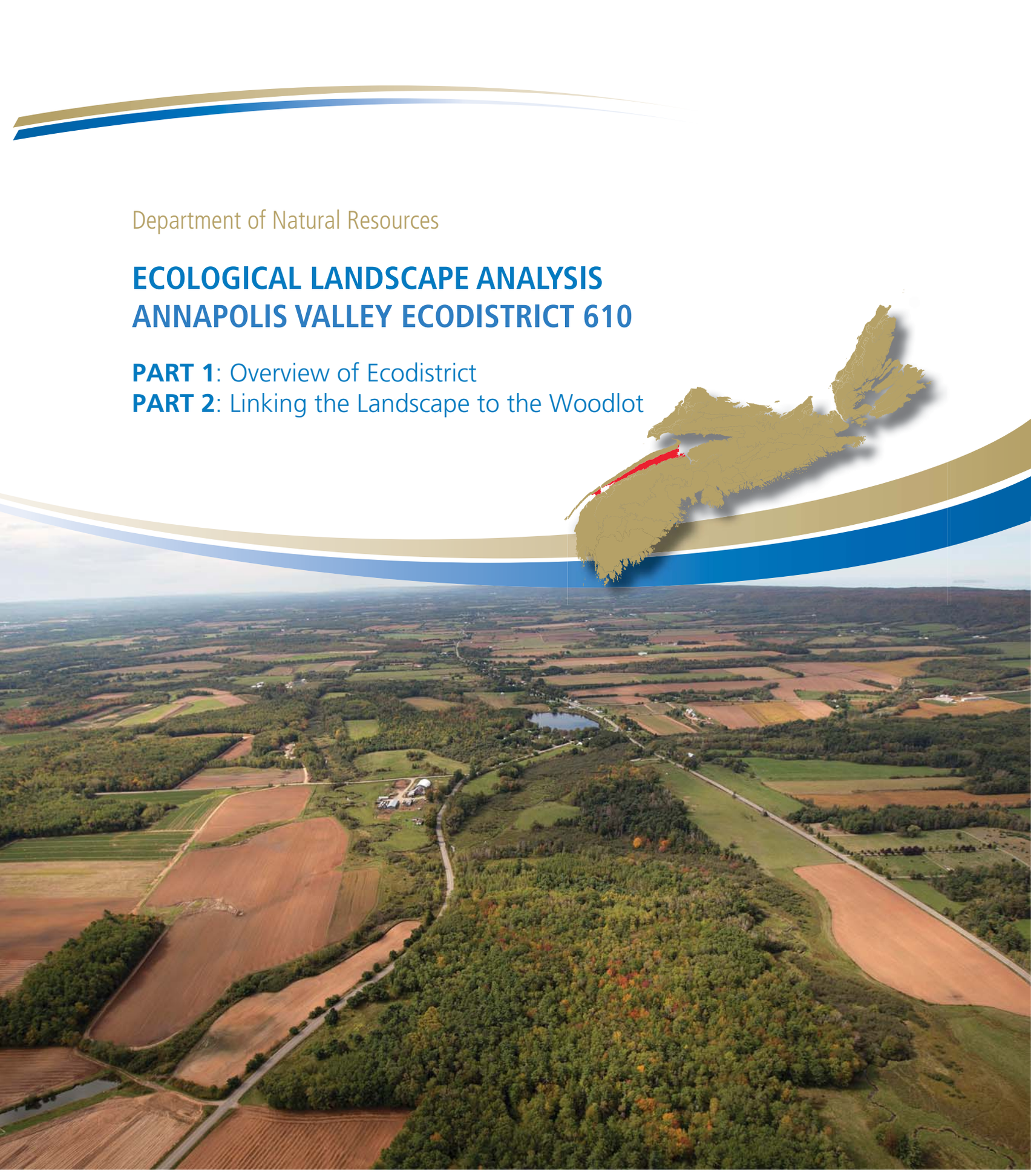
Department of Natural Resources

ECOLOGICAL LANDSCAPE ANALYSIS ANNAPOLIS VALLEY ECODISTRICT 610

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



ELA 2015-610

NOVA SCOTIA

Ecological Landscape Analysis, Ecodistrict 610: Annapolis Valley

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This report, one of 38 for the province, provides descriptions, maps, analysis, photos, and resources of the Annapolis Valley 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 (2002) – stand volume, species composition
- Crown Lands Forest Model landbase classification (2006) – provides forest inventory update for harvesting and silviculture from satellite photography (2005), silviculture treatment records (2006) and forest age increment (2006)
- Roads and Utility network – Service Nova Scotia and Municipal Relations
- (2006) Significant Habitat and Species Database (2007)
- Atlantic Canada Data Conservation Centre (2013)

Conventions

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

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

REPORT FOR ELA 2015-610

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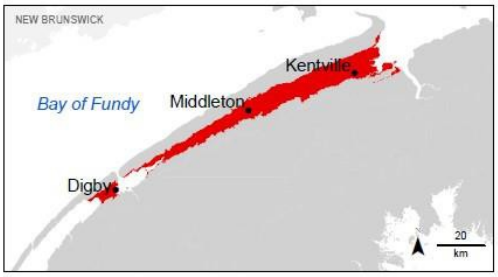


An objective of ecosystem-based management is to manage landscapes in as close to a natural state as possible. The intent of this approach is to promote biodiversity, sustain ecological processes, and support the long-term production of goods and services. Each of the province's 38 ecodistricts is an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

This Ecological Landscape Analysis (ELA) provides detailed information on the forest and timber resources of the various landscape components of Annapolis Valley Ecodistrict 610. 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 Annapolis Valley Ecodistrict is bounded by the south-facing slopes of the North Mountain and the north-facing slopes of the South Mountain. The ecodistrict, with an area of 92,800 hectares, is about 130 kilometres long and varies in width from 3 to 11 kilometres. The small adjacent Gaspereau Valley has been included in this ecodistrict.

The shelter provided by the North and South mountains allows the Annapolis Valley to have early springs and hot summers, making it one of Nova Scotia's most productive agricultural areas.

The valley is underlain by sedimentary deposits that have provided the parent material for the sandy soils found in the ecodistrict. The valley is drained by two rivers: the Annapolis River flows southwest to the Annapolis Basin and the Cornwallis River flows northeast to the Minas Basin.

The high tides of the Bay of Fundy affect both basins and have formed extensive areas of tidal salt marsh. Most of this marshland, which is now protected from the salt water by a system of dykes, is used for agriculture. The dykes were originally built by the early French settlers in the 1600s.

A mix of fields and forests on the Valley floor near Bridgetown follow along the lower slope of the North Mountain.

Agricultural use of the land occurs on 43% of the ecodistrict, followed by forested land at 32%, and urban lands at 10%. Wildlife species that benefit from this arrangement are those that occupy edge habitats and have a preference for agricultural and urban landscapes, such as red fox, striped skunk, raccoon, and meadow vole. Bald eagles are also common in the ecodistrict.

Remnant sand heathland with broom crowberry and red pine near Kingston. These rare, globally unique ecosystems are under threat from land use pressures. They contain several rare plants including golden heather and rockrose.

Private land ownership accounts for 92% of the ecodistrict. Provincial and federal governments own 1% and 2%, respectively. Aboriginal and other lands account for the remainder.

In many areas of the ecodistrict, the valley floor is not flat but comprises small hills and hummocks where the soil is not excessively sandy. These sites will support shade-tolerant hardwoods on the upper slopes and red spruce, hemlock and pine on the lower or shaded slopes. Black spruce and larch grow on the wetter sites.

The rapid to well-drained sandy soils on the valley floor are prone to drought and support pure stands of white pine, red pine, and red oak or mixtures of these species. The alluvial soils along the major rivers once supported a riparian hardwood forest with elm, black cherry, and black ash.

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 11 key landscape elements – ten patch elements and a corridor element – in Annapolis Valley. In this ecodistrict, there was not a single dominant matrix element.

Spruce Hemlock Pine Hummocks and Hills, representing 32% of area of elements in ecodistrict, is the largest patch element. The main trees species are shade-tolerant red spruce, hemlock, and white pine, along with black spruce, red maple, and tamarack. Abandoned farmland reverts to old field forests, usually white spruce, aspen, or tamarack.

Pine Oak Flats and **Pine Oak Hills and Hummocks**, the next two largest patch elements with a combined area of 35%, support white pine and red oak, along with black spruce, red pine, jack pine, aspen, and red maple. The other patch elements, in order of size, are **Red and Black Spruce Hummocks**, **Marshes and Grasslands**, **Spruce Pine Flats**, **Floodplain**, **Wetlands**, **Salt Marsh,** and **Tolerant Hardwood Hills**.

Valley Corridors, a linear corridor element, includes the riparian areas along major rivers, such as the Annapolis, Cornwallis, Nictaux, Black, Fales, South, and Gaspereau.

Forest Ecosystem Management
For Annapolis Valley 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 Annapolis Valley Ecodistrict 610. 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 Annapolis Valley Ecodistrict was up to 2008. These baseline measurements can be used to assess trends through comparison with present and future inventories.

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

Finally, the relationship between inherent structure and existing conditions is used to guide future direction. The ELA is part of an ecosystem approach that will expand to encompass other initiatives of 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 Annapolis Valley – *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

Annapolis Valley is part of the Valley and Central Lowlands Ecoregion.

