Department of Lands and Forestry

2019 Update

ECOLOGICAL LANDSCAPE ANALYSIS
LaHAVE DRUMLINS ECODISTRICT 740

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

ELA 2019-740

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 740: LaHave Drumlins
2019 Update for Part 1 and 2

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This report, one of 38 for the province, provides updated figures and tables to supplement the original Ecological Landscape Analysis documents.

Information sources and statistics (benchmark dates) include:

- Crown Lands Forest Model landbase classification (2017v.1)

Note this geodatabase includes the latest Forest Inventory Databases (FID), forest disturbance information, forest harvesting information, crown land purchases and new protected area designations. Forest harvesting, silviculture, and fire disturbance (including satellite updates) are current as of end of 2015.

As revision and peer-reviewing of Natural Disturbance Regimes mapping in Nova Scotia becomes available, any major changes will be incorporated in future updates.

Selected updated Tables and Figures

This document provides recalculated values for the following:

Table 1 (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 3 (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 5a (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Table 5b (Figures may vary slightly from 2015 ELA because of new Forest Inventory Databases and change in the base geodatabase)
Development Class Targets by Elements – Only major forest elements are reported in the update. Wetlands and Valley Corridors are not reported in this update.

Table 2 was not updated as Integrated Resource Management Land Use Categories have not been updated.
Table 4 was not updated because the land capability for individual polygons has not changed since the original report. Land generally still has that same capability rating now as it did previously, regardless of any management activities at the site.

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Tables

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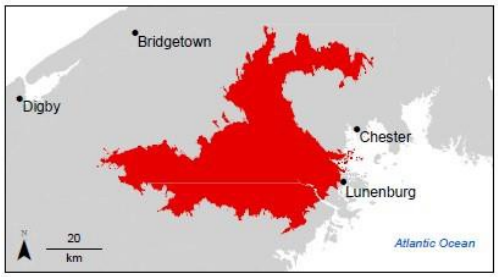


Ecodistrict Profile

Ecological Landscape Analysis Summary
Ecodistrict 740: **LaHave Drumlins**

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 LaHave Drumlins Ecodistrict 740. 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.

As the name indicates, one of the defining features of this ecodistrict is its many drumlins. These are teardrop-shaped hilly deposits left behind as glaciers melted. The LaHave Drumlins area is considered one of the finest examples of drumlins in eastern North America.

The total area of the ecodistrict is 274,961 hectares, of which about three-quarters is privately owned.

The drumlinized till plain of this ecodistrict is considered one of the best drumlin landscapes in eastern North America. The classic streamlined, teardrop-shaped deposits of glacial till rise roughly 4-50 m with the tapered or narrow end pointing in the direction of glacial movement.

This ecodistrict encompasses an area from New Ross in the east to the Kejimkujik National Park in the west. This part of the province generally has early, warm springs and a long growing season, followed by a relatively mild winter. The area receives approximately 1,400 to 1,500 mm of precipitation annually.

About 79% of LaHave Drumlins is forested. Softwood forests largely comprise mature or multi-aged species of trees that grow well in shade, such as red spruce, white pine, and hemlock. The hardwood forests have a more balanced representation of all development types. Red maple is the dominant species with lesser amounts of white birch. Shade-tolerant species include sugar maple, beech, and yellow birch. Red oak occurs occasionally.

Shallow, stony till derived from the underlying slates dominates the ecodistrict. Most of the soils can be characterized as well-drained, shallow, sandy loams except those developed on drumlins, which tend to be deeper and less stony.

Total freshwater area in the ecodistrict is 27,634 hectares, or about 10%. The main rivers are the the LaHave and Medway. There are a number of lakes of varying sizes. Rivers and abundant small streams are often shallow and fast-moving. There are also many wetlands.

Nine gold districts are scattered throughout the ecodistrict and they produced more than 110,000 ounces of gold from the late 1880s until the 1950s.

About twenty-five offshore islands in Mahone Bay are included in the LaHave Drumlins Ecodistrict. These islands are important wildlife habitats, serving as breeding and roosting areas for many seabirds that breed in colonies, such as herons, terns, gulls, sea ducks, puffins, black guillemots and cormorants.

The Atlantic whitefish is a species at risk only found in the Petite Rivière watershed in the LaHave Drumlins Ecodistrict.

Species in the ecodistrict considered to be at risk include fish species (Atlantic whitefish, Atlantic salmon), and coastal bird species (piping plover, roseate tern).

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 five key landscape elements – one dominant matrix element and four smaller patch elements – in LaHave Drumlins.

Tolerant Mixedwood Drumlins is the matrix element. Prior to European settlement, this element would have supported a forest of trees that grow well in shade. These include hardwoods – sugar maple, yellow birch, and beech – and softwoods, such as red spruce, eastern hemlock, and white pine. The matrix, representing close to half the ecodistrict, has been fragmented as a result of farming, forestry, and Christmas tree cultivation.

Spruce Hemlock Pine Hummocks and Hills is the largest patch element, representing a little more than a quarter of the ecodistrict's area. Shade-tolerant softwoods are most common, while mixedwoods generally include red maple. The other patch elements, in order of size, are **Spruce Pine Flats, Wetlands,** and **Pine Oaks Hills and Hummocks.**

Forest Ecosystem Management
For LaHave Drumlins 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 LaHave Drumlins Ecodistrict 740. 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 represent inventory based off the Forest Inventory Database (FID) current as of the end of 2015 and the Crown Land Forest Model (CLFM) current as of 2017. The update provides a reference to compare to the baseline conditions provided in the ELA 2015, which in the case of the LaHave Drumlins Ecodistrict was up to 2006. 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 Department of Lands and Forestry, 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 LaHave Drumlins – *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 LaHave Drumlins, one of eight ecodistricts in the Western Ecoregion, is 2,750 square kilometres in size. The area is bounded by the following ecodistricts: South Shore 830 to the south, South Mountain 720 to the north, St. Margarets Bay 780 to the east, and on the west by Rossignol 750.

