Conservation-Based Land Use Plan for the Walton Clay Plain

EPS 2007

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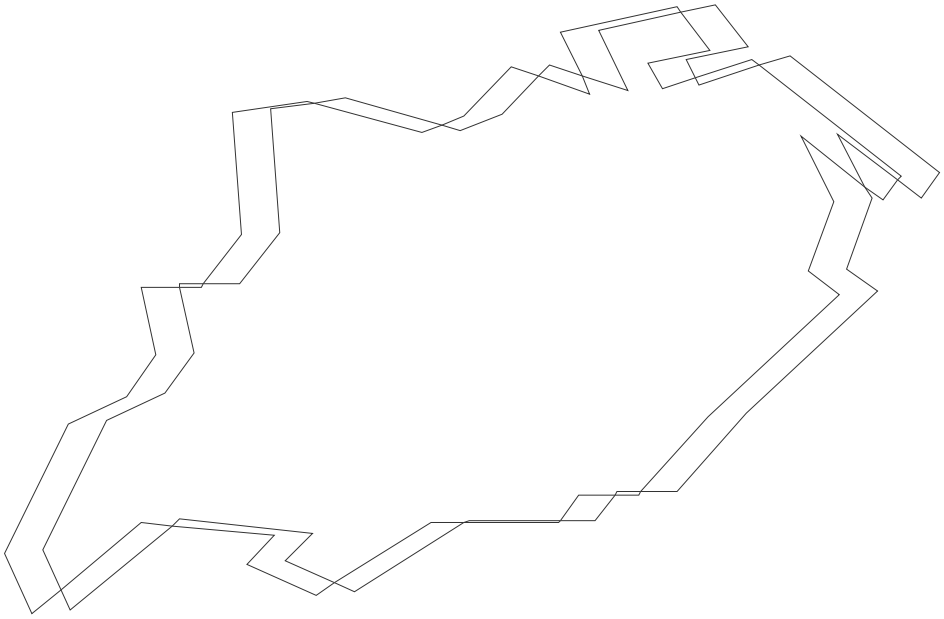

Environmental Planning Studio 2007
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Executive Summary

The Walton Clay Plain is an ecologically-diverse and hydrologically-complex landscape in northern Hants County, Nova Scotia. Current and future development pressures threaten landscape function and, along with the undervaluation of the natural features, create challenges to protecting the landscape. However, with the shift in landscape protection philosophy from a focus on aesthetic values to one based on ecosystem representation and landscape function, the Walton Clay Plain has become a strong candidate for protection.

The purpose of this project was to inform land use decisions regarding the protection of natural landscape values within the Walton Clay Plain. The objective was to identify areas most advantageous for protecting the natural structures and functions of the landscape, while maintaining the cultural values and addressing the need for landscape representation.

This project was completed using the environmental planning approach, including the environmental history, McHargian Overlay, Ecological Land Classification, and landscape ecology modelling techniques. The method involved three stages: inventory of landscape features; analysis of thematic inventories (resource use, recreation, hydrologic function, environmental values, disturbance); and synthesis of conservation values and cultural values to identify areas most advantageous for protection. From these stages, four conservation priority zones were delineated using manual overlay techniques and computerized geographic information systems. This project also identifies the opportunities and constraints for each conservation priority zone, and recommends implementation options for land protection and remediation measures for displaced land uses.

The results from this project provide the foundation for the multi-stakeholder negotiations that will develop a protected areas system for the Walton Clay Plain.

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1. CONTEXT

The Conservation-Based Land Use Plan for the Walton Clay Plain represents the 2007 Environmental Planning Studio (EPS) project at Dalhousie University's School of Planning. The overarching rationale for the project was to solve a challenging environmental problem while fulfilling a real community need. The Ecology Action Centre's Wilderness Committee was the client in support of this project.

The Ecology Action Centre approached the EPS for assistance in determining where it would be most advantageous to establish a protected area within an area known as the Walton Clay Plain, located in Hants County, Nova Scotia (see Figure 1, Appendix A). The Walton Clay Plain has been identified for conservation interest due to a landscape form that is unique in the province. This landscape is hydrologically rich, containing the headwaters of three major rivers, as well as many bogs, fens, and other wetland features. This clay plain and the rivers it supports provide habitat and landscape values that are not yet represented in the Province's formal mechanisms for natural areas protection.

The Walton Clay Plain and its river watersheds are also identified for conservation interest because much of the area is part of a provincial crown land assembly referred to as the Stanley Block. Crown Land areas are considered ideal locations for protected areas because of the many legal mechanisms on public lands to facilitate their establishment. However, this public land area also supports land allocations to large industrial users in forestry, mining and peat extraction in support of the provincial economy. Furthermore, as public land the area is heavily used by surrounding communities for recreation purposes.

Further context for this work is provided through understanding the general progression of conservation planning in the province of Nova Scotia. Conservation efforts initially formed through concern over the loss of pristine wilderness due to development pressure. Early development of conservation areas was often justified on an aesthetic and recreation basis. More recently, the field of conservation biology has expanded conservation approaches to include considerations of biodiversity and ecosystem function in protected areas planning. On this basis, representing the diversity of ecosystems present in Nova Scotia has become more of a priority over aesthetics alone. Within Nova Scotia, the Department of Environment and Labour's 1997 protected areas strategy aims to protect representative areas from each of the 80 different natural landscapes found in the province (NSDEL). As recently as 2007 the Provincial government also enacted the Environmental Goals and Sustainable Prosperity Act that commits to protecting 12 percent of the provincial land area by the year 2015.

This study necessitates a detailed assessment of environmental and cultural values. The work presented herein provides an analysis of these values, their opportunities and constraints, to identify areas of conservation priority as the primary building block for a new provincial protected area.

2. PROJECT BOUNDARIES

2.1 Goals and Objectives

The purpose of this project is to inform land use decisions for protecting natural landscape values within the Walton Clay Plain. The goal is to identify areas most advantageous for protecting natural processes (structure and function) and protecting natural heritage (representation).

Six major objectives have been to set achieve this goal:

+ *To identify and classify ecological structure and function of the study area*
+ *To understand hydrological structure and function of the study area*
+ *To identify cultural and resource values of the study area*
+ *To identify the policy frameworks governing the area*
+ *To assess natural resource and recreation land use demands*
+ *To overlay all landscape features to determine areas most amenable to conservation and make recommendations for implementation.*

2.2 Delineation of the Study Area

The study area landscape has been influenced and transformed by a historically glaciated environment and both natural and human-induced disturbances. The landscape is largely defined by a topography with little relief, complex river and wetland systems, several small lakes, and softwood dominated forests.

In order to best examine conservation goals and implications on this landscape, the study area boundary had to include an extensive area that represents many of the influencing features. These features represent a mixture of administrative, functional, and ecological boundaries. The study area boundary for this work includes the greatest extent of: the Walton Clay Plain (NSMNH 1997); Walton River Clay Plain Landscape (NSDEL 2002); the watershed boundaries of the Cogmagun, Walton and Tomcod Rivers, and the contiguous area of provincial Crown Land referred to as the Stanley Block (Figure 2, Appendix A). This boundary development is shown in Illustration 1.

The derived study area is a 41,530 hectare block bounded to the north by Highway 215 and the Minas Basin, Highway 354 to the east, the Kennetcook River to the south, and the Avon River to the west. The study area contains the communities of Tennycape, Walton, Summerville, Cogmagun, and Stanley. In the study of such an extensive area, inventory information had to be collected from data mapped at a variety of scales (1:10000, 1:25000, and 1:50000). Those inventories were combined and analyzed at a working scale of 1:50000, with a final scale set at 1:100000 for the effective summation of the work carried out. Collectively the landscape within this study area will hereafter be referred to as the Walton Clay Plain.

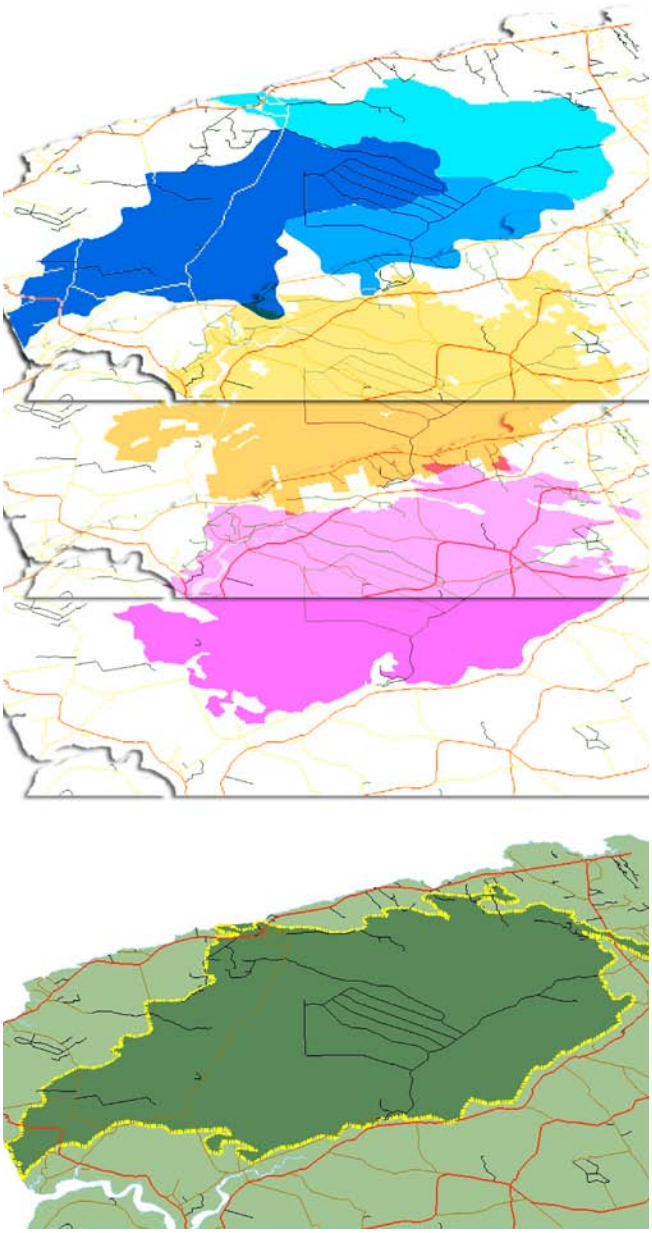
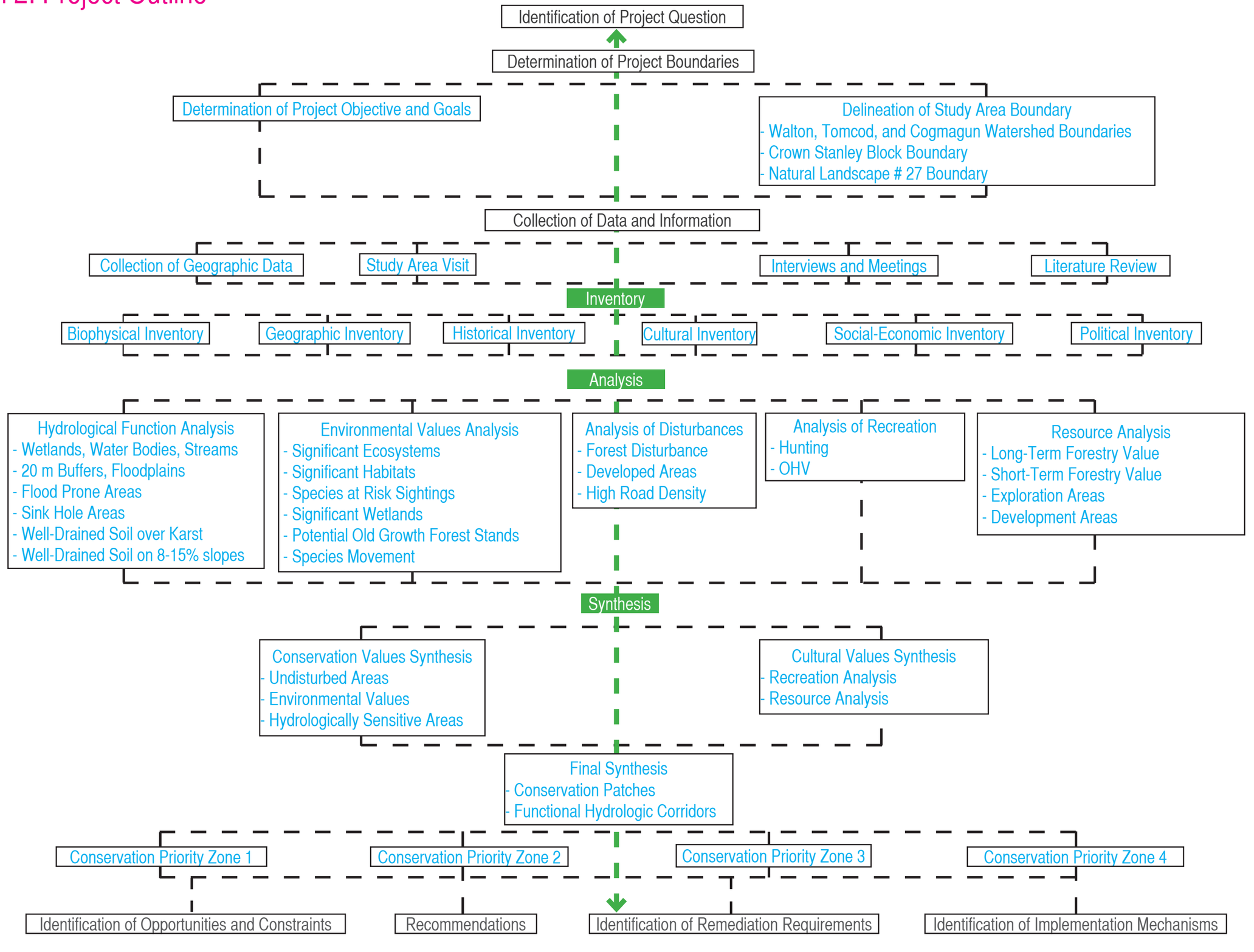


Illustration 1: Delineation of Study Area Boundary

Illustration 2: Project Outline



3. METHOD

Illustration 2 outlines our project tasks and method.