A variety of soils exist in this ecodistrict. The valley is underlain by Triassic sedimentary deposits that are easily eroded and have provided the parent material for the sandy soils in the ecodistrict. Where the Annapolis Valley merges with the North Mountain, parent material includes volcanic rock, such as basalt. Along the ecodistrict's juncture with South Mountain, parent material can also contain slates, shales, and granites.

The Annapolis Valley is drained by the Annapolis River and the Cornwallis River. The headwaters of both rivers is the large peat area known as Caribou Bog, near Berwick.

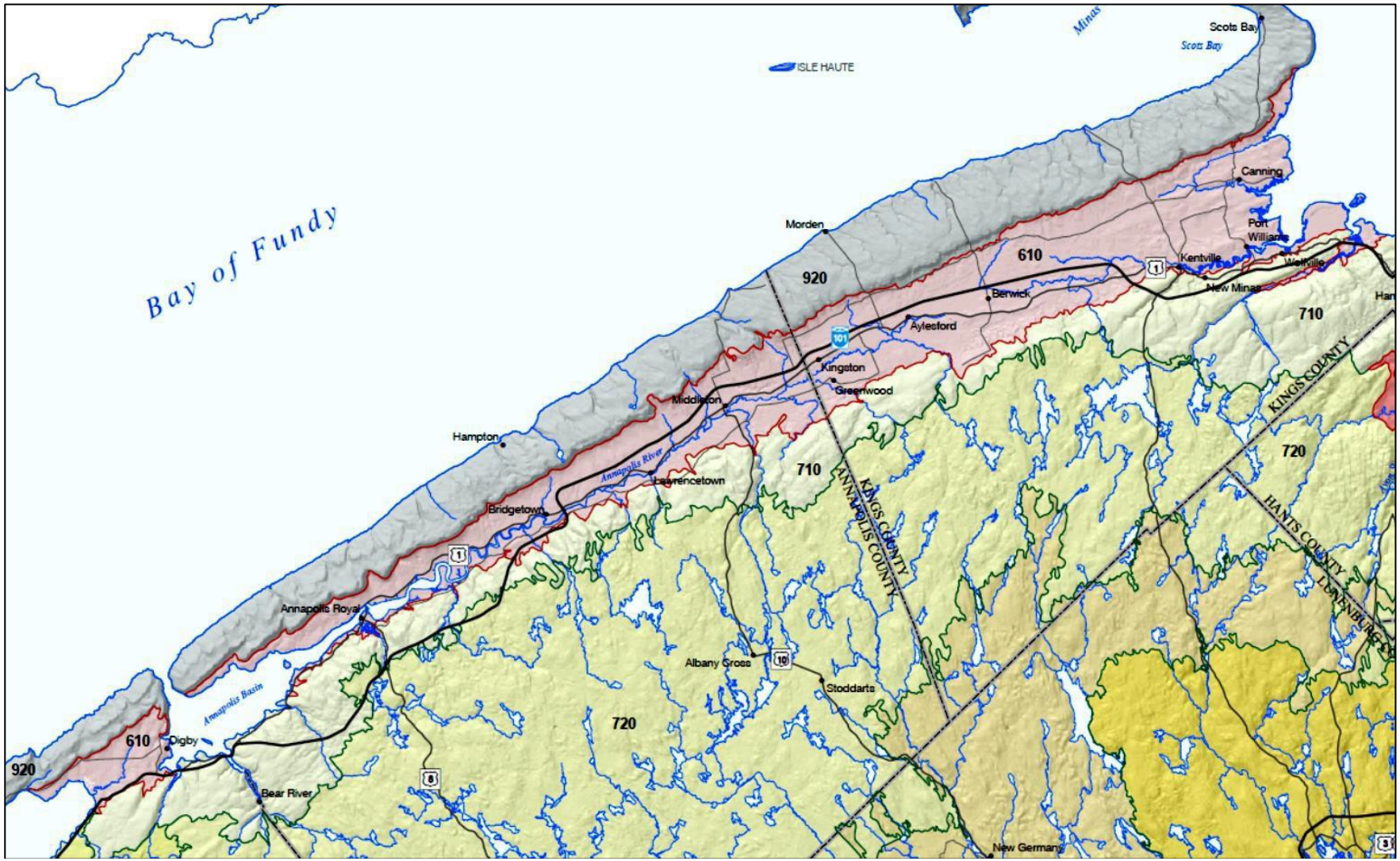
A landscape view of the valley shows a relatively flat ecodistrict, much of which has been converted to agricultural or urban uses, with generally small patches of forest distributed among the converted areas.

The dominant climax forest, occurring mostly on well-drained fine- to medium-textured soils, was the red spruce-hemlock-white pine association.

The coarser, sandy soils support white pine-red oak-red pine. Black spruce occurs on the imperfectly and poorly drained sites. Sugar maple, white ash, and elm is found on the flood plains of the two major rivers. Sugar maple-yellow birch-beech occurs on the more fertile and better-drained fine- to medium-textured soils on hummocky terrain.

Natural disturbance agents in the ecodistrict are primarily associated with hurricanes and windstorms on the medium- to fine-textured soils. Where soils are sandy, coarse, and dry, fires have been associated with the pine and oak forests that have resulted. Insect defoliation has not been a significant factor in forest disturbance, although forest tent caterpillars have defoliated aspen stands in the past. The loss of American elm on the floodplain forests due to Dutch elm disease has had an impact on these ecosystems.

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



The Annapolis Valley Ecodistrict 610 is a narrow band of land – much of it used for agriculture – between the North and South mountains that stretches from Digby County in the west to Kings County in the east.
(From Ecodistricts of Nova Scotia map 2007)

Land Area

Most of the land, at 92%, is held by private owners (Table 1). Crown land, at only 1% of the area, is made up of only a few scattered blocks, the largest being the Belleisle marshes. Aboriginal land is located at Cambridge.

Table 1 – Land Area by Ownership in the Valley Slope Ecodistrict*

Ownership	Area (hectares)	Percent of Total Area
Provincial Crown land	926	1
Private	85,335	91.9
Federal	2,178	2.3
Aboriginal	19	<0.1
Other (Includes inland water bodies and transportation corridors)	4,365	4.7
Total	**92,823**	**100**

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

Sizable urban areas are located throughout the ecodistrict and include Kentville, Berwick, Middleton, Lawrencetown, Bridgetown, and Annapolis Royal. Outside the urban areas, agriculture land interspersed with forest dominates.

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	47	5.1
C2 – Multiple and Adaptive Use	417	45
C3 – Protected and Limited Use	75	8.1
Unclassified	387	41.8
Total	**926**	**100**

In Annapolis Valley, the main Crown category is C2 (45%), followed by C3 (8%), and C1 (5%). The remaining 42% is unclassified.

The former Canadian National and Dominion Atlantic Railway lines run through this district. The rail line corridors – the lines have been pulled up and the corridors are now owned by the province – are generally 30 metres wide, but wider at old station and siding sites. The long-term plan for this land is trail development, but it presents a number of administrative issues. There are a large number of existing private crossings and new crossings are being applied for.

This ecodistrict comes in contact with tidal water in several locations. Most of the shoreline of the Annapolis Basin is located within the ecodistrict, as well as the head of St. Marys Bay and a section of the Minas Basin.

Almost all land below the mean high water mark is provincial Crown land. Permits are required from DNR for activities that take place on this land. These activities include wharf construction, bank stabilization, and installation of saltwater intake and outflow pipes.

Forests

Table 3 provides a breakdown of the land use categories within the 92,823 hectares (land and water) of the ecodistrict. The major land use is agriculture at 43%, followed by forested lands at 32%, and urban at 10%.

Table 3 – Area Distribution by Land Category for All Owners

Category	Hectares	Percent
Forested	29,868	32.2
Wetland	4,414	4.8
Agriculture	40,241	43.4
Barrens	199	0.2
Urban	8,868	9.6
Road, Trail, Utility	2,861	3.1
Other	6,372	6.9
Total	**92,823**	**100**

Almost 50% of the forest is made up of early seral species with 17% late seral, and the remainder mid-seral. The majority of the forest is mature (48%) or multi-aged (32%).

Early seral species include white birch, aspen, red maple and white spruce. Late seral species include white pine, red pine, black and red spruce, oak, and the tolerant hardwoods.

Nearly 50% of the softwood covertype is late seral species. The other covertypes contain a much smaller late seral component. The softwood covertype is dominated by white spruce on former agricultural land with lesser amounts of red and black spruce or pines.

Mixedwoods contain a relatively high percentage (almost 50%) of mid-seral species, which are often the intolerant hardwoods, along with pine and red or black spruce.

Intolerant hardwoods such as red maple, white birch, and aspen make up most of the hardwood covertype. These same intolerant hardwoods are most common in the mixedwood covertype.

The ecodistrict has generally higher than average site capability for growing trees.

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

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

Table 4 – Area of Forested Land by Land Capability Rating

Land Capability (LC) Rating (m^3/ha/yr)*	Hectares	Percent
2 or less	105	0.4
3	579	1.9
4	3,328	11.2
5	11,344	38.0
6	13,004	43.5
7 or more	1,508	5
Total	**29,868**	**100**

*Based on growth potential for softwood species.