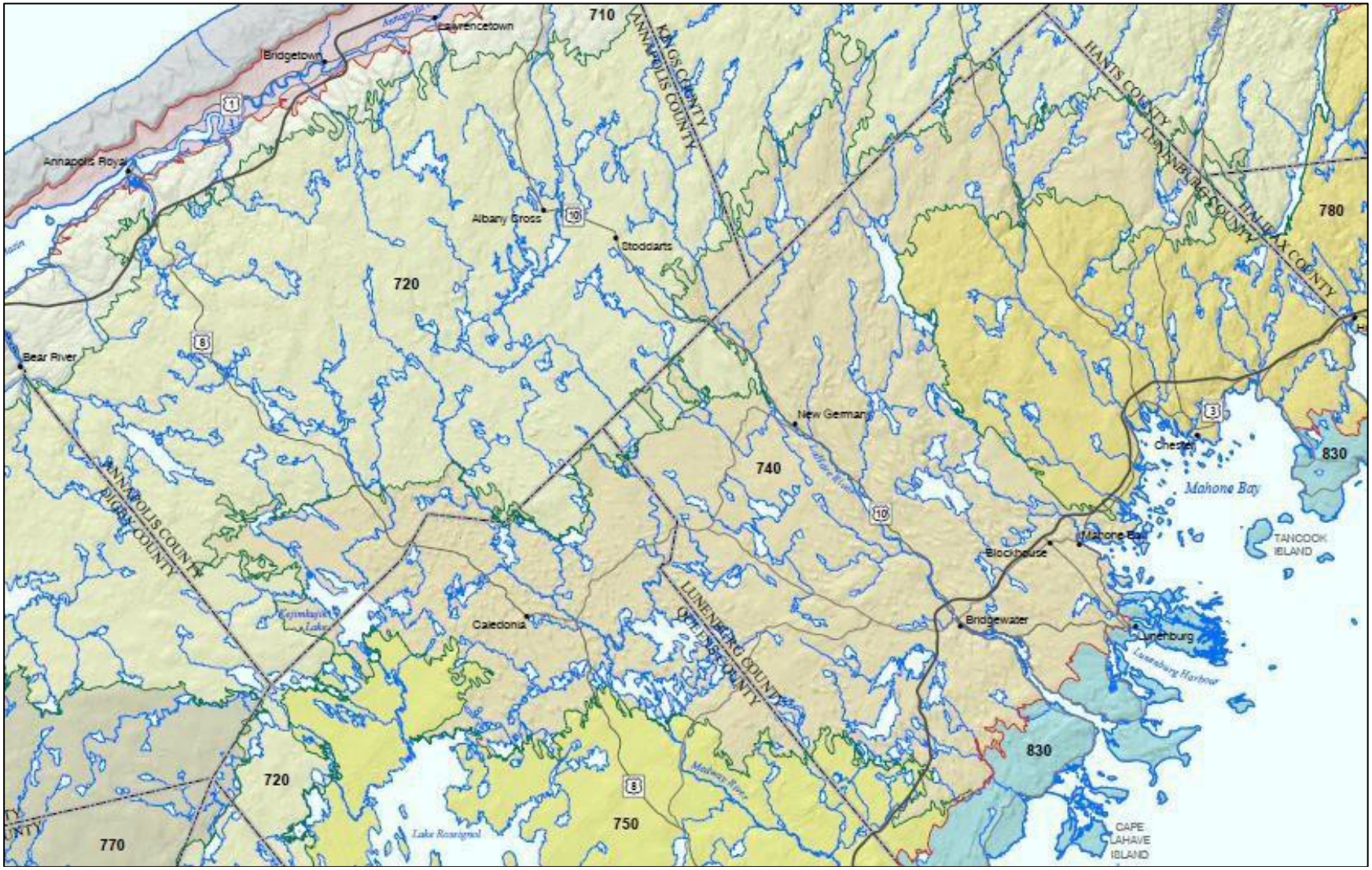
The characteristic feature of this ecodistrict, as its name implies, is the extensive drumlin fields. The drumlins, comprising till transported by glaciers, form tear-shaped hilly deposits with the narrow end pointing in the direction of glacier movement.

The most common soils are sandy loams derived from the underlying slates. These soils can be stony. Areas between drumlins have a shallow, stony till. Depressions are poorly drained. The drumlins themselves have deeper, less stony soils. Generally speaking, the drumlins with finer-textured soil (more clay content) are located in the eastern portion of the ecodistrict. Elsewhere, coarser soils predominate.

LaHave Drumlins has a warm spring and long growing season. There is some variation in climate as the coastal influence is felt along the ecodistrict's southeastern boundaries.

The ecodistrict has a long history of land use. Many of the drumlins, beginning in the 1700s, were cleared for agricultural purposes and the forested land used to support the shipbuilding and lumber industry. Many of the cutovers regenerated to balsam fir and by the 1950s these trees helped create an important Christmas tree industry.

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



Most of the LaHave Drumlins Ecodistrict 740 is in Lunenburg County with smaller areas in Annapolis and Queens countiesin the west and Kings, Hants, and Halifax counties in the east.
(From Ecodistricts of Nova Scotia map 2007)

Land Area

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

Table 1 – Land Area by Ownership in the LaHave Drumlins Ecodistrict*

Ownership	Area (hectares)	Percent of Total Area
Provincial Crown land	30,060	10.9
Private	202,882	73.8
Federal	12,495	4.5
Aboriginal	516	0.2
Other (Includes inland water bodies and transportation corridors)	29,007	10.5
Total	**274,961**	**100**

*Note: Figures may vary slightly from table to table because of rounding, averaging, and overlapping of categories and other factors.

Provincial Crown land blocks, representing 11% of the area, are scattered throughout. Most of these are west of the LaHave River, with the largest area running north from Shingle Lake.

Federal land is the Kejimkujik National Park at the ecodistrict's western edge. Aboriginal land is located at Ponhook and Wallaback lakes.

The largest urban areas occur at Bridgewater, Lunenburg, and Mahone Bay, all located in the southwestern corner of the ecodistrict.

Within the interior of the LaHave Drumlins, larger settlements can be found at New Germany and New Ross. Much of the remainder of the ecodistrict features a mix of forested landscape interspersed with areas of rural settlement, agriculture, or Christmas tree sites.

IRM Resource Classification for Provincial 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; C2, Multiple and Adaptive Use (allows most uses, but special management may be required); or C3, Protected and Limited Use (such as beaches and sites of cultural and historic significance).

More than 93% of the Crown land in LaHave Drumlins is C1 or C2, with C3 accounting for less than 5%.

Table 2 – Land Use Categories for Provincial Crown lands in Ecodistrict		
IRM land use category	**Hectares**	**Percent of Crown Lands**
C1 – General Resource Use	9,501	42.8
C2 – Multiple and Adaptive Use	11,299	50.8
C3 – Protected and Limited Use	1,046	4.7
Unclassified	377	1.7
Total	**22,223**	**100**

There are a few campsite leases on Crown land in the ecodistrict. No new campsite leases are being issued.

