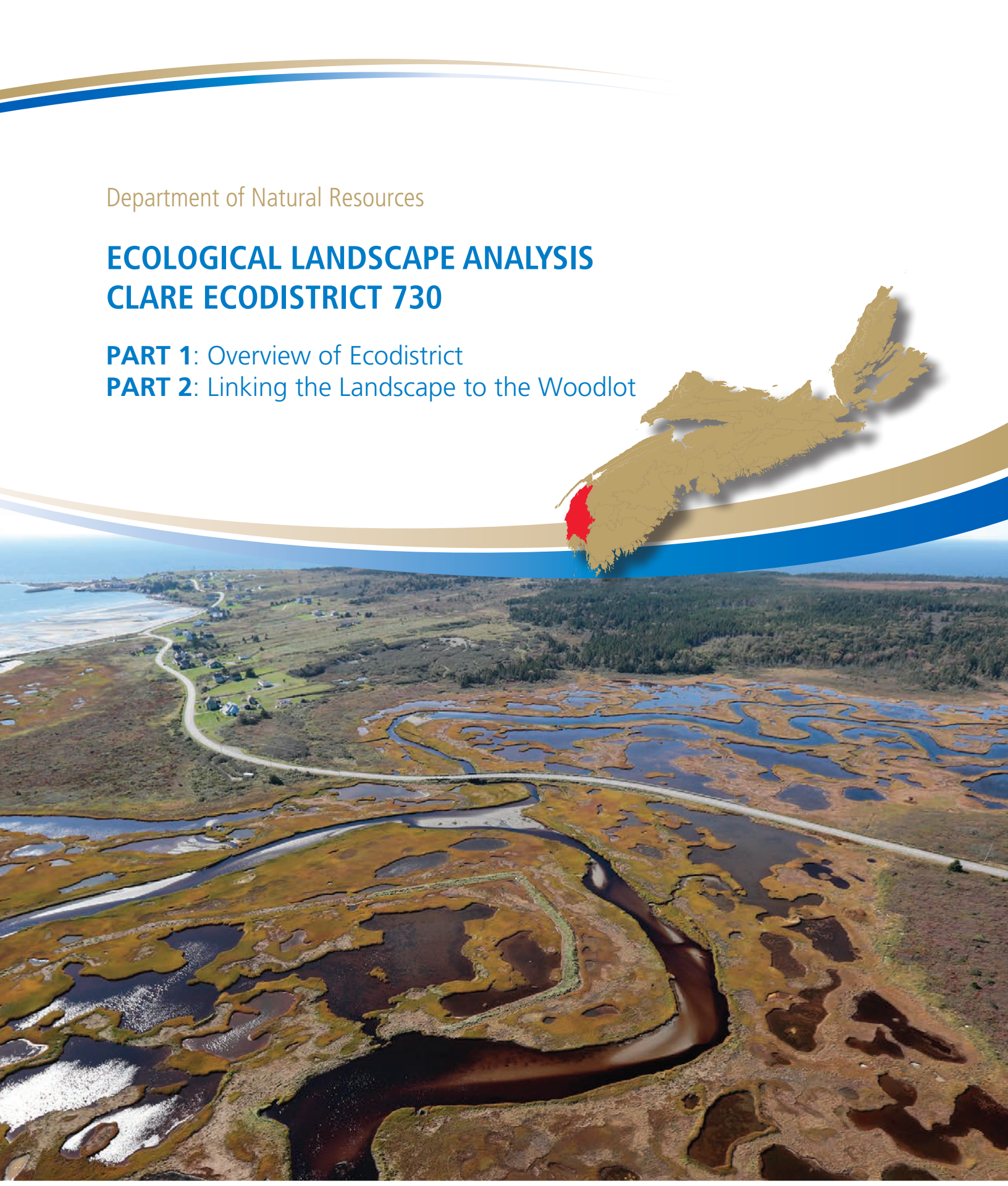
Department of Natural Resources

ECOLOGICAL LANDSCAPE ANALYSIS CLARE ECODISTRICT 730

PART 1: Overview of Ecodistrict
PART 2: Linking the Landscape to the Woodlot



ELA 2015-730

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 730: Clare

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This report, one of 38 for the province, provides descriptions, maps, analysis, photos, and resources of the Clare Ecodistrict that can help landowners and planners understand important characteristics of the landscape. The report details the main elements in the ecodistrict and, of particular interest to woodland owners, vegetation types within forest stands.

Ecological Landscape Analysis (ELA) is a first step in developing an ecosystem approach to managing resource values at a landscape level. It supports planning by landowners wanting to understand how their land fits into the landscape ecosystem. Additional direction will be provided by a landscape planning guide, and internet-based inventory update system, both of which are currently under development.

The ELAs were analyzed and written from 2005 – 2009. They provide baseline information for this period in a standardized framework of ecosystem mapping and data summary designed to support future data updates, forecasts, and trends. This document includes Part 1 – *Learning About What Makes This Ecodistrict Distinctive* – and Part 2 – *How Woodland Owners Can Apply Landscape Concepts To Their Woodland.* Part 3 – *Greater Detail for Forest Planners and Analysts* – will be available on request by contacting DNR officials at their regional offices.

Information sources and statistics (benchmark dates) include:

- Forest Inventory (2002) – 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.

A glossary of definitions is provided for words that are underlined.

REPORT FOR ELA 2015-730

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A NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES PUBLICATION

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An objective of ecosystem-based management is to manage landscapes in as close to a natural state as possible. The intent of this approach is to promote biodiversity, sustain ecological processes and support the long-term production of goods and services. Each of the province's 38 ecodistricts is an ecological landscape with distinctive patterns of physical features. (Definitions of underlined terms are included in the print and electronic glossary.)

This Ecological Landscape Analysis (ELA) provides detailed information on the forest and timber resources of the various landscape components of Clare Ecodistrict 730. The ELA also provides brief summaries of other land values, such as minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat.

If you are travelling from Digby to Yarmouth, most of the trip will be spent in the Clare Ecodistrict, bounded on the northwest by the waters of St. Marys Bay. Farther south, the waters change into the Bay of Fundy and then the Gulf of Maine.

The more than 100 kilometres of coastline provides habitat for wintering concentrations of waterfowl, including black duck, common eider, greater scaup, long-tailed duck, and common merganser. These birds are generally found close to the shore along the coast and in river estuaries.

The Clare Ecodistrict has the longest growing season in the province, with 210 days where the temperature is five degrees Celsius or above.

Land ownership patterns in this ecodistrict influence the diversity of forest ecosystems, both in size and composition.

The ecodistrict is located on an undulating to gently rolling, drumlin till plain.

A tin deposit that extends from the northeast of the East Kemptville Tin Mine to the Atlantic coast near Yarmouth is part of the ecodistrict.

Private land ownership accounts for about 80% of the ecodistrict, with a little less than 10% owned by the Crown and the remainder as mainly inland waters and transportation corridors. Some of the private lands, particularly along the Acadian Shore of St. Marys Bay, are long and narrow. This is a reflection of past inheritance practices, where lands were divided to ensure each parcel contained shore lands and woodlands.

About three-quarters of the total area is forested. Red spruce is a dominant softwood species, generally occurring on well-drained sites. Black spruce is most common on the wettest sites. Mixedwoods are often dominated by red maple.

Sites of ecological significance are found at Belliveau Lake, Gilfillan Lake, and the Tusket River Nature Reserve.

Saltwater marshlands provide seasonal habitat for many migratory waterfowl.

The ecodistrict is heavily covered with lakes and rivers, representing 9.6% of the area. Major rivers include the Tusket, Carleton, Annis, Silver, Sissiboo, Meteghan, and Salmon. Many of the tributaries to the rivers are slow-moving, meandering streams that often passing through wetlands. Lakes are generally shallow, sometimes aligned as a chain with interconnecting rivers and streams.

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. These elements are described by their physical features – such as soil and landform – and ecological features – such as climax forest type. These characteristics help determine vegetation development.

Element descriptions promote an understanding of historical vegetation patterns and the effects of current disturbances. This landscape analysis identified and mapped seven key landscape elements – one dominant matrix element, five smaller patch elements, and a corridor element– in Clare.

Tolerant Mixedwood Hummocks is the matrix element, representing nearly half of the ecodistrict. The matrix element naturally supports mainly long-lived tree species that like to grow in shade, such as red spruce, white pine (which also does well in moderate sunlight), and eastern hemlock. Most of the matrix is currently either mixedwood or softwood. Red maple is the main hardwood species.

Tolerant Mixedwood Drumlins is the largest patch element, accounting for about one-quarter of the area. Tree species are similar to the matrix, but the landscape is dominated by drumlins. The other patch elements, in order of size, are **Wetlands, Tolerant Hardwood Hills, Pine Oak Hills and Hummocks,** and **Spruce Pine Hummocks**.

Valley Corridors is a linear element associated with the major watercourses in the ecodistrict that passes through several element types. *The ecodistrict also contains the tiny elements Coastal Beach and Salt Marsh.*

Forest Ecosystem Management
For Clare Ecodistrict

The primary ecological goals of ecosystem-based management are to maintain and conserve ecosystem biodiversity, productivity and resilience. Integration of economic, ecological, and social values within a single planning process provides opportunities for creative solutions to meet the challenges of sustainable resource management. By maintaining their integrity, ecosystems can better adapt to environmental stressors such as extended cycles of climate change, atmospheric pollution, changes in land use and vegetation cover.