Forests and farmland are both common in the Annapolis Valley, nestled between the North and South mountains.

Rivers and streams provide important water resources in the ecodistrict.

Water Resources

Inland waters make up 226 hectares, or 0.2%, of the ecodistrict.

The Annapolis Valley is drained by two major rivers – the Annapolis and Cornwallis. Both of these systems originate in Caribou Bog, near Berwick. Numerous first and second order streams from the adjacent North Mountain and Valley Slope ecodistricts feed these rivers. Many freshwater wetlands occur on both river systems, particularly between Middleton and Kentville. Tidal influences from the Annapolis and Minas basins formed salt marshes along both rivers.

The Annapolis Tidal Power Station is located on the Annapolis River at Annapolis Royal.

Power stations affecting flow of water into the ecodistrict are located at Lequille, Paradise, Nictaux, Lumsden Dam, and Hollow Bridge.

Designated water supply areas are located just outside the ecodistrict's northern boundary (Lily and Second lakes for Middleton) and southern boundary (Tupper Lake for Kentville).

Natural watershed municipal surface water supply areas are located outside the ecodistrict's northern boundary (Van Tassel Lake for Digby, and Croskill and Foster lakes for Bridgetown) and southern boundary (Baxter Brook for Lawrencetown).

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

Minerals, Energy and Geology

The Annapolis Valley Ecodistrict is a long narrow ecodistrict that trends northeast-southwest, extending from just beyond Digby in the west to the Minas Basin in the east and encompassing what is locally referred to as the Annapolis Valley. This ecodistrict also includes the Gaspereau Valley on the eastern end, south of Wolfville.

Though the ecodistrict gets its name from the Annapolis Valley, the Gaspereau Valley also plays an important role in the region.

The Annapolis Valley Ecodistrict was carved out through the erosive action of what we now know as the Annapolis and Cornwallis rivers. These rivers once flowed at right angles to their current flow direction.

The source waters were on the South Mountain and the rivers flowed over the present Annapolis Valley and North Mountain, discharging into a river located in the centre of the present Bay of

Fundy. Several glaciation events and erosion of the overlying younger basalt rocks of the North Mountain exposed the underlying and softer sedimentary sandstone rocks of the Blomidon and Wolfville formations.

The sandstones eroded at a faster rate than the harder basalts and eventually eroded away to a point where the rivers no longer flowed over the North Mountain basalts. The river courses evolved into a path flowing parallel with the North Mountain, discharging into the sea at either end of the valley.

Bedrock in this ecodistrict is dominantly from the Blomidon and Wolfville formations – from 200 to 240 million years old –with small sections of bedrock from the Meguma Supergroup along the southern margins of the ecodistrict. North Mountain basalt is found in a few small areas along the northern margin of the ecodistrict.

There is little Wolfville Formation outcrop in this ecodistrict, but small sections can be found along the slopes of the South Mountain in river beds and in the Kingsport area. The Wolfville Formation is a fluvial and Aeolian sandstone and conglomerate bedrock unit and accounts for 70% of the ecodistrict.

Blomidon Formation outcrop is found at the western end of the valley, where erosion from the Minas Basin has exposed the red sandstones at the base of the North Mountain in the Blomidon and Cape Split areas. The Blomidon Formation is a red shale, mudstone, and sandstone bedrock unit and accounts for 25% of the ecodistrict.

The remaining 5% comprises of slates from the Meguma Supergroup, granites from the South Mountain Batholith, and glaciofluvial conglomerates, slates, and shales from the Horton, Torbrook, and Kentville formations.

Surficial geology dominates this ecodistrict and plays an important role in the agricultural resources and rich productive soils on the valley floor. Glacial till is the dominant surficial deposit within this ecodistrict and is characterized into three different units – glaciofluvial deposits, glaciolacustrine and marine deposits, and silty till.

Glaciofluvial deposits (kames, eskers, and outwash fans) are predominantly found between Lawrencetown and Wolfville and comprise gravel, sand, and silt. The sand deposits are important economic resources for local contractors and are heavily used in the construction industry for road building, septic systems, and cement production.

Located within the glaciofluvial deposits are several peat deposits in the Kingston to Coldbrook areas. These are typically bogs and fens and have been actively developed over the past 60 years in the Berwick area.

Glaciolacustrine and marine deposits are found at the lower reaches of the Cornwallis and Annapolis rivers, near the Minas and Annapolis basins. Glaciolacustrine deposits comprise silt and clay with a minor sand component and are deposited adjacent to the rivers in the ecodistrict – predominantly the Annapolis River.

Many of the rich agricultural lands in the ecodistrict have been reclaimed by dyking.

Marine deposits are typically found in salt marshes and tidal flats which have formed along the estuarine part of the Annapolis and Cornwallis rivers.

Many of these areas have been reclaimed by dyking to form rich agriculture lands. Active deposition of silt and clay continues in the estuarine areas not protected by dykes.

Extending along the entire northern half of the ecodistrict, adjacent to the North Mountain, are silty till glacial deposits. These tills comprise material that has been released from the base of an ice sheet during melting and are among the most productive agriculture lands in the province. Unlike the high drainage sands of the glaciofluvial deposits, these tills have moderate drainage and have a higher silt, clay, and organic component derived from local and distant sources.

Behind Middleton, there are several drumlins located at the base of the North Mountain. Drumlins are rare within this ecodistrict; this is the only location where they are found. The drumlins are made up of a silty till with a higher clay component, typically red-coloured clay.

Exploration activity within the ecodistrict is low with the majority of activity centred on general reconnaissance exploration on the margins of the ecodistrict and exploration for kaolin in the Middleton-Bridgetown areas.

In the Torbrook area, exploration was associated with iron production where 350,000 tonnes of iron ore were produced between 1825 and 1913. This area is a contact zone between the intruding South Mountain Batholith and the Meguma Supergroup and the Torbrook, White Rock, Kentville and Canaan formations. This is an important exploration area given the unique geology associated with this intrusion. These past production and exploration areas are current exploration targets for prospectors and exploration companies.

There are several abandoned mine openings associated with the past mining activities in the Nictaux-Torbrook area. The mine openings are located on both Crown and private lands and caution should be used when walking or working in this 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.

Parks and Recreation / Protected Areas

The Annapolis Valley Ecodistrict consists of the floor of the Annapolis Valley, bordered by the North and South mountains.

Parts of the Annapolis Valley Ecodistrict can be seen from the Valleyview Provincial Park.

Due to its favourable growing conditions, the valley was settled early, with farming being the primary industry. This led to the development of towns and villages scattered from one end of the valley to the other end, with rural properties in

Railroads served as the link to these communities, both within the valley and leading to other parts of the province. Those rail corridors, abandoned in the early 1990s, now serve as multi-use shared recreational trails, used by residents and visitors. Although these corridors are owned by the province, they are maintained as recreational trails by local community groups. Four wheelers, snowmobilers, walkers, runners, bikers, and cross-country skiers all use the trails.

The few Crown properties on the valley floor include several day-use parks and part of two camping parks. There are also several privately owned campgrounds in this ecodistrict.

Category A: Existing designated parks, protected areas, and nature reserves. This category includes properties designated under the Parks Act, Wilderness Protection Act, and Special Places Act.

(Part of)	Blomidon Provincial Park	8.2 hectares
	Upper Clements Provincial Park	8.6 hectares
	Coldbrook Provincial Park	2.9 hectares
	Clairmont Provincial Park	23.4 hectares

In 2011, it was announced that Upper Clements Park, a non-profit organization that manages the theme park, had purchased adjoining Crown lands, including much of the Upper Clements Provincial Park.

Category B: Other properties with protection value or for which there is a level of commitment to protect. This category includes non-designated but operational parks, non-designated nature reserves, and properties to which some legal obligation or ministerial commitment to protection is attached.

(Part of)	Blomidon	1.5 hectares
	Joggins Bridge	0.1 hectares
	Upper Clements West	7.9 hectares

Category C: Other park properties containing highly significant multiple outdoor recreational, natural or cultural values.

Designated Abandoned Railway Corridor:

With no agreement	73.9 kilometres
With agreement	56.2 kilometres

There are several national historic sites and parks in the ecodistrict, including:

Abraham Gesner National Historic Site	1 hectares
Bloody Creek National Historic Site	5.1 hectares
Fort Anne National Historic Site	11.3 hectares
Grand-Pré National Historic Site	3.6 hectares
Port-Royal National Historic Site	6.0 hectares

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 Annapolis Valley 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 Annapolis Valley 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.

Wetlands and Aquatic Habitat

While freshwater wetlands make up only 4% of the Annapolis Valley area, they are extremely important. In addition to providing wildlife habitat, wetlands perform vital environmental functions, such as flood and erosion control, groundwater recharge, and water filtration.

Given their importance to wildlife in southwest Nova Scotia, and their potential for containing rare species, all wetlands in this ecodistrict are considered to be a significant component of the landscape.

Wetlands data are contained in DNR's GIS wetland layer, collected primarily through aerial photograph interpretation. Wetlands of 0.2 hectares or more in size which are visible on aerial photos are included.

Most of the wetlands occur along two major rivers, the Annapolis and the Cornwallis, and their tributaries. Wetlands along the edges of these watercourses are meadows, fens, seasonally flooded flats, lakeshore wetlands, and shrub swamps.