The ecodistrict reaches the Atlantic shoreline in a few locations, such as the LaHave River estuary and Mahone Bay. The land below the mean high water mark is provincial Crown land and permission is required from Department of Lands and Forestry for activities that take place on this land. A section of the LaHave River below Bridgewater is a federal harbour and federal officials grant permission for activities on this submerged land.

Forests

Within the LaHave Drumlins Ecodistrict, there are about 275,000 hectares of land (Table 3).

Approximately 79% (217,346 ha) is forested, whereas only 5.7% is considered non-forested, which includes barrens, agriculture, and urban sites.

Wetlands account for 13,711 hectares, or 5%, of the area. Other uses represent 26,371 hectares, or 9.6%, and include areas of brush, gravel pits, and alders. Nearly 1%, or 2,014 hectares, is used as road, trail, or utility corridors.

Table 3 – Area Distribution by Land Category for All Owners		
Category	**Hectares**	**Percent**
Forested	217,346	79.0
Wetland	13,711	5.0
Agriculture	7,918	2.9
Barrens	517	0.2
Urban	7,084	2.6
Road, Trail, Utility	2,014	0.7
Other	26,371	9.6
Total	**274,961**	**100**

The current forest contains 88,398 hectares of softwood stands (more than 75% softwood species) which account for 41.8 % of the forest cover. Hemlock, red spruce, and white pine will be found on the side slopes of the drumlins and on the moist soils of lower slopes. The imperfectly drained soils occupy the areas between the drumlins and support forests of black spruce with white pine. Balsam fir is also a component of the coniferous forest.

Mixedwood stands of 78,405 hectares account for 37.1 %, and hardwood stands of 32,927 hectares (>75% hardwood composition) represent 15.6% of the forest cover.

Shade-intolerant hardwoods (mostly red maple with some birch and aspen) dominate the hardwood covertype. Tolerant hardwoods can be found on the tops of some of the drumlins and the upper slopes of well-drained hills. Sugar maple, red oak, and beech are also found on the valley floors of the major waterways. Red oak is found on the drier sites in association with aspen, white birch, and red maple.

Shade-tolerant species of softwoods, such as red spruce, hemlock, and white pine, and hardwoods, such as sugar maple, red oak, and beech, are found in the LaHave Drumlins Ecodistrict.

The average Land Capability (LC) of forested land in this ecodistrict is estimated to be 5.1 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.

The average LC in LaHave Drumlins of forested land is slightly higher than the provincial average, indicating the 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	2,581	1.2
3	10,316	4.9
4	28,017	13.5
5	100,781	48.8
6	61,961	30.0
7 or more	3,293	1.6
Total	**206,949**	**100**

*Based on growth rating for softwood species.

About 94% of the forested land is LC 4 rating and greater. Areas considered not suitable for growing fibre (LC <= 3), resulting mostly from poorly drained soils, account for 6% of the forested area.

Water Resources

Inland waters make up 27,638 hectares, or approximately 10% of the ecodistrict.

The larger watersheds are drained by the LaHave and Medway rivers, with the Mersey, Gold, and Mushamush rivers draining smaller areas. There are numerous lakes. Rivers and abundant small streams are often shallow and fast-moving.

Wetlands, most often in the form of bogs, are common, along with forested swamps which are often difficult to identify through aerial photo interpretation.

The ecodistrict also contains the designated water supply areas for the communities of Bridgewater, Lunenburg, and Mahone Bay.

Nova Scotia Power has flowage rights or leases on a number of the lakes and river systems.

Larger watersheds in the ecodistrict are drained by the LaHave and Medway rivers, with the Mersey, Gold, and Mushamush rivers draining smaller areas. Part of the LaHave River near Pinehurst is shown.

Minerals, Energy and Geology

The LaHave Drumlins Ecodistrict extends from the eastern shores of Milipsigate and Molega lakes, along the southern margin of the South Mountain Batholith and encompasses the LaHave River area which extends west to Gold River. The Meguma Supergroup covers 85% of the ecodistrict and is comprised of sedimentary rocks that have been altered by metamorphism. These rocks were formed from sediments deposited off the coast of Africa half a billion years ago.

The Meguma Supergroup is divided into the Goldenville Formation and overlying Halifax Formation that were metamorphosed and folded during the Acadian Orogeny, a mountain-building period, prior to the intrusion of the granites.

The Halifax Formation consists mostly of black, grey, and rust-brown slates with areas of abundant iron minerals containing iron and sulphur, such as pyrite, pyrrhotite, and arsenopyrite, which can generate acid in water. The oxidation of high concentrations of arsenopyrite in the slate can adversely affect the quality of drinking water by releasing arsenic into the water table.

The Goldenville Formation comprises varying amounts of metasandstone and metasiltstones – sandstones and siltstones that have been changed by heat and pressure – and this is where many gold districts are found in Nova Scotia. There are nine gold districts located in the ecodistrict. Combined, these former mining areas produced over 111,400 ounces of gold from the late 1880s until the 1950s.

The South Mountain Batholith covers approximately 15% of this ecodistrict and are part of a large slab of granite formed from molten rock deep in the earth's crust during a mountain-building period 300- to 410-million years ago. The batholith covers an area of about 7,300 square kilometres. Only a small portion is within the LaHave Drumlins Ecodistrict.

The unique mineralization associated with the granite outcrops of the South Mountain Batholith and the contact margins of the Meguma Supergroup are excellent targets for future mineral exploration and potential development. Mineralization associated with the batholith consists of tin, tungsten, uranium, molybdenum, arsenic, fluorite, copper, and zinc.

In the New Ross area, 1,258 tons of manganese was produced from 1912 until 1921 and 4,200 tons of tin was produced in 1907. These past production areas are current exploration targets for prospectors and exploration companies.

A few small patches of Windsor Group sedimentary rocks – formed in layers and deposited by water, wind or ice – occur along the coast and account for 1% of the ecodistricts geological composition. This group of rocks is about a third of a billion years old. Early carboniferous, Windsor Group sedimentary rocks can be found in small patches along the coast. These rocks are made up of marine sediments and are an important source rock for coal, salt, gypsum and, to a lesser extent, base metals.

Current exploration activity within the ecodistrict is modest with the majority of activity centered on gold exploration. Past exploration in this ecodistrict was extensive and at one time, a large percentage of the ecodistrict was held under mineral exploration licenses for gold, base metals, and uranium.

Overlying the bedrock in many parts of LaHave Drumlins Ecodistrict are sediments which were deposited over the last 2.6 million years. These contribute to the development of soils, and have been used as aggregate. Numerous aggregate and slate deposits are found within the ecodistrict and mined in pits and quarries. These provide an important source of sand, gravel, slate, and dimension stone to area residents and construction companies.