This ELA provides detailed information on the resources and descriptions of various components of the landscape for Clare Ecodistrict 730. Resources and their components include the natural elements that make up the landscape and may affect functions like connectivity – how a landscape enables or impedes movement of resources, such as water and animals – as well as conditions of forest composition, road density and land use intensity.

Only brief summaries are presented for other land values, including minerals, energy and geology, water resources, parks and protected areas, wildlife and wildlife habitat. These summaries are included in the document to present the range of land values that must be balanced during the design stage of the land management process and are not intended to be exhaustive treatments of the respective land values. Where possible, the reader will be referred to additional sources for detailed information.

Application

The data in this ELA does not represent current inventory, but instead provides baseline conditions for the time when the report was researched, which in the case of the Clare Ecodistrict was up to 2008. These baseline measurements can be used to assess trends through comparison with present and future inventories.

The ELA supports an approach to maintaining healthy ecosystems by mimicking natural conditions. The report describes the inherent natural structure and condition of landscapes based on enduring physical features, such as elements. It goes on to show how this structure may influence ecosystem functions, such as wildlife movement and connectivity. The ELA summarizes conditions of ecosystems such as forest composition, land use intensity, and road density at the time the report was written.

Finally, the relationship between inherent structure and existing conditions is used to guide future direction. The ELA is part of an ecosystem approach that will expand to encompass other initiatives of the Department of Natural Resources (DNR), such as The Path We Share: A Natural Resources Strategy for Nova Scotia 2011 – 2020 (http://novascotia.ca/natr/strategy/pdf/Strategy_Strategy.pdf).

The intention is to describe important ecological characteristics to consider during resource planning – the ELA is not a plan in itself.

Part 1: An Overview of Clare – *Learning About What Makes This Ecodistrict Distinctive*

This first part of the report provides an overview of the ecodistrict for a broad readership. By reviewing several key topics, the reader will have a better understanding of the features that help give the area its character and set it apart as a distinct and unique ecodistrict.

Ecodistrict Characteristics

The Clare Ecodistrict is part of the Western Ecoregion. This ecodistrict, with a total area of 1,915 square kilometres, stretches from near Digby in the north to near Yarmouth in the south.

Clare is bounded on the south by the Sable Ecodistrict 760 and Tusket Islands Ecodistrict 840. To the east is Western Barrens Ecodistrict 770 and to the north South Mountain Ecodistrict 720. The main western boundary is the waters of St. Marys Bay.

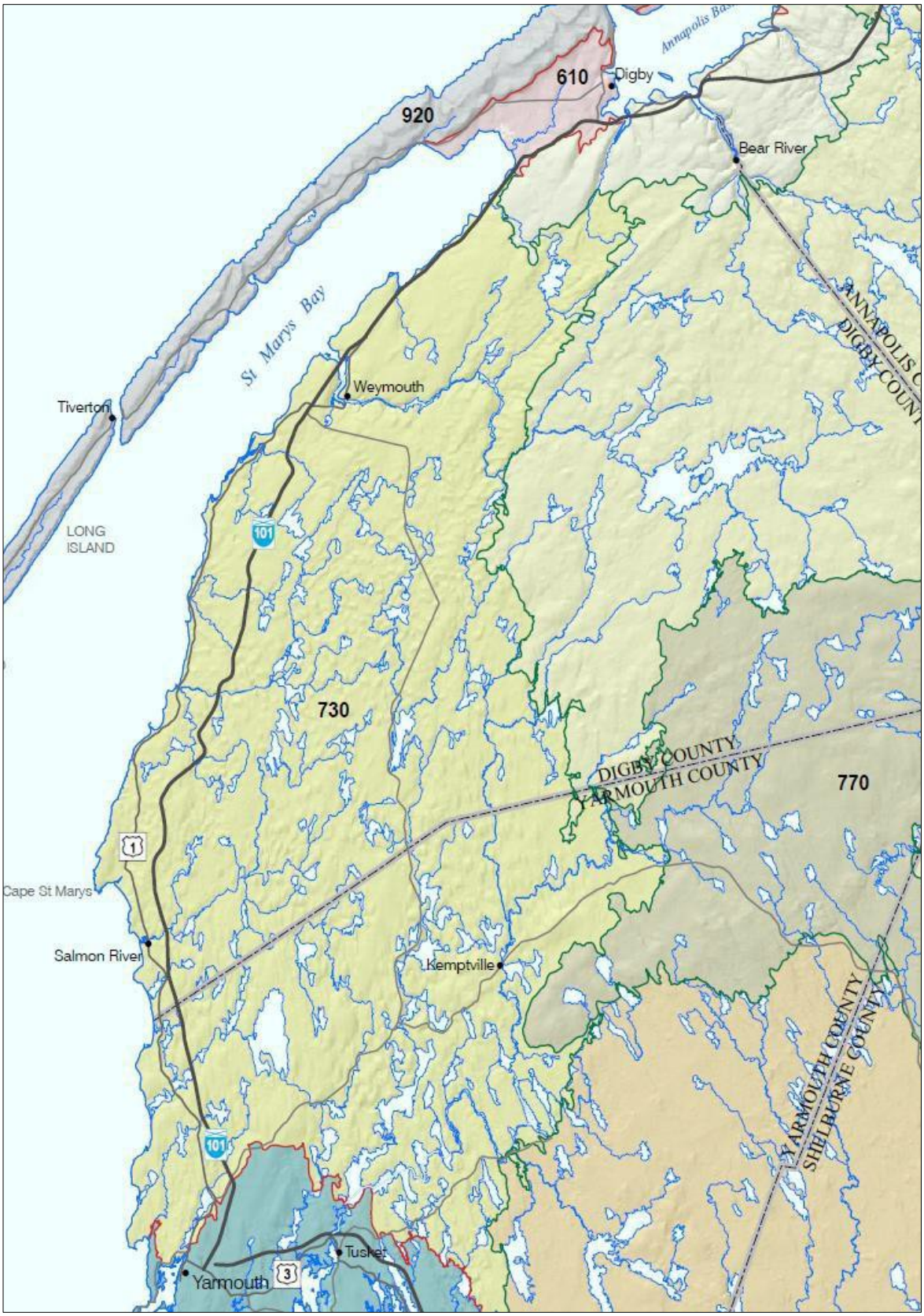
Freshwater lakes and rivers are abundant, covering more than 9% of the total area. Clare has the longest growing season in the province and a climate characterized by cool summers with coastal fog and mild winters.

The Clare Ecodistrict is located on an undulating to gently rolling, drumlin till plain underlain by grey wacke, slate, quartzite, and schists. The soils that have developed on the slate and quartzite till plain are predominately well-drained, stony, sandy loams. Imperfectly drained soils are found in the depression between drumlins and hummocks, as well as those areas where internal drainage has been restricted due to glacial soil compaction.

The numerous drumlins are low, generally 20 metres or less in height. Scattered eskers are present at the Boarsback near Wentworth Lake and on the west side of Gaspereau Lake. Interesting glacial features, such as end-moraine complexes and cliffs, can be found along the shoreline of St. Marys Bay. Numerous beaches are located along the coast.

Prior to European settlement, parts of the ecodistrict likely supported long-lived, shade-tolerant hardwoods and softwoods. A long history of human activities associated with settlement, such as agriculture and forestry, have changed the composition of the forest. Today, there are more early successional species that have become established following these disturbances.

See map on following page for overview of the Clare Ecodistrict, including adjacent ecodistricts, locations of area towns and villages, county boundaries, and major waterways.



Clare Ecodistrict 730 extends north of Yarmouth to south of Digby. Its coastline is dominated by the waters of St. Marys Bay and the Bay of Fundy.
(From Ecodistricts of Nova Scotia map 2007)

Land Area

The Clare Ecodistrict is one of eight ecodistricts in the Western Ecoregion.

The majority of the land is held by a large number of private owners (Table 1).

Individual parcel size varies but some of the properties, particularly along the shore of St. Marys Bay, are extremely long and narrow. This is a reflection of past inheritance practices where lands were divided lengthwise so that shore and woodlands were contained in every parcel.

Table 1 – Land Area by Ownership in the Clare Ecodistrict*

Ownership	Area** (hectares)	Percent of Total Area
Provincial Crown land	17,911	9.3
Private	153,772	80.3
Other (Inland water bodies, transportation corridors)	19,924	10.4
Total	**191,607**	**100**

*Note: Figures may vary slightly from table to table because of rounding, averaging, and overlapping of categories and other factors.
***Major changes in land ownership occurred in 2013, reflecting the province's purchase of former Bowater Mersey Paper Company Limited lands. Provincial Crown land increased to 28,147 hectares, representing 14.7% of total area. Ownership of private and other lands decreased to 163,461 hectares, representing 85.3% of total area.*

Crown land, representing approximately 9% of the area, occurs as scattered blocks across the ecodistrict. Some of the larger Crown parcels are located at Richfield, Wentworth Lake, Squash Lake, and Danvers.

The area is largely rural with the more urban-like patterns of settlement evident in outlying communities near Yarmouth and in the string of houses stretching out along the Acadian Shores as one community blends into another.

IRM Resource Classification for Crown Lands

The Integrated Resource Management (IRM) classification for Crown lands was developed through a public consultation process of the strategic phase of IRM completed in 2002.