A number of small bogs are scattered throughout the ecodistrict, but there are several larger bogs found between Berwick and Kingston, which actually form the headwaters of the two rivers. The Annapolis runs southwest to the Annapolis Basin and the Cornwallis runs northeast to the Minas Basin. Most of the tributaries entering these rivers originate on the slopes of the North and South mountains.

Connected to many watercourses flowing through relatively flat terrain, the watercourse wetlands together make up 81% of total wetland area. Of these, shrub swamps are the most common type, at 38% of wetland area. Associated with watercourse floodplains, meadows and seasonally flooded flats account for 25% and 16%, respectively.

There are very few lakes in this ecodistrict, and lakeshore wetlands thus make up a very small percentage (0.4 %) of total wetland area.

Bogs receive their water primarily from rainfall, so they are not closely associated with watercourses in the ecodistrict, except where streams carry draining water away. Compared to

other ecodistricts in southwestern Nova Scotia, the proportion of bogs is relatively low, at 15% of wetland area.

Other noteworthy features of the ecodistrict are the salt marshes and river estuaries. Fresh water from the rivers ultimately moves into basins at each end of the valley and estuaries exist where the fresh and salt water meet.

The tidal extremes of the Bay of Fundy exert a very strong influence on the extent of these estuaries. Tidal movement carries salt water considerable distances inland through river channels so that for several kilometres near their mouths, the rivers have deep channels with high muddy banks exposed at low tide. These estuaries provide excellent conditions for the establishment of salt-tolerant marsh grasses with sheltered, muddy sites subject to very little wave action.

Salt marshes and wetlands provide important habitat in the ecodistrict.

Historically, salt marshes in this ecodistrict were far more extensive than they are currently. Beginning with the Acadian settlers, much of the original salt marsh at the northeastern end of the valley has been converted to agricultural land over time. Acadians constructed dykes, ditches, and aboiteaux – dykes with sluicegates that drain flood water but keep out salt water – to artificially create farm fields in areas that used to be salt marshes.

Existing salt marsh can be found at the mouths and riverbanks of the Habitant, Canard, Cornwallis, and Gaspereau rivers. At the southwestern end of the ecodistrict, the existing marsh is largely restricted to Allains Creek, which drains into the Annapolis River near Annapolis Royal. A large salt marsh previously existed at St. Marys marsh, now dyked agricultural land.

In addition to fresh and salt water wetlands, Annapolis Valley watercourses provide important aquatic and riparian habitat. In these areas, aquatic plants and invertebrates support fish and semi-aquatic mammal species such as beaver and muskrat. Wetlands also support several species of waterfowl, especially black ducks, as well as amphibians and reptiles, including a number of frog, salamander, snake, and turtle species.

The riparian zone, the area where terrestrial vegetation meets a watercourse or wetland, is one of the most productive habitat zones on the planet, and it promotes a rich diversity of wildlife species.

Fish availability is a limiting factor for populations of fish predators such as river otters and common loons. Fish in Annapolis Valley watercourses include species such as brook trout, brown trout, yellow perch, and white perch. Anadromous fish species such as American shad, striped bass, Atlantic salmon and American eel, the invasive smallmouth bass and, more recently, the chain pickerel are also becoming established in many of the Annapolis Valley watercourses.

Terrestrial Habitat

Because of its rich soils, the Annapolis Valley has a long history of extensive land clearing for agricultural purposes. Much of this ecodistrict has been converted to a mix of open farmland and forest cover.

Forested wildlife habitat is highly fragmented, with a high proportion of early and multi-aged mixedwood containing intolerant hardwood, as well as stands of predominantly early to mid-successional intolerant hardwood.

A range of predictable wildlife species, associated with various forest stand compositions mixed with agricultural and urban lands, are expected to occur in these habitats. Wildlife species that benefit from this arrangement are those that occupy edge habitats and have a preference for agricultural and urban landscapes, such as red fox, striped skunk, raccoon, and meadow vole.

The red fox is one of the species that does well in agricultural and urban habitat.

In attempting to broadly assess the characteristics of forested wildlife habitat within an ecodistrict, much can be learned by focusing on the availability of preferred habitat for common species such as white-tailed deer and snowshoe hare.

Deer prefer a mix of habitat types, as needs change seasonally. Ideal habitat for white-tailed deer would provide a combination of mature softwood cover, regenerating hardwood browse, open sites with herbaceous plants and fruits and access to water.

Much of the Annapolis Valley forest is currently in the establishment or young forest development classes, so food availability for deer could be high in young stands of intolerant hardwood and mixedwood, especially in regenerating cut-overs. Stands of mature softwood are widely scattered, so the degree of canopy closure needed for adequate winter cover appears to be limiting.

Although there is potential for good quality white-tailed deer habitat, deer numbers will depend on the arrangement of the needed habitat components and will therefore be variable throughout. Some deer may need to move around seasonally and could even be moving between this and adjacent ecodistricts.

Ideal habitat for snowshoe hare has low dense ground cover, shrubs, and regenerating hardwoods, and is near open areas that provide access to green plants in summer. The best habitat which could potentially support large populations of snowshoe hare would be early succession hardwood and mixedwood.

In this ecodistrict, snowshoe hare, like deer, will do well in the young intolerant hardwood and mixedwood stands, especially where these are near forest openings and open fields. The abundance of hare and deer in the Annapolis Valley may be limited somewhat by the low occurrence of wooded swamps, with their rich soils and understory of shrubs and other food plants.

Like deer, snowshoe hare will occur throughout the ecodistrict, but abundance will depend on the arrangement of suitable habitat features. Their distribution and abundance will in turn influence that of their predators, mainly bobcats and coyotes.

Birds of prey (raptors) are high trophic level feeders that occupy large territories and are far less abundant than their prey species. Because they are relatively few in number, raptor species are of concern from a conservation standpoint.

A number of wintering bald eagles, above, and red-tailed hawks, below, are found in the ecodistrict.

Identifying existing or suspected nest site locations is one important aspect of raptor conservation. Information on nest locations is accumulated opportunistically, and because of their transitory nature, these data require regular updating.

Raptor habitat requirements vary, but most need large mature trees for nesting. Red-tailed hawks hunt a variety of prey in areas of mixed open and wooded habitat, so the Annapolis Valley would provide good conditions for this species if there are suitable nest trees near feeding areas.

Goshawk occurrence in this ecodistrict has been documented, and these are more specific in their nesting requirements. They are relatively uncommon because of their need for old mature forests with their large areas of continuous forested land where they hunt birds, and a preference for large old growth trees (usually hardwoods) for nesting.

An interesting feature related to raptors is the significant number of wintering bald eagles that congregate at the northeastern end of the Annapolis Valley and adjoining Valley Slope Ecodistrict.

Eagles use stands of large mature trees on the steep ravine along the Gaspereau River for night roosting. During the day these birds feed mainly on agricultural carrion from poultry farms. Red-tailed hawks are also attracted to this food source and their numbers increase noticeably in winter.

During summer and fall, hundreds of thousands of migratory shorebirds stop over in the area to feed on the bountiful resources living in the extensive mud flats of the Southern Bight of the Minas Basin. They visit briefly to build up fat reserves so that they can continue their migration south.

Another notable terrestrial habitat of the ecoregion is the sand barren created from windblown sand and dunes, possibly from glacial outwash deposits. This strikingly unique habitat type – also known as heathland – is in plain view along the valley floor from the highway between Kingston and Greenwood. Sand barrens communities are one of the most threatened types of habitats and are in dire need of management, as they support rare and uncommon assemblages of plants and animals.

It is estimated that less than 3% of the Annapolis Valley's original sand barren is left. This dramatic habitat loss is due to the construction of roads, residential developments, and conversion to agriculture. As well, natural processes – such as fire and wind – that maintain open heathland have been reduced or eliminated, and this enables woodlands to take establish in the sand barren.

Heathlands are characterised by soils that are low in nutrients, dry, and susceptible to disturbance – harsh conditions that make it difficult for most plants and many animals to survive. A rather unique assemblage of plants and animals – some common and some rare – are found in this portion of the Valley floor.

Notable rare plant species present include the rock rose, hudsonia, and arrow-leaved violet. Other examples of native sand barren species present in this area are jack pine, common bearberry, broom crowberry, panic grass, and largepod pinweed.

Additionally, because of the unique growing conditions of heathlands, individuals of common plant species, such as black berries, cherries, and juneberries that are present in sand barrens often are genetically distinct from ones growing elsewhere in the province.

Fragmentation caused by development and moderate to high levels of human-associated disturbance (e.g. ATV trails, domestic pets, land clearing, and human habitation) pose challenges for a natural heathland ecological community to develop and thrive in this ecodistrict.

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 disturbance agents in the ecodistrict are primarily associated with hurricanes and windstorms on the medium- to fine-textured soils.

Where soils are sandy, coarse and dry, fires have been associated with the pine and oak forests that have resulted.

Insect defoliation has not been a significant factor in forest disturbance although forest tent caterpillars have defoliated aspen stands in the past. The loss of American elm on the floodplain forests due to Dutch elm disease has impacted these ecosystems.

An increase in average annual temperature due to global warming may have a significant impact on forest composition, possibly increasing the abundance of pine and oak. Soil moisture may not change since precipitation amounts are not expected to decrease with climate change. However, the frequency and extent of natural disturbances such as fires caused by lightning and the blowdown of large forested tracts by hurricanes may be enhanced.