3.1 General Approach

The study was undertaken using an environmental planning approach. Environmental planning is the lens through which the protection of natural landscape values on the Walton Clay Plain was investigated. It is the basis for the project assumptions, values, and methods.

Environmental planning is a broad term applied to planning and management activities that focus on cultural, social, economic, and political factors within the context of environmental considerations (Marsh 2005). Within an environmental planning context a number of techniques were used in this project, including: environmental history, the McHargian Overlay method, ecological land classification, and landscape ecology modeling. Using a diversity of methods facilitated managing and communicating the large volume of information on the Walton Clay Plain needed to meet the project objectives.

3.1.1 Environmental History

Environmental history involves constructing a historical timeline and building an understanding of the landscape as it influences cultural, social, economic, political, and environmental events and changes. It identifies landscape change across multiple spatial scales, while characterizing the pattern of human activities over that period as they are reflected through the physical environment.

An environmental history was compiled for the study area as a primary inventory layer. Information for this section was collected from historical texts, documents, maps, and photographs at the Nova Scotia Archives and Records Management (NSARM) and the University of King's College library; websites managed by local historical societies and community organization; and an informal interview with a staff member of the Nova Scotia Department of Natural Resources (NSDNR).

3.1.2 McHargian Overlay

Ian L. McHarg, a landscape planner, founded and popularized the concept of integrating land uses with natural landscapes through an overlay mapping method. This method follows three stages: (1) environmental inventory; (2) analysis; and (3) synthesis and recommendations. Through this process, natural landscape features, such as soils, vegetation, and surface hydrology, are identified and mapped as discrete layers. This information can then be used to identify environmental opportunities and constraints and, thereby, inform land use decision-making. The method is referred to as the McHargian principles of opportunities and constraints mapping. Opportunities and constraints mapping is the evaluation of land uses that support the continued function of the natural environment (McHarg 1969; Marsh 2005).

In this project, the McHargian Overlay method was applied at the inventory, analysis, and synthesis stages. At the analysis stage, the information from the thematic inventories were combined into core analysis map layers. The synthesis stage integrated the five core analysis layers, hydrological, environmental values, recreation, resources, and disturbances, through an overlay method to determine the opportunities and constraints to protected areas establishment.

3.1.3 Ecological Land Classification

Ecological Land Classification (ELC) maps landscape features that can best provide an approximation of the spatial pattern of ecosystems at a variety of scales. ELC provides a description of the physical and biophysical environment affecting ecological structures and functions, and the biodiversity of ecosystems. It is used in Nova Scotia by the Department of Natural Resources to delineate physical landscape structure in a hierarchy of scale detail and homogeneity. The first order in the hierarchy is the ecozone, which is represented as vegetation at the global scale (1:1,000,000). The second order is the ecoregion, which is characterized by climate, soils, and vegetation groups at the continental scale (1:500,000). The third order is the ecodistrict, which is delineated as distinct groupings of topography, geology, soils and vegetation at the provincial scale (1:250,000). The fourth order is the ecosection, which is represented by repeating patterns of topography, soil and vegetation within ecodistricts at the landscape scale (1:50,000) (NSDNR 2003).

As one of the goals of protection in Nova Scotia is landscape representation, the results of the synthesis process were assessed using the ELC of the Walton Clay Plain to determine the level of representation achieved in each area.

3.1.4 Landscape Ecology Modeling

Landscape ecology modeling maps and interprets the structure and function of biophysical and cultural landscape elements (Darmstadt et al 1996; Gergel and Turner 2002). The landscape ecology model describes patterns in the landscape by organizing landscape features into three major structural elements: patches, corridors, and a matrix. The matrix is the most extensive and connected landscape element. It plays the dominant role in the function of the landscape. Patches are non-linear landscape elements embedded in the matrix, but which differ from this surrounding area in species composition and structure. Corridors are linear landscape elements that provide connectivity within the matrix, patch to matrix, and between patches. The organizational structure of these spatial elements influence the flow, exchange, and movement of species, energy, and materials across a landscape. These interactions define landscape function.

Landscape ecology modeling was used during the synthesis stage for the interpretation of the connectivity and functionality of environmental and cultural values. The modeling structure provided a basis for assessing the resulting mosaic of conservation priority patches derived from the synthesis process. Landscape ecology modeling was then used to determine the functional connection between identified conservation patches using hydrological corridors and their proximity-based aggregation to identify a matrix conservation values.

3.2 Information and Data Collection

The detailed information required to complete this study approach was collected through: a site visit; literature review of information specific to conservation-based planning; review of relevant municipal planning documents for East Hants and West Hants, and provincial protected areas legislation, policies, and strategies; informal interviews and consultation with provincial staff from NSDNR and NSDEL; informal interviews and discussions with community groups and organizations, such as local hunting associations and OHV groups; online discussion forums with community groups; and paper and digital maps.

3.3 Applied Method

Identifying, interpreting, and combining the many landscape features of the Walton Clay Plain, as well as addressing both environmental values and cultural values, required a multi-stage and non-linear method (Illustration 2). The project consisted of three majors stages of work: inventory, analysis, and synthesis. These three stages often overlapped with each other. For example, the inventories were refined as information gaps were identified in the analysis stage; analysis layers were also redesigned during the synthesis process to achieve the most effective consideration of values. Following these three stages, the results were assessed to identify the opportunities and constraints associated with each identified conservation priority area; determining the required extent of restoration; making recommendations for protection; and finding practical implementation strategies for the recommendations. It is also important to note that in the application of the method much of the work relied on the geographic information system capabilities provided by the ArcGIS software created by ESRI Ltd.

3.3.1 Inventory

The inventory stage involved McHargian Overlay and environmental history techniques. Information and data were collected, as discussed above, and assembled into thematic inventories, maps, feature descriptions, and charts. Thematic layers included: study area boundary, elevation, slope, bedrock geology, surficial geology, soils, general habitats, surficial hydrology, land use, and legislative jurisdictions. The information and data at this stage were compiled into a geographic information system (GIS) database for future mapping and analysis.

3.3.2 Analysis

In this stage, information and data from the thematic inventories were spatially analyzed, using McHargian Overlay methods on the GIS, and summarized into thematic layers that could be used in the synthesis process. Thematic layers included: resource values, recreation values, hydrological function, disturbance, and environmental values. The specific method used for each analysis is described in Chapter 8.

3.3.3 Synthesis

In this stage, the five major analysis layers were combined using the McHargian overlay method to produce three different syntheses: (1) environmental values synthesis; (2) cultural values synthesis; and (3) conservation priority zone synthesis. The syntheses were first created using manual overlay techniques, as a form of visual thinking to develop the method of combination that would best achieve the project goals. With the combination method established the analysis maps were converted to a raster grid in the GIS and overlaid, allowing each 1ha area of land to be assessed for its content of landscape attributes, allowing for an assignment of conservation value. A detailed description of this synthesis process is provided in Chapter 9.

4. ENVIRONMENTAL HISTORY

The study area presents a cultural heritage that evokes a landscape legacy cultivated by economic priorities. As residents move elsewhere, age, and find employment in sectors indirectly, rather than directly, tied to the land, the relationships between the local communities and the landscape are becoming less tangible and less prolific. Even so, the communities are sustaining the traces of their cultural interactions with nature through stories, tourist sites, built structures, and environmental management systems.

The modern landscape pattern arises from centuries of cultural interactions with the bedrock, till mantle, and soils; accessibility, first by water and then by road or trail; timber and peat extraction; and recreational activities. Historically, the area was occupied by the Mik'maqs and used for 'hunting and gathering' until the arrival of the Acadians around 1685, and later, of European settlers in the 1750s and 1760s. A significant number of Acadian villages were established around Windsor, and along the Avon and Kennetcook Rivers. Spatially, Acadian villages - Tennycape (Petite Riviere), Walton, Cheverie (Village des Chevarie), Summerville, and Cogmagun - still remain key components in the human structuring of the landscape. The Acadians capitalized on the extensive water resources and began developing extensive agricultural lands. Dykes were constructed to enable agricultural and economic development in the previously tidal-flooded zones at the mouths of the Walton and Cogmagun Rivers. Grazing land was maintained by intentionally burning the woodlands and wetland ecosystems. Burning regimes were sustained for nearly 200 years. As open-range practices fell out of favour, previously maintained disturbance patches slowly succeeded into forested areas (Mosher 1977a; Mosher 1977b; Mosher and Fox 1989).

Logging has been a persistent practice in the region, changing over time with local, regional, and global economies. Shifts in technology have also created substantial shifts in logging intensity during this history. Forestry activity has been much reduced in recent years within the study area due to ongoing salvage harvesting of forests damaged in other areas of the province during Hurricane Juan (September, 2003). Industrial scale forestry activity is, however, expected to recommence within the next ten years. Open-pit and underground mining of metals and minerals, such as gypsum, have also been a long-standing industry within this landscape. Oil was extracted from the late 1800s through to the 1940s. There is currently exploration being undertaken for natural gas deposits. Peat mining development began in 1987 in the McDonald Bog, and continues to this day. Traditionally, the study area has been one of the most hunted landscapes in Nova Scotia. This hunting pressure has generally been generated by residents from other counties, such as Halifax County, towards the deer population. However, due to demographic changes, and other cultural/social influences, the hunting pressure has decreased by 25 percent over the last 30 years.

5. BIOPHYSICAL INVENTORY

Maps illustrating the physical and biological attributes of the study area are provided in Appendix A.

5.1 Lay of the Land

The study area exhibits a predominantly flat terrain with only minor relief and undulating terrain at the study area boundaries. Elevations range from mean sea level to 115 metres above at the western end. Moderate slopes up to 15 percent are located along the valley walls of the major river systems. Figures 3 and 4 (Appendix A) illustrate the details of the elevation and slope pattern in the study area.

5.2 Landscape Materials

The underlying bedrock in the study area is early to late carboniferous sandstones and carbonates, such as gypsum and limestone (NSDEL 2002) (Figure 5, Appendix A). Fault lines divide theses bedrock formations and groups. Fluvial sandstone, siltstone, and shale of the Cumberland Group dominate the elevated lands in the centre and west of the Walton Clay Plain. The lowlands surrounding the Walton and Cogmagun rivers are dominated by gypsum, limestone, and mudstone. Sandstone and mudstone underlie a small portion of the study area to the north.

A blanket of fine textured till covers the landscape to depths of approximately 30 metres (Figure 6, Appendix A). Organic, alluvial, and marine deposits spread over the low-lying areas. The till plain contains silty and compact (clay) materials derived from both local and distant sources. A stony till is also present over parts of the landscape and is comprised of a sandy matrix derived from local bedrock sources.

Marine and alluvial material is located along the Walton, Tomcod, and Cogmagun rivers. Marine deposits consist of gravel, sand, silt, and clay and are overlain by peat (salt marshes). Alluvial deposits are composed of gravel, sand, and mud. Organic deposits of sphagnum peat over a clay substrate formed extensive peatlands in the region.

A poorly-drained soil loam (Queens) over clay loam derived from shale till dominates the landscape (Figure 7, Appendix A). Clay loams impede drainage and have a propensity for wetland formation. Other soils within the area are moderately- to well-drained. Organic soil peat (Castley) is extensive in the area – considerably more than what is found in the rest of the province.

5.3 The Living Landscape

The landscape of our study area is a complex of forest, wetland, and heathland communities (Figure 8, Appendix A). The uplands include various forest stands at different stages of ecological succession and some areas of barrens. The lowlands support freshwater wetlands dominated by peatlands: bogs, and fens. Marshes and swamps are uncommon in the lowlands, with the exception of estuarine areas which are dominated by salt marsh ecosystems. There are a few small lakes and an extensive network of streams that feed into the three watersheds of the Walton, Tomcod, and Cogmagun rivers.

5.3.1 Upland

Softwood Forest

Due to the flat terrain and poorly-drained clay soils in the study area, softwood forests constitute the majority of stand types. Larch forest communities grow in the nutrient-poor and water-logged soils. With improved drainage the forest composition tends toward a black spruce dominance, with a rare association of black spruce and red pine in some areas. Well-drained softwood sites are dominated by stands of red spruce, white pine, and hemlock. Current stand structure is highly influenced by the disturbance history, naturally an infrequent stand replacement pattern (stand replacing disturbance at an interval equal to or greater than the lifespan of the upper canopy species) with some variation caused by a human caused fire history (a probable cause for the black spruce and red pine association).

Mixed Forest

The abundance of mixed forest composition on most well drained sites in the study area is indicative of characteristic Acadian Forest conditions. Generally, these stands develop though a gap replacement disturbance pattern, rarely if ever experiencing full stand replacing disturbance. The forest structure in these areas tends to contain a mix of age classes growing at a variety of canopy layers. This structure fosters the growth of shade tolerant and long lived species of both hardwood and softwood. In this study area these include red spruce, white pine, hemlock, yellow birch, sugar maple, and red oak.

Hardwood Forest

Few pure hardwood stands grow in the study area due to the poor drainage of most soils. When present, late successional hardwood forests share a similar structural pattern as the mixed forest and mostly contain yellow birch, sugar maple, red oak, and some red maple. Within the study area there are also some mid-successional even-aged stands of hardwood, consisting of white birch, red maple, and red oak.