Table 2 provides a summary of Crown lands designated as either C1, General Resource Use (21.7%); C2, Multiple and Adaptive Use (allows most uses, but special management may be required) (62.2%); or C3, Protected and Limited Use (such as beaches and sites of cultural and historic significance) (16%).

Table 2 – IRM Land Use Categories for Provincial Crown Lands in Ecodistrict		
IRM land use category	**Hectares**	**Percent of Crown Lands**
C1 – General Resource Use	3,879	21.7
C2 – Multiple and Adaptive Use	11,146	62.2
C3 – Protected and Limited Use	2,870	16
Unclassified	18	0.1
Total	**17,913**	**100**

There are 10 campsite leases in this ecodistrict. No new campsite leases are being issued.

There is one special lease for growing blueberries. Nova Scotia Power has flowage rights and leases on a number of lakes and river systems. The former Dominion Atlantic Rail Line runs through the ecodistrict. The right-of-way is generally 30 metres wide.

Forests

Within the Clare Ecodistrict, about three-quarters of the land, or 142,776 hectares, is forested (Table 3).

Non-forested land includes barrens, agriculture, and urban sites.

Wetlands account for 10,579 hectares, or 5.5%, of the area. Other includes areas of brush and alders, accounting for 12.8% of the area.

Table 3 – Area Distribution by Land Category for All Owners		
Category	**Hectares**	**Percent**
Forested	142,776	74.5
Wetland	10,579	5.5
Agriculture	5,662	3
Barrens	480	0.3
Urban	5,292	2.8
Road, Trail, Utility	2,197	1.1
Other	24,621	12.8
Total	**191,607**	**100.0**

Among the forests, 55,082 hectares, or 43%, are softwood stands (more than 75% softwood species). Black spruce dominates the imperfectly drained soils whereas red spruce, eastern hemlock, and white pine thrive on the side slopes and better-drained soils. Mixedwood stands of red spruce, eastern hemlock, white pine, sugar maple, yellow birch, and beech account for 52,676 hectares, or 41%. Hardwood stands (more than 75% hardwood species) account for 18,307 hectares, or 14%, of the forest cover, with 2,094 hectares, or 2%, unclassified.

The average Land Capability (LC) of forested land in this ecodistrict is estimated to be 5.4 cubic metres per hectare per year (m^3/ha/yr), based on the ratings in Table 4. The average forest LC for the province is 4.9 m^3/ha/yr.

Some areas are not suitable for trees. These non-forested areas consist mainly of rock outcrops and barren lands.

In Clare, more than 93% of the forested land is LC 4 rating and greater (Table 4). This rating indicates the Clare Ecodistrict has good potential for forest growth.

Table 4 – Area of Forested Land by Land Capability Rating

Land Capability (LC) Rating (m^3/ha/yr)*	Hectares	Percent
2 or less	1,436	1
3	7,755	5.4
4	11,384	7.9
5	42,855	30
6	63,368	44.5
7 or more	15,979	11.2
Total	**142,777**	**100**

*Based on growth rating for softwood species.

Water Resources

Inland waters make up more than 9% of the ecodistrict.

Major rivers include the Tusket, Carleton, Annis, Sissiboo, Silver, Meteghan, and Salmon. Many of the tributaries to the rivers are meandering streams that often pass through wetlands. Lakes are generally shallow, sometimes aligned as a chain with interconnecting rivers and streams. The lakes are usually oriented in a north-south direction, a result of past glacial activity.

Wetlands account for approximately 3.8% of the ecodistrict. This total does not include innumerable forested swamps, which are difficult to identify using photo interpretation and other means.

Water quality is considered oligotrophic – with low levels of plant nutrients and high amounts of dissolved oxygen – due to acid rain and the granite bedrock through which the water often passes.

The Lake George watershed, the town of Yarmouth's water supply, has been designated as a protected water area under the Environment Act.

Minerals, Energy and Geology

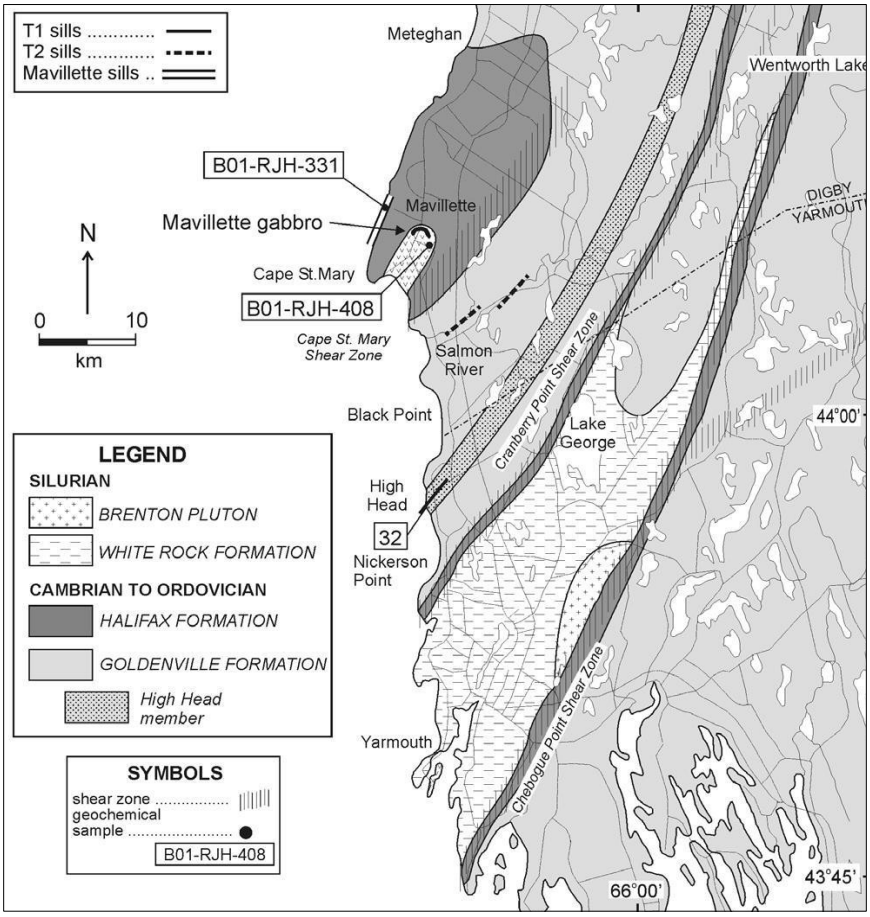
The Clare Ecodistrict lies on the western end of the South Mountain Batholith, the western boundary being the Atlantic Ocean. The area is dominated by Meguma Group rocks that are about half a billion years old.

In the southern portion of the ecodistrict, there are three major shear zones that extend from the coastal southern edge in a northeastern direction to the eastern limit of the ecodistrict.

These shear zones contain sections of metamorphosed sedimentary and volcanic rocks from the White Rock Formation which are up to 440 million years old. There are several small granite intrusions in this ecodistrict as well as significant mineral deposits.

The major bedrock unit in this ecodistrict is the Meguma Group, which is divided into two formations: the Goldenville Formation and the Halifax Formation. The Goldenville Formation consists of metamorphosed sandstone, minor siltstone, and slate and has abundant trace fossils. The Halifax Formation consists of slate (tends to be sulphide-rich), schist, metamorphosed siltstone, and migmatite.

The White Rock Formation is constrained by two shear zones and extends from the Atlantic coastline at Yarmouth trending northeastward just past Lake George. The formation also has small outcroppings located near Mavillette and Wallace Lake (adjacent to the South Mountain Batholith). There are small granite intrusions located at Mavillette, Nickersons Point, Lake George, and Wentworth Lake, which are all gabbros (a type of granite rock).



A figure from a publication of DNR's Mineral Resources Branch illustrates some of the geological features within the ecodistrict.

This area is host to the Southwest Nova Scotia Tin Domain from which Rio Algom produced approximately 19 million tonnes of tin ore over from 1985 to January 1992 with reserve estimates of 56 million tonnes. The tin domain forms a northeast-trending zone that extends from the northeast of the East Kemptville Tin Mine deposit through to the Atlantic coast near Yarmouth.

Numerous base and precious metal deposits of tin, zinc, copper, and silver are found both within the granites of the batholith as well as the rocks adjacent to the batholith. There are several plutons within this district that exhibit similar mineral characteristics to the East Kemptville deposit, which indicate a high potential for the discovery of other economic deposits.

The structural geology is fairly complex in this ecodistrict. The Meguma Group and White Rock Formation were deformed during the Acadian Orogeny, which resulted in a regional scale, northeast trending folding to the bedrock. There are four major shear zones contained within the Meguma Group: Cranberry Point, Cape Forchu, Chebogue and Kemptville shear zones. These shear zones all have economic mineralization associated within and adjacent to the boundary zones.

There is very good economic potential within this ecodistrict. Numerous base metal and precious metal deposits are known to be associated not only with the shear zones, but also with the gabbro plutons and granite deposits (e.g. Lithium-Beryllium pegmatite at Brazil Lake).

The most significant mineral deposit in this ecodistrict is the East Kemptville tin-zinc-copper-silver deposit. The Goldenville Formation is host to several tin-zinc-copper occurrences adjacent to the South Mountain Batholith and it is also host to numerous auriferous vein-quartz deposits.

