ecology and land use of barrens of Western Nova Scotia. Canadian Journal of Forest Resources. 2(3): 276-290.

USDA Forest Service.1999. Roads analysis: informing decisions about managing the national forest transportation system. Misc. Rep FS-643. Washington, D.C.: U.S. Department of Agriculture, Forest Service. 222 p.