Successional Forest

Successional forests represent areas that are currently undergoing early stages of succession and have not yet formed a full structure. Species types vary, and data for these areas does not reflect the climatic or edaphic species types. Generally these areas are caused by recent stand replacing disturbance (human or natural), at the edges of lowland areas, or at the transitional zones between forest and barrens.

Barrens

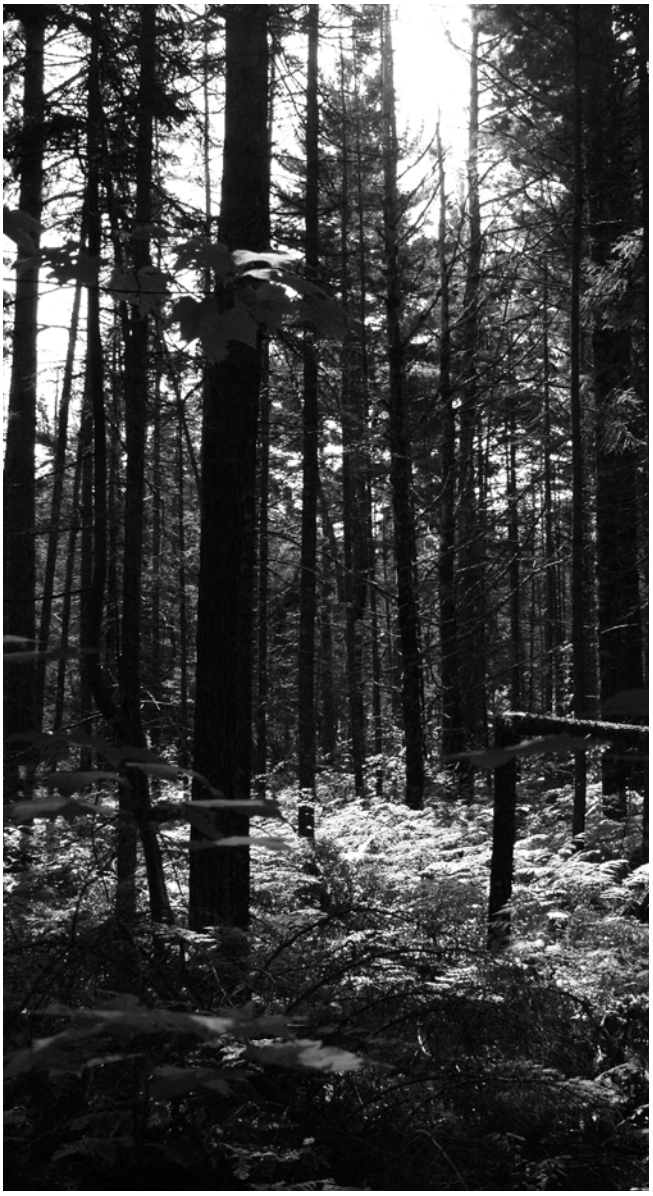
Barrens are areas of exposed bedrock with little or no soil cover. They are not treed, except in low areas between ridges. A white spruce, black spruce and balsam fir forest community inhabits the area between the ridges, with sphagnum mosses and ericaceous shrubs occupying the waterlogged bedrock pockets (NSMNH 1997). The barrens of this area likely originate from the persistent fires used to manage the landscape. They are degraded

environments, the result of soil decomposition and erosion.

5.3.2 Lowland

Coastal Estuaries

Estuaries form at the confluence of the Cogmagun and Walton Rivers with the Minas Basin. An estuarine environment fluxes with the change in tides and river flow. These areas lie on the periphery of the study area. The salt marshes in the area provide vital habitat for birds, fish, invertebrates, and mammals that come to marshes to feed.



Open Bogs

The landscape is wetland rich because of the poor drainage of the overburden soils and underlying glacial till. The large bogs in the study area are domed bogs, which means they have an elevated layer of living and non-living ericaceous shrubs and sphagnum mosses. Raised bogs are ombrotrophic; they have isolated regional groundwater flow and receive mineral input only from precipitation and organic decomposition (NWWG 1997). The smaller bogs of the area are basin bogs. Some of these bogs are alkaline due to calcic groundwater flow in the karst regions. Bogs are typically acidic because of limited nutrient sources. That makes the alkaline bogs of the area unusual.

Open water is also restricted to bog ponds on the large domed bogs, or adjacent depressions that are currently undergoing terrestrialization as the bog slowly pushes forward with its depositional force. The natural history of bog terrestrialization has most likely removed many open ponds from this landscape.

Treed Bogs

Many of the bogs found in the study area landscape are treed bogs, likely as a result of changing climatic conditions from when the bogs first formed many thousands of years ago (Almquist-Jacobson and Foster 1995). Black spruce and some larch grow on top of the peat deposits. The high water table still allows sphagnum and ericaceous shrubs to thrive in these areas. Many of the open bogs are wrapped by edges of treed bog habitat as these structures slowly dry out and facilitate the growth of forest communities.

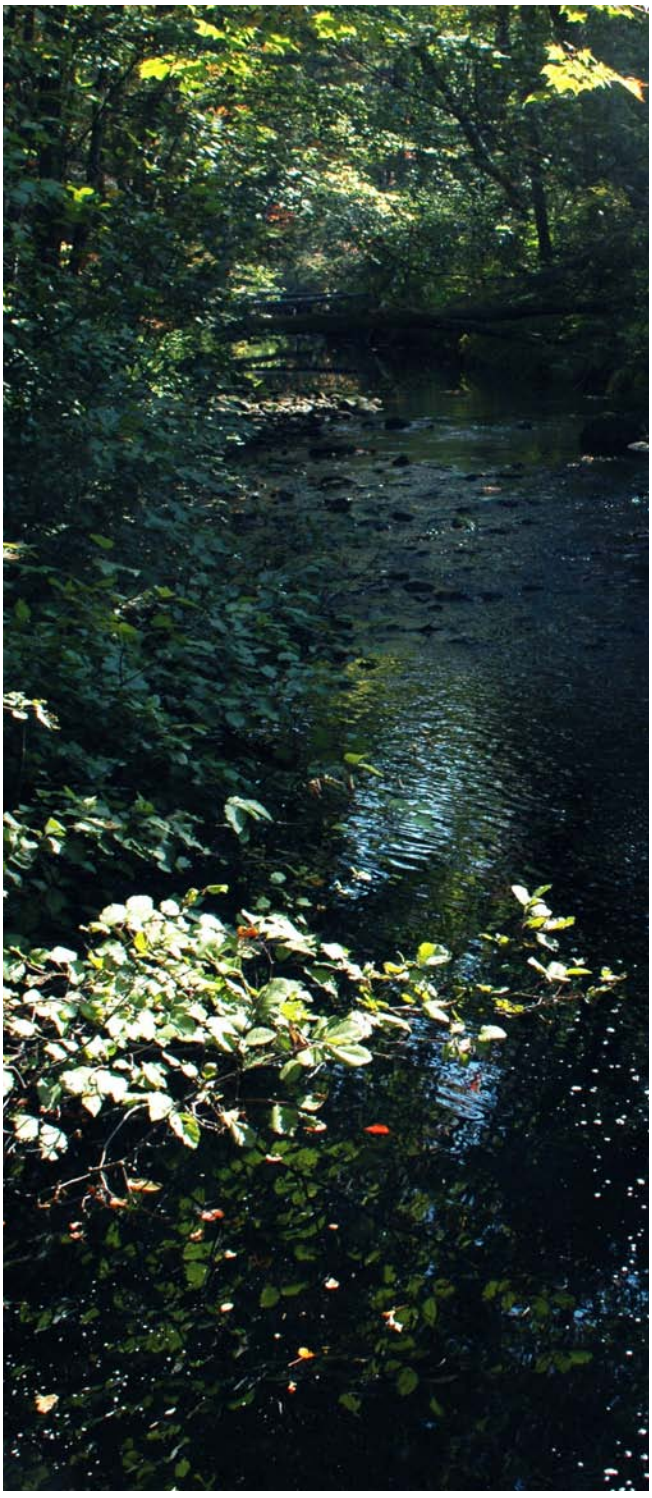
Fen

Fens have formed in the landscape where poor drainage prevents the quick passage of streams, or

where depressions encourage discharge and water accumulation. These habitats are minerotrophic (rich in dissolved minerals) and their water level fluctuates according to precipitation and groundwater changes (NWWG 1997). The plant communities that dominate fens are sedge grasses and brown peat moss (NWWG 1997). Poor decomposition in the high-acidity, waterlogged environment promotes the accumulation of organic material. Riparian fens are the dominant type that has developed in the study area. The influx of nutrients contributes to a wetland that supports relatively higher biodiversity than the ombrotrophic bog type.

Streams and Rivers

The streams and rivers of the area support a variety of fish species such as Redbelly Dace, White Sucker, and the introduced Brown Trout found in slow moving streams. Brook Trout, Atlantic Salmon, Common Shiner, White Suckers and Yellow Perch are found in the faster flowing streams in the area (Province of Nova Scotia 1996).



5.4 Hydrology

When rain falls in Walton Clay Plain, the water hits the top organic surface layer of the soil, and quickly infiltrates. However, as much of the area is overlain with clay-based soil, the water flows down to this relatively impervious layer and is held back from migrating any lower in the strata. This process raises the water table, and, depending on the amount of rainfall and topography of a specific location, results in waterlogging of the organic soil layer. As clay holds back the water vertically, it is thus forced laterally, and this movement over time has produced areas of discharge. At the landscape level, a dense, dentritic drainage pattern of streams exemplifies this historical hydrological evolution. Since much of the

area has flat slopes (less than 3% grade), the water has time to pool in shallow basins. Since the last glaciation, water filled some of these flat areas formed as lakes, and eventually filled as bogs when peat moss grew quickly in the cool, wet climate.

Today, very little surface water still remains, but the remains of those past water bodies can be seen in the many large, expansive bogs throughout the area, such as the MacDonald, Petite, and Colins bogs. These structures hold large amounts of water, however little water exchanges between the top living layer, and the more dense, dead peat moss layer below. Since they do cover such a large area of the watershed, the bogs act as rain catchments, and serve as vital recharge areas, forming the headwaters of the Walton, Tomcod and Cogmagun rivers in the Walton Clay Plain. In addition, their absorption capacity allows bogs to hold precipitation after large rainfalls, thus slowing the movement of water over the landscape, in turn preventing erosion, and stabilizing the magnitude of river flow over time.

Clay based tills do not underlay the entire study area. In the north and west, this fact is significant as carboniferous limestones and gypsums form the bedrock – structures prone to karst formation. With limited clay soil to impede drainage to the lower bedrock, water can flow through, and erode over time through the bedrock, forming deep, fast-moving ground water flow. Sink holes have appeared along the western carboniferous seam, and signify areas where surface water flows directly connect to the groundwater with little filtration, thus leaving ground water flows sensitive to the activities at the terrestrial level. In these areas, alkaline wetlands have grown out of areas of poor drainage and calcareous (calcium based) ground water flow.

Since the Walton Clay Plain has adapted over time to the high concentration of water at its surface and subsurface layers, the landscape remains sensitive to

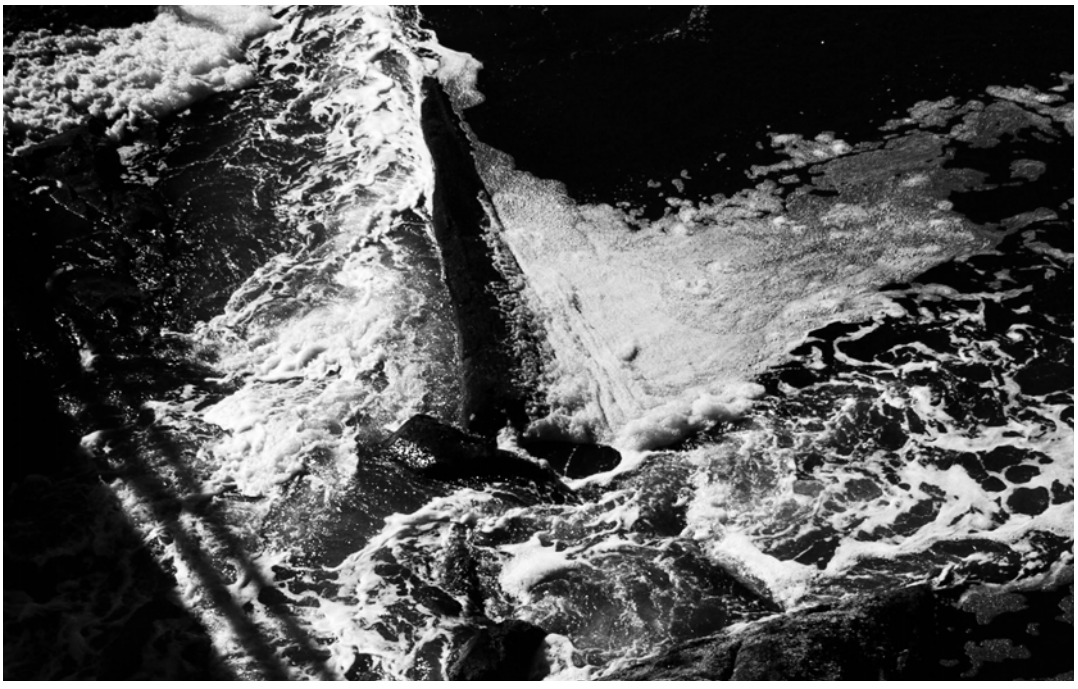
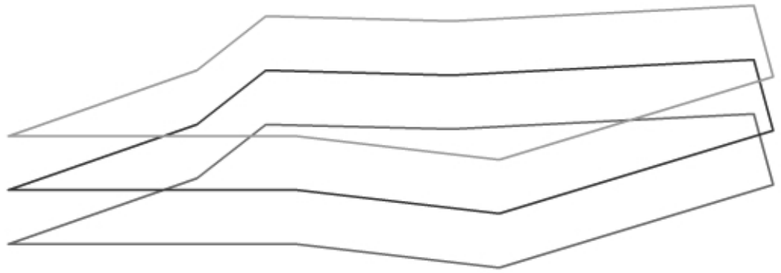