Through recent geological mapping in this area by the DNR, the extent of known shear zones has been expanded and several new shear zones have been delineated. These have not been fully evaluated and are excellent targets for future exploration.

There is a history of gold mining at Kempt, Carleton, Arcadia, Kemptville, and Pembroke Cove, and lead mining at Kempt Snare Lake, where lead was produced. Within the Clare Ecodistrict, there are currently 54 abandoned mine sites that produced gold, and one abandoned mine that produced lead. All abandoned mine sites are located on private lands.

Potential geohazards, such as abandoned mine openings, potential karst areas, flood risk areas, sulphide-bearing slates, and underground coal workings, can be viewed at the following web sites: http://gis4.natr.gov.ns.ca/website/nsgeomap/viewer.htm
http://gis4.natr.gov.ns.ca/website/mrlu83/viewer.htm
Please report any additional geohazards found on Crown lands to your nearest Natural Resources office.

Currently there is no active mining in the Clare Ecodistrict. The East Kemptville Tin Mine shut down production due to the low price of tin and other economic factors. A large number of claims have been staked around the contact margins of the major shear zones and exploration activity is modest.

The surficial geology comprises large drumlins with silt to stony tills and the area has numerous peat and organic deposits, some of which are potential fuel grade peat deposits. There are a few glaciofluvial deposits (kames, eskers) which are excellent sources of sand and gravel.

Numerous aggregate and slate deposits are active within the ecodistrict as well as a few quarry operations. These provide an important source of sand, gravel, slate, and dimension stone to the local area and construction companies. The Halifax Formation is susceptible to acid rock drainage due to the high iron and sulphide content within the slates.

Parks and Recreation / Protected Areas

Clare Ecodistrict has six designated provincial parks. Those include Ellenwood Lake, Port Maitland Beach, Mavillette Beach, Smugglers Cove, Savary and Glenwood. These parks cover 184 hectares. Park reserves are located at Bluff Head, Pembroke Beach and Ogden Lake, with a total area of 23 hectares.

A portion of the Tobeatic Wilderness Area (2,563 ha) is within the boundaries of Clare, along the ecodistrict's southeastern limits.

Majors Point, Church Point and Bartletts are all locations of designated beaches.

Sites of ecological significance can be found at Belliveau Lake, Gilfillan Lake, Tusket River Nature Reserve (all three areas have Atlantic Coastal Plain Flora), and Cape St. Marys (featuring a salt marsh and sand dune ecosystem).

The Tusket River Nature Reserve is a site of ecological significance in the Clare Ecodistrict where Atlantic Coastal Plain Flora can be found.

The Dominion Atlantic Rail Line (DAR) has 88 kilometres of line within Clare. This abandoned rail corridor is managed by the DNR in cooperation with the Sport and Recreation Commission under a provincial policy for Rails to Trails in Nova Scotia, which supports community-based trail development. Much work has been done on developing the corridor as a trail.

Chebogue Meadows, in Yarmouth County, is an interpretive trail.

Traditional outdoor activities, such as fishing, hunting, trapping, off-highway vehicle travel, and camp use, are common in the ecodistrict. Canoeing on some of the larger rivers is a popular pastime.

The most current and up-to-date information for parks and protected areas in this ecodistrict can be found at: http://novascotia.ca/parksandprotectedareas/plan/interactive-map/.

Wildlife and Wildlife Habitat

Wildlife in the Clare Ecodistrict includes relatively common species of plants, animals, and other organisms, along with some species that are rare and/or at risk in Nova Scotia.

Wildlife information for Clare and other ecodistricts comes from a number of sources, including surveys, harvest statistics, hunter / trapper reports (abundance rankings), biological collections from harvested and road killed animals and observations and reports from the public and DNR staff. Information on important sites is documented by DNR in the Significant Habitats Database and by the Atlantic Canada Conservation Data Centre in Sackville, N.B.

Old forests are recognized as providing important wildlife habitat. The provincial goal is to have a minimum 8% for old forests on Provincial Crown land. Shade-tolerant hardwoods and softwoods may provide important wildlife structural components, such as cavity trees, and are encouraged across the landscape through appropriate silviculture systems.

Wetlands and Aquatic Habitat and Wildlife

Water is a prominent and significant feature of this ecodistrict, which is one of the wettest in the province.

The Clare Ecodistrict is characterized by a series of modest hills and low areas. Within these depressions are an abundance of lakes, watercourses, and wetlands that provide aquatic and riparian habitat to many species of wildlife, including an exceptionally large number of rare plants.

In addition to providing important habitat, wetlands perform vital environmental functions, such as flood and erosion control, groundwater recharge, and water filtration. Given their abundance and potential for containing rare species in southwest Nova Scotia, all wetlands in this ecodistrict were considered to be a significant component of this landscape.

Freshwater wetlands in the Clare Ecodistrict are of several diverse types: bog, deep marsh, fen, lakeshore wetland, meadow, seasonally flooded flats, shallow marsh, shrub swamp, and wooded swamp. Bogs and fens are most common, accounting for more than 60% of the wetlands area.

A few individual wetlands deserve special mention. A bog of 216 hectares southwest of Gaspereau Lake in Digby County is the largest wetland in the ecodistrict. The largest fen is on the Silver River near Barrio Lake, with 160 hectares of fen extending about 6 kilometres along the river. A 14 hectare lakeshore wetland at the north end of Spectacle Lake in Digby County stands out because of its potential for relatively high productivity, species diversity, and value to wildlife.

The combination of wetlands and major watercourses and their tributaries results in an abundance of aquatic and riparian habitat. There is a high availability of aquatic plants and invertebrates. These support semi-aquatic mammal species, such as beaver and muskrat; waterfowl species, particularly ring-necked duck, common merganser and black duck; and amphibians and reptiles, including a number of frog, salamander, snake, and turtle species.

Considerable habitat for a number of freshwater fish species such as white perch and yellow perch is available, with even small tributaries used for spawning by brook trout. However, productivity is likely relatively low in Clare's watercourses because of high acidity.

A number of river systems within the Clare Ecodistrict also are, or have been, significant for seasonal runs of anadromous fish, which migrate upriver from the sea to spawn. Spring runs of gaspereau occur in the Salmon, Meteghan, Belliveau, and Annis rivers. Gaspereau also enter Lake Milo and Doctors Lake from Yarmouth Harbour. Rainbow smelt use the Sissiboo and Chebogue rivers, and the Meteghan and Chebogue rivers support a run of striped bass. Fish availability in turn provides opportunities for fish predators, such as otters, common loons, and osprey.

Wetlands and watercourses combine to create a wealth of aquatic and riparian habitat in the ecodistrict, in areas such as Cape St. Marys Marsh, shown above.

Illegal introductions of chain pickerel and smallmouth bass to several lakes and rivers in the Clare Ecodistrict have created a major threat to native salmon and trout populations, freshwater invertebrates and amphibians, through predation and competition. Brook trout have been eliminated or seriously reduced in a number of Clare watersheds, but they persist in some locations, such as Coldstream on the western side of the ecodistrict, where pickerel are unable to achieve access.

Another important ecological feature of the Clare Ecodistrict is the significant length of coastline (over 100 km) on the western side, along St. Marys Bay and the Gulf of Maine. The most notable wildlife occurrence in this coastal zone is wintering concentrations of waterfowl, including black duck, common eider, greater scaup, long-tailed duck, and common merganser. These birds are generally close to shore along the coast and in river estuaries. Black ducks also utilize salt marshes along the coast year-round; the largest of these is a 46 hectare salt marsh at Cape St. Marys.

Terrestrial Habitat and Wildlife

Despite limited variation in topography, the ecodistrict contains a mosaic of forest cover in varying species, age classes, and patch sizes. Forests often also contain abundant edges and open areas, mostly related to past human activity in the way of forest harvesting, agriculture, and development.

White-tailed deer are common and prefer a mix of habitat types, as their needs change seasonally. A high proportion of mature softwood in the ecodistrict provides good winter cover, but regenerating hardwoods from cut-over sites may be lacking. Some of the mature softwood occurs in wooded swamps, a favoured habitat for deer. In general, the ecodistrict provides adequate habitat for white-tailed deer, but lacks the land richness of other ecodistricts.

The snowshoe hare is another species of considerable public interest in this ecodistrict. In general, Clare provides good snowshoe hare habitat, although this may be somewhat limited in mature softwood situations. This species would also do well in the abundant wooded swamps which tend to have rich soils and an understory of shrubs and other food plants.

The needs of white-tailed deer, which are common in the ecodistrict, change with the seasons.

Raptor nests are another important feature of Clare's terrestrial wildlife habitat. The most prominent bird of prey in the ecodistrict is the osprey, owing to the ample opportunities for nesting near water where fish are available. The mix of open areas and a variety of forest species and ages also provides considerable habitat for red-tailed hawks. The goshawk occurs in the ecodistrict, but is relatively uncommon because of its association with old growth forests, the need for large areas of continuous forested land, and a preference for large old growth trees (usually hardwoods) for nesting.

Species at Risk

Perhaps the outstanding wildlife feature of the Clare Ecodistrict is the occurrence of rare plant species belonging to a group known as Atlantic Coastal Plain Flora (ACPF). These plants became established in southwestern Nova Scotia between 10,000 and 14,000 years ago as a result of a land bridge that existed between Nova Scotia and Massachusetts. As glaciers melted and the sea level gradually rose, the land connection disappeared under the water, isolating the plants.

