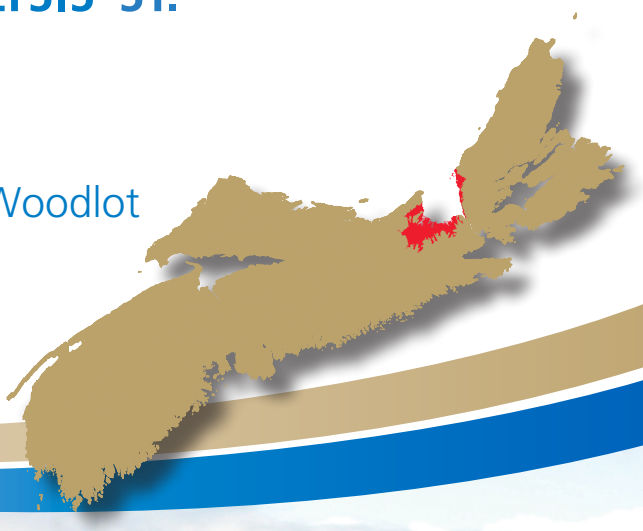
Department of Natural Resources

ECOLOGICAL LANDSCAPE ANALYSIS ST. GEORGES BAY ECODISTRICT 520

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



ELA 2015-520

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 520: St. Georges Bay

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ISBN 978-1-55457-588-6

This report, one of 38 for the province, provides descriptions, maps, analysis, photos, and resources of the St. Georges Bay Ecodistrict.

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

Information sources and statistics (benchmark dates) include:

- Forest Inventory (1997 to 1999) – 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 2015-520

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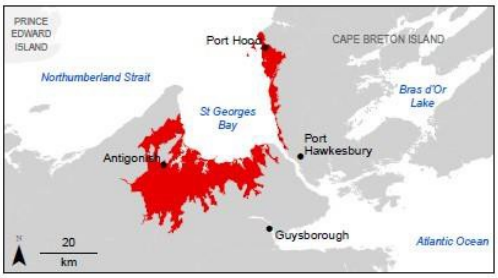


Ecodistrict Profile

Ecological Landscape Analysis Summary
Ecodistrict 520: **St. Georges Bay**

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 St. Georges Bay Ecodistrict 520. 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.

The lowlands, wrapping around St. Georges Bay, extend inland to the Mulgrave Plateau Ecodistrict 360 on the mainland and to the Cape Breton Hills Ecodistrict 310 on Cape Breton Island.

Including most of Antigonish County and incorporating the Judique lowlands of Inverness County, this area has been used extensively for farming. Elevations are between 30 to 60 metres above sea level although there is a consistent rise inland from the coast to an elevation of 150 metres.

The unusual prograding (seaward shifting shoreline) sand dunes at Pomquet Beach Provincial Park are one of many sandy beaches along the shoreline of St. George's Bay.

Underlying the ecodistrict are sedimentary rocks of sandstone, shale, and limestone. In some areas, gypsum outcrops and associated karst topography – a landscape of depressions, shafts, and sometimes caves formed by water dissolving rocks such gypsum and limestone – can be seen. One such area is the cliffs along St. Georges Bay, north of Antigonish.

The ecodistrict contains several significant wildlife habitats and species at risk. For example, the white sand beaches bordering the Northumberland Strait provide nesting and rearing habitat for the endangered piping plover.

Rivers such as the West, Rights, South, Pomquet, Afton, Monastery, and Tracadie sustain annual runs of brook, rainbow and brown trout, as well as Atlantic salmon, and, in some cases, gaspereau.

The extensive agricultural history has modified many of the natural forest communities. Abandoned agricultural lands often revert to stands of white spruce. In Antigonish County, there are more than 10,000 hectares of forest stands where white spruce comprises at least 30% of the cover.

Sandy beaches surround the St. George's Bay ecodistrict such as this one at Port Hood Provincial Park.

The ecodistrict has an area of 89,295 hectares. Private land ownership accounts for 92%. Only 5% of the ecodistrict is under provincial Crown ownership.

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 eight key landscape elements – one dominant matrix element, six smaller patch elements, and a corridor element – in St. Georges Bay.

Tolerant Hardwood Hills is the matrix element, representing 60% of the ecodistrict. On the upper slopes, this element naturally supports a forest of shade-tolerant species, such as sugar maple, yellow birch, beech, and white ash. On the lower slopes, the addition of red spruce and hemlock combine with the hardwoods to create mixedwood forests.

Spruce Pine Hummocks, representing nearly 22% of the ecodistrict, is the largest patch element with forests dominated by black spruce, white pine, tamarack, and red maple. **Spruce Fir Hills and Hummocks** is the second largest patch, followed by **Floodplain**, which is mainly associated with smooth, level terrain along major rivers. The remaining three patch elements, in order of size, are **Coastal Beach, Wetlands,** and **Salt Marsh,** which in total represent less than 1% of the area.

Valley Corridors, a linear element associated with major watercourses, accounts for 6% of the ecodistrict.

Forest Ecosystem Management
For St. Georges Bay 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 St. Georges Bay Ecodistrict 520. 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 St. Georges Bay 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 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 St. Georges Bay – *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 St. Georges Bay Ecodistrict is one of six ecodistricts within the Northumberland / Bras d'Or Lowlands Ecoregion. This ecodistrict, with a total area of approximately 893 square kilometres, curls around St. Georges Bay and includes most of Antigonish County and the Judique lowlands in western Inverness County.

There is a consistent rise in elevation from the coast inland where the mainland portion of this ecodistrict is bounded on the south by the Mulgrave Plateau Ecodistrict 360 and on the west by Pictou Antigonish Highlands Ecodistrict 330. The narrow portion of this ecodistrict located on Cape Breton Island is bounded on the east by the Cape Breton Hills Ecodistrict 310.

Overall, the climate is characterized by a late cold spring and moist summer, with generally adequate moisture throughout the growing season. Much of this ecodistrict consists of gently rolling hills that have been extensively cleared and used for agriculture.

Prior to European settlement, the upper slopes and better-drained areas supported stands of shade-tolerant hardwood, such as sugar maple, yellow birch, white ash, and beech. The moist lower slopes and flatter areas naturally supported black spruce changing to tolerant softwoods as drainage improved.

Gap disturbances were likely the dominant agent of change for hardwood stands, with softwood stands being influenced more by frequent stand-initiating events.

A long history of activities, such as agriculture and forestry which are associated with a significant level of settlement, has changed the type of forest naturally supported. Much of this cleared land reverts initially to white spruce when agricultural use is abandoned. Subsequent harvesting of white spruce stands generally results in regeneration of balsam fir and intolerant hardwoods.