Illustration 3: Hydrological Inventory

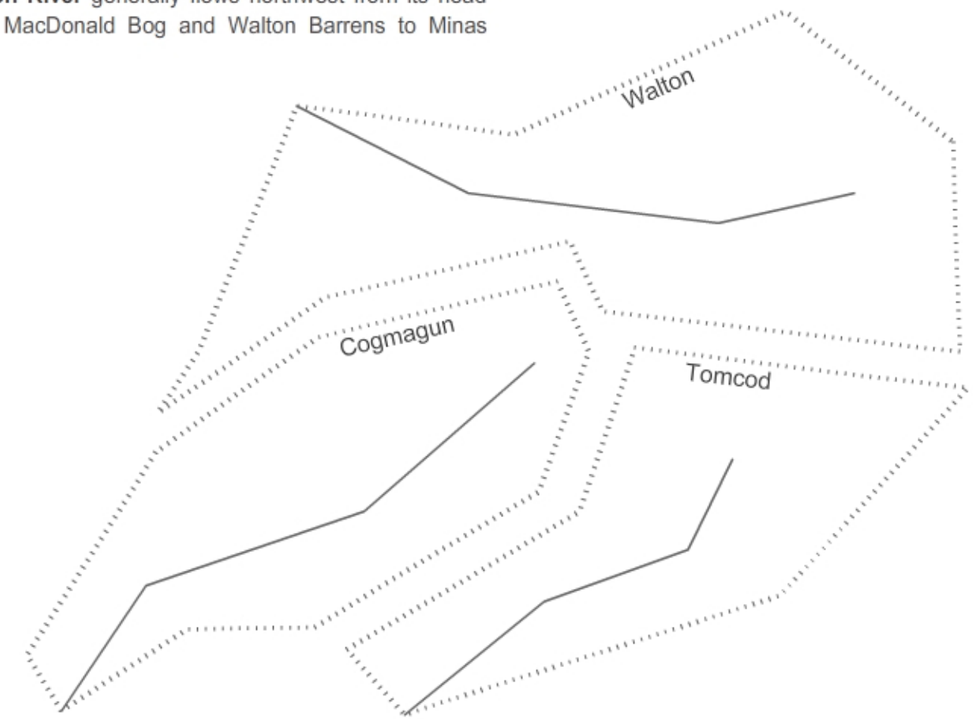
Precipitation / Climatic Regime

1000mm per annum, 130+ days of snow cover, wet springs and summers, drier falls and winters. Cold winter and warm summer. (The Province of Nova Scotia, 1996)

Waterflow / Watersheds



The **Walton River** generally flows northwest from its head waters in MacDonald Bog and Walton Barrens to Minas Basin.



The **Cogmagun River** generally flows southwest from its head waters in Petite Bog and The Barrens, to Avon River.

The **Tomcod River** generally flows southwest from its head waters in MacDonald Bog to the Kennecook River, then to Avon River.

Geological and Soil Factoring

The study area straddles geological formations of limestone/gypsum and sandstone. The soluble subterrainian karst promotes active waterflow, resulting in discharge areas at areas of depressions. Conversely, the sandstone coupled with the clay based soil of the region forms a relatively impermeable layer that provides less infiltration of water, supports a high watertable, and increases overland flux. As these factors are combined with the flat landform, a flood prone and waterlogged landscape forms with slow waterflow, and dendritic stream network and numerous wetlands.

Bog / Wetland Factoring

The largest wetlands in the area are domed bogs. These wetlands function as broad catchment structures for the watershed. However, little ground water exchanges between them and the hummocky terrain on their periphery. They are significancant as they buffer flow and hold recent precipitation in the top zone of biologiical accumulation and growth Due to past succession of domed bogs into land, few open water bodies remain in the landscape.

Unlike the domed bogs, the basin bogs and riparian fens of the study area filter and buffer flow from outside their bounds. These recieve runoff from the higher outlying hills, purifying water through sedimentation and biological filtering. These bogs and fens are also areas of discharge for calcareous groundwater flow from the karst topography.

changes in the hydrological regime. The wetlands, streams, water bodies and ground water features all serve some function to the water that flows through, over, or past them. Further, these hydrological features have given rise to significant habitats, and any change in the water cycle will also impact the ecology too. Figure 9 (Appendix A) illustrates the hydrologic features of the study area.

5.4.1 Watersheds

The study area can be largely divided into three distinct watersheds: Walton River, Tomcod River, and Cogmagun River (see Illustration 3). While each of these watersheds exhibits unique biophysical features, drains its own tributaries and main river, and varies greatly in area, they are all major contributors to the study area's hydrologic regime. The catchment geology, micro-climatic conditions, vegetation types, and landscape changes associated with each of the rivers and their tributaries dictate the character of the local freshwater ecosystems and are, in turn, essential to our overall understanding of the entire study area.

6. LAND USE INVENTORY

6.1 The Human Landscape

The Walton Clay Plain was used historically as wild pasture, cleared by uncontrolled burning. Poor soil conditions generally prevented the successful development of other forms of agriculture in this area. Mining activities opened access to inland areas with the construction of roads. These roads were then used for the expansion of forestry activities during the last 50 years. While many of these past land uses have diminished or been abandoned, forestry has grown into the dominant land use in the study area.

Settlement occurs near the periphery of the Walton Clay Plain at or near the coast or in the river valleys mostly represented

by the villages of Walton, Summerville, and Cogmagun. Agriculture is confined to the major valleys and is mainly pasture for cattle. There is one small area of blueberry harvesting (12 hectares near the Stanley airport at the study area periphery), and an expanding area of peat mining on one of the bogs. There are 24 abandoned mine heads near Walton. The current land use pattern has been mapped on Figure 10 (Appendix A).

6.2 Recreation

An extended community enjoys a wide variety of outdoor recreational activities in the study area. These activities are mostly comprised of hunting, fishing, and Off-Highway Vehicle (OHV) use.

6.2.1 Hunting and Fishing

Brook Trout found in the major watercourses of the Tomcod, Cogmagun, and Walton Rivers attract anglers to the study area. Hunting is the most significant recreation activity in the area, mostly focused on white tail deer. This study area is one of the most hunted regions of Nova Scotia, with forty-three percent of all deer hunting allocations in the province assigned to this area. There are two factors that influence this high level of hunting, the area is open to non local hunters (NSDNR 2007), and the abundant deer population due to the dominance of young vegetation structures on the landscape. Deer are currently so populous that the Nova Scotia Department of Natural Resources increased hunting allocations by 25 percent from 2006 to 2007 (NSDNR 2007).

6.2.2 Off-Highway Vehicle (OHV) Use

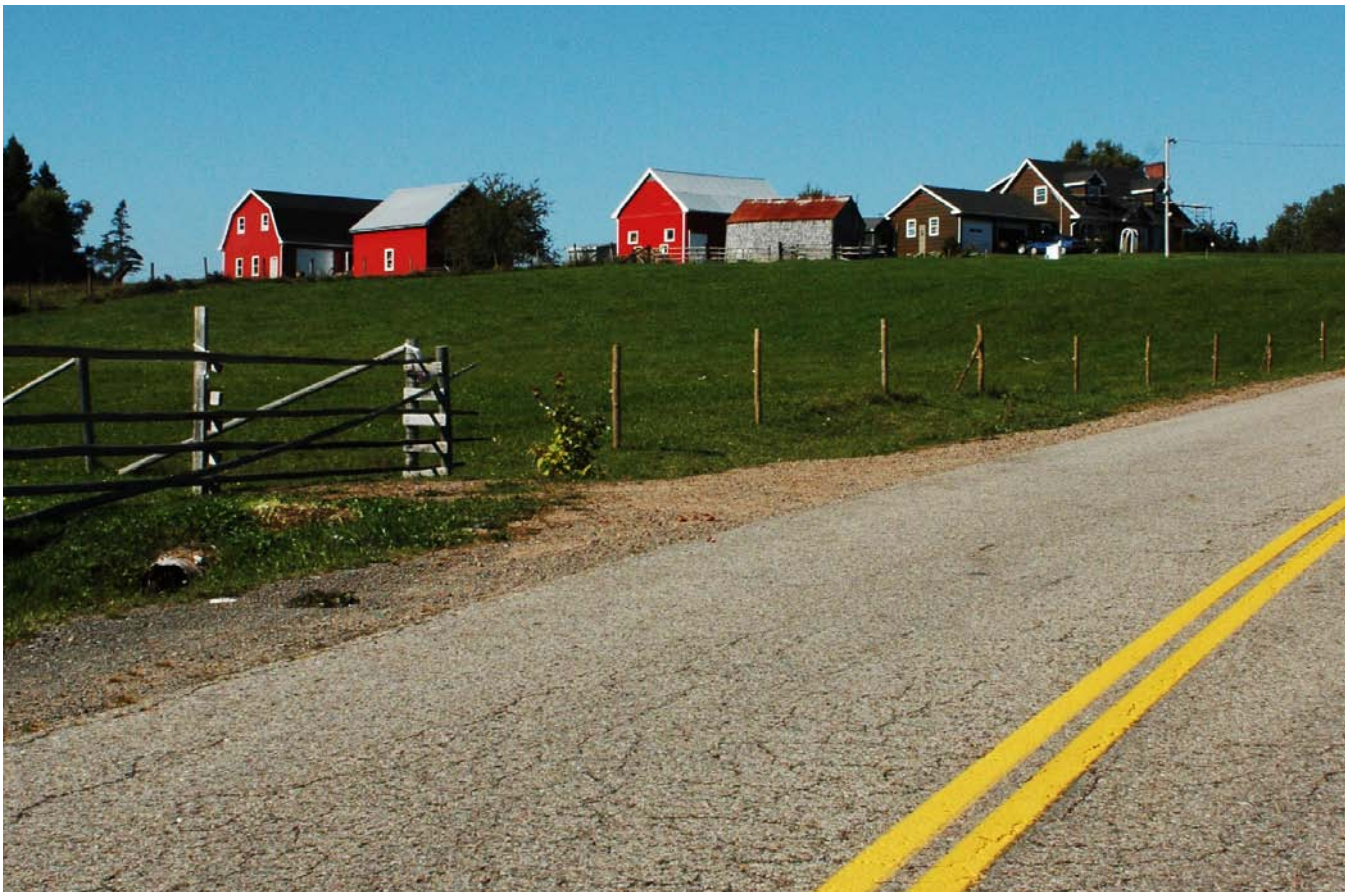
Off-Highway Vehicle is a generic term used to describe off-road vehicles such as dirt bikes, snowmobiles, and all-terrain vehicles (ATV), designed for cross-country travel and recreation. OHV use in Hants County is largely centred in the Stanley Block and interviews with conservation officials (Bonar 2007) confirm an increase in the frequency of use in the area over the last couple of years in spite of new robust provincial legislation restricting OHV use to authorized trails. The spatial extent of OHV use in the study area is relatively confined to a network of loose roads in the centre of the Stanley Block. OHV recreation is also known to occur on some of the local roads and cart roads in the area.

7. LEGISLATIVE INVENTORY

The study area contains many levels of political boundaries, leading to overlapping legislative authority and consideration. Much of the land base exists within an area of crown land managed primarily by the Nova Scotia Department of Natural Resources. This crown land block is also bisected into an area under the jurisdiction of the Municipality of East Hants and an area under the jurisdiction of the Municipality of the District of West Hants (Figure 11, Appendix A). Each of these levels of land governance, provincial and municipal, contribute legislative considerations to land use in the study area.

7.1 Provincial Jurisdiction

The province of Nova Scotia is committed to protecting representative examples of its natural history throughout the province. This protection comes in the form of



Wilderness Areas, Nature Reserves and Provincial Parks. In 1992, the government of Nova Scotia formally committed to completing a comprehensive system of parks and protected areas that represent Nova Scotia's landscape diversity through the Sustainable Development Strategy for Nova Scotia. More recently, the government of Nova Scotia passed legislation stating that 12 percent of the Province's total land mass will be legally protected by the year 2015 under the 2007 Environmental Goals and Sustainable Prosperity Act. Currently, 8.1 percent of the land mass of Nova Scotia, or approximately 447,870 hectares, is protected in the Province.

Two provincial departments are responsible for identifying and protecting special areas in Nova Scotia: the Department of Environment and Labor and the Department of Natural Resources.

7.1.1 Department of Environment and Labor

The Protected Areas Branch of the Department of Environment and Labour (DEL) has a mandate to protect the natural heritage of Nova Scotia. More specifically, this department is responsible for establishing and managing a comprehensive protected areas system through the creation of Wilderness Areas and Nature Reserves. These protected areas are designated under the Wilderness Areas Protection Act and the Special Places Protection Act, respectively.

The DEL administers Nova Scotia's Protected Areas Strategy to achieve the overarching goals of the Province to protect 12 percent of the total land mass of the province.