The Clare Ecodistrict has 18 ACPF species that are at risk in Nova Scotia, five of which are listed under the Nova Scotia Endangered Species Act. There are several important sites of occurrence along gently sloping gravelly lake shorelines in the Tusket River and Annis River watersheds.

Eastern white cedar is listed as vulnerable under provincial legislation. Some of the largest stands of eastern white cedar in the province occur in Clare Ecodistrict, with the largest population being found at Hectanooga, inland from Cape St. Marys at similar latitude.

For more detailed and more current information on species at risk and species of conservation concern in this ecodistrict, refer to Appendix 3 and Map 6 in a separate Part 3 of this document. These species are important components of the landscape and are given priority attention in planning, management, and stewardship activities.

With much of the ecodistrict privately owned, effective wildlife management will to a great extent rely on active, informed stewardship by the many landowners. The DNR can assist private land stewardship by providing knowledge and information on various management strategies. Legislation such as the Wildlife Habitat and Watercourse Protection Regulations, the Endangered Species Act, and the Activities Designation Regulations address species and habitat concerns within the forest and wetland ecosystems.

Part 2: Linking the Landscape to the Woodlot – *How Woodland Owners Can Apply Landscape Concepts to Their Woodland*

This second part of the report provides information on how landscape concepts can be applied at the woodlot level. The starting point is an introduction to natural disturbances and succession to provide a foundation for better understanding forest ecosystems. The focus then shifts to elements that make up each ecodistrict and the forest groups and vegetation types at the stand level. This allows woodland owners to move between elements and stands to see how their woodland fits in with the larger landscape.

Forest Disturbances and Succession

Forest Disturbances

A disturbance can be described as an event, either natural or human-induced, that causes a change in the existing condition of an ecological system.

Disturbance pattern controls forest development classes (establishment, young, mature, multi-aged / old forest) and their distribution over area and time.

Due to the coastal location of Nova Scotia and its Maritime climate, the extent, intensity, and frequency of natural disturbances is difficult, for the most part, to predict. Prior to European settlement, natural disturbances were only curtailed by natural barriers such as water, climate, topography, and vegetation change. After about 400 years of activity by European settlers, the frequency, intensity, and magnitude of these natural processes has been affected.

New disturbances have been introduced as a result of human activity and include:

- clearing of forests for agriculture
- timber harvesting
- urbanization and development
- introduction of exotic animals, plants, and insects
- disease-causing agents, such as viruses or bacteria
- fire suppression in the forest
- changes in the chemical and physical characteristics of the atmosphere

Understanding how ecosystems respond to disturbances is critical to understanding how they function and how they can be managed. This will assist woodland owners and forest managers in:

i. assessing the potential for old forest stands and development class distributions
ii. determining appropriate patch sizes and species composition to emulate natural structures and processes
iii. prescribing the appropriate rotation age and development class structure across a forested landscape

iv. projecting future changes to the forest due to climate change and human disturbances
v. maintaining and conserving biodiversity

Natural disturbances are agents that abruptly change existing conditions and initiate secondary succession to create new ecological communities.

By adapting forest management practices to create the structures and processes that emulate natural disturbances, woodland owners and forest managers can help shape forest landscapes.

One approach that closely mimics nature is to allow ecosystems to naturally develop without active management. This approach is particularly effective on lands with long-lived tree species, such as red spruce, white pine, hemlock, sugar maple, yellow birch, and beech. One of the roles of protected areas is to allow this to occur and also provide a model to compare with managed forests.

Natural Succession

Succession refers to the changes in vegetation types (communities) following disturbance which, over time, often leads to a climax stage. Most changes follow a course of vegetation community development (seral stages) for a particular disturbance regime.

Climax vegetation refers to vegetation communities that are relatively long-lasting and self-replacing. Three types of climax vegetation can be described as follows:

Climatic climax – Vegetation types that are mainly a function of regional climate conditions; these occur on sites with average (mesic) moisture and nutrient conditions.

Disturbance climax – Vegetation types which, due to frequency of disturbance, do not progress to the climatic climax.

Edaphic climax – Vegetation types that are mainly a function of soil and site conditions (i.e. low or excess moisture, low or high fertility) which do not progress to the climatic climax.

Another Definition of Succession

Succession, as defined by Odum (1971), is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable.

Successional development generally proceeds through a number of distinct seral stages (e.g. early, middle, late) that replace one another in a predictable sequence and which culminates in a relatively stable and self-perpetuating community condition called a climax.

– From *Part 1: Vegetation Types (2010) of Forest Ecosystem Classification for Nova Scotia* *http://www.gov.ns.ca/natr/forestry/veg-types*

Clare – Elements Defined

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. These elements are described by their physical (e.g. soil, landform) and ecological features (e.g. climax forest type). These characteristics help determine vegetation development. Elements promote an understanding of historical vegetation patterns and present disturbances.

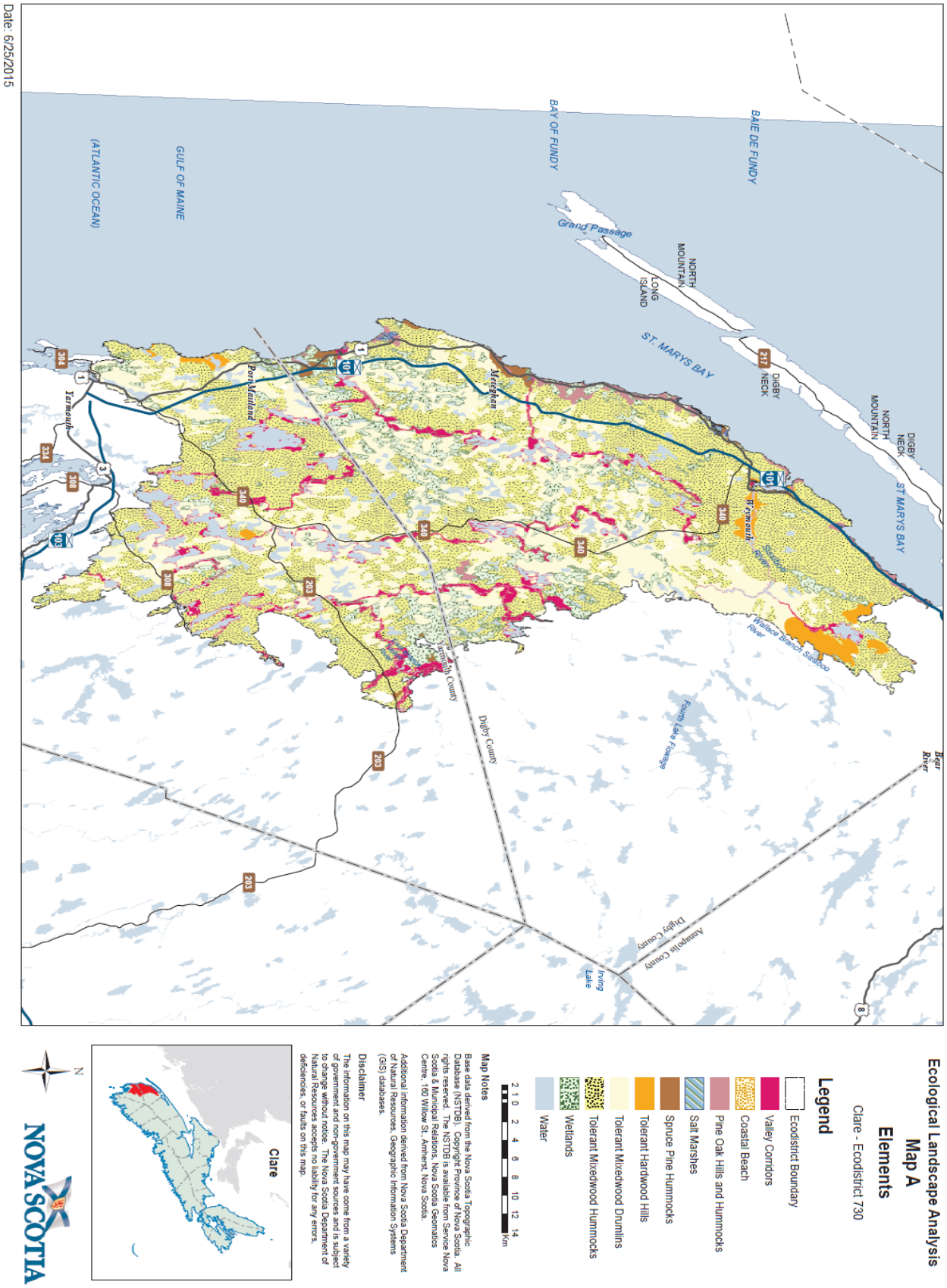
A landscape profile identified and mapped seven distinctive landscape elements in the Clare Ecodistrict – one matrix, five patches, and a corridor (Table 5a). A matrix is the dominant community type. Patches are smaller yet still distinctive community types. Corridors are natural linear communities, such as river valleys, that link parts of the ecodistrict.