Drumlin deposits dominate the surface geology in this ecodistrict and the area has a relatively thick till cover in most areas. Peat resources, diatomaceous earth deposits (containing fossil remains of ancient organisms known as diatoms), and a few glacial kame deposits are also present.

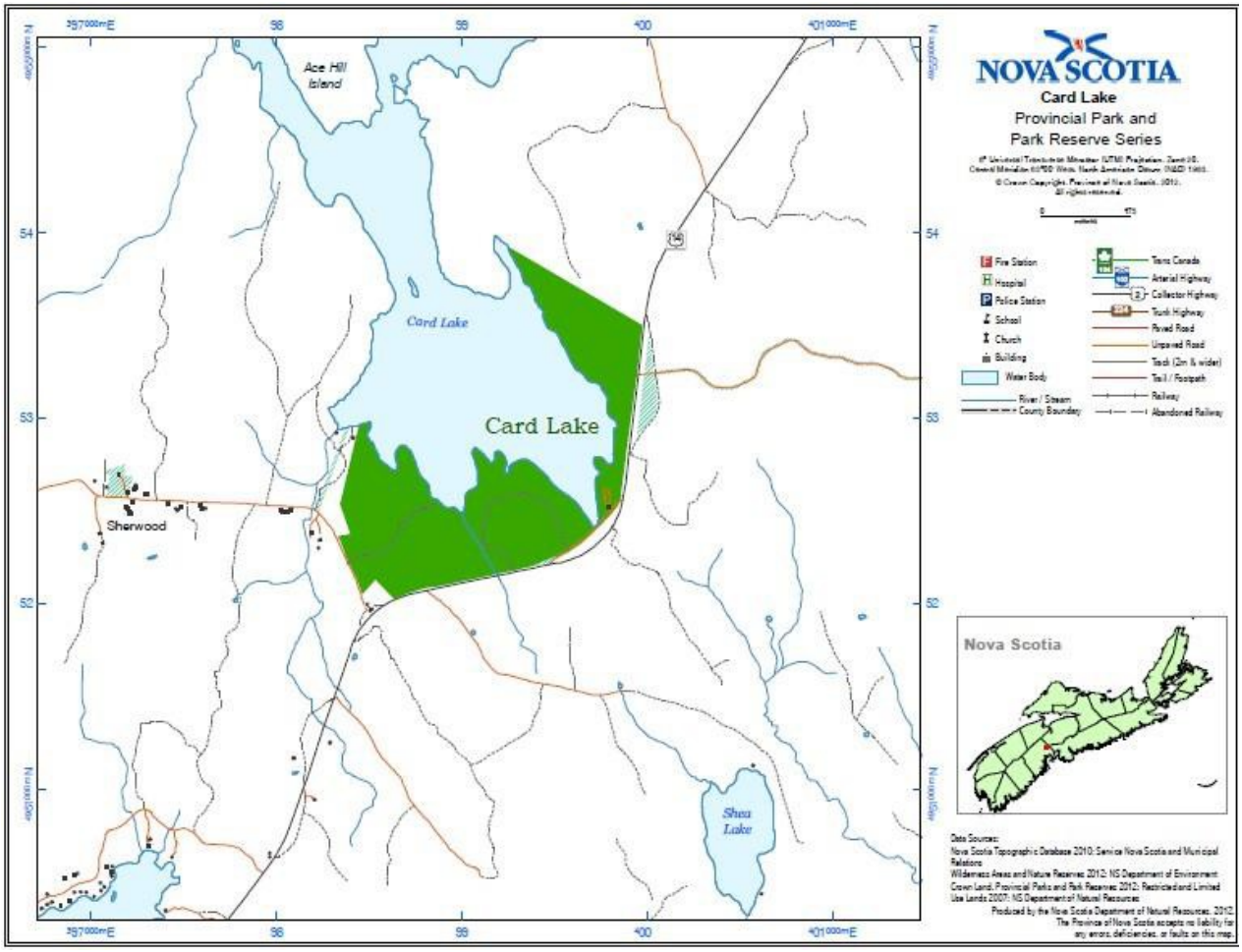
There are a large number abandoned mine openings associated with the past mining activities throughout the ecodistrict. The mine openings are located on Crown and private lands.

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.

Parks and Recreation / Protected Areas

For the parks and protected areas within your ecodistrict, please refer to the Park and Protected Areas website (http://novascotia.ca/parksandprotectedareas/plan/interactive-map/) and the Provincial Landscape Viewer, at the following url: https://nsgi.novascotia.ca/plv/.

Ponhook Lake, a site of ecological significance where populations of rare coastal plain plants are found, is part of the LaHave Drumlins Ecodistrict



Card Lake is one of the provincial parks found in the LaHave Drumlins Ecodistrict.

Wildlife and Wildlife Habitat

Wildlife in the LaHave Drumlins 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 LaHave Drumlins and other ecodistricts comes from a number of sources, including surveys, harvest statistics, hunter and trapper reports (abundance rankings), biological collections from harvested and road killed animals, and observations and reports from the public and Department of Lands and Forestry staff. Information on important sites is documented by Department of Lands and Forestry 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, Aquatic Habitat and Wildlife

Water is a relatively prominent feature, comprising approximately 10% of this ecodistrict. In general terms, the character of the LaHave Drumlins Ecodistrict terrain can be described as a series of gently rolling, well-drained hills surrounded by low lying areas. The drumlins are rich glacial deposits that support a great diversity of wildlife. Within the depressions are an abundance of lakes, watercourses, and wetlands. These provide aquatic and riparian habitat for many species of wildlife, including a number of rare plants, mammals, and reptiles.

Freshwater wetlands in the LaHave Drumlin Ecodistrict are of several types: bog, deep marsh, fen, lakeshore wetland, meadow, seasonally flooded flats, shallow marsh, shrub swamp, wooded swamp, and salt marsh. Total area in hectares occupied by all wetland types in the ecodistrict is about 4.5%. Bogs and fens occupy the most area (3%) and shrub swamps account for about 1% of the ecodistrict.

However, because tree canopies can make it impossible to detect them on aerial photographs, it's known that wooded swamps can be greatly under-represented. Wooded swamps are actually more common in the landscape than reported, and most certainly constitute a highly abundant wetland type in this ecodistrict.

The combination of wetlands and major watercourses and their tributaries means an abundance of aquatic and riparian habitat. The riparian zone, the area where terrestrial vegetation meets a watercourse or wetland, is one of the most productive habitat zones on the planet, regardless of the vegetative communities present, and it promotes a rich diversity of wildlife species.