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

The St. Georges Bay Ecodistrict covers most of Antigonish County and includes the western coast of Inverness County on Cape Breton Island.
(From Ecodistricts of Nova Scotia map 2007)

Land Area

Land ownership is primarily made up of small private holdings. The area is largely rural in nature but does have urban-like land use patterns in and around the Town of Antigonish.

Table 1 – Land Area by Ownership in the St. Georges Bay Ecodistrict*

Ownership	Area (hectares)	Percent of Total Area
Provincial Crown land	4,697	5.3
Private	82,179	92
Federal	0	0
Aboriginal	239	0.3
Other (Includes inland water bodies and transportation corridors)	2,180	2.4
Total	**89,295**	**100**

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

The 5% Crown-owned portion of the ecodistrict is made up of scattered properties, which for the most part are granted lands that have reverted back to the province. See Table 1 for the land ownership distribution.

IRM Resource Classification for Provincial Crown Lands

The Integrated Resource Management (IRM) classification for Crown lands was developed through a public consultation process during 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).

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	3,460	73.7
C2 – Multiple and Adaptive Use	654	13.9
C3 – Protected and Limited Use	515	11
Unclassified	68	1.4
Total	**4,697**	**100**

Forests

Within the St. Georges Bay Ecodistrict, two-thirds of the land is forested.

Of the remaining land, fewer than 3,000 hectares are occupied by naturally non-forested areas such as wetlands, barrens, and beaches.

The majority of the non-forested area is a result of land use activity, primarily agriculture. Table 3 shows the land category distribution.

Crown land is primarily forested land and the majority of this land is under a license and management agreement with NewPage Corporation, formerly StoraEnso Port Hawkesbury Ltd. *The mill was purchased by a new buyer and re-opened in October 2012 as Port Hawkesbury Paper LP.*

The majority of the private land is in small individual holdings.

Table 3 – Area Distribution by Land Category for All Owners

Category	Hectares	Percent
Forested	60,191	67.4
Wetland	2,324	2.6
Agriculture	13,424	15
Barrens	40	<0.1
Urban	3,252	3.6
Road, Trail, Utility	1,990	2.2
Other	8,074	9
Total	**89,295**	**100**

Though there is considerable agricultural activity in this ecodistrict, forestry is the most common land use activity, often occurring on lands where farming was discontinued.

The average Land Capability (LC) of forested land in this ecodistrict is estimated to be 5.7 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.

Table 4 – Area of Forested Land by Land Capability Rating

Land Capability (LC) Rating (m^3/ha/yr)*	Hectares	Percent
2 or less	71	0.1
3	820	1.4
4	7,145	11.8
5	15,171	25.3
6	25,592	42.5
7 or more	11,392	18.9
Total	**60,191**	**100**

*Based on growth potential for softwood species.

Agricultural land accounts for 15% of the ecodistrict, which is relatively high for most parts of Nova Scotia.

Water Resources

The major rivers that flow through this ecodistrict have their headwaters in the surrounding upland areas. Streams within the St. Georges Bay Ecodistrict flow over gentle topography and generally have dendritic branching patterns that look like a tree.

With the exception of a small area in the southwest corner of the ecodistrict that drains into Lochaber Lake, the majority of the water from this ecodistrict enters into St. Georges Bay. Many of these streams enter the bay through inlets and estuaries that extend inland as a result of the low-lying nature of the lands. These inlets and estuaries contain salt marshes and other important habitat features. Lakes and freshwater wetlands are relative infrequent in this ecodistrict.

Water is an important provincial resource that must be considered in the context of IRM in general, and specifically within individual ecosystems.

The Environmental Goals and Economic Prosperity Act, which was enacted in early 2007, has committed the province to prepare a comprehensive water strategy. This strategy will include a high-level evaluation of water resources. *Nova Scotia's water strategy can be found at http://www.novascotia.ca/nse/water.strategy/docs/WaterStrategy_Water.Resources.Management.Strategy.pdf*

Most of the rivers and streams flow into St. Georges Bay, which is the main water feature in the ecodistrict.

Minerals, Energy and Geology

The St. Georges Bay Ecodistrict includes the Antigonish Basin and a narrow strip of land along the southwestern coast of Cape Breton Island. The ecodistrict occurs within the Avalon, Aspy, and Bras d'Or terranes – fragments of crust material from one tectonic plate joined to the crust of another plate. The basement rocks are generally overlain by sedimentary strata more than 300 million years old and ranging in geologic periods from Late Devonian to Late Carboniferous (Horton, Windsor, Mabou, and Cumberland groups).

A number of metallic mineral deposits, including copper, lead, zinc, iron, and manganese, occur in the ecodistrict. Mineral exploration dates back to the late 1800s. Shafts were driven on the more promising showings and undocumented abandoned mine openings may still exist.

The strata include unmetamorphosed conglomerates, sandstones, siltstones, shales, mudstones, gypsum, anhydrite, salt, and limestone. The Middle to Upper Carboniferous strata are easily eroded, generally underlie areas of lowest relief, are susceptible to coastal erosion and probably underlie St. Georges Bay.

Exploration for base metals has been most intense in the basal part of the Windsor Group where copper-lead-zinc mineral occurrences and prospects are common.

Salt deposits occur at Southside Antigonish Harbour, Antigonish, and James River. Potash salts are known in low grade zones and disseminations in the Southside Antigonish Harbour and James River salt deposits.

Approximately 20 gypsum occurrences are documented in the Antigonish Basin. At least two gypsum quarries have operated within the ecodistrict and one is currently operating. The gypsum deposits near Harbour Centre, Lanark, Lower South River, and Southside Antigonish Harbour have tide water access.

Limestone has been produced in small quantities from local pits to primarily serve local agricultural requirements. A high grade calcium limestone quarry at Southside Antigonish Harbour is producing product for the chemical recovery process at a nearby pulp mill and for local agricultural use.

Historically, the Macumber Formation sandstone has been used as a local source of structural stone but this has ceased. Additional mineral occurrences and deposits may exist within the ecodistrict. At present, mining activity is limited to sand and gravel operations and the quarrying of gypsum and limestone.

The ecodistrict's mineral occurrences and deposits are principally found in the Windsor Group strata. The Windsor Group is a primary source of minerals such as salt, potash, gypsum, anhydrite, limestone, dolomite, barite, celestite, fluorite, and base metals. Exploration and production of these commodities has made a major contribution to the mineral economy of the province for the past 40 years and will remain a stable basis for the future.

Exploration and development potential for Windsor Group resources has not been exhausted and substantial areas remain unexplored and under explored. This is partly the result of poor and inconsistent outcrop exposure and burial beneath thick surficial deposits in the lowland areas. The Windsor Group can have a considerable impact on groundwater supplies, surface drainage, land development, and land use.