Tolerant Mixedwood Hummocks is the matrix element. Prior to European settlement, the matrix was mainly long-lived, shade-tolerant softwood species, such as red spruce, eastern hemlock, and white pine. Mixedwood and hardwood have increased since then. Red maple is the major hardwood species with smaller amounts of white birch, sugar maple, yellow birch, and beech.

Tolerant Mixedwood Drumlins is the largest patch element. Tree species are similar to the matrix, but the landscape is dominated by drumlins. The other patch elements, in order of size, are **Wetlands, Tolerant Hardwood Hills, Pine Oak Hills and Hummocks,** and **Spruce Pine Hummocks**.

Valley Corridors is the corridor element, which usually follows riparian areas along the major rivers and inter-connected lakes and passes through numerous element types. *The ecodistrict also contains the tiny elements Coastal Beach and Salt Marsh.*

Map of Elements in Ecodistrict



Forest Stands Within Elements

Each element contains a number of stands which are forest ecosystems 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.

Viewed online or available in print through DNR, woodland owners can learn about the characteristics of a particular forest community. See Table 5a for descriptions of elements and Table 5b for forest stands that are likely to be found within elements, which in turn shape the landscape.

A variety of forest stands and vegetation types are found within the various elements of the Clare Ecodistrict landscape, shown in areas such as Mavillette above.

Table 5a – Elements Within Clare		
Landscape Element	**Size (Hectares)**	**Element Description**
Tolerant Mixedwood Hummocks (Matrix)	90,481 49.5%	The matrix element is very similar to the patch-level Tolerant Mixedwood Drumlins in this ecodistrict, but it usually has more softwood-dominated mixedwoods and carries a higher percentage of pure softwood forests. These productive soils predominantly yield forest stands comprising shade-tolerant hardwood and softwood species but which may occur as pure and/or mixedwood covertypes. Often the crests and upper slope positions are preferred by the hardwood species with the softwood becoming more dominant in the middle to lower slope positions. Primary species include red spruce, hemlock, white pine, yellow birch, beech, and sugar maple. Red oak and red maple may also be components. With progressively poorer drainage on the level terrain between hummocks, black spruce, tamarack, and red maple dominate the forest vegetation.
Tolerant Mixedwood Drumlins (Patch)	48,211 26.4%	Tolerant Mixedwood Drumlins is the largest patch element in this ecodistrict. Drumlin or drumlin-like landforms comprising unsorted glacial tills yield soils of medium textures that are typically well-drained. Primary species include red spruce, hemlock, white pine, yellow birch, beech, and sugar maple. Red oak and red maple may also be components. With progressively poorer drainage on the level terrain between drumlins, black spruce, tamarack, and red maple dominate the forest vegetation. In toe slope positions and in flow accumulation zones where soils are moist to wet and nutrient enriched, red spruce, hemlock, yellow birch, and white ash are common. Early and mid-successional forests will have red maple, white pine, red spruce, white birch, balsam fir, and red oak.
Wetlands (Patch)	18,936 10.4%	Wetlands are generally treeless or sparsely forested woodlands. For the most part, sites are underlain by poorly drained mineral soils or organic soils derived from peat (sphagnum mosses) or sedges. Where coarse-textured soils are encountered these have originated from wave-washed gravel deposits and are embedded with the well-drained coarse-textured soils along St. Marys Bay. Where trees can establish and grow forests, woodlands of black spruce, tamarack, and red maple will occur. The occurrence of eastern white cedar is possible throughout this element in the Clare Ecodistrict. This element plays a critical role in water collection, filtering, and groundwater recharge.
Tolerant Hardwood Hills (Patch)	3,270 1.8%	This patch element occurs in a few isolated patches, the largest being in the northern portion of the ecodistrict near Doucetteville. This element occurs primarily on low hills and steep slopes associated with upland sites. Productive soils yield forest stands comprised of shade-tolerant hardwood species such as sugar maple, yellow birch, beech, ironwood, and white ash. On crests and upper slope positions, beech and sugar maple are more dominant but as moisture progressively increases towards middle and lower slope positions, yellow birch and white ash become more common along with red spruce and hemlock on the lower and toe slope positions. Red maple is possible as a canopy component on most sites in this element and red oak is most likely on the coarser-textured soils. Stands can develop old forest characteristics.

Table 5a – Elements Within Clare		
Landscape Element	**Size (Hectares)**	**Element Description**
Pine Oak Hills and Hummocks (Patch)	2,367 1.3%	Pine Oak Hills and Hummocks occurs as a patch-level element in the Clare Ecodistrict on hummocky terrain primarily along the St. Marys Bay. The soils have developed from wave-washed gravel underlain by marine sediments and are thus rapidly drained as well as coarse-textured. The inherent soil fertility is poor and when combined with the droughty nature of these soils the area is thought to have had the potential to support a late successional white pine - red oak ecosystem although few clues for this condition exist due to the intensive altered use of this element for settlement. Currently, earlier successional forests with black spruce, white spruce, and red maple are abundant on abandoned pasturelands and old fields. Often this element is bordered by wetlands, salt marshes and/or coastal beach.
Spruce Pine Hummocks (Patch)	1,248 0.7%	This is a patch-level ecosystem occurring along St. Marys Bay. The distinguishing feature is the low fertility of the soils which leads to a forest of black spruce and white pine and a significant understory of woody heath-like shrubs. With progressively poorer drainage, black spruce, tamarack, and red maple dominate the forest vegetation. Red spruce, hemlock, and the shade-tolerant hardwoods are unlikely to be present in this element. Natural disturbances are frequent, resulting in even-aged forests. Early successional forests may include red maple, white birch, aspen, and red oak. This element has been heavily altered by settlement and agriculture. White spruce is common on abandoned farmland.
Valley Corridors (Corridor)	18,187 10%	Riparian corridors along the major rivers and inter-connected lakes have been delineated. These generally well-forested corridors are mainly mature or multi-aged. Mid seral intolerant mixedwoods of red maple and red spruce and late seral softwoods of black spruce or red spruce with scattered white pine or hemlock are present. Occasionally pure stands of red maple or tolerant hardwoods can be found.
Total	**182,700***	*Area is not the same as in Table 1 because water has not been included. *The ecodistrict also contains the tiny elements Coastal Beach and Salt Marsh.*

Table 5b – Forest Vegetation Types[1] Within Elements in Clare

Element	Successional Stage					
	Early	% *	Middle	%	Late	%
Pine Oak Hills and Hummocks	IH1, IH4, SP8	43	IH2, IH6, SH9, SP4, SP6	34	SP5, **SP9**, SH4	17
Spruce Pine Hummocks	IH1, SP2, SP8	48	IH2, IH6, SP3, SP4, SP6, SH9	18	**SP5, SP7,** SP9	28
Tolerant Hardwood Hills	IH3, IH5, IH6, OF1, OF3	15	IH7, TH8	41	**TH1, TH2,** TH3, **TH5, TH6**	35
Tolerant Mixedwood Drumlins	OF1, OF2, OF3, OF4, IH3, IH4, IH5	18	IH6, IH7, MW2, MW4, SH5, SH6	39	TH1, TH2, TH5, **MW1, MW3,** SH1, SH2, SH3, SH4	36
Tolerant Mixedwood Hummocks	OF1, OF2, OF3, OF4, IH3, IH4, IH5	18	CE2, IH6, IH7, MW2, MW4, MW5, SH5, SH6	42	TH1, TH2, TH5, **MW1, MW3,** SH1, SH2, SH3, SH4	31
Wetlands	CE1, FP3, WC1, WC2, WC4, WC5, WC6, WC7, WC8, WD1, WD2, WD3, WD4, WD6, WD7, WD8, SP7					

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.

Photos Illustrating Vegetation Types in Elements

The following photos show some of the vegetation types expected to be found within their respective elements.

Eastern white cedar – Balsam fir / Step-stair moss (CE2) is a mid- successional vegetation type found in the Tolerant Mixedwood Hummocks matrix element.

Balsam fir – Red maple / Wood sorrel – Goldthread (MW4) is a mid-successional vegetation type found in the Tolerant Mixedwood Drumlins patch element.

Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum (WD7) is a vegetation type found in the Wetlands patch element.

White pine – Balsam fir / Shinleaf – Pine-sap (OF3) is an early successional vegetation type found in the Tolerant Hardwood Hills patch element.

Black spruce – Red maple / Bracken – Sarsaparilla (SP6) is a mid-successional vegetation type found in the Pine Oak Hills and Hummocks patch element.

Black spruce / False holly / Ladies' tresses sphagnum (SP7) is a late successional vegetation type found in the Spruce Pine Hummocks patch element.

Landscape Composition and Objectives

Landscapes contribute to the maintenance and conservation of native biodiversity. 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. DNR is developing a number of additional approaches and planning tools which will be integrated with objectives defined in the ELA protocol.

Human activities, such as forest harvesting, can have a significant impact on the structure and composition of the forested landscape. Well-planned harvesting can provide a tool to achieve landscape composition goals.

Natural Disturbance Regimes

Three natural disturbance regimes dominate natural forests:

Frequent Stand Initiating – Disturbances usually occur more frequently than the average life span of the dominant species and are of sufficient intensity to kill most of the existing mature trees, thereby promoting the establishment of a new forest within a relatively short period. Some unharmed trees often survive the disturbance in pockets and/or as scattered individuals.

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.

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 the replacement of a small group of trees.

The two most prominent natural disturbance regimes in Clare are infrequent and gap.