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:

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

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.

The rapid to well-drained sandy soils on the valley floor are prone to drought and support pure stands of white pine, red pine, and red oak or mixtures of all three of these species. Earlier successional stages include red maple, white and grey birch, red oak, and poplar.

Floodplains along the major rivers once supported riparian forests of elm, ash, and sugar maple. Only scattered remnants of this forest remain due to the clearing of forests – on the silt-enriched alluvial soils – for farming. There are still a few areas where cedar is found.

Red spruce and hemlock grow on the north-facing valley slope and extend into the valley on the fresh-moist sites. In many areas, the valley floor is not flat but comprises small hills and hummocks where the soil is not excessively sandy. These sites will support tolerant hardwoods on the upper slopes and red spruce, hemlock, and pine on the lower, or shaded, slopes.

Black spruce and larch grow on the wetter sites. Scattered red pine will also be found on imperfectly to poorly drained soils, which is contrary to the usual life history and characteristics of the species, but not unusual in this ecodistrict.

Throughout the valley on the better-drained soils, sugar maple, yellow birch, beech, and ironwood will be found, but they rarely form pure hardwood associations, occurring instead with white pine, hemlock, and red spruce.

Annapolis Valley – 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.

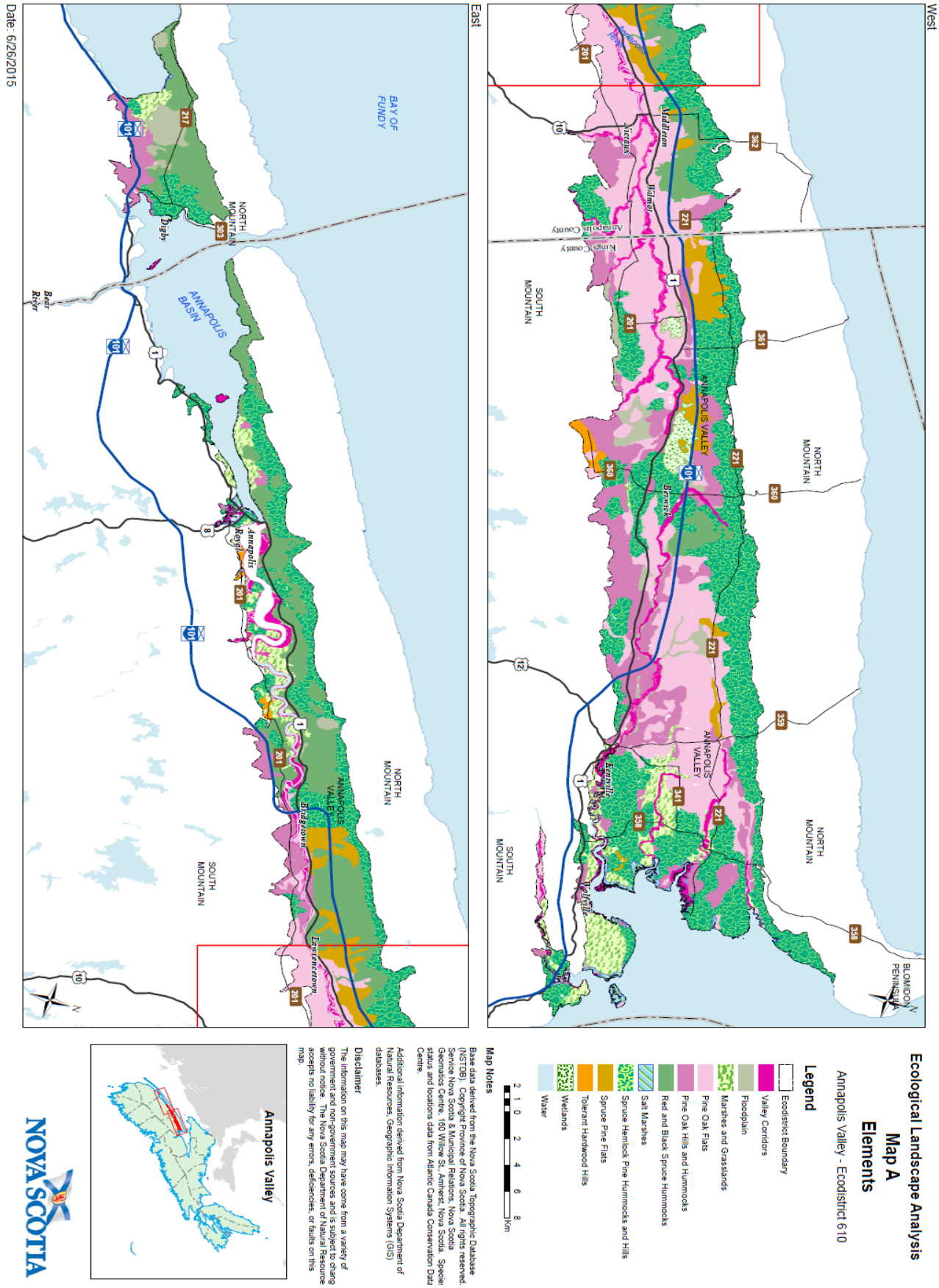
A landscape profile identified and mapped 11 distinctive elements in the Annapolis Valley Ecodistrict – ten patches and a corridor (Table 5a). A matrix – not identified in this ecodistrict – is the dominant community type. Patches are smaller yet still distinctive community types. Corridors are natural linear communities, such as river valleys, that link parts of the ecodistrict.

Spruce Hemlock Pine Hummocks and Hills, representing 32% of area of elements in ecodistrict, is the largest patch element. The main trees species are shade-tolerant red spruce, hemlock, and white pine, along with black spruce, red maple, and tamarack. Abandoned farmland reverts to old field forests, usually white spruce, aspen, or tamarack.

Pine Oak Flats and **Pine Oak Hills and Hummocks**, the next two largest patch elements with a combined area of 35%, support white pine and red oak, along with black spruce, red pine, jack pine, aspen, and red maple. The other patch elements, in order of size, are **Red and Black Spruce Hummocks**, **Marshes and Grasslands**, **Spruce Pine Flats**, **Floodplain**, **Wetlands**, **Salt Marsh,** and **Tolerant Hardwood Hills**.

Valley Corridors, a linear corridor element, includes the riparian areas along major rivers, such as the Annapolis, Cornwallis, Nictaux, Black, Fales, South, and Gaspereau.

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.

Table 5a – Elements Within Annapolis Valley		
Element	**Size (Hectares)**	**Element Description**
Spruce Hemlock Pine Hummocks and Hills (Patch)	29,258 31.6%	This is the largest of the patch elements in the ecodistrict, occurring primarily on hummocky terrain. The element is most often located along the lower slopes of the North and South mountains. The soils are well-drained of medium to fine texture derived from glacial tills. The zonal condition supports a late successional forest of red spruce, hemlock and white pine. On the level terrain between hummocks with progressively poorer drainage, black spruce, red maple, and tamarack dominate the forest vegetation. This element has been used extensively for agriculture and is currently very fragmented with few large areas of intact forest. Farmland, when abandoned, reverts to old field forests of white spruce, tamarack, and aspen.
Pine Oak Flats (Patch)	20,155 21.8%	This large patch element occurs on well to imperfectly drained coarse-textured soils on level terrain. It is associated with the Pine Oak Hills and Hummocks element and together form a contiguous landform running east-west on the valley floor from Canning to Bridgetown. The soils are derived from sands and gravels deposited by glacial meltwaters. These sandy soils have an inherently low level of soil fertility and support late successional forests dominated by black spruce, white pine, and red oak. Earlier successional forests will include red pine, jack pine, aspen, red maple, and sometimes red oak.
Pine Oak Hills and Hummocks (Patch)	12,176 13.1%	This element comprises a narrow band of ridges and hummocks running east-west on the valley floor from Kentville to Kingston. The well to rapidly drained soil has an inherently low level of soil fertility and when combined with the droughty nature of these soils supports a late successional white pine-red oak ecosystem. Earlier successional forests will include red pine, aspen, and red maple. Black spruce will become more abundant on moister soils. Fire was likely the dominant natural disturbance in this element before fire suppression reduced the occurrence of wildfires.
Red and Black Spruce Hummocks (Patch)	11,811 12.8%	This patch element occurs primarily on hummocky terrain in the western portion of the ecodistrict, on imperfectly drained medium- to fine-textured soils derived from sandstones and siltstones. Red spruce, hemlock, and white pine are dominant with black spruce occupying the flatter terrain between hummocks. Both spruce species are susceptible to stand-level disturbances caused by windthrow due to shallow rooting and the wetter soils. Abandoned fields will revert to white spruce, tamarack, and aspen. Northern white cedar is an endangered species in Nova Scotia and occurrences are known in this element west of Kingston.
Marshes and Grasslands (Patch)	5,099 5.5%	A history of reclamation first started by the 17th century Acadians using dykes and wooden sluices has resulted in a large area of land being reclaimed from salt marshes through drainage and protection from daily saltwater flooding. These lands have become some of the most fertile agricultural areas in the province. Most of the salt marshes along the Annapolis and Cornwallis rivers have been reclaimed and are being used for agriculture. Dykes have also been used to reclaim a significant area along the Canard and Habitant rivers and from the Minas Basin near Grand Pré.