Evaporate minerals of the Windsor Group, including gypsum, anhydrite, and salt, are dissolved by circulating groundwater and contribute undesirable calcium, sodium, sulphate, and chloride to the water. Surface and near-surface evaporate karst terrains present challenges for construction, agriculture, forestry, and development activities.

The Port Hood coalfield is situated near the village of Port Hood. The coal measures are exposed in a narrow belt along the coast from Little Judique Harbour to Black Point and extend westward out under the Gulf of St. Lawrence. The coalfield is relatively small and the near surface resources are largely exhausted. Documented mining goes back to 1865 and continued intermittently until 1966. Coalfield production totaled 1.3 million tonnes.

The long coal mining history, both legal and illegal (known as bootleg), has left a number of liabilities, including, abandoned mine openings, areas prone to surface subsidence, acid rock drainage, and contaminated mine sites. Approximately 40 coal-related abandoned mine openings, such as shafts, pits and subsidence and collapse features are documented in the provincial database. The location and extent of bootleg shafts, slopes, and mine workings are not fully

documented. Coal has been reported in a thin seam in the Pomquet area of Antigonish County, but no indications of any significant deposits have been recognized in the onshore area.

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.

The sedimentary rocks of the Carboniferous are targets for oil and gas exploration, providing both source and reservoir rocks for hydrocarbons. Five boreholes were reported to have minor hydrocarbon shows. A small flow of natural gas was encountered in a salt exploration borehole. East of Antigonish Harbour, near Monks Head, limestones have been found to contain pockets of oil. Several oil shale occurrences have been documented in the Antigonish Basin.

In 1865, an oil shale exploration and development shaft was driven at Big Marsh, the second largest known oil shale resource in the province. Most of the Carboniferous rocks of the ecodistrict are currently held under petroleum agreements. The commercial viability of coalbed methane extraction is being studied in the Port Hood coalfield.

Unsorted sand and gravel deposits occur in kame deposits along the sides of several streams and rivers, such as Wallace and Ogdens brooks and the South, Pomquet, and Tracadie rivers. Alluvial sand and gravel deposits occur in several of the ecodistrict stream valleys, such as the South, West, South Rights, and Graham rivers.

Unconsolidated granular aggregate resources are extracted at a number of locations, especially in the Antigonish area, to supply the requirements of the local construction industry.

Streams flowing northward from Antigonish County into the Northumberland Strait often form extensive drowned estuaries (Antigonish Harbour, Pomquet Harbour, Tracadie Harbour, and Havre Boucher).

The Horton Group sandstones and conglomerates are more resistant to erosion and generally form higher ground, including foothills and slopes bordering the surrounding elevated ecodistricts. The St. Georges Bay Ecodistrict is characterized by an undulating surface, well dissected by streams.

The Antigonish Basin is a structural basin that has a prominent northeast-southwest linearity defined by a series of major faults, including the Glenroy, Lanark, and Morrison faults. The major fold features are probably related to movement on the Antigonish Thrust Fault.

To the northeast, the Antigonish Basin is submerged beneath the waters of St. Georges Bay, but probably extends as a continuous structural feature into southwestern Cape Breton. These two Carboniferous outcrop areas, together with their extensions beneath St. Georges Bay, may be considered parts of a larger structural basin, the Antigonish-Mabou Subbasin.

Karst topography typical of exposed gypsum and limestone outcrops are part of the St. Georges Bay Ecodistrict.

The surficial geology of the St. Georges Bay Ecodistrict consists predominantly of silty glacial till, generally ranging in thickness from 3 to 30 metres. Surficial deposits make a major contribution to soil development and may be a source of aggregate. These silty till plains provide some of the best agricultural land in the province.

Scattered across the ecodistrict are several small organic deposits of sphagnum moss and peat moss in swamps and bogs.

Sections of shoreline contain recent marine and coastline sediments. Locally there are small areas dominated by weathered bedrock and rolling to rugged exposed bedrock, overlain by a discontinuous veneer of till.

Parks and Recreation / Protected Areas

The St. Georges Bay Ecodistrict comprises provincial parks and protected areas with a total area of 1,540 hectares (2% of ecodistrict), the majority of which is located on Crown lands.

Provincial parks, park reserves, and protected beaches include:

Pomquet – Monks Head – Dunns Beach: operating day-use park; classed as natural environment park and core park; provincially significant; site of ecological significance as a dune beach;

endangered species (piping plover); contributes to provincial representation objectives; one of few beaches that has a range of successional forests; regionally significant; potential for a range of interpretive themes, coastal processes, unique ecosystems, wildlife habitat, and landscapes; interpretive panels; at district level, Delorey property includes Acadian culture; regionally significant for tourism; one of a number of high quality beach parks along St. Georges Bay; offers picnicking, beach access, swimming, walking, and potential for ecotourism; close to 100 series highway; potential for partnerships.

Bayhead: operating day-use park; classed as a wayside park and secondary park; small land base and portion of the park is designated under the Beaches Act; small beach park with few other public opportunities that serves primarily local and regional area; well-marked on highways.

Barrios Beach: park reserve; secondary park; only public access on Tracadie Harbour.

Linwood: park reserve; secondary park; short section of low quality ocean shorefront.

Pomquet – Monks Head – Dunns Beach is a provincial park that features beautiful sand beaches and also a range of successional forests.

Cape Jack: park reserve; secondary park.

Mahoney Beach: park reserve; secondary park; provides access to protected beach and offers potential hiking.

Long Point: operating day-use park; designated park.

Inverness and Mulgrave Railbed: portions of the abandoned railbeds to Inverness and Mulgrave are within St. Georges Bay (approximately 135 ha)**;** the Inverness line is being managed as a railbed trail; there is no formalized use on the Mulgrave line.

Protected Beaches: along the coastal boundaries of this ecodistrict are eight beaches designated under the Beaches Act; Mahoneys, Dunns, Monks Head, Pomquet, Bayfield, Myettes, Linwood and Cape Jack represent an area of 512 hectares, of which 277 hectares are on Crown lands. *Port Hood Beach is also protected.*

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 St. Georges Bay 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 St. Georges Bay 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 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.

Old growth or old forest habitats on Crown land are uncommon in this area because of the long history of settlement, relatively low percentage of Crown land, and the make-up of the existing forest. About 380 hectares of Crown woodland has been designated as old forest or potential old forest.

The St. Georges Bay Ecodistrict features a variety of soil types that offer good biological productivity. Evidence for this is found in the large number of farms, both working and abandoned, that occur in this area and provide a variety of old field, agricultural and forest habitats that are ideal for wildlife such as snowshoe hare, red fox, raccoon, eastern coyote, white-tailed deer, and black bear.

Two white-tailed deer, one a piebald with a brown and white spotting pattern, and the other with a typical colour pattern, pause on a snowy field.