The infrequent natural disturbance regime is associated with shade-tolerant softwood species, such as red spruce, white pine, and hemlock.

Clare has an abundance of area in the potentially long-lived (125+ years) tolerant softwood climax covertype. Fires are uncommon due to the amount of precipitation, fog, wetlands, and interspersed mixed or hardwood covertypes. Hurricanes rarely occur. Winter storms of ice and wind can result in localized patches of damaged trees. Isolated incidences of insect damage, such as spruce budworm and tussock moth, have occurred in the past. Over-mature white spruce growing on tolerant hardwood sites have been afflicted with the bark beetle.

The gap disturbance regime is a feature of the tolerant hardwood climax covertype. This regime favours the development of uneven-aged structure, shade-tolerant species, and the formation of old growth conditions. Mortality is commonly by insects, disease, lightning, blowdown, and old age.

Regeneration occurs under openings in the canopy after the death of individual or small groups of trees. Usually tolerant species regenerate in the openings and, as more gaps are created in the overstory, the regeneration is released into the canopy and shares the space with surviving older trees.

In Clare, old age and disease are likely the primary causes of mortality. Beech bark disease has resulted in significant loss of vigour and value and increased mortality in native beech trees.

Less common natural disturbance regimes in Clare are frequent and open seral. An example of the frequent regime is the black spruce - white pine vegetative type. The interval between stand-initiating events is shorter than the longevity of the climax species. The disturbance is intense enough that there is rapid mortality and a new even-aged forest becomes established on the site. Stand development is interrupted with another disturbance before the stand can become uneven-aged. Fire and wind are the usual disturbances.

Open seral regimes occur where site conditions restrict or limit tree growth, creating sparse forest cover. The wetland ecosystem in Clare, where excessive moisture, thick organic peat layers, or heath-like species hinder tree growth, is a good illustration of the open seral regime.

Forest Composition

Forest disturbances lead to forest renewal and the development of young forest habitats with characteristic successional patterns. Management of landscapes to conserve biodiversity requires sustaining ecologically adequate representation of natural habitat diversity, among a number of other measures and planning approaches.

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

- forest establishment (0 to 6 m height)
- young competing forest (7 to 11 m height)
- mature forest (> 11 m height; including multi-aged and old forest)
- multi-aged / old forest (multiple layered)

Within this simplified description there is considerable variation in the processes and structures that evolve in particular stands. When the current forest inventory is used to classify development classes, the height criterion is used. When forecasting future conditions using the Forest Model, the age criterion is preferred.

Harvesting and silviculture activities, such as planting and thinning, have been ongoing on Crown land since the 1940s.

Seral Stages 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
- mid
- late

Early successional species are those that do well in direct sunlight and include white and grey birch, aspen, poplar, white spruce, tamarack, pin cherry, jack pine, and red pine. These species grow quickly, but are usually short-lived.

They are replaced by mid-successional species that can tolerate moderate amounts of shade, such as white ash and red oak.

Late successional species generally have a high shade tolerance and include hemlock, red spruce, sugar maple, and beech, as well as yellow birch and white pine. The species often develop slowly in shaded understories and can be long-lived and form old growth.

Covertypes descriptions 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%)

Forest Composition Objectives

Within ecodistricts, the forest composition should contain a range of conditions that sustain the inherent forest communities and dominant natural disturbance regimes. Table 6 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.

Woodland owners can use this guidance to assess how their holdings contribute to the overall ecodistrict structure by referring to the landscape element bar charts that illustrate where deficiencies exist. For example, landowners who have a large amount of mature forest in an element where this is in short supply can recognize the contribution of their holdings to the overall health of the landscape.

Four hundred years of European settlement in the Acadian region has left insufficient natural landscape structure to confirm these ranges. Facing similar challenges, a comprehensive modeling approach was used by the Ontario Ministry of Natural Resources to support "range of variation" targets for natural disturbance regimes in the Great Lakes St. Lawrence region (http://www.ontario.ca/document/forest-management-great-lakes-and-st-lawrence-landscapes).

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

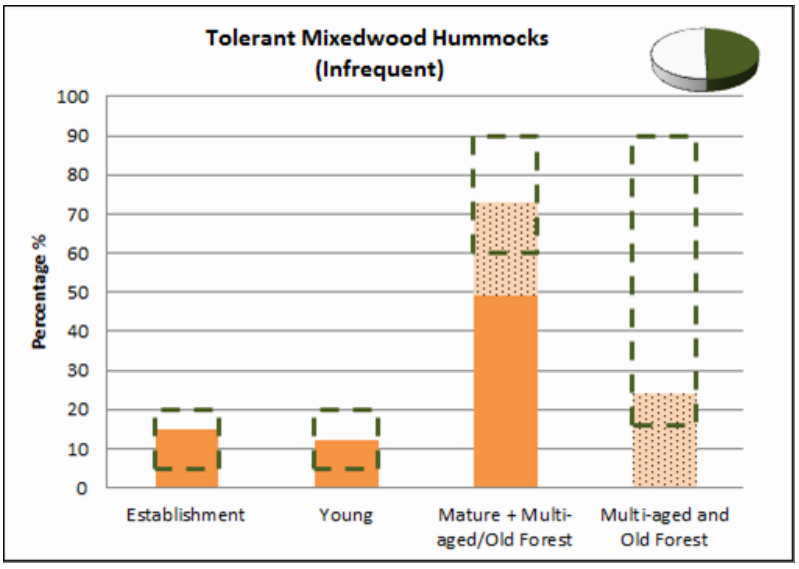
Natural Disturbance Regime	Development Class			
	Forest Establishment	Young Competing Forest	Mature Forest (including multi-aged and old forest)	Multi-aged and Old Forest
Frequent Stand Initiating	5 - 30%	5 - 30%	>40% early, mid, and late seral representation	>8%
Infrequent Stand Initiating	5 - 20%	5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

Table 6 indicates that for frequent stand-initiating disturbances, both establishment and young development class forests would typically comprise between 5 and 30% of area, while mature forest – which includes multi-aged and old forest – would cover more than 40%. Mature forest should consist of a relatively even balance of early, mid, and late successional stands. At least 8% of the mature forest should be in the multi-aged and old forest class. The targets for the other disturbance regimes are shown in Table 6. Forest planning should strive to maintain composition within these targets, and identify corrective and mitigating measures when outside these ranges.

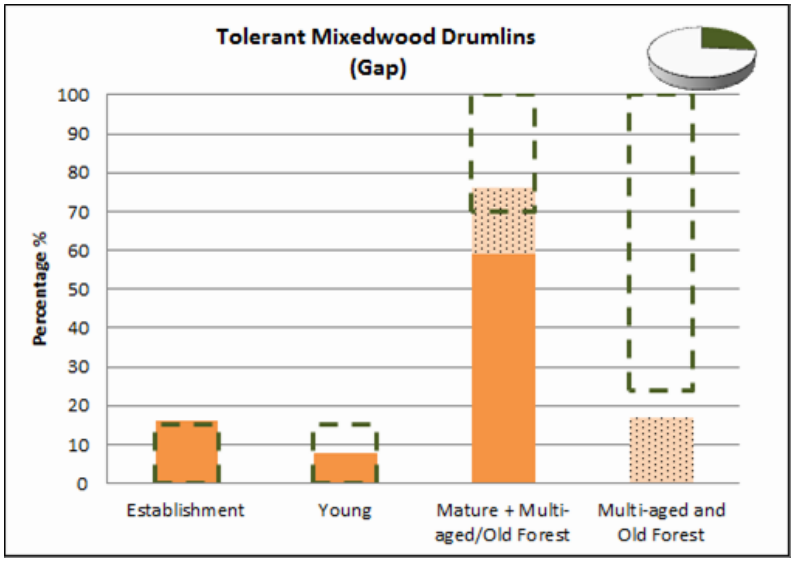
Development Class Targets by Element

The series of charts that follow combine data on development classes for each element with desired or target percentages, based on the type of natural disturbance regime. The target percentages (from Table 6) are represented by rectangles of broken green lines. The light brown bars show the percentage of each development class at the time the original data was gathered. The dotted area in the mature class shows the amount of multi-aged and old forest area included. The coloured portion of the small pie chart in the corner of the graphic shows the relative size of the element within the ecodistrict.

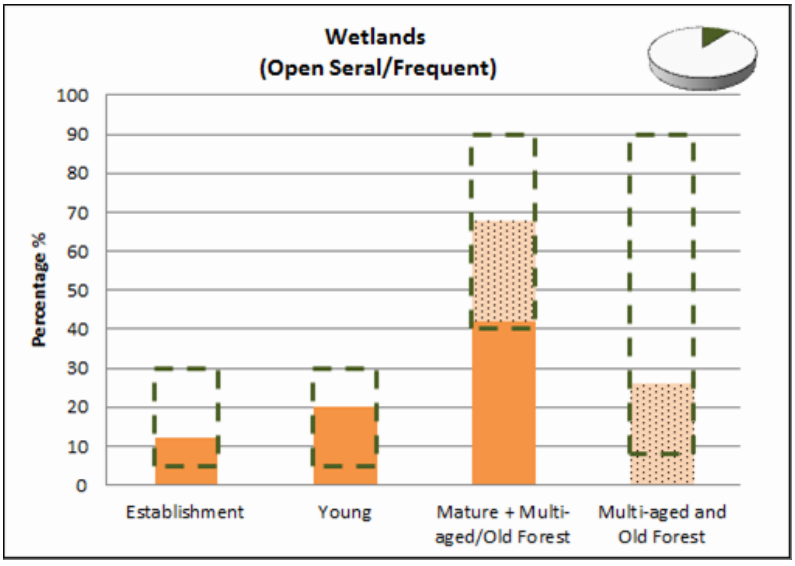
The **Tolerant Mixedwood Hummocks** matrix element has a good balance of development classes, all within the suggested ranges. Mature forests with a good representation of climax species should be encouraged to support connectivity functions. Extended rotations, natural regeneration, promotion of late seral species, and uneven-aged practices are most appropriate for infrequent natural disturbances. This is the only significant occurrence of this element in the ecoregion.