Table 5a – Elements Within Annapolis Valley		
Element	**Size (Hectares)**	**Element Description**
Spruce Pine Flats (Patch)	3,868 4.2%	This element occurs as several large areas starting at Aylesford and continuing westerly on the north side of the Annapolis River. It occurs primarily on imperfectly drained soils of fine texture (clay loams) on flat terrain. Riparian zones along brooks and wetlands are embedded within this element. Forests of slow-growing black spruce are typical but on the better-drained soils red and black spruce, balsam fir, and white pine are common. As soil drainage becomes poorer, wet forests of red maple, tamarack, alders, and willows are common.
Floodplain (Patch)	2,716 2.9%	This element has two dominant forest types. The most prominent is the floodplain forest associated with the major rivers. These forests occur on active floodplains that are annually or periodically flooded and enriched with sediment. The climax forest is the shade-tolerant hardwood floodplain forest of sugar maple, white ash, and elm. The second forest type occurs on level terrain not associated with annual or periodic flooding. The soils support a black spruce and white pine forest or wet forests of red maple, aspen, willows, and cherry.
Wetlands (Patch)	847 0.9%	The wetlands element is usually embedded within other elements, especially Red and Black Spruce Hummocks, Spruce Pine Flats, and Floodplain. The Caribou Bog west of Berwick is a very large, sparsely treed peatland and is the headwater for both the west-flowing Annapolis River and the east-flowing Cornwallis River. Wetlands are generally treeless or sparsely forested woodlands. Generally, sites are underlain by poorly drained mineral soils or organic soils derived from peat (sphagnum mosses) or sedges.
Salt Marsh (Patch)	610 0.7%	The twice daily tidal actions of the Bay of Fundy created extensive areas of salt marsh along many of the rivers of the Annapolis Valley and also along the tidal flats of the Annapolis and Minas basins. Reclamation for agriculture use has resulted in most of these marshes being drained and protected from daily saltwater flooding. Currently there are still large areas of salt marsh remaining at the estuaries of the Pereaux, Habitant, and Gaspereau Rivers along the Minas Basin and at Allains Creek near Annapolis Royal.
Tolerant Hardwood Hills (Patch)	462 0.5%	One of the larger areas of this element is near Morristown. The smooth, sloping terrain is an extension of the South Mountain valley-facing slopes just before they reach the valley floor. Soils are typically well-drained with variable textures. These productive soils, enriched from upslope seepage of nutrients and moisture, yield forest stands comprising shade-tolerant hardwood species, such as sugar maple, yellow birch, beech, and white ash.
Valley Corridors (Corridor)	5,595 6%	Valley Corridors is a linear element that includes rivers and streams that have riparian corridors associated with them. The approximate locations of riparian corridors have been delineated along the major rivers (Annapolis, Cornwallis, Nictaux, Black, Fales, South, Gaspereau, Habitant, and Pereaux). Forested riparian corridors can play an important role in landscape connectivity. Significant areas of riparian corridors are on longer in a forested state.
Total	**92,597***	*Area is not the same as in Table 1 because water has not been included.

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

Element	Seral Stage					
	Early	% *	Middle	%	Late	%
Pine Oak Flats --- Floodplain ecosite	IH1, IH2, IH4, IH6, OW2, OW4, OW5, MW5, SP2, SP10 --- OF1, OF2, OF3, OF4, OF5, FP5, FP6, CE2	44	MW4, SP3, SP4, SP6, SP8 --- FP2, FP3	30	SP5, SP7, **SP9** --- **FP1**	23
Pine Oak Hills and Hummocks	IH1, IH2, IH4, IH6, OW2, OW4, OW5, MW5, SP2, SP10	40	MW4, SP3, SP4, SP6, SP8	33	SP5, SP7, **SP9**	22
Spruce Pine Flats	IH1, IH4, IH6, MW5, OW2, OW4, SP2, SP10	60	MW4, SP3, SP4, SP6, SP8	18	**SP5**, SP7, SP9	14
Red and Black Spruce Hummocks	IH3, IH4, IH5, IH6, MW5, OF1, OF2, OF3, OF4, OF5	53	MW2, MW4, SH5, SH6	22	SH1, SH2, **SH3, SH4**	13
Spruce Hemlock Pine Hummocks and Hills	IH3, IH4, IH5, IH6, MW5, OF1, OF2, OF3, OF4, OF5	57	MW2, MW4, SH5, SH6	20	SH1, SH2, **SH3, SH4,** MW1, MW3	11
Tolerant Hardwood Hills	IH3, IH4, IH5, H6	56	TH8	24	**TH2, TH3,** TH4,	14
Floodplain --- Spruce Pine ecosite	OF1, OF2, OF3, OF4, OF5, FP5, FP6, CE2 --- IH1, IH4, IH6, MW5, SP2, SP10	38	FP2, FP3 --- MW4, SP3, SP4, SP6, SP8	34	**FP1** --- **SP5**, SP7	18
Salt Marsh	Grasslands of *Spartina spp.*					
Marshes and Grasslands	Cultivated Fields and Freshwater Wetlands (cattails, willows, alders, WC, WD)					
Wetlands	WC1, WC2, WC4, WC5, WC6, WC7, WD1, WD2, WD3, WD4, WD5, WD6, WD7, WD8, CE1					

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.

Red spruce – Hemlock / Wild lily-of-the-valley (SH3) is a late successional vegetation type found in the Spruce Hemlock Pine Hummocks and Hills patch element.

Eastern white cedar – Balsam fir / Stair-step moss (CE2) is an early successional vegetation type found in the Floodplain ecosite of the Pine Oak Flats patch element.

Red pine / Blueberry / Bracken (SP2) is an early successional vegetation type found in the Pine Oak Hills and Hummocks element.

Hemlock / Pin cushion moss / Needle carpet (SH1) is a late successional vegetation type found in the Red and Black Spruce Hummocks patch element.

White pine / Blueberry / Bracken (SP4) is a mid-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 Tolerant Hardwood Hills element.

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

Red maple / Cinnamon fern / Sphagnum (WD2) is a vegetation type found in the Wetlands element.

Landscape Composition and Objectives

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

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

Natural Disturbance Regimes

Three natural disturbance regimes dominate natural forests:

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

Infrequent Stand Initiating – The time between stand-initiating disturbances is usually longer than the average longevity of dominant species, thereby supporting processes of canopy gap formation and understory development in mature forests.

Gap Replacement – An absence of stand-initiating disturbances supports the development of a dominant overstory that is sustained through dynamic processes of canopy gap formation, understory development, and overstory recruitment. Gap formation ranges from individual tree mortality to the replacement of a small group of trees.

The two prominent natural disturbance regimes in Annapolis Valley Ecodistrict are the infrequent and frequent.

The infrequent natural disturbance regime occurs when the interval between stand-initiating disturbance events is longer than the longevity of the climax species. This disturbance regime 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.

Frequent regimes are typical of white pine-red oak-red 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.

Not as common, 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, tolerant species, and formation of old growth conditions. Mortality in a gap regime is commonly by animal or insect predation, disease, lightning, blowdown, or old age where individual trees or small groups of trees die. Regeneration occurs under openings (gaps) where mortality has occurred.

Tolerant species usually regenerate in the openings. 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 the gap regime.

Forest Composition

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

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

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

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

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

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

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

- early
- mid
- late

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

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

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

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

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

Forest Composition Objectives

Within ecodistricts, the forest composition should contain a range of conditions that sustain the inherent forest communities and dominant natural disturbance regimes. Table 6 provides target ranges for development class and seral stage composition appropriate for different disturbance regimes. These ranges have been derived from the professional judgment of DNR forest ecologists to guide composition objectives for large landscape areas.

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

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

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

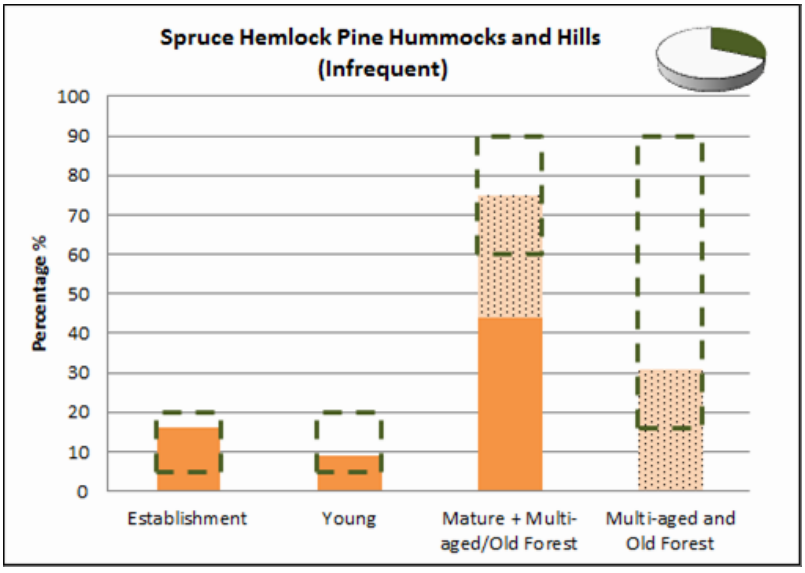
Table 6 - Landscape Composition Target Ranges (by Development Class / Disturbance Regime)				
Natural Disturbance Regime	**Development Class**			
	Forest Establishment	**Young Competing Forest**	**Mature Forest (including multi-aged and old forest)**	**Multi-aged and Old Forest**
Frequent Stand Initiating	5 - 30%	5 - 30%	>40% early, mid, and late seral representation	>8%
Infrequent Stand Initiating	5 - 20%	5 - 20%	>60% most in mid and late seral stages	>16%
Gap Replacement	0 - 15%	0 - 15%	>70% most in late seral stage	>24%