Protected Areas Strategy

In order to complete effective protected areas planning, the DEL has delineated and recognizes 80 natural landscape regions throughout the province as part of the Protected Areas Strategy. Within this strategy, protection may occur in one or more areas of a landscape and include one or more of the ecosystem features found in that landscape. The aim of the program is to protect groups of entire ecosystems within Natural Landscapes in order to protect natural processes which occur within and between ecosystems. The Department of Environment and Labour (DEL) is the lead provincial department with respect to protected areas and describes a natural landscape as "a mosaic of different but interacting ecosystems that are repeated in a similar pattern to form a distinct and definable land unit or area. A recent report (DeGooyer 2006) identified only 28 (35 percent) of these landscapes regions as having a "satisfactory" or a "near satisfactory" level of protection, leaving the remaining 52 (65 percent) natural landscapes with little or no protected area status, including the Walton Clay Plain.

Wilderness Areas

These areas are designated under the Wilderness Areas Protection Act. They are generally large in size with an aim to protecting biodiversity and providing opportunity for wilderness recreation. Wilderness Areas protect representative examples of Nova Scotia's natural landscapes, as well as native biological diversity, and outstanding natural features. The general uses for Wilderness Areas include scientific research, education, recreation and nature-tourism related activities.

Nature Reserves

The Special Places Protection Act enables the Province to protect areas of archeological and historical significance, as well as areas of ecological significance. Ecologically significant areas may include those with rare or endangered species, areas which are representative of natural ecosystems, and areas which are regenerating

after human impact and offer an opportunity to study the natural recovery of ecosystems.

7.1.2 Department of Natural Resources (DNR)

The Department of Natural Resources's (DNR) Parks and Recreation Division has a mandate to provide opportunities for outdoor recreation; however, through the Provincial Parks Act, the DNR can set aside natural areas for the purpose of preserving significant aspects of the natural environment. Provincial Parks tend to be smaller in size and allow more intensive uses than Wilderness Areas. In certain circumstances these two designations are used together to both protect natural spaces and provide human access an area. Provincial parks make user access possible by allowing infrastructre such as roads, parking, camp and picnic grounds, and washroom facilities, which are not permitted in Wilderness Areas.

7.2 Municipal Jurisdiction

Planning and development decisions at the municipal level can have a significant impact on the health and function of the natural environment within a community. The policies guiding decision-making processes can also have a significant influence on the condition of the natural environment. The study area for this project falls within the legislative jurisdiction of both the Municipality of East Hants and the Municipality of the District of West Hants. Much of land within the study area is Provincial Crown land, and therefore not subject to municipal land-use controls or policies. Municipal legislation applicable to private land within the study area is considered when identifying municipal policies that facilitate conservation of ecologic integrity, hydrological function, and the preservation of socio-economic values of the area.

7.2.1 Municipal Policy

Municipal Planning Strategies are statements of policy outlining a community's vision for the future of the physical environment. They serve to guide long-range decision-making, act as the basis for formulating secondary policies, and assist planning staff and officials in reviewing and evaluating day-to-day physical development matters. Statements of policy also serve

to secure compliance and communicate with officials, citizens, and developers the hopes and expectations of council and the citizens they represent. The two municipalities in which the Walton Clay Plain lies possess different policies and supporting bylaws that reflect the vision each community has for the future of the environment. These differences pose challenges for implementation of a conservation-based plan. Any proposed plan will need to bridge the often-conflicting visions and policies of both constituent municipalities.

7.2.2 Planning Policy

The East Hants Official Community Plan recognizes the complex ways in which social, economical, and physical forces impact the physical environment, as reflected through the various policies and regulations. Municipal policy statements relevant to conservation objectives of this project are found in Appendix B.

In 2001, the Planning Department of the Municipality of the District of West Hants began merging the four separate Municipal Planning Strategies (MPS) of Area 2, Area 3, Upper Falmouth, and Falmouth into a unified Community Plan, all in an attempt to create a single comprehensive and consistent document. Presently the municipality is in the final stages of policy updates with the release of the third draft of the Municipal Planning Strategy in the Spring of 2007. This draft is presently being reviewed and amended in community consultations and is scheduled to go in front of Council

for adoption in the winter of 2007. The draft Municipal Planning Strategy uses a controlled development approach in an attempt to achieve a settlement pattern that efficiently accommodates a variety of land uses in a compatible and environmentally-sensitive manner. Appendix B provides a list of municipal policy statements that meet preservation and conservation objectives of the project.

7.2.3 Development Control

The Walton Clay Plain Study area is not zoned within the Land Use Bylaw of the Official Community Plan of the Municipality of East Hants. As such, there are very minimal standards and regulations governing permitted uses within the study area. The study area is subject to general land-use control provisions in Chapter 4 of the Land Use Bylaw; however, these regulations do not consider specific environmental opportunities and constraints, limiting the policies that can be drawn upon for conservation and preservation initiatives.

The Walton Clay Plain study area is zoned General Resource (GR) within the Land Use Bylaw of the Municipality of the District of West Hants. While the Municipal Planning Strategy states that one of the general goals of the plan is to "promote the protection of the natural environment, watercourses and environmentally sensitive areas through land use controls and setback requirements" (Municipality of the District of West Hants 2007), the General Resource (GR) designation has been assigned to all residual lands outside the Growth Centres, Villages, and Hamlets which are not designated for agricultural use. This designation makes no specific consideration for site specific environmental opportunities or constraints. As such, there are few land-use controls and setback requirements that can be drawn upon to meet conservation objectives.

8. ANALYSIS

Following the collection of inventory data, a map based spatial analysis summarized the data into thematic layers used for landscape level decision-making. The thematic layers created were resource value (Figure 12, Appendix A), recreation (Figure 13, Appendix A), hydrologic function (Figure 14, Appendix A), environmental value (Figure 15, Appendix A), and landscape disturbance (Figure 16, Appendix A). The specific method used for each analysis layer is described below.

8.1 Resource Value

The land uses identified in the inventory are displayed in combination with an analysis of resource values within the study area to provide a spatial representation of constraints to protected areas for this landscape (Figure 12, Appendix A). The resources analysis was carried out using the data provided in the forestry inventory database provided by the Department of Natural Resources, mining license areas mapping, and peat resource mapping. Mining and peat uses have been displayed based on their existing locations, while forestry uses have been analyzed based on the planning horizon in which direct economic value could be extracted from the landscape (Table 1). This resources analysis is meant not as a quantification of values, but rather as a prediction of where resource uses may constrain or conflict with protected area development. The intended use of this analysis is to determine what locations can be explored for conservation goals with minimal impact on the resource values of this landscape.

Table 1: Analysis Criteria for Resource Uses

Forestry Value	**Criteria**	**Explanation**
Long Term	Site capability greater than or equal to $5m^3/ha$	Land capability thresholds are used to represent the value of areas for continuous forestry activities. The land capability will determine how quickly stands will regenerate following a harvest or respond to silviculture treatments[1]. The remaining criteria are set as those areas with poor access or high sensitivity to disturbance that would not be suitable for long term and repeated forestry operations.
	Excluding areas of poorly-drained soil	
	Excluding fine-textured soils and imperfect drainage on flat topography	
	Excluding wetlands or dykelands	
	Undeveloped area	
	Outside 20m watercourse buffer	
Short Term	Areas with a standing volume of greater than or equal to $90m^3/ha$	These areas represent locations of accessible timber volume, available for harvest within the next 20 years. These volumes provide one of the most direct measures of the opportunity cost of creating a protected area for this study site. Soil conditions influence short term values through restricted access or high risk of environmental damage.
	Are at a maturity class that would be merchantable within 20 years	
	Excluding poorly-drained areas	
	Excluding inaccessible areas	
	Undeveloped areas	
	Outside 20m watercourse buffer	
Mining Value	**Criteria**	**Explanation**
Exploration Areas	Existence of crown land license for claims, exploration, or development	License areas represent active interest in mineral resources. The area coverage is not representative of areas that may be required for mining activities.[2]
Peat Resource	**Criteria**	**Explanation**
Development Areas	Peat bogs undergoing active development or under development license	Peat bogs identified through remotely-sensed data and a site visit as those undergoing active peat harvesting,[3] as well as peat bog areas known to be under crown land license for peat extraction.[4]

Figure 12 (Appendix A) illustrates the results of this analysis as a spatial pattern of opportunities and constraints for any protected areas efforts. While not traditionally viewed as a high value forestry area, the study area does contain substantial current timber volume and large areas of long term potential for forestry activity. Mining exploration has a heavy concentration in two distinct sections of the study area.

While these mining uses can not be considered direct conflicts, as the likelihood of future development in any of the exploration areas is unknown, they do indicate potential constraints. The peat extraction area shown on the map corresponds to a leased development area, the removal of which for protected areas would have serious economic implications.

8.2 Recreation

The recreation analysis, illustrated in Figure 13 (Appendix A), assesses the spatial extent of recreation uses within the Walton Clay Plain study area. Research, interviews, and a site visit revealed that there are two main recreational activities in the Walton Clay Plain, hunting and off highway vehicle use. In this analysis layer these primary activities were weighted and mapped individually according to criteria derived from interviews and the academic literature. Both uses were then combined into a unified map layer to represent the spatial pattern of recreational values within the study area.

8.2.1 Hunting

While hunting for species such as grouse, pheasant, and waterfowl occurs to a marginal degree, this analysis limits the scope of investigation to the hunting of ungulates such as white-tailed deer (*Odocoileus virginianus*), which is the most hunted species within the study area.[5,6]

8.2.2 Off Highway Vehicle (OHV) Use

The recreation analysis also assessed the spatial extent of Off-Highway Vehicle (OHV) use within the Walton Clay Plain study area. OHV is a generic term used to describe off-road vehicles such as dirt bikes, snowmobiles, and all-terrain vehicles (ATV), designed for cross-country travel and recreation. OHV use is considered as one of the most culturally valued recreational activities by local residents and visitors within the study area.[10, 11] While legislation exists under the Off Highway Vehicle Act,[12] to limit OHV use in wetlands and environmentally sensitive areas and to centralize recreational snowmobiling to provincial designated trails,[13] provisions limiting the distribution of ATV and dirt bike remains largely absent in the province. OHV use is largely limited to ATV use within the study area, therefore this analysis relied on field observations and personal interviews with Department of National Resources (DNR) representatives[14, 15] to identify areas of ATV use.

8.2.3 Combined Recreation Value

The combined recreation value provides an analysis revealing the locations of concentrated recreational uses. These locations were highly clustered at the center of the study area. This area is characterized by a series of loose roads north of the Stanley Airfield forming a looped trail network. Other areas of high recreational value, but of lower intensity, include the northeast corner, and the northwesterly limit of the study area. The nature of these primary recreations uses is not compatible with some forms of land protection; however, these forms of recreation provide one of the strongest cultural values to stakeholders in the region. For these reasons, the recreational values identified in this analysis play a key role in the synthesis process determining potential protected areas.

Table 2: Analysis Criteria for Hunting Recreation

Recreation Value	Score	Criteria	Explanation
Hunting	2	Local Roads, Loose Roads, and Highway	Hunting is one of the most culturally valued recreational activities within the Walton Clay Plain. Distance from public roadways has shown to be inversely related to hunter density, and as such is one of the most effective ways to identify high levels of hunting potential.[7] As such, a buffer distance of 860 m from local roads, loose roads and highways was used to identify areas with the most probable occurrence of hunting activity based on a study[8] which showed this distance to be the average maximum distance traveled from roadways by hunters of white-tailed deer. Wetlands abutting the 860 m buffer from local roads, loose roads and highways were also considered, as these areas support rich populations of white-tailed deer that are grazing and/or watering.
	1	Local Roads, Loose Roads, and Highway	Research has shown that hunter density is inversely related to slope and distance from roads.[9] Considering the vast majority of study area is flat, slope cannot be considered a deterrent to hunting in the area. As such all areas accessible by foot outside a buffer distance of 860 m from local roads, loose roads and highways are considered to be areas of possible hunting activity.
	0	Waterbodies	These areas are considered to be unlikely to impossible locations of hunting activity because they are inaccessible to hunters by foot, OHV, and other motorized land vehicles.

Table 3: Analysis Criteria for OHV Recreation

Recreation Value	Score	Criteria	Explanation
OHV Use	2	Local Roads, Loose Roads, and Cart Roads	The distribution of OHV use within the study area is largely limited to ATV use, which is largely unregulated under provincial legislation.[16] As such, a personal interview[17] with the local conservation officer was conducted to identify the preferred areas for ATV use within the study area.
	1	Local Roads, Loose Roads, and Cart Roads	The distribution of OHV use in the study area is largely determined by the availability of roaded areas and trail systems with width adequate to support vehicles such as ATVs.[18] Two-way ATV trail requires a minimum width of 3.66 m to ensure rider safety.[19] Therefore, all roads outside the preferred area with adequate width are considered in this category.
	0	Local Roads, Loose Roads, and Cart Roads	These areas are considered to be unlikely locations of OHV activity because they are inaccessible to ATVs. That is, these areas are not roaded or are impassable.
		Waterbodies	

8.3 Hydrological Function

Figure 14 (Appendix A) illustrates the spatial extent of hydrologically sensitive areas within the Walton Clay Plain. In an effort to maintain the ecological and hydrological landscape of the Walton Clay Plain, certain hydrological features must be conserved. Two levels of hydrological sensitivity were established and mapped for terrestrial, aquatic and wetland forms. Areas of high sensitivity were identified as those easily altered by land uses, impacting stream characteristics, such as water quality, quantity (ground water flow, stream flow, flooding) and biotic activities. The second level identified areas where disturbance would affect local hydrology, with less impact on the watershed as a whole. The following chart outlines and provides the criteria for this sensitivity analysis.