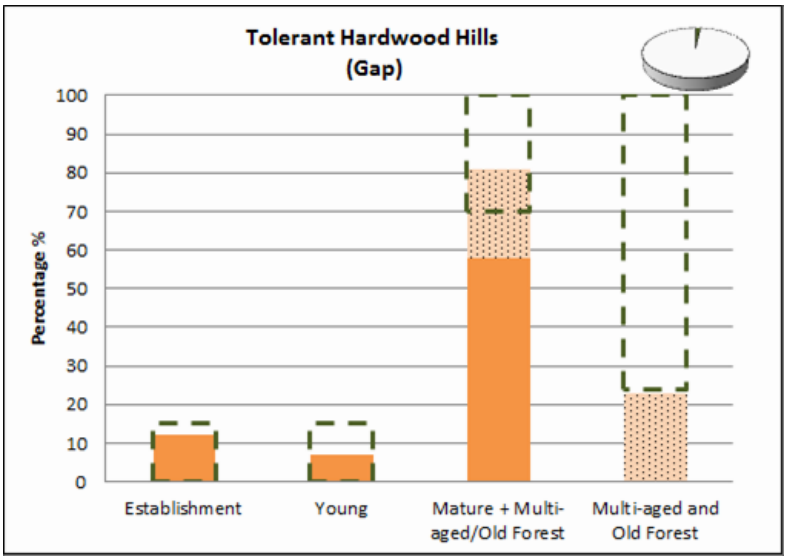
In **Tolerant Mixedwood Drumlins**, multi-aged and old forest is below target, while establishment levels are high. Partial harvests, including retention of large old trees, will promote multi-aged forest, particularly in tolerant hardwood stands. Managing immature stands to favour climax species will provide future mature forest opportunities.



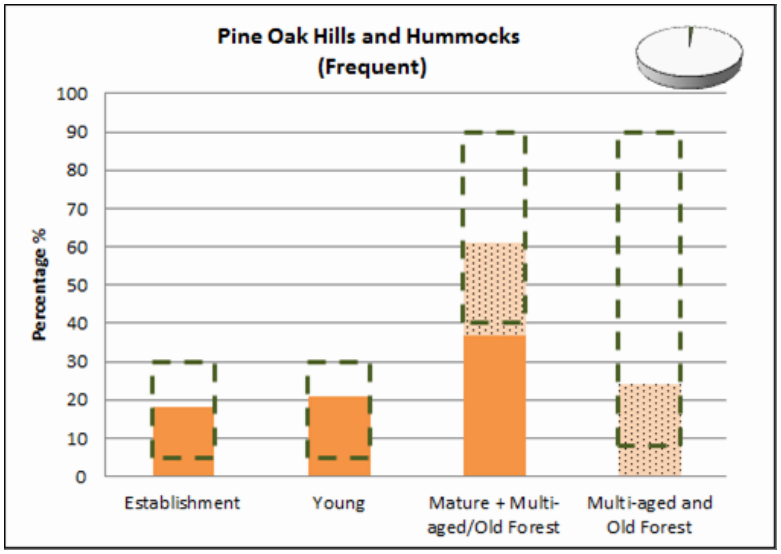
The forested component of the **Wetlands** element is predominately mature and multi-aged. This element is often variably composed of mature forest interspersed with woodlands and open wetlands. Disturbances are often patchy, reflecting the diverse structure. On wetter sites, succession will trend towards black spruce, while the better-drained pockets may support red spruce, hemlock, and yellow birch.



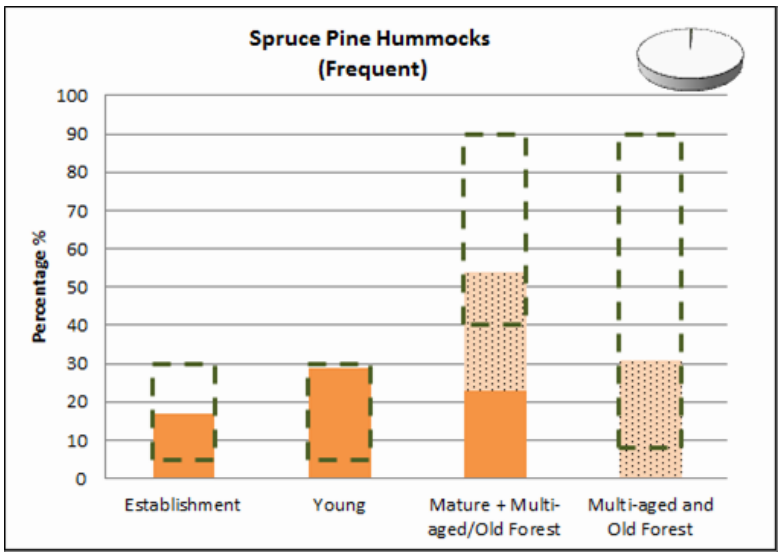
The **Tolerant Hardwood Hills** forms a small element, with a few scattered patches. Composition is dominated by mature and multi-aged forests, which is appropriate for this element. Partial harvests consistent with gap disturbance, including retention of old trees, will promote multi-aged forest development, particularly in tolerant hardwood stands. Moist fertile slopes associated with this element will support nutrient demanding species such as white ash.



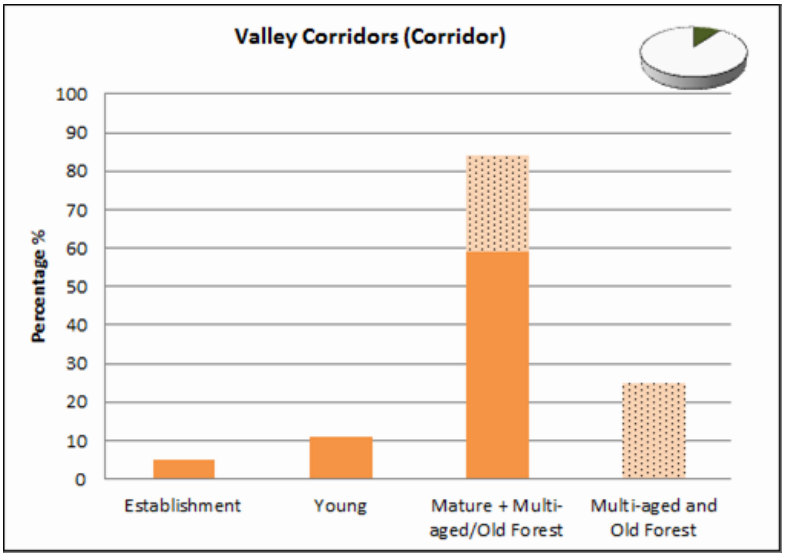
In the **Pine Oak Hills and Hummocks** element, development classes are within suggested ranges. This very small element is subject to heavy land use such that half the area has been converted to non-forest, and little of the pine-oak community remains. Pine-oak is naturally long-lived, and adapted to forest fires for regeneration. In this era of fire suppression silviculture efforts should aim to restore these species.



Spruce Pine Hummocks is the smallest patch element and therefore the balance of composition classes is sensitive to local disturbances. It has a similar distribution to Pine Oak Hills and Hummocks and is also subject to heavy land use with almost half the area converted to non-forest. This element forms the matrix in the neighbouring Sable 760 Ecodistrict, where land use pressure is low and the forest composition is within target ranges.



The **Valley Corridors** element includes parts of several elements and doesn't have a specific disturbance regime or composition target. The current dominance of mature conditions should enhance forest cohesion and support connectivity functions along this linear element feature.



Summary of Parts 1 and 2

This ends the first two parts of this report, which are available online to anyone who wants to view them. The intent was for the first part to provide a general overview of the ecodistrict for members of the public. The second part was designed for woodland owners to show how landscape ideas, such as elements, can be applied at the woodlot level.

The third part of the report, which includes more detailed information, maps, appendices, glossary, and literature citations, is designed for forest planners, managers, ecologists, analysts, and interested woodland owners.

Glossary A: Terms in Parts 1 and 2

Biodiversity	The diversityof 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.
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 these Ecological Landscape Analysis reports 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.
Drumlin	A low, smoothlyrounded, elongate hill of compact glacial till built under the margin of the ice and shaped by its flow.
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.
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.
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.
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).
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.
Impact assessment	A study of the potential future effects of resource development on other resources and on social, economic, and/or environmental conditions.
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.
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.

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 forest. Mature forests include multi-aged and old forest. 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 forest.
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.)
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.
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 that 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.
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.

Vulnerable species	A species of special concern due to characteristics that make it particularly sensitive to human 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).