There is a high availability of aquatic plants and invertebrates, which in turn supports many semi-aquatic species such as beaver, and muskrat, waterfowl species, particularly ring-necked ducks, common mergansers and black ducks; as well as amphibians and reptiles, including a number of frogs, salamanders, snakes, and turtle species.

A number of rare plants, notably several species of the Atlantic Coastal Plain, are found in riparian habitat from this area.

The ecodistrict contains numerous lakes of varying sizes. Many of these lakes contain islands that represent important habitat for many wildlife species, especially waterfowl, loons, and other ground-nesting bird species. Most water bodies are important staging and breeding areas for numerous species of waterfowl. Ospreys and bald

Islands in Hirtle Lake provide important habitat for seabirds and other wildlife.

eagles also nest along the shores of many lakes or in close proximity to major water bodies, including the ocean.

Approximately twenty-five offshore islands in Mahone Bay are included in the LaHave Drumlins Ecodistrict. These islands are important wildlife habitat, serving as breeding and roosting areas for many colonial nesting seabirds such as herons, terns, gulls, sea ducks, puffins, black guillemots, razorbills, and cormorants.

Freshwater fish species, such as white perch, white sucker, and yellow perch are present, with small tributaries being used for spawning by brook trout. However, the overall level of productivity for freshwater fish is relatively low within the ecodistrict because of high acidity in most watercourses.

Illegal introductions of chain pickerel and smallmouth bass to lakes and rivers in the LaHave Drumlins Ecodistrict also have posed a major threat to native salmon and trout populations because of the resultant increased levels of predation and competition. Brook trout have been eliminated or seriously reduced in a number of LaHave watersheds, but continue to persist in some locations.

The river systems within the LaHave Drumlins Ecodistrict, which include portions of the LaHave, Petite Rivière, upper Medway, and Mushamush rivers, are, or have been, significant for seasonal runs of diadromous fish – migrating between fresh and salt water – such as Atlantic salmon, American eel, gaspereau, and rainbow smelt. This availability of fish provides opportunities for fish predators, such as otters, eagles, common loons, and osprey.

Another important aquatic feature of the LaHave Drumlins Ecodistrict is a short (approximately 50 km) section of coastline, mostly in the estuary of the LaHave River and a portion of Mahone Bay. Black ducks and other ducks also use the few salt marshes, marine flats, estuarine flats, and coastal saline ponds (total of 16.4 ha) along the coast year-round.

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. During winter, these species generally remain close to shore in pockets of open water along the coast and in river estuaries. All of these very rich and productive coastal habitats are important to many wildlife species.

Terrestrial Habitat and Wildlife

Despite little variation in topography, the ecodistrict contains a mosaic of rich forest cover in varying species, age classes, and patch sizes, with abundant edges and open areas. This is mostly related to past human activity, such as forest harvesting, agriculture, and development. The landscape is significantly altered, with many drumlins having been cleared for agricultural purposes. White-tailed deer, which are common in the area, require this mix of habitat types.

The high proportion of mature softwood in the ecodistrict means that good winter cover for deer is common and regenerating hardwoods from cut-over sites are generally abundant, particularly in

the areas where forest harvesting occurs. A good proportion of the mature softwood would be in wooded swamps, a favoured habitat for deer. In general, the ecodistrict provides high quality habitat for white-tailed deer.

Raptor nests are another important feature of the LaHave Drumlins terrestrial wildlife habitat. Information on nest locations has been accumulated opportunistically by Department of Lands and Forestry. Due to the transitory nature of nest locations, this data quickly becomes outdated.

Osprey are relatively common because of ample opportunities for nesting near water where fish are available. The mix of open areas and a variety of forest species and ages offers considerable habitat for red-tailed hawks, bald eagles, sharp-shinned hawk, and various owl species.

The goshawk also occurs in the ecodistrict. It is relatively common in the LaHave Drumlins Ecodistrict because it flourishes in older continuous forested habitat which is present in the ecodistrict.

The sharp-shinned hawk is one of the raptors found in the LaHave Drumlins Ecodistrict.

Species at Risk

A number of species considered to be at risk can be found in LaHave Drumlins. Notable endangered species include the Atlantic (Acadian) whitefish and the Atlantic salmon in the LaHave River, Blanding's turtle, and piping plover.

A prominent collection of rare species in the ecodistrict are plants belonging to the Atlantic Coastal Plain Flora (ACPF). These plants became established in southwestern Nova Scotia as a result of a land bridge which existed between Nova Scotia and Massachusetts between 10,000 and 14,000 years ago. Sea level was likely about 110 metres lower than today, exposing a broad plain along the Atlantic coast, which is submerged in present day. A rise in sea level from melting glaciers eventually cut off the bridge, leaving disjunctive populations of plants and animals geographically and genetically isolated from more southern populations.

The LaHave Drumlins Ecodistrict has 16 ACPF species that are at risk in Nova Scotia, six of which are listed under the Nova Scotia Endangered Species Act. The most important sites of occurrence tend to be along gently sloping gravelly lake shorelines in the Medway and upper Mersey River watershed, an assortment of various wetlands and the LaHave River estuary.

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 Department of Lands and Forestry 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 to 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