The overall character of the landscape is relatively flat, and dendritic drainage patterns contribute significantly to heavy use of the area by furbearers such as beaver, and to a lesser extent, river otters which are found in streams, rivers, and coastal estuarine areas.

The geological character of this area has helped determine the species that inhabit it. The gypsum and limestone outcrops and cliffs that rim part of Antigonish Harbour and St. Georges Bay support a number of uncommon plants that grow in calcium-rich soils.

Rivers such as the West, Rights, South, Pomquet, Afton, Monastery, and Tracadie sustain annual runs of brook, rainbow, and brown trout, as well as Atlantic salmon, and, in some cases, gaspereau. Many of these rivers exit through drowned river valleys and small estuaries into the Northumberland Strait.

Striped bass, provincially designated as sensitive to habitat loss and overfishing, are found in the South River estuary and along the coast line. Estuaries and in some cases small harbours are biologically very productive areas and attract large numbers of waterfowl, such as geese and ducks and at times bald eagles. Ospreys are also found in the area, although they are much less numerous. The relatively protected harbours also provide nesting, feeding, and resting areas for an assortment of seabirds such as arctic and common terns, black guillemots, and gulls.

Ecodistrict 520 contains several significant wildlife habitats and species at risk including the white sand beaches bordering the Northumberland Strait that provide nesting and rearing habitat for the endangered piping plover. Mahoneys Island (formerly Mahoneys Beach), Dunns Beach, Port Hood Station Beach, and Pomquet Beach are known sites for nesting piping plover in this ecodistrict.

The sand beaches of the Northumberland Strait within the St. Georges Bay Ecodistrict provide habitat for the endangered piping plover.

Associated habitats, such as vegetated sand dunes and salt marshes, are important for Nelson's sharp-tailed sparrows and willets.

Grassland birds, such as short-eared owls and bobolinks, are few, and their populations appear to be declining. Other species such as barn swallows, cliff swallows, eastern bluebirds, and rusty blackbirds are present, but overall numbers appear to be declining as well. Common loons are found on most lakes large enough to support their dietary requirements.

Northern goshawks and long-eared owls are two of the more relatively uncommon raptors that have been found in this ecodistrict.

The West, South, and Rights river systems and Brierly Brook all have confirmed reports of wood turtles, a species provincially and nationally threatened, that prefers intervale soils and sand and gravel bars that are often associated with slow to moderate flowing watercourses. These watercourses and many of the lakes found in this ecodistrict also provide habitat for snapping turtles, which are sensitive to human activities and are designated provincially as vulnerable, and nationally as of special concern.

Freshwater mussels occur in all of the major watercourses flowing into St. Georges Bay. One of these, the triangle floater, is rare in this ecodistrict and regionally.

Endangered mainland moose are occasionally sighted throughout this ecodistrict, but are most commonly seen between Big Marsh and Lakevale, especially during the early fall breeding season when males wander into the area from adjacent highland habitats looking for mates. Sightings records suggest that this ecodistrict has very few resident moose living in the area year round.

White-tailed deer are much more numerous and widespread, most likely because of their affinity with farmland and land use patterns that cause fragmentation of the landscape. There are three known deer wintering areas in this ecodistrict where deer traditionally congregate when snow becomes deeper.

Ecodistrict 520 also contains a number of recognized areas of wildlife significance that are protected federally, provincially, or through land use agreements.

The southwestern arm of Antigonish Harbour is a provincial wildlife management area specifically designated to protect migrating and staging waterfowl. Despite being established for waterfowl originally, other wildlife benefit from this protection through regulations that prohibit any type of trapping and hunting.

Pomquet Beach Provincial Park is recognized both as an important bird area for piping plovers and as an International Biological Program (IBP) site for providing a world class example of a prograded – expansion of a river delta into the sea – dune system.

The Nature Conservancy of Canada has acquired Pomquet Island, near Bayfield, and a large property at Monks Head. These properties will protect habitats for nesting colonies of double crested cormorants and great blue herons and migrating waterfowl. Also, there are five Ducks Unlimited sites in this ecodistrict that provide habitat for waterfowl and wildlife normally associated with wetlands.

For more detailed and 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 Environment Act's 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

St. Georges Bay – 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.

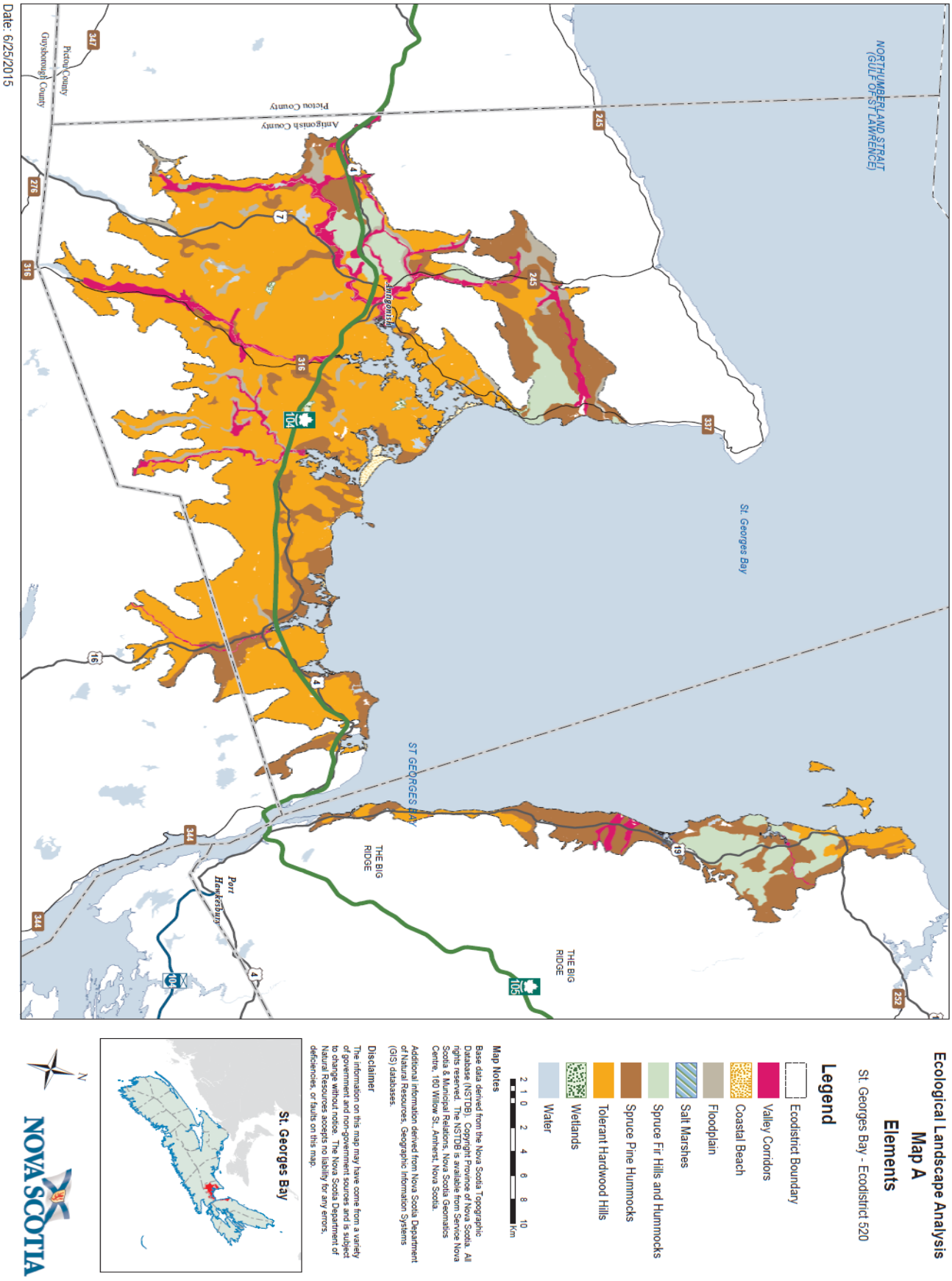
A landscape profile identified and mapped eight distinctive elements in the St. Georges Bay Ecodistrict – one matrix, six patches, and a corridor (Table 5a). A matrix is the dominant community type. Patches are smaller yet still distinctive community types. Corridors are natural linear communities, such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