8.4 Environmental Values

This analysis illustrates ecological values within the Walton Clay Plain study area. The feature types studied include potential old growth forest stands, significant ecosystems, significant habitats, species at risk sightings, and significant wetlands (Table 5). The ranking systems used were based on scientifically established criteria that either came with the data or were taken from the scientific literature (Figure 15, Appendix A).

Table 4: Analysis Criteria for Hydrological Features

Landscape Function	Score	Criteria	Explanation
Hydrology	High	Wetlands	Wetlands act as discharge / recharge zones for ground water flow.[20] They also purify / treat water, positively influencing the quality of water flow. Large bogs typically form the headwaters of watersheds and buffer water flow. Wetlands slow and hold water, preventing and mitigating flooding and drought conditions.[21] Nova Scotia plans to adopt a 'no net loss of wetlands' regulation in 2009 under the Environmental Goals and Sustainable Prosperity Act.[22]
		Water courses	Water courses channel water and drain the surficial landscape.[23] They also act as recharge / discharge zones for ground water reservoirs; provide significant habitat; as well as flood paths in high precipitation events.[24]
		Riparian zones (20 m water course buffers) [25]	Vegetation in these zones filter and slow water as it runs into the stream body, and provide an area of water absorption during periods of flooding. The thick root systems of vegetation prevent erosion from stream flow. [26]
		Floodplains	Floodplains are flat areas along stream networks.
		Water bodies	Water bodies hold water; prevent/mitigate flooding and drought; and act as recharge / discharge zones for ground water reservoirs.
		Sink hole areas	Sink holes are surface features formed after sub-terrainean karst structures collapse. Flowing surface water can directly stream into sink holes and the fluid groundwater system, with little time for filtering or purification by biological or physical processes.[27]
		Well-drained soil on karst topography	Well-drained soil allows water to quickly infiltrate their strata. When karst underlies this type of soil, surface water may quickly flow from surface to groundwater networks without significant treatment of water quality.[28]
	Moderate	Well-drained soil on 8-15% slopes	Well-drained soils on moderate slopes erode quickly in heavy precipitation events.[29]
		Flood prone areas (0-3% slope)	Flood prone areas are natural resting place for water during flood events.[30] Disturbance in these areas may affect the ability of the stream and outlying flood plain areas to absorb water flow, prevent erosion and sedimentation of the stream.[31]

Table 5: Analysis Criteria for Environmental Values

Ecological Features	Criteria	Explanation
Significant Ecosystems	Ecosystem type (based on vegetation, topography, and geology)	The Nova Scotia Department of Environment and Labour have compiled a database of provincially significant ecosystems. These ecosystems were chosen based on their level of rarity within the province as well as their ability to support biodiversity and in some cases, rare species.[32]
Significant Habitats	Habitat type	This data was compiled by the Nova Scotia Department of Natural Resources to identify significant habitats.[33] They include: - sites where species at risk or other species of conservation concern can be found; and/or - sites where unusually large concentrations of wildlife occur; and/or - habitats that are rare in the province.
Species at Risk Sightings[33]	ACCDC Provincial Rank 1 and 2 (extremely rare or rare)	The Atlantic Canada Conservation Data Centre identifies these as sightings of species that are extremely rare or rare throughout their range in the province (20 or fewer occurrences or few remaining individuals).
	ACCDC Provincial Rank 3 (uncommon)	The Atlantic Canada Conservation Data Centre identifies these as sightings of species that are uncommon throughout their range in the province, or found only in a restricted range, even if abundant in at some locations (21 to 100 occurrences).
Significant Wetlands	Size, fertility, open water vegetation, and vegetation structure	This data is based on the 1970's wetlands inventory undertaken by the Nova Scotia Department of Natural Resources.[35] The wetlands were asses on their ability to support biodiversity. The identified areas represent freshwater wetlands that have high local wildlife value or outstanding wildlife potential. These wetlands should be protected from development.

Table 5 continued: Analysis Criteria for Environmental Values

Ecological Features	Criteria	Explanation
Potential Old Growth Stands	Age: Greater than 150 years old or classified as 'all aged'	These conditions correspond to the old growth forest characteristics in the Acadian Forest as present the local forest compostion.[36] Criteria are selected based on known characteristics that can be analyzed within currently available inventory data.[37]
	Structure: Multi-layered canopy	
	Height: Greater than 17m	
	Species: Red Spruce, Red/Black Spruce, Tolerant Hardwood, White Pine	
	Viable Patches: Areas that meet at least 3 of the above conditions and are greater than or equal to 10ha; areas that meet all the above conditions regardless of size; areas that are within 50m of a 10ha+ viable patch.	
Movement	Topography, wind patterns	Movement on the landscape is largely influenced by topography and wind patterns.[38] Movement occurs within valleys and along ridges. The dominant southwesterly winds influence movement by affecting the dispersal of plants and insects.

Table 6: Analysis Criteria for Disturbance

Disturbance	Criteria	Explanation
Forest Disturbance	All areas classified as clearcut	Because the natural successional development in the study leads to forest cover, any non-forest areas are considered disturbed.[39] The other criteria describe conditions that indicate a recent disturbance or disturbance intensity that would limit ecosystem function.[40]
	All areas classified in regeneration stage	
Developed Areas	Agricultural areas, urbanized areas, and mining areas	
High Road Density	Road density at greater than or equal to 3km/km^2	

8.5 Disturbance

An analysis of the spatial distribution of disturbance within the study area, illustrated in Figure 16 (Appendix A), was carried out for two primary purposes. Disturbed areas, although capable of undergoing a successional restoration, do not generally provide a strong foundation for conservation areas. Conservation goals are more successfully achieved through the protection of undisturbed areas as a core, which can then be expanded to include previously disturbed areas.[38] In addition, when determining implementation criteria for a protected area the amount of habitat that must be restored, either through active remediation or natural succession, will be a significant factor in the implementation strategy.

9. SYNTHESIS

To determine the most advantageous locations for protected areas, the five major analysis layers from Chapter 8 were combined using the overlay process described in the Methods section of the report. Each analysis results guided the consideration of high conservation values and the cultural values that may conflict with protected area development. To effectively make this consideration, the analysis layers were refined into intermediate stage synthesis maps. The first synthesis, representing conservation values, included the combination of the environmental values analysis layer, hydrologically sensitive areas from the hydrology analysis, and undisturbed areas from the disturbance analysis (including an additional exclusion zone of 600m from any major road due to edge effects). This environmental synthesis layer was developed on a raster grid of 1ha cells in the GIS. The second intermediate synthesis was the combination of the recreation analysis layer with the resource analysis layer into a cultural values synthesis. Because of the nature of the resource and recreation uses in the study area, their spatial pattern is complimentary. In this way, the cultural values synthesis represents the constraint to the protection of conservation values. This second layer was also developed on a raster grid of 1ha cells in the GIS. With both intermediate synthesis layers on the same raster grid structure they could be directly compared regardless of the many different input information boundaries. Each of the raster layers contained cell attribute codes that could be used to identify all the

input values existing in that 1ha cell area.

With a consistent grid established for the two intermediate synthesis layers, one representing opportunities (environmental synthesis) and one representing constraints (cultural values synthesis), and information depth maintained in each raster cell a final overlay could be carried out. Using a direct comparison of the depth of value on each layer of the overlay, cells could be allocated to either conservation or cultural uses, depending on which was greater. This overlay process has been illustrated in Table 7 below and Illustration 4-6.

The output from this synthesis was a mosaic of patches containing high conservation value. To determine the areas most advantageous for protection these patches had to be aggregated and linked into a more contiguous pattern. Because hydrology exerts such a strong influence on ecological function in the study area, major hydrological corridors were used as linkages between patches. Following this connecting process any patches that were within one hundred metres of another were aggregated into one larger area. The combination of patches, through the function corridors of hydrology and aggregation by proximity, established areas considered to have a matrix of conservation value. A boundary was then drawn around these areas based on the cluster of conservation values, with additional edges created to separate areas at major roads or watershed divides. The final result of this synthesis process was the identification of four distinct conservation priority zones, illustrated in Figure 18 (Appendix A).

Illustration 4: Combination rules used for synthesis

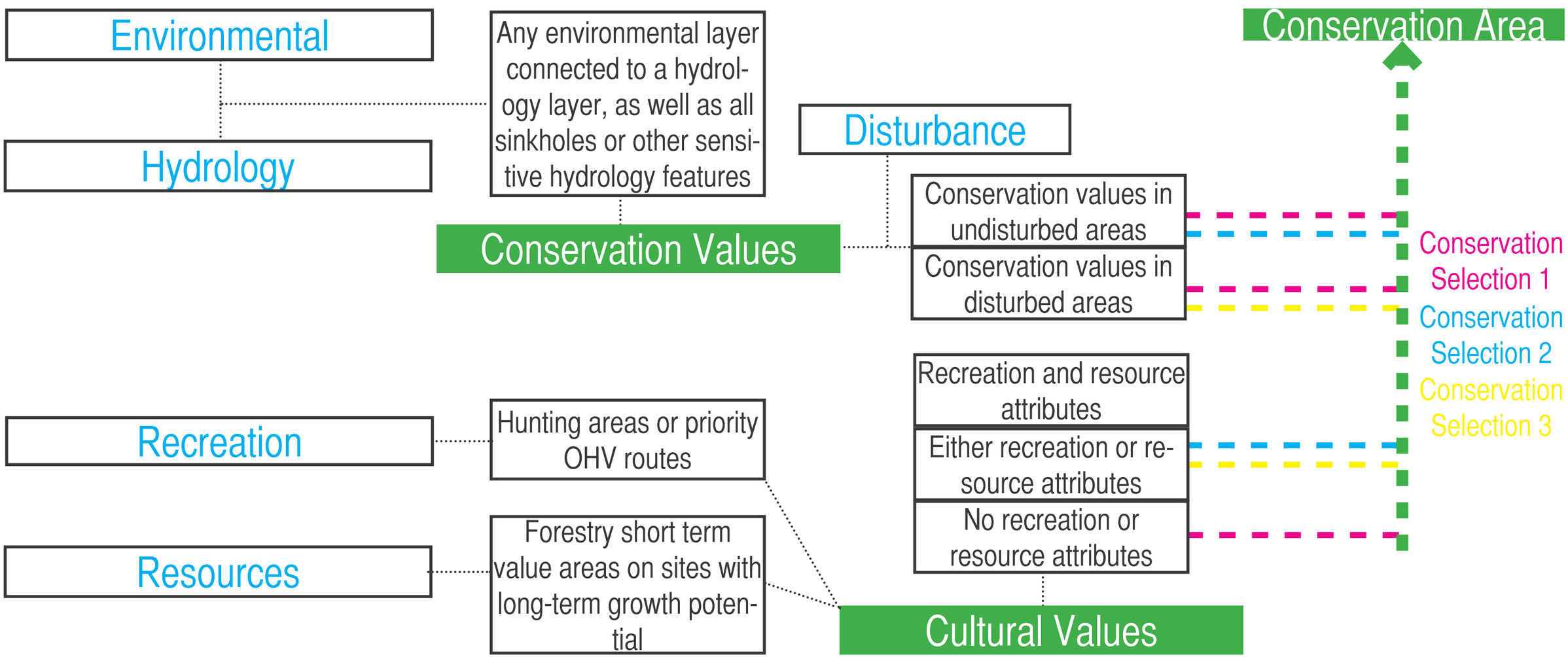


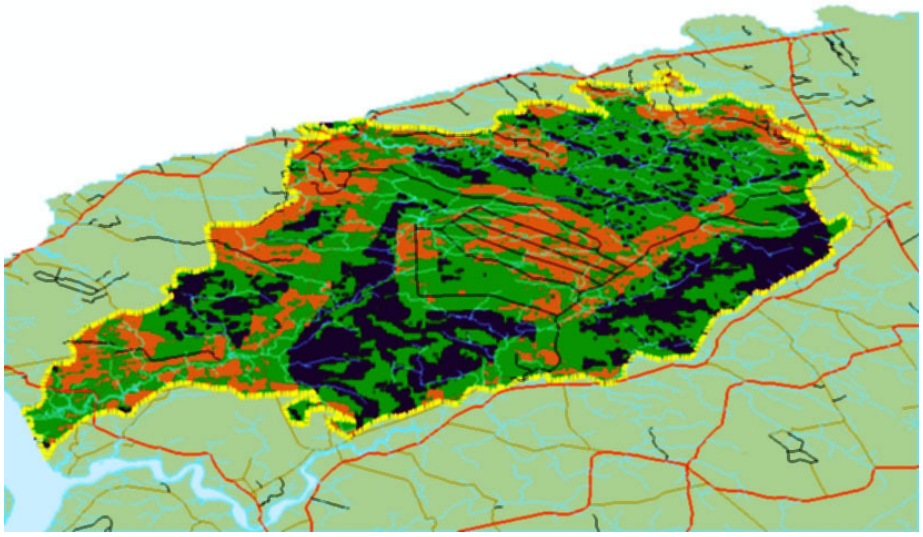
Illustration 4: Cultural Values Synthesis