LaHave Drumlins – Elements Defined

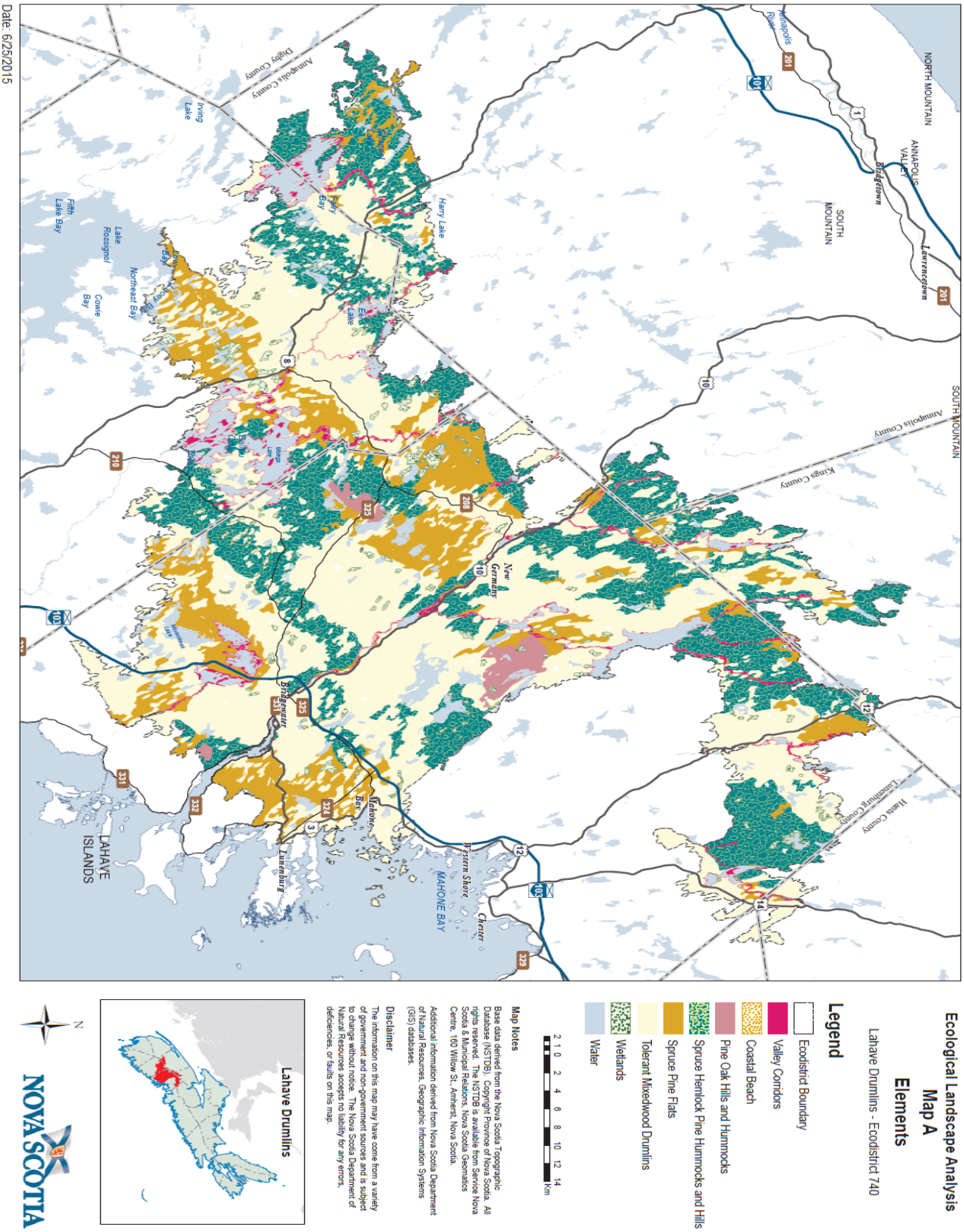
Landscapes are large areas that function as ecological systems and respond to a variety of influences. Landscapes are composed of smaller ecosystems, known as elements. These elements are described by their physical (e.g. soil, landform) and ecological features (e.g. climax forest type). These characteristics help determine vegetation development. Elements promote an understanding of historical vegetation patterns and present disturbances.

A landscape profile identified and mapped five distinctive landscape elements in the LaHave Drumlins Ecodistrict – one matrix, and four patches (Table 5a). A matrix is the dominant community type. Patches are smaller yet still distinctive community types.

Tolerant Mixedwood Drumlins is the matrix element, made up mainly of red spruce or white pine and red maple, with lesser amounts of red oak and white birch. A considerable amount of this element has been converted to other uses, such as agriculture and urban. There are also large areas in old field forests of white pine and, to a lesser degree, white spruce.

Spruce Hemlock Pine Hummocks and Hills is the largest patch element, which prior to European settlement would have been mainly tolerant softwoods and today contains a considerable amount of red maple. The other patch elements, in order of size, are **Spruce Pine Flats**, **Wetlands,** and **Pine Oak Hills and Hummocks.** See Table 5a for more detailed descriptions and Map A for element locations.

Map of Elements in Ecodistrict



Forest Stands Within Elements

Each element contains a number of forest stands that can be classified by vegetation, soil, and ecosites. The Department of Lands and Forestry 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 Department of Lands and Forestry, woodland owners can learn about the characteristics of a particular forest community. Refer to Table 5a for descriptions of elements and Table 5b for forest vegetation types that are likely to be found within elements.

Table 5a –Elements Within LaHave Drumlins		
Landscape Element	**Size (Hectares)**	**Element Description**
Tolerant Mixedwood Drumlins (includes Mahone Bay Islands component) (Matrix)	125,814 50.9%	Tolerant Mixedwood Drumlins is the matrix element in this ecodistrict, covering nearly half of the land. Drumlin or drumlin-like landforms comprising unsorted glacial tills yield soils of variable textures that are typically well-drained. These productive soils produce forest stands comprising both shade-tolerant hardwood and softwood species which may occur as pure and/or mixedwood covertypes. 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. Historically, drumlins have been extensively used for settlement and farming. Late successional forests are uncommon. Abandoned agricultural lands tend to revert to forests of white pine and white spruce. Many islands within Mahone Bay are drumlins and are included in this element. The well-drained soils of these drumlin islands have often been converted to other land uses and examples of late successional forest conditions are rare. Red spruce and white pine with scattered sugar maple, yellow birch, and hemlock were reported which indicates that these islands are afforded some protection from the Atlantic Ocean.
Spruce Hemlock Pine Hummocks and Hills (Patch)	72,066 29.1%	Spruce Hemlock Pine Hummocks and Hills is the largest patch element occupying more than one-quarter of the area of the LaHave Drumlin Ecodistrict. The typical forest is very similar to the tolerant softwood forest that occurs on the matrix element, but is dominated by more softwood forests of red spruce, hemlock, white pine, and balsam fir. Drier and less fertile soils, often coarser in nature and/or shallow to bedrock support a forest dominated by white pine, red and black spruce, and their hybrid. Occasionally, a tolerant hardwood mix of sugar maple, red maple, and yellow birch can be found on upper slopes where soils are well-drained. On lower slopes and on level terrain between hummocks with progressively poorer drainage, black spruce, red maple, and tamarack dominate the forest vegetation. Following infrequent stand-level natural disturbances such as fire and hurricane, early successional forests may include shade intolerant hardwoods such as red maple and white birch and balsam fir. Stands can develop old forest characteristics. Some of the element has been converted to non-forest uses and much of the area is used for Christmas tree cultivation. Abandoned farmland reverts to forests of white pine and occasionally white spruce.