Tolerant Hardwood Hills is the matrix element, representing 60% of the ecodistrict. On the upper slopes, this element naturally supports a forest of shade-tolerant species, such as sugar maple, yellow birch, beech, and white ash. On the lower slopes, the addition of red spruce and hemlock combine with the hardwoods to create mixedwood forests.

Spruce Pine Hummocks, representing nearly 22% of the ecodistrict, is the largest patch element with forests dominated by black spruce, white pine, tamarack, and red maple. **Spruce Fir Hills and Hummocks** is the second largest patch, followed by **Floodplain**, which is mainly associated with smooth, level terrain along major rivers. The remaining three patch elements, in order of size, are **Coastal Beach, Wetlands,** and **Salt Marsh,** which combined represent less than 1% of the total area.

Valley Corridors, a linear element associated with major watercourses, accounts for 6% of the ecodistrict.

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 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. Refer to Table 5a for descriptions of elements and Table 5b for forest vegetation types that are likely to be found within elements.

Hardwood and softwood stands of trees in the St. Georges Bay Ecodistrict are seen at a landscape level.

Table 5a – Elements Within St. Georges Bay		
Element	**Size (Hectares)**	**Element Description**
Tolerant Hardwood Hills (Matrix)	53,137 60%	The gently rolling hummocks and hills surrounding St. Georges Bay create the conditions for this tolerant hardwood matrix element. The soils on this upland terrain are well-drained, comprising a variety of soil textures. The crests and upper slopes support a forest of sugar maple, yellow birch, beech, and white ash. On the lower slopes, red spruce and hemlock combine with the hardwoods to create mixedwood forests. Where steep slopes follow the larger streams and rivers, mixedwood forests with a strong component of hemlock and yellow birch are common. With progressively poorer drainage on level terrain, black spruce, tamarack, and red maple dominate the forest vegetation. When fields are abandoned, white spruce, tamarack, and aspens reforest the sites. A long history of forest harvesting has also increased the abundance of earlier successional species such as red maple, balsam fir, aspens, and white birch.
Spruce Pine Hummocks (Patch)	19,041 21.5%	Spruce Pine Hummocks is a patch landscape element occurring primarily on imperfectly drained hummocky terrain. The imperfect drainage conditions expressed in the soils underlying this terrain can be attributed to the gentle slope of the landscape, shallow soils, compaction, and clay content. When combined with the inherent low fertility of the substrate, derived from sandstones, siltstones, and shales, the forests tend to be dominated by black spruce and scattered white pine. With progressively poorer drainage, black spruce, tamarack, and red maple dominate the forest vegetation and wetlands are embedded throughout the element. On hilly terrain underlain by clay soils, black spruce and white pine are typical but with steeper gradient, better-drainage and enhanced nutrient levels hemlock, and sometimes red spruce, and shade-tolerant hardwoods are found. These later successional Acadian-like forests are typical near Brophy-Morristown and Judique-Port Hood.
Spruce Fir Hills and Hummocks (Patch)	6,806 7.7%	This element occurs on imperfectly drained hummocky to gently rolling hilly terrain underlain by finer-textured soils (clay loams). The forests tend to be dominated by black spruce, white spruce, and balsam fir. With progressively poorer drainage, black spruce, tamarack, and red maple dominate the forest vegetation and wetlands are embedded throughout the element. Early successional forests tend to have a higher component of aspen, tamarack, and balsam fir but overall regenerating forests from stand-level harvesting will also include red maple, white and grey birch.
Floodplain (Patch)	3,299 3.7%	Floodplains in this ecodistrict are associated with smooth, level, terrain along the major rivers such as the South, West, and Pomquet as well as along larger streams. Alluvial deposits of sediment occur with annual or periodic flooding. This is a linear, patch element with soils that range from coarse sandy loams to finer-textured silt and clay loams that can be well to imperfectly drained. The soils are usually stone free. The climax forest for this element occurring on the better-drained alluvial soils is the shade-tolerant hardwood forest of sugar maple, white ash, and elm.