Cultural Values

recreational analsyis

and

resource analysis

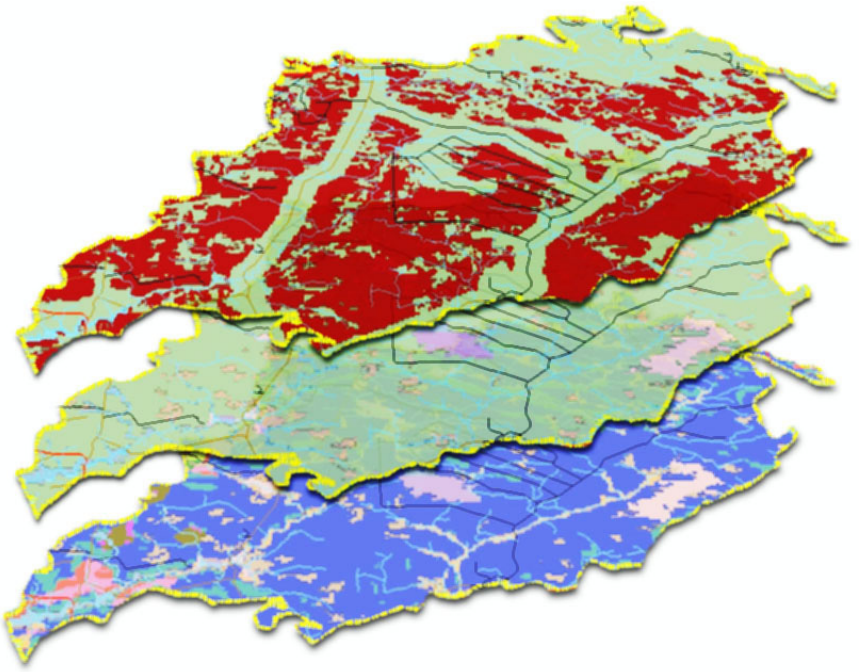


result:

cultural values synthesis

Illustration 5: Conservation Values Synthesis

Environmental Values



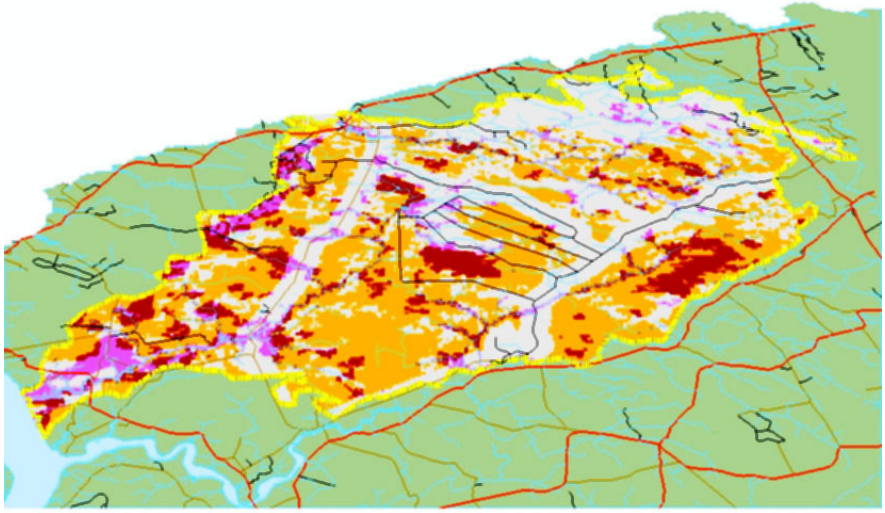
undisturbed areas

and

environmental values

and

hydrologically sensitive areas



result:

environmental values synthesis

Illustration 6: Final Synthesis

Final Synthesis

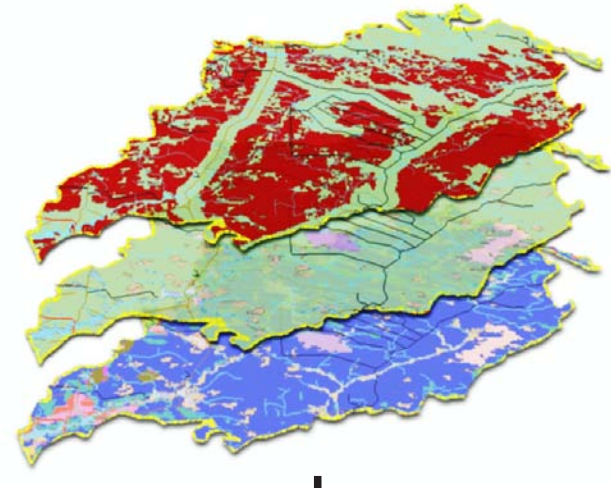
recreational value

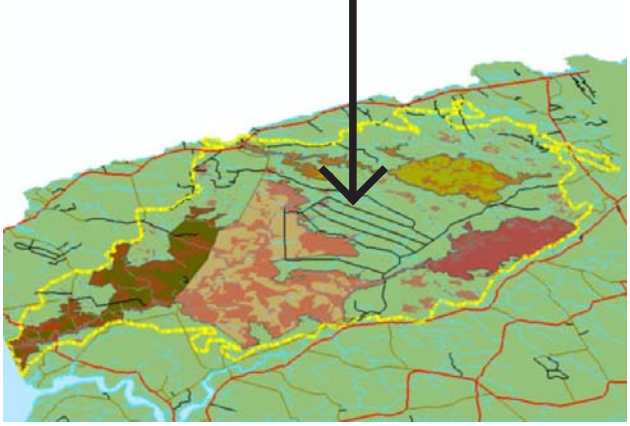
resource value

undisturbed areas

ecological value

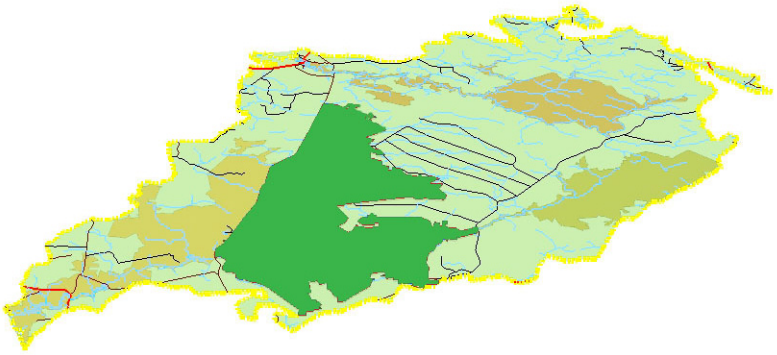
hydrological value





result:

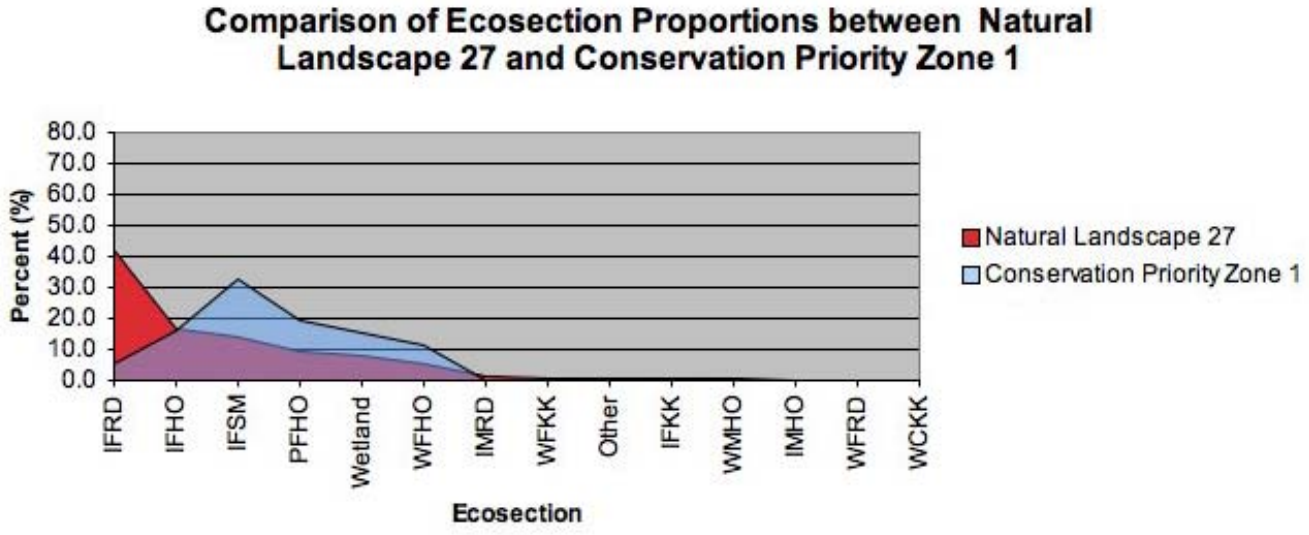
4 conservation priority zones



9.1 Conservation Priority Zone 1

Conservation Priority Zone 1 is the largest of the four zones at 7298 ha representing 18 percent of the study area. This zone is bound on the west by Walton Woods Road and extends eastward to the central network of logging and recreational roads (Figure 18, Appendix A). The dominant ecosections found in this zone include 32 percent imperfectly drained, fine textured soils on flat terrain (IFSM) and 30 percent imperfectly and poorly drained, fine textured soils on hummocky terrain (IFHO and PFHO). Wetlands make up 15 percent of this zone.

Conservation Priority Zone 1 captures 59 percent of the representative ecosection distribution in Natural Landscape 27 (as seen in the red/blue overlap of Graph 1). A comparison between the distribution of ecosections found within Conservation Priority Zone 1 and Landscape 27 reveals an overall shortfall of 41 percent (red portion with no blue overlap). This shortfall is largely made up of imperfectly drained, fine textured soils on ridges (IFRD); imperfectly drained, medium textured soils on ridges (IMRD); and imperfectly drained, fine textured soils on hills (IFKK). Surpluses of 41 percent (blue portion), emanating from imperfectly



Graph 1: Representation Comparison for Conservation Priority Zone 1

drained, fine textured soils on flat terrain (IFSM); poorly drained, fined textured soils on hummocky terrain (PFHO); wetlands; and well drained, fine textured soils on hummocky terrain (WFHO) was also found. Graph 1 illustrates this comparison between Conservation Priority Zone 1 and Natural Landscape 27. A detailed explanation

9.1.1 Opportunities

The large size of this zone allows for the protection of the greatest contiguous area. The relatively round shape allows for less edge and more interior habitat.

Zone 1 incorporates a high concentration of environmental values, including numerous significant ecosystems, patches of potential old growth forest, and two high value wetlands. More than two-thirds of the rare species sightings within the landscape (19 of 25) occur within this zone. Of particular importance is the inclusion of Petite Bog, which is both a high value wetland and an area of significant habitat. This zone also incorporates the headwaters of the Cogmagun River, the protection of which would ensure the quality and quantity of water downstream where there are many environmental values present. This zone has no conflict with peat extraction or mining exploration.

9.1.2 Constraints

The area contained within Conservation Priority Zone 1, if protected, represents an 8 percent (1694 ha) loss of long-term forestry operational area. Fifteen percent (305,680 m3) of the short-term timber volume would also be lost. This loss in timber value translates to an economic impact on the forestry companies that operate in this area. However, given the size of the zone and the conservation values contained in it, these losses do not outweigh its conservation priority status.

Potential conflict within this zone also exists with recreational users. One road that connects to the central road network used for recreation is within this zone. In order to protect the many environmental values, recreational uses would have to be directed away from this road. The decommissioning of this road would have minimal impact on the primary recreation area located on the central road network identified in the recreational analysis section.

Another constraint to protecting land within this zone is that 22 percent (1642 ha) of the land is in a disturbed condition. This disturbance is largely influenced by previous forestry activity and almost 38km of logging roads within the zone.

9.1.3 Recommendations

Core protected area

The large size of this zone represents an opportunity to protect many environmental values as well as a hydrologically functional landscape. While some timber value would be lost with the protection of this zone, the concentration of environmental values within this zone, its large contiguous area with many interior forest habitats, outweigh these losses. Overall, the conflicts in land uses within this zone are easily mitigated and the priority given to environmental values can be justified.

9.1.4 Remediation

Restore clear-cut areas and cart roads

The large number of disturbance patches and previously used logging access roads should be left to naturally succeed and re-incorporate into the forest matrix. This form of restoration is possible because these areas are already in early stages of succession and, if left alone, will succeed naturally. The areas of more recent disturbance

are surrounded by the forest matrix which will provide the seed source needed for natural reforestation.

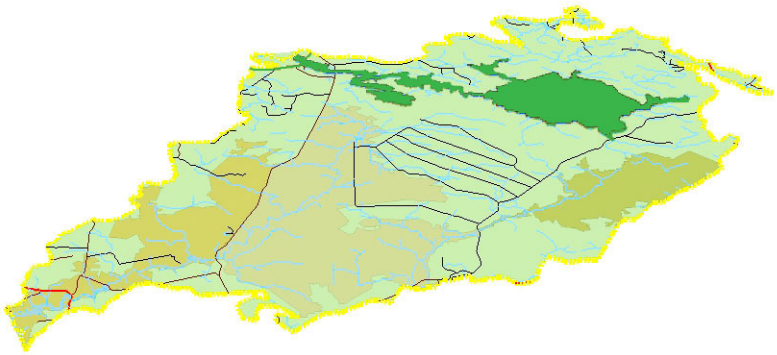
Decommission road

The western branch of the central road network used by loggers and recreational users must be decommissioned in order to protect the many environmental values located adjacent to this road. The decommissioning of this road will not affect the ability of recreational users to access the main road network.