Table 5a – Elements Within LaHave Drumlins		
Element	**Size (Hectares)**	**Element Description**
Spruce Pine Flats (Patch)	39,890 16.1%	This significant patch-level element occurs throughout the ecodistrict on a variety of soil textures and flat terrain. It is also embedded on the flat terrain associated with other imperfectly drained elements that occur on hummocky and drumlin topography. Wetlands are also part of this element. Forests of black spruce, white pine, and red pine are typical on the less than fertile soils of this element. Where there are better-drained soils of higher fertility, red / black spruce, spruce / fir, and balsam fir all with white pine potential are common. As soil drainage gets progressively poorer, wet forests of red maple, tamarack, alders, false holly, winterberry, and other woody shrubs are common. This element is frequently disturbed by windthrow, fire and/or natural aging which limit the potential for old growth forest development. Due to the fuel nature of pine and spruce litter and the heath-like vegetation associated with this element, fire can be a significant disturbance agent.
Wetlands (Patch)	6,294 2.5%	The wetlands element is a small patch-level ecosystem of bogs, fens, swamps, and poorly drained areas in the LaHave are usually associated with the headwaters of streams. Smaller disjoint wetlands are often embedded within other elements, especially the Spruce Pine Flats. Wetlands are generally treeless or sparsely forested woodlands of black spruce, tamarack, and red maple but when soils are better-drained, as happens on slightly higher ground around the various wetlands, black spruce and white pine forests will occur. When wetland soils are being enriched by groundwater/seepage, wetland forests of red spruce, hemlock, white ash, and yellow birch are possible and these occur primarily on the level terrain in the drumlin landscapes.
Pine Oak Hills and Hummocks (Patch)	3,253 1.3%	Pine Oak Hills and Hummocks occurs as a patch-level element in only a few places in the LaHave Drumlins Ecodistrict. The inherent soil fertility is poor and while the area is thought to have the potential to support a late successional white pine - red oak ecosystem, forests are primarily black spruce, red maple, and white pine. Stand level disturbances, usually fire, were historically frequent although both red oak and white pine can withstand understory fires which can maintain the dominance of these two species in the canopy.
Mahone Bay Islands	14 <0.1%	Tiny element found in Mahone Bay Islands and a component of the matrix element.
Total	**247,403***	*Area is not the same as in Table 1 because water has not been included.

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

Element	Seral Stage					
	Early	%*	Middle	%	Late	%
Pine Oak Hills and Hummocks	IH1, IH4, SP2, SP8	11.3	IH2, IH6, SH9, SP3, SP4, SP6	51.1	SP5, **SP9,** SH4	27.3
Spruce Pine Flats		14.7		33.5	**SP7**	33.5
Spruce Hemlock Pine Hummocks and Hills	IH3, IH4, IH5, IH6, MW4, MW5	18.7	SH5, SH6, MW2	34.3	**SH1, SH2, SH3, SH4,** MW1, MW3	31.7
Tolerant Mixedwood Drumlins[2]	OF1, OF2, OF3, OF4, IH3, IH4, IH5	18.7	IH6, IH7, MW2, MW4, SH5, SH6	30.3	TH1, TH2, TH3, TH4, TH5, TH6, TH8, **MW1, MW3,** SH1, SH2, SH3, SH4	30.4
Wetlands	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 Department of Lands and Forestry 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)
[2] Red oak can be a component of this element.
*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.

White pine – Balsam fir / Shinleaf – Pine-sap (OF3) is a common early successional vegetation type found in the Tolerant Mixedwood Drumlins element.

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

Large-tooth aspen / Christmas fern – New York fern (IH3) is an early successional vegetation type found in the Spruce Hemlock Pine Hummocks and Hills element.

Hemlock / Cinnamon fern – Sensitive fern / Sphagnum (WC8) is a vegetation type found in the Wetlands element.

Red oak – White pine / Teaberry (SP9) is a late successional vegetation type found in the Pine Oak Hills and Hummocks 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 Department of Lands and Forestry is employing to try and realize this objective. Department of Lands and Forestry 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 the LaHave Drumlins Ecodistrict are gap and infrequent.

The gap disturbance regime is a feature of a tolerant mixedwood or hardwood climax covertype. This regime favours the development of an uneven-aged structure, multiple layer, shade-tolerant species and formation of old growth conditions. The gap regime can support old growth conditions. Mortality is commonly by animal or insect predation, disease, lightening, blowdown, or natural old age where individual trees or small groups of trees across the landscape succumb to mortality. Regeneration occurs under openings (gaps) where mortality has occurred. Usually shade-tolerant species regenerate in the openings, and as gaps in the canopy enlarge, regeneration is released into the canopy and shares growing space with the surviving old growth trees. Major stand-initiating events do not occur under this regime.

The infrequent natural disturbance is associated with tolerant softwood covertypes (red spruce, white pine, hemlock). Agents of disturbance are often hurricane, fire, and insects. If the interval

between major disturbances is long enough, the area may take on old growth characteristics with multiple canopy layers.

Less common disturbance regimes in LaHave Drumlins are frequent or open seral.

Frequent regimes are typical of black spruce - white pine communities. The interval between stand initiating events is shorter than the longevity of the climax species. This disturbance is intense enough that there is rapid mortality and a new even-aged forest becomes established. Fire and wind are the usual disturbances.

Open seral regimes take place where site conditions restrict or limit tree growth, creating sparse forest cover. The Wetlands element in LaHave Drumlins, 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 Department of Lands and Forestry 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 Department of Lands and Forestry 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%

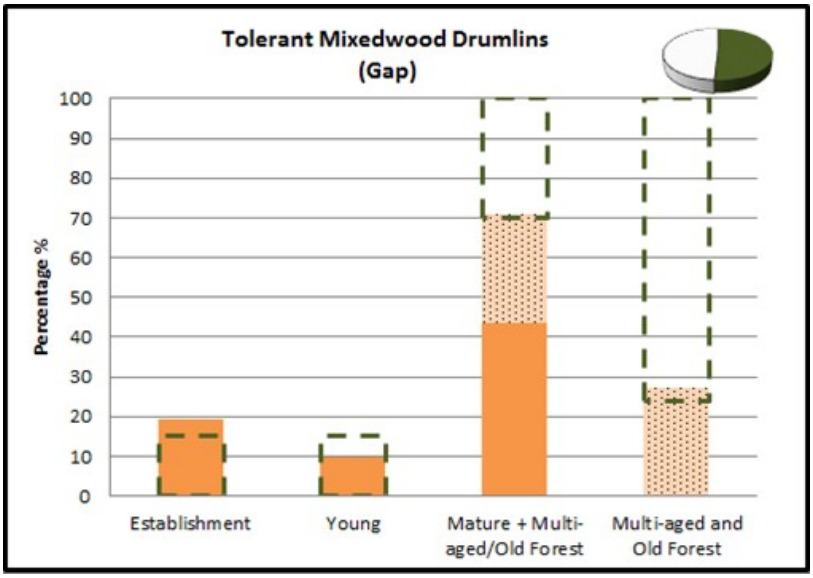
Table 6 indicates that for frequent stand-initiating disturbances, both establishment and young development class forests would typically comprise between 5 and 30% of area, while mature forest – which includes multi-aged and old forest – would cover more than 40%. Mature forest should consist of a relatively 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