Table 5a – Elements Within St. Georges Bay		
Element	**Size (Hectares)**	**Element Description**
Coastal Beach (Patch)	497 0.6%	Coastal beaches are wave-dominated deposits composed of a mixture of sand, gravel, and other sizes of sediments. Sand dunes are often associated with beaches and depending on size and distance and age support a variety of vegetation including beach grass, bayberry, and white spruce. The beaches at Antigonish and Pomquet are classified as barrier beaches and have formed as a result of rising sea level and the erosion of adjacent headlands forcing a landward retreat of the beach. The extensive dune system at Pomquet, more properly classified as wave-created beach ridges, supports a community of beach grass and associates near the high-water mark with a progressing development of woody shrub and forest communities as the soil stabilizes and incorporates organic content and water retaining capabilities.
Wetlands (Patch)	221 0.2%	The wetlands element is a patch ecosystem comprising freshwater bogs, fens, swamps, and poorly drained areas. The largest wetland can be viewed from the Trans-Canada Highway near Dagger Woods Road with another large wetland near Pitchers Farm. The element may occur as a large wetland complex associated with rivers and lakes, as narrow linear communities associated with flow accumulations and small streams, as a community of hydrophytic vegetation (sedges, sphagnum moss, false holly, and winterberry) associated with level terrain where drainage is impeded or as a depression in the landscape where water remains in excess.
Salt Marsh (Patch)	81 0.1%	The twice daily tidal actions along the Northumberland Strait have created salt marshes with the most prominent at Antigonish Harbour, Pomquet, Monastery, and Judique. Deposits of silty clay loam sediments with semi-decomposed grasses and sedges trapped in the accumulating layers, formed along the tidal shores and in estuaries found at the mouths of rivers and streams subjected to tidal conditions. The reclamation of arable land using dykes has not been a significant feature of these marshes and most are still in a natural state.
Valley Corridors (Corridor)	5,450 6.2%	The most evident linear features within this ecodistrict are associated with watercourses. Eleven of the most prominent of these features, totaling 5,450 hectares, have been identified for this analysis. These corridors are made up of numerous different small parts. The current forest cover contains a fairly well-balanced distribution of development and covertype classes. The seral stage distribution contains somewhat more early seral vegetation types than predicted inherent conditions, possibly due to high land use activities in some parts of the corridors, which will influence how these corridors function.
Total	***88,532**	*Area is not the same as in Table 1 because water has not been included.

Table 5b – Forest Vegetation Types[1] Within Elements in St. Georges Bay

Element	Seral Stage					
	Early	% *	Middle	%	Late	%
Floodplain	FP4, FP5, FP6	58	FP3	12	**FP1**	9
Spruce Pine Hummocks	IH1, IH4, IH6, SP10	43	SP4, SP6, SP8	19	**SP5**, SP7	21
Spruce Fir Hills and Hummocks	SP10, IH4, SP6, SP8	46	MW4, MW5	15	**SH9, SP7,** SH8, SH10	19
Tolerant Hardwood Hills	IH6	56	IH7, TH7	14	**TH1, TH2**, TH3, TH4, **TH8**	11
Salt Marsh	Grasslands of *Spartina spp.*					
Coastal Beach	CO7, Beach grass, Bayberry, Rose spp., White spruce					
Wetlands	WC1, WC2, WC6, WC7, WD1, WD2, WD3, WD5, WD6, WD7					

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

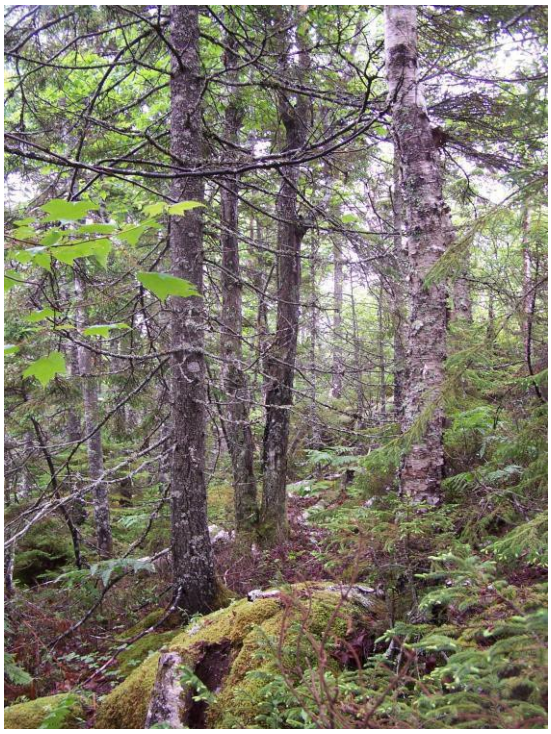
The following photos show some of the vegetation types expected to be found within their respective elements.

Sugar maple – White ash / Silvery spleenwort – Baneberry (TH4) is a late successional vegetation type found in the Tolerant Hardwood Hills matrix element.

White pine / Blueberry / Bracken (SP4) is a mid-successional vegetation type found in the Spruce Pine Hummocks patch element.

Sugar maple – White ash / Ostrich fern – Wood goldenrod (FP1) is a late successional vegetation type found in the Floodplain element.

White Spruce / Bayberry (CO7) vegetation type is found on coastal sand dunes in the Coastal Beach element and marks the last stage of dune vegetation succession.



Black spruce – Red maple / Bracken – Sarsaparilla (SP6) is an early successional vegetation type found in the Spruce Fir Hills and Hummocks element.

Black spruce / Cinnamon fern / Sphagnum (WC1) is found in the Wetlands element in poorly drained flatlands.

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.

Natural disturbances shape the diversity of the forest ecosystem. In the St. Georges Bay Ecodistrict, gap replacement is considered to be the predominant natural disturbance regime when forest stands are in a late seral stage. This type of disturbance pattern is characteristic of shade-tolerant hardwood forests. Openings are subsequently filled with regeneration creating multi-layered and multi-aged stands.

In landscapes characterized by gap disturbance regimes, if left to natural disturbance alone, up to 30% of the forest may comprise forest establishment and young competing forest development classes combined. Under such natural conditions, greater than 70% of the forest is likely to be in mature forest with representation in early, mid, and late seral stages, with greater than 24% of this mature forest in multi-aged and old growth stands.

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%

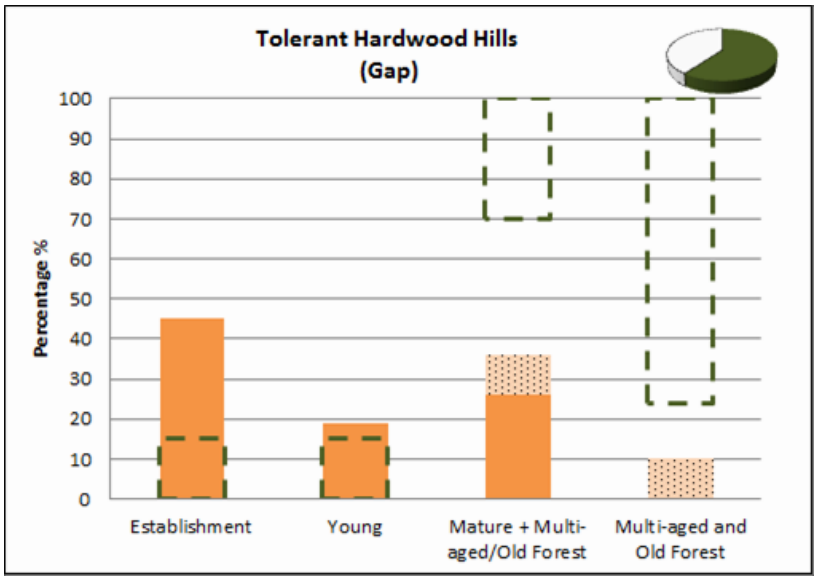
Table 6 indicates that for frequent stand-initiating disturbances, both establishment and young development class forests would typically comprise between 5 and 30% of area, while mature

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.