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

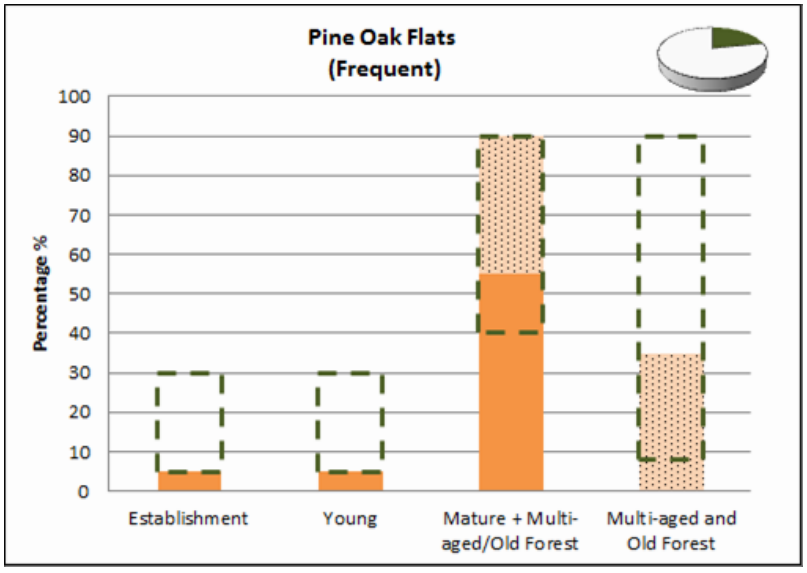
Development Class Targets by Element

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

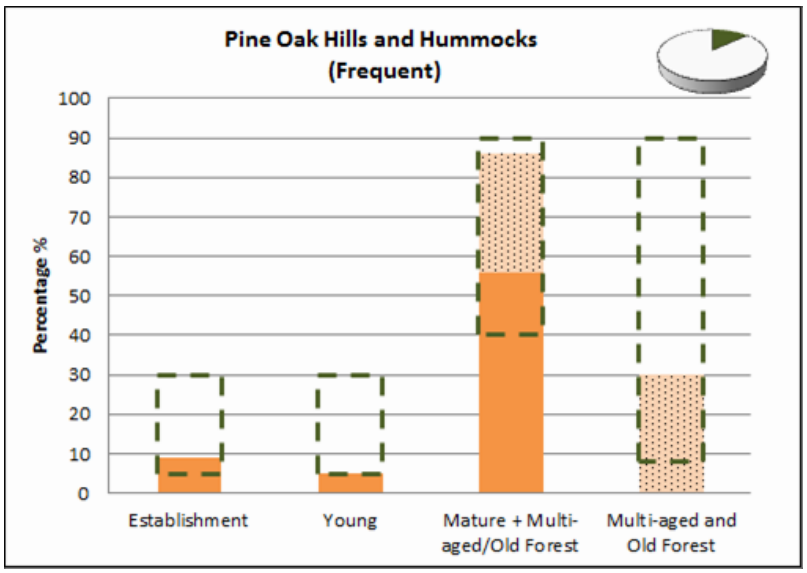
In the **Spruce Hemlock Pine Hummocks and Hills** patch element, all classes are within their target ranges. Harvest regimes that extend rotation lengths or favour uneven-aged conditions will support mature forest targets and conserve connectivity. Favouring climax species will enhance late successional forests and future management options.



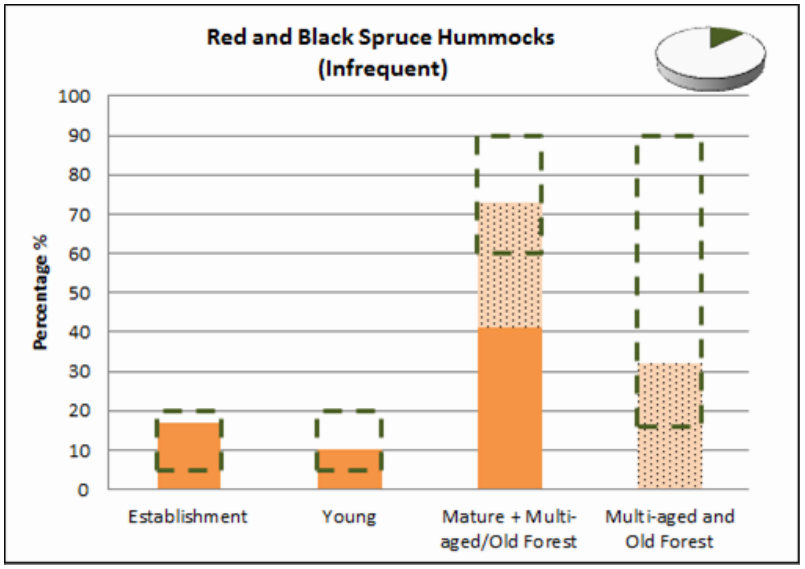
In **Pine Oak Flats**, in this era of fire suppression even-aged management techniques are required to maintain early successional forests of red pine and aspen. Silviculture efforts can be used to enhance late successional forests of oak and white pine on appropriate sites.



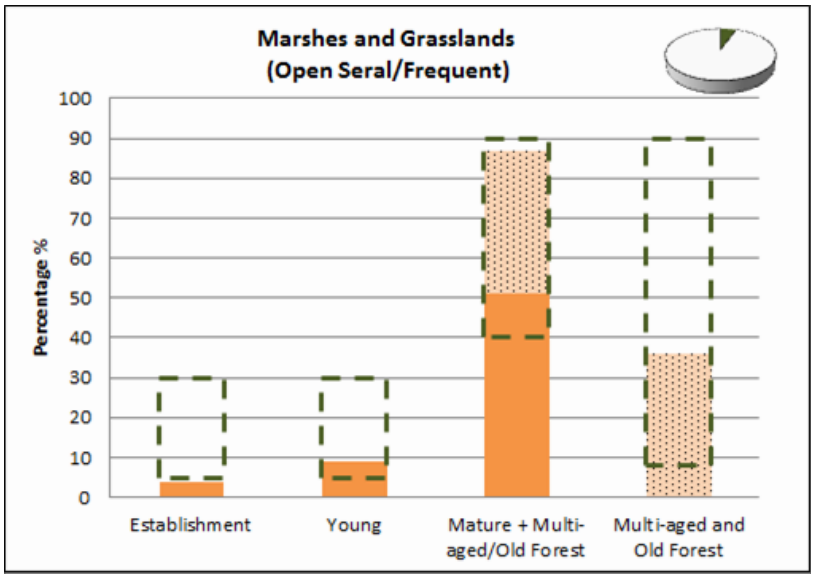
The **Pine Oak Hills and Hummocks** element is a fire-adapted ecosystem with stand renewal a function of fire intensity. Even-aged forest management can be used to establish earlier successional forests of red pine, aspen, and black spruce on appropriate sites. Later successional stages can be enhanced with silviculture techniques to favour longer-living red oak and white pine.



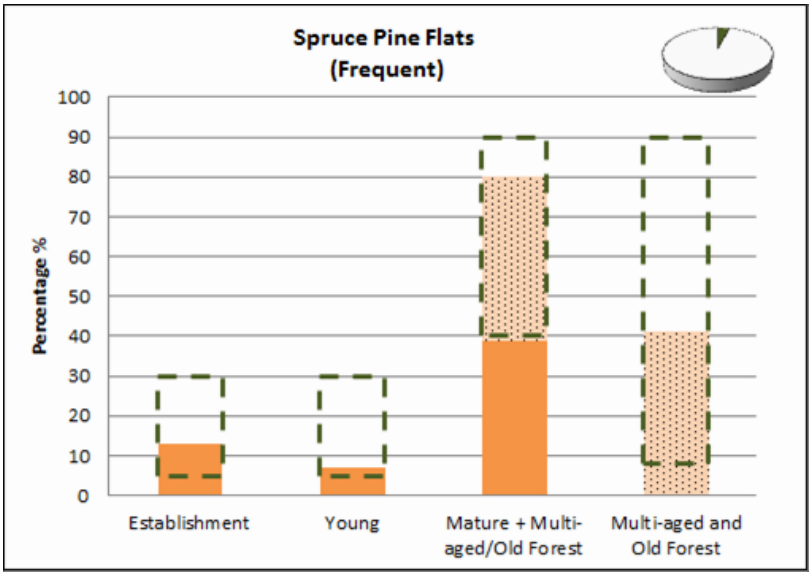
Development classes in the **Red and Black Spruce Hummocks** element are within their target ranges. The more fertile red spruce sites should provide opportunities to maintain and restore mature forest with extended rotations and uneven-aged practices to favour climax species. Thinning in establishment and young forests can improve species' composition and growth rates.