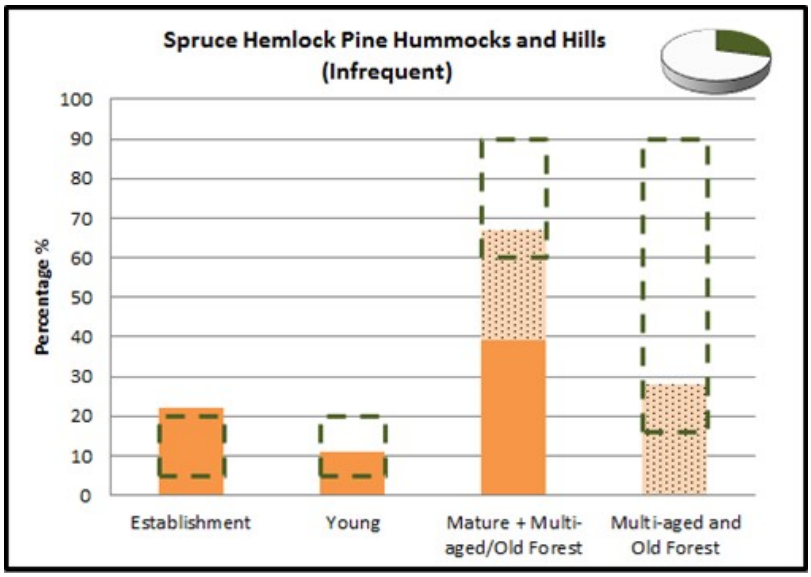
The series of charts that follow combine data on development classes for each element with desired or target percentages, based on the type of natural disturbance regime. The target percentages (from Table 6) are represented by rectangles of broken green lines. The light brown bars show the percentage 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.

All non-forest elements, (e.g. Rockland, Wetland, Beach, Urban, Marshes/Grasslands, Salt marsh) and the Valley corridor element have not been measured or included in the 2019 update.

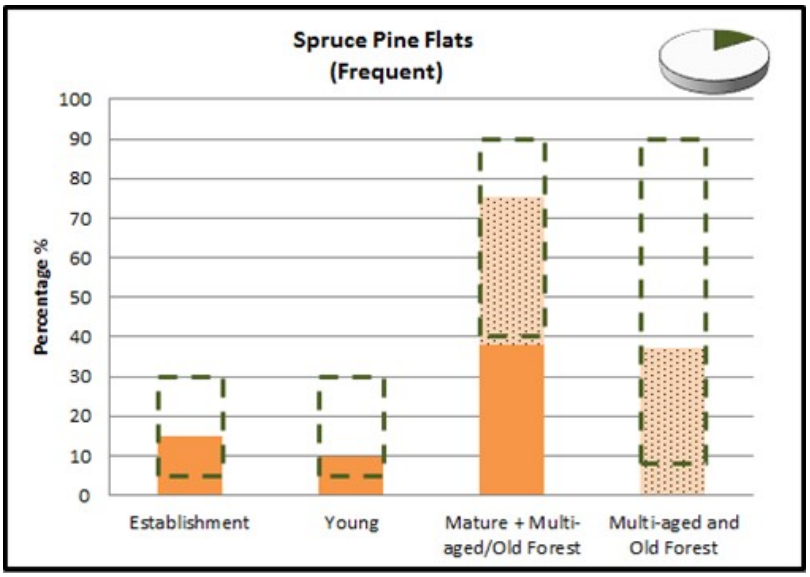
The matrix element, **Tolerant Mixedwood Drumlins**, is dominated by mature and multi-aged forests, within the target range for gap disturbance. Partial harvests, including retention of large climax trees, will promote multi-aged forest, particularly in tolerant stands. This element will support old growth development.



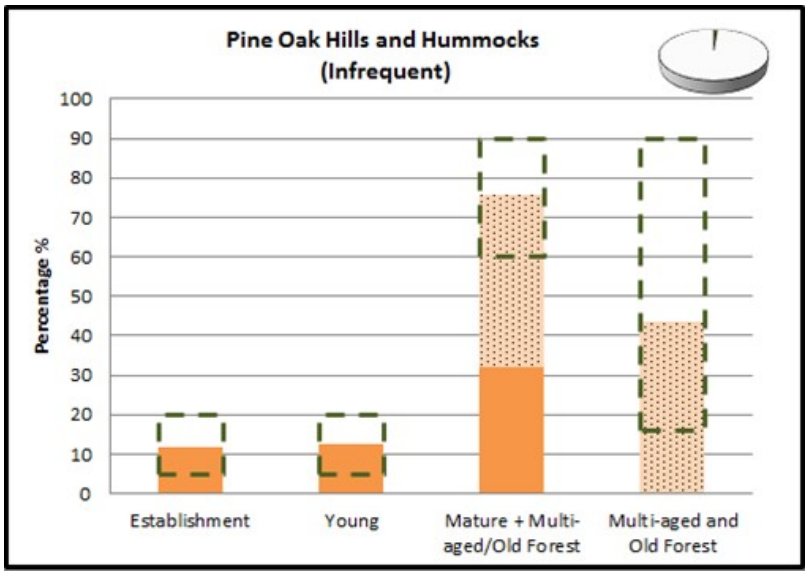
Composition of the **Spruce Hemlock Pine Hummocks and Hills** element is within target ranges. This most dominant element in the western ecoregion supports an infrequent NDR, in which the time between stand- initiating events typically exceeds the average life of the main species. This supports the development of long-lived mature forests, and regeneration of shade-tolerant understories.



In **Spruce Pine Flats** all the classes are within target ranges, with fairly high levels of mature and multi-aged forests. Frequent NDR forests support stand-initiation events that favour establishment of a dominant, even-aged cohort of mixed seral species. Disturbances typically retain mature survivors, particularly pine, which provide seed trees and mature structure in developing stands.



In the tiny **Pine Oak Hills and Hummocks** element, the development classes are within target ranges, although little of it is currently composed of pine and oak. As with all small elements, composition is sensitive to fluctuation from local-level events. Silviculture to favour pine and oak would help restore natural habitats.



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 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.
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.
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 Department of Lands and Forestry 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).