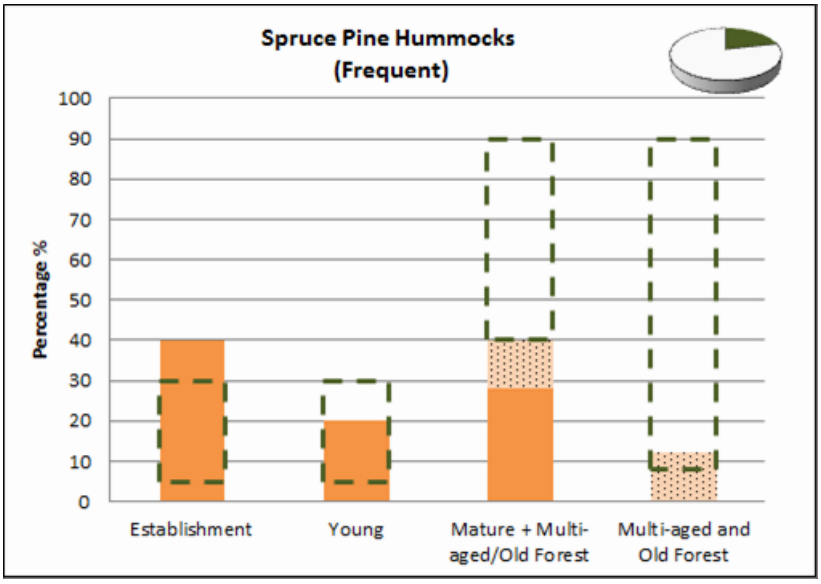
Development Class Targets by Element

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.

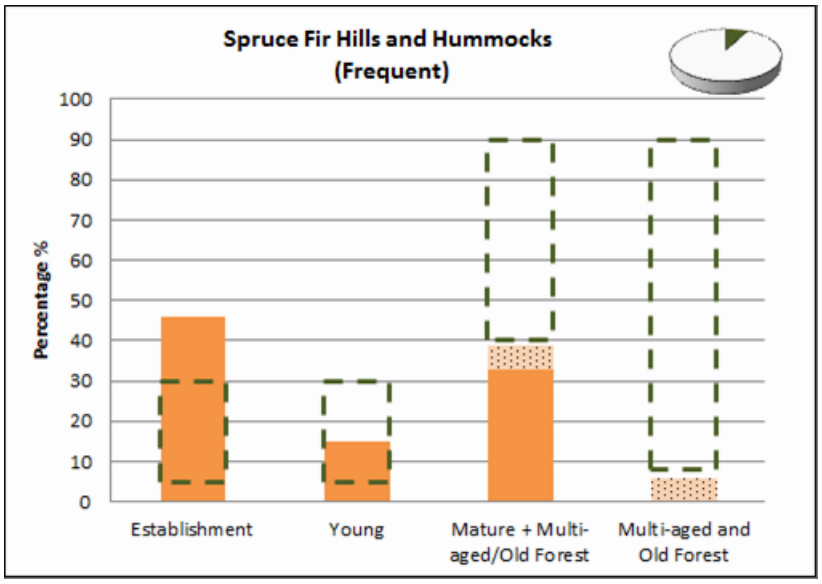
In the **Tolerant Hardwood Hills** element, the multi-aged and old forest class is below its target range. Partial harvests consistent with gap disturbance, including retention of old trees, will promote multi-aged forest development, particularly in tolerant hardwood stands. Favouring climax species in establishment and young forests will provide future mature forest opportunities.



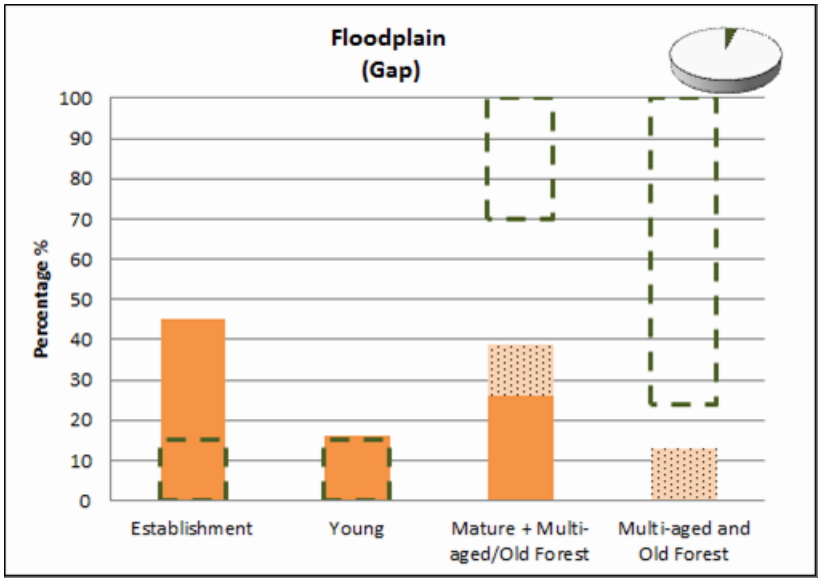
In **Spruce Pine Hummocks**, most of the development classes are within their target ranges, though the establishment class is excessive and in the mature and multi-aged classes the range is only barely met. These frequent natural disturbance regime forests support periodic stand-initiation events that favour establishment of an even-aged forest, often with scattered surviving mature pine that provide large seed trees and super canopy structure.



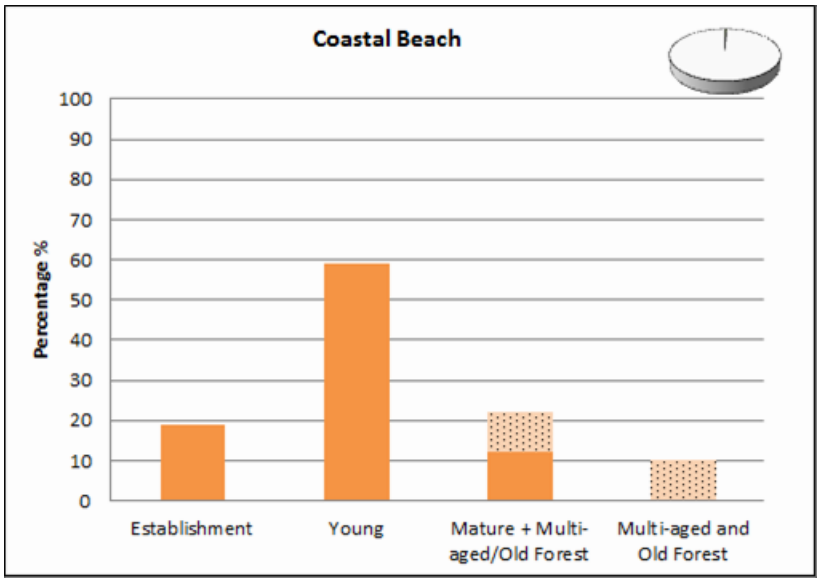
In **Spruce Fir Hills and Hummocks**, the establishment class is significantly above the target range due to the harvesting of the abundant mature to over mature old field white spruce forests. This element occurs on moist soils which increases the risk for windthrow if stands are partially harvested. Practices which enhance natural regeneration are preferred. Stand maturity is critical in terms of producing adequate seed for regeneration.