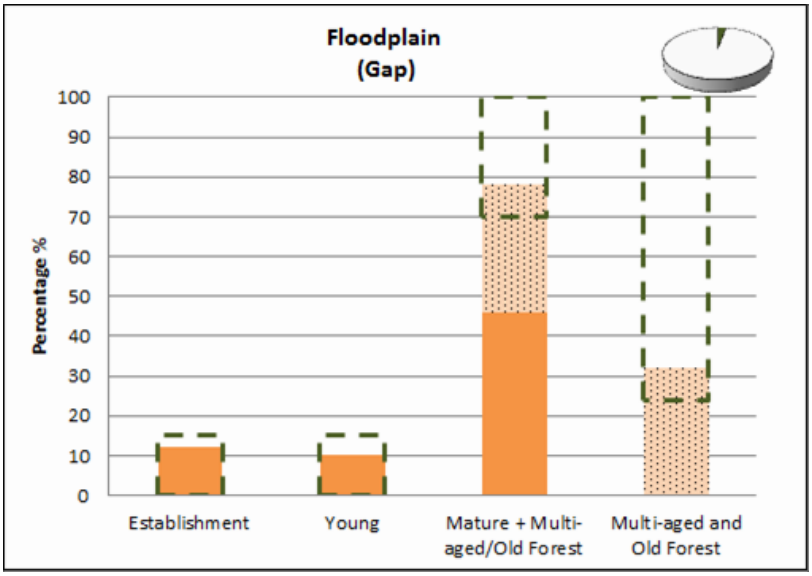
Forest inclusions in the **Marshlands and Grasslands** element are in balance with desired target levels for frequently disturbed forests. The small, localized areas of forest embedded in this element are sensitive to disturbance. Forest management opportunities may exist but are limited due to site conditions. Mature and multi-aged stands contain important wildlife habitat.



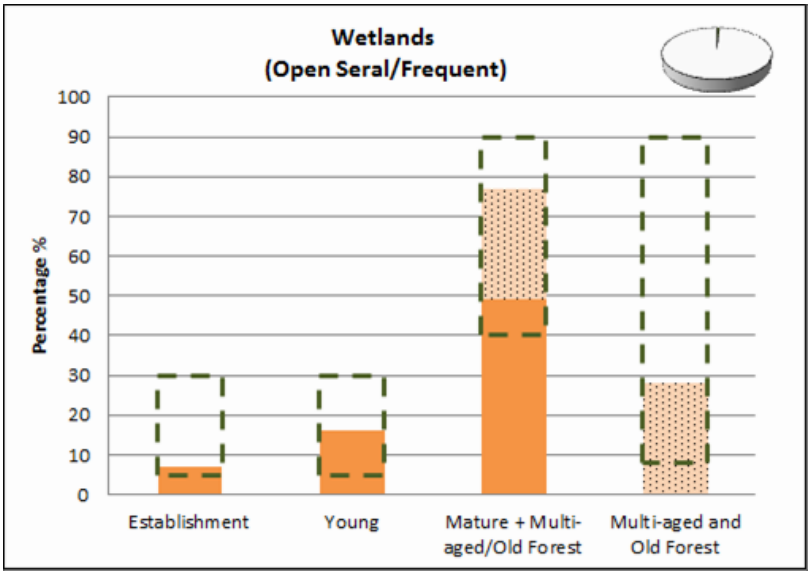
In **Spruce Pine Flats,** all the classes are within target ranges, with fairly high levels of mature and multi-aged forests. Natural disturbances are frequent in this forest and stand level management that favours establishment of an even-aged cohort of mixed early seral species is preferred. Disturbances typically retain abundant mature survivors, particularly pine, that provide seed trees and mature structure in developing stands.



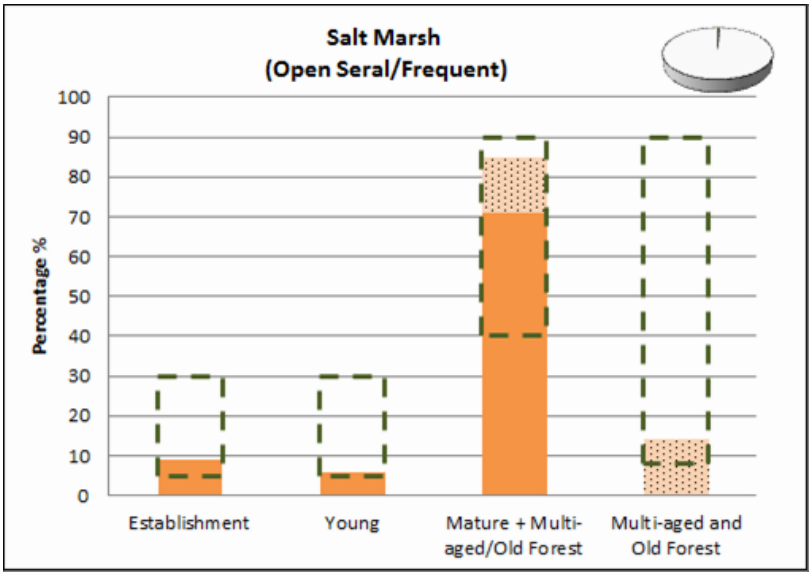
The **Floodplain** patch element occurs along the major rivers and is also a component of the Valley Corridors element. Floodplain features can also be embedded in the Oak Pine Flats and Wetlands elements. Due to significant human land use on the floodplains, mature and older forests are limited in size, extent, and distribution. Forest management practices that maintain forest climax conditions are preferred.



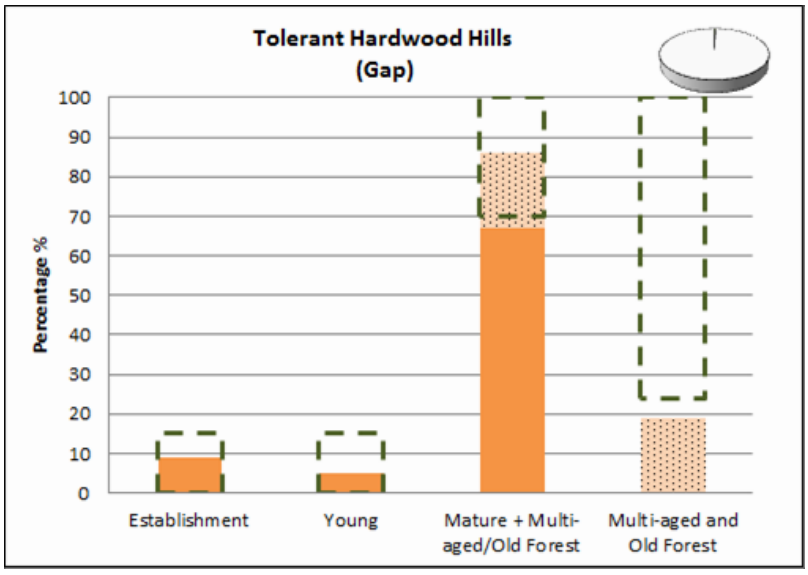
The **Wetlands** element is variably composed of forest, interspersed with woodlands and open wetlands. Disturbances are often patchy, reflecting the diverse structure. The relatively high amount of establishment and young may reflect height growth limitations in poor sites, as well as past harvesting. Some thinning opportunities may exist, as well as potential for small patch harvesting following natural boundaries.



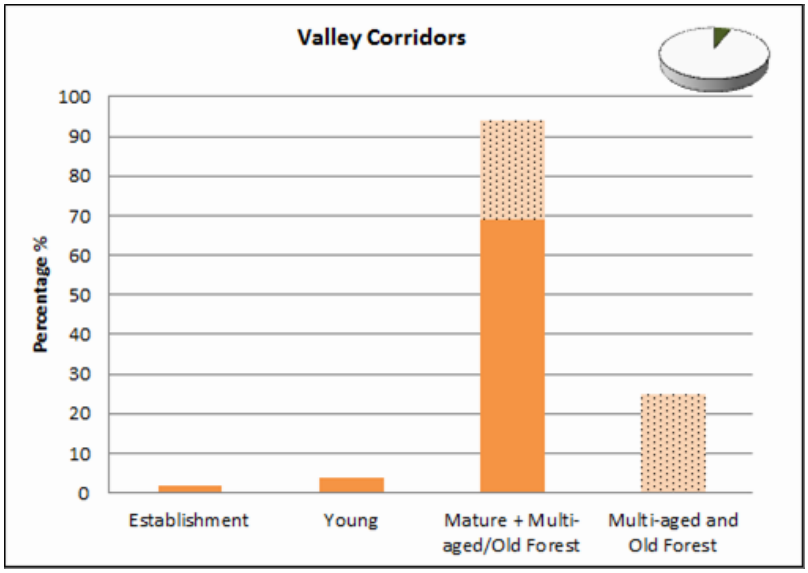
The small amount of forest embedded with the **Salt Marsh** element has a balance of development classes appropriate for frequent natural disturbance regime. This habitat provides important interface to the wetland ecosystems. Forestry operations should employ special practices to protect sensitive sites.



In the tiny **Tolerant Hardwood Hills** element, land use has reduced the late successional forest. 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 enhance late successional forests.



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.



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 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).