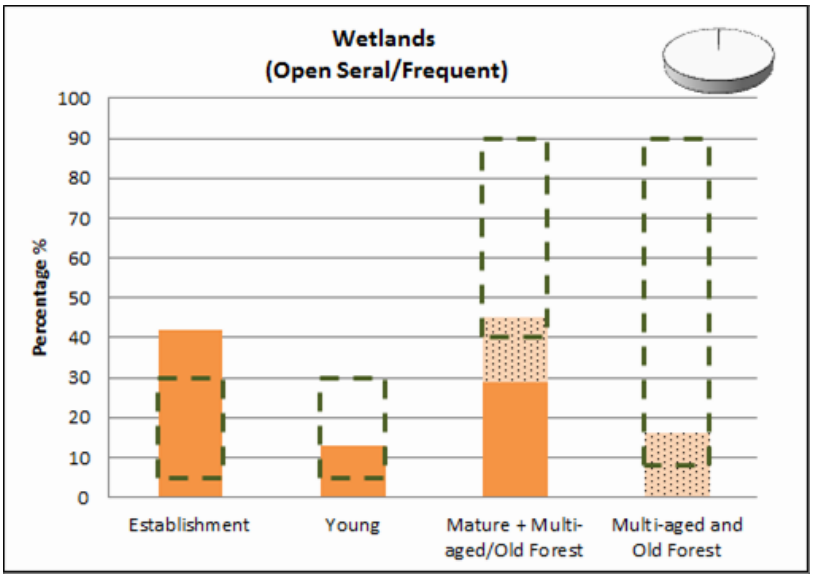
The small **Floodplain** patch element is often associated with the valley corridors and the wetlands elements and provides a habitat interface with the hydrological system. The small size and limited distribution of this element make its composition sensitive to local-level disturbance.



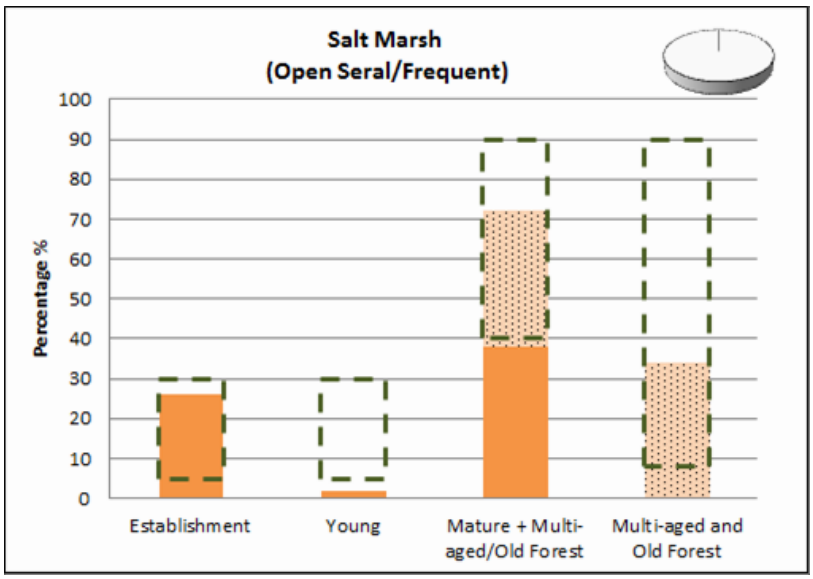
The small amount of forest associated with the **Coastal Beach** element has development classes appropriate for frequent natural disturbance regime. This uncommon habitat provides important interface to the coastal ecosystems. Forestry operations should employ special practices to protect sensitive sites.



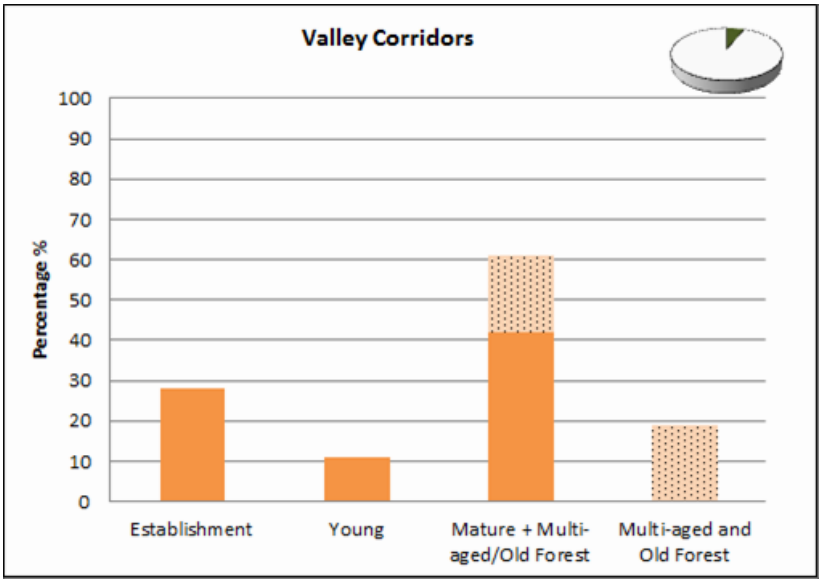
The **Wetlands** element, which has an open seral / frequent disturbance regime, is within the target ranges for all classes. This element is often variably composed of forest, interspersed with woodlands and open wetlands. Disturbances are often patchy, reflecting the diverse structure. Small patch harvesting following natural boundaries is appropriate.



The small amount of forest associated with the **Salt Marsh** element has a balance of development classes appropriate for frequent natural disturbance regime. This habitat provides important interface to the wetland ecosystems. Forestry operations should employ special practices to protect sensitive sites.



The **Valley Corridors** element includes parts of several elements and does not 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. This is particularly valuable in riparian zones, where closed canopies and small openings are most appropriate.



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 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 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 activities or natural activities or natural events. May also be referred to as "species of special concern." A species declared vulnerable unde 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).