9.1.5 Implementation

Wilderness Area Protection Act

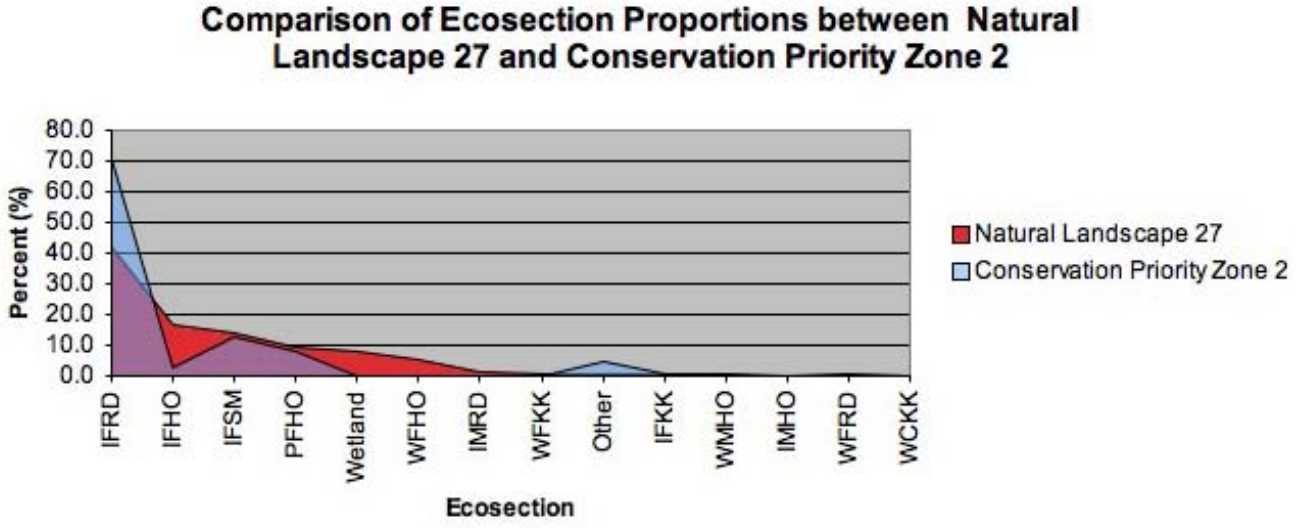
This legislation facilitates the creation of Wilderness Areas for the purpose of landscape representation, maintenance and restoration of natural process and biodiversity, and protection of rare, unique natural features and phenomena (Government of Nova Scotia 1998). It is recommended that a Wilderness Protected Area is created in Conservation Priority Zone 1 because of its large size, connected habitats, and the presence of multiple environmental values.



9.2 Conservation Priority Zone 2

Conservation Priority Zone 2 is located in the northeastern portion of the study area and incorporates the Walton River and many of its tributaries (see Figure 18, Appendix A). This zone is 2945 ha in size.

Conservation Priority Zone 2 captures 67 percent of the representative ecosection distribution in Natural Landscape 27 (as seen in the red/blue overlap of Graph 2). This zone is made up of over 70 percent imperfectly drained, fine textured soils on ridges. A comparison between the distribution of ecosections found within Conservation Priority Zone 2 and Landscape 27 reveals a shortfall of 33 percent (red portion with no blue overlap). This shortfall is made up of imperfectly drained, fine textured soils on hummocky terrain (IFHO); wetlands; and well drained, fine textured soils on hummocky terrain. Surpluses of 33 percent (blue portion) are largely made up of imperfectly drained, fine textured soils on ridges (IFRD); and ecosection found in the "OTHER" category of the Ecological Land Classification (see Appendix C). Graph 2 illustrates this comparison between Conservation Priority Zone 2 and Natural Landscape 27.



Graph 2: Representation Comparison for Conservation Priority Zone 2

9.2.1 Opportunities

The Walton River and its tributaries found within Conservation Priority Zone 2 provide valuable habitat for the wood turtle, listed as a vulnerable in the province of Nova Scotia (NSDNR 2007). According to information provided by the Department of Natural Resources, one of the main reasons why wood turtles are in decline in Nova Scotia is the destruction of their river and stream habitat. The Provincially owned crown land surrounding the Walton River represents an opportunity to protect the habitat of this vulnerable species. Other environmental values found in Conservation Priority Zone 2 include almost 400 ha of potential old growth forest and 40 ha of high value wetlands.

9.2.2 Constraints

The significant habitat along the Walton River, provides one of the primary attributes leading to its selection as a conservation area. However, the riparian habitat value also leads to a linear shape for the conservation priority zone. The eastern portion of this zone expands to include a larger contiguous area due to a cluster of potential old growth forest patches. The boundaries of this zone were also restricted by the surrounding areas of high road density, considered disturbed area, and high value forestry areas. The shape of this conservation zone presents a constraint on protection as it contains a high proportion of edge habitat.

The area contained within this zone, if protected, represents an 8 percent (1588 ha) loss of long term forestry operational area and a 6 percent (127,577 m3) loss of short term timber value. Mining exploration is taking place over 1281 ha in this zone. This area represents a large proportion of the total mining exploration that is taking place in the study area and while there are no active claims, this points to a potential future land use conflict.

Another constraint to protecting land within this zone is that 29 percent (875 ha) of the land is in a disturbed condition. This disturbance is largely influenced by almost 26km of logging roads within the zone. Patches of recently disturbed areas caused by forestry activity also contributes to the level of disturbance in the zone.

9.2.3 Recommendations

Protection of environmental values

Protection of wood turtle habitat along the Walton River and the potential old growth forests that surround its headwaters should be of prime importance when considering management of this zone.

9.2.4 Remediation

Restore clear-cut areas and cart roads

The large number of disturbance patches and previously used logging access roads should be left to succeed and re-incorporate into the forest matrix. This form of restoration is possible because these areas are generally already in early stages of succession, and if left alone will redevelop forest structures. The areas of more recent disturbance are surrounded by the forest matrix which will provide the seed source needed for natural reforestation to take place.

9.2.5 Implementation

The protection of the many high environmental values found within this zone can be accomplished through a variety of strategies:

Special Management Zone

The Wildlife Habitat and Watercourses Protection Regulations found within the Forests Act (Government of Nova Scotia 1989) requires the identification of Special Management Zones on both private and publicly

owned land. Currently, Special Management Zones are established to restrict logging activity for the protection of watercourses and the maintenance of habitat values. These zones extend for 20 metres around all water bodies including wetlands with permanent open water, and on both sides of streams greater than 50 cm in width. It is recommended that efforts are made to extend the special management zone criteria to include areas of high ecological value, including identified area of viable old growth forest, high value wetlands, and significant habitats and ecosystems. With this extension of the definition of a special management zone, the protection of the environmental values present in Conservation Priority Zone 2 could be achieved while still allowing forestry activity to continue in the surrounding areas.

Wilderness Protected Area

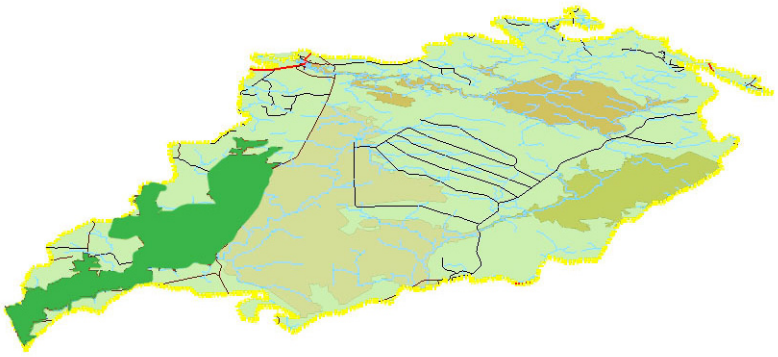
While this zone is not sufficiently large in size to be protected as a Wilderness Area, its close vicinity to Conservation Priority Zone 1 provides an opportunity for it to be connected, at least in part, to a larger protected area. The highly valued environmental characteristics of Zone 2 would make it a valuable addition to the contiguous ecosystems found within Zone 1. The main barrier to this option is the well-used road that separates the two zones. This road connects Walton Woods Road with the central network of logging/ recreational roads found in the centre of the study area. While this road presents a physical barrier between these zones, the Wilderness Areas Protection Act does permit permanent roads within Wilderness Areas. It is recommended that further research is carried out to determine the potential affects of this type of road on wildlife movement if this option is to be developed further.

Nature Reserve

The *Special Places Protection Act* allows for the protection and study of ecological sites which are considered important to the natural heritage of Nova Scotia. Considering both the constraints of this zone and its concentration of environmental values, one of the options for protection is a designation as a Nature Reserve under this legislation. According to the Act, Nature Reserves must have the following characteristics (Government of Nova Scotia 1989(2)):

(i) are suitable for scientific research and educational purposes,
(ii) are representative examples of natural ecosystems within the province,
(iii) serve as examples of ecosystems that have been modified by man and offer an opportunity to study the natural recovery of ecosystems from such modification,
(iv) contain rare or endangered native plants or animals in their natural habitats,
(v) provide educational or research field areas for the long-term study of natural changes and balancing forces in undisturbed ecosystems.

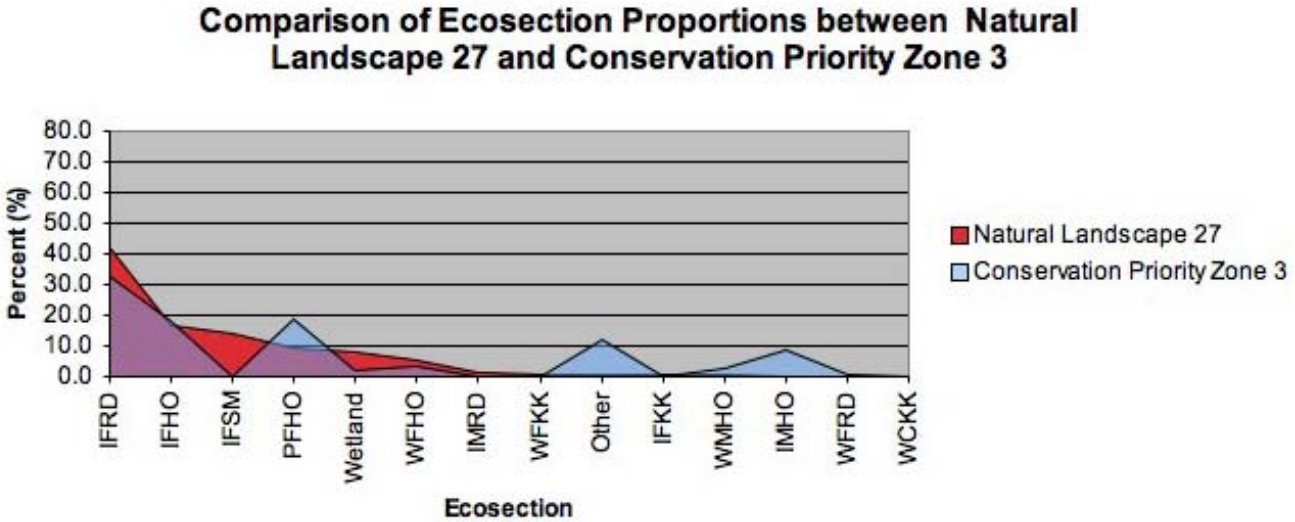
Conservation Priority Zone contains all of the above attributes and therefore should be considered for designation as a Nature Reserve.



9.3 Conservation Priority Zone 3

Located in the southeastern section of the study area, this 3459 ha parcel of land is separated from Conservation Priority Zone 1 by Walton Woods Road (see Figure 18, Appendix A). The dominant ecosections found in this zone include 32 percent imperfectly drained, fine textured soils on ridges and 37 percent imperfectly and poorly drained, fine textured soils on hummocky terrain.

Conservation Priority Zone 3 captures 66 percent of the representative ecosection distribution of Natural Landscape 27 (as seen in the red/blue overlap of Graph 3). A comparison between the distribution of ecosections found within Conservation Priority Zone 3 and Landscape 27 reveals a shortfall of 34 percent (red portion with no blue overlap) which is made up of imperfectly drained, fine textured soils on ridges (IFRD); imperfectly drained, fine textured soils on flat terrain (IFSM); and wetlands. Surpluses of 34 percent (blue portion) are mainly poorly drained, fine textured soils on hummocky terrain (IFHO); imperfectly drained, medium textured soils on hummocky terrain (IMHO); and ecosection found in the "OTHER" category of the Ecological Land Classificaiton. Graph 3 illustrates this comparison between Conservation Priority Zone 3 and Natural Landscape 27.



Graph 3: Representation Comparison for Conservation Priority Zone 3

9.3.1 Opportunities

This area is underlain by early to late carboniferous sandstones and carbonates, such as gypsum and limestone (NSDEL 2002). Owing to this carboniferous bedrock, a large section of Conservation Priority Zone 3 exhibits karst topography, including sinkholes, caves and closed depressions, which have emerged from mildly acidic groundwater and surface water dissolving the soluble bedrock. Furthermore, dissolution and enlargement of fractures and bedding planes in the bedrock also greatly increase permeability and infiltration rates to surface water. For this reason, Conservation Priority Zone 3 is hydrological significant as it acts as an area of groundwater recharge. Another major opportunity in this area is that the weathering of the carboniferous bedrock creates distinct local soil conditions which support unique assemblages of environmental values, including prime habitat for the endangered Ram's-Head Lady Slipper (*Cypripedium arietinum*).

9.3.2 Constraints

Unlike the majority of the study area which lies in the crown lands of the Stanley Block, greater than 50 percent of the land making up Conservation Priority Zone 3 is privately owned. While private land ownership is not a direct conflict, it does reduce the conservation mechanisms available for protecting the landscape. In addition to containing mostly privately-owned lands, approximately 50 percent of this zone lies outside of Natural Landscape 27 (Walton Clay Plain) and as such is only partially contributing to landscape representation within the study area. A final constraint is the amount of agricultural and urban land uses, making Conservation Priority Zone 3 the most highly disturbed of all the candidate protection zones. Over 33 percent of the area has been characterized as disturbed.

9.3.3 Recommendations

Special consideration for surface to groundwater interaction

Owing to the high permeability rates of the karst topography in the area, surface water often bypasses the normal landscape filtering process that occurs in porous aquifers, resulting in reduced opportunities for contamination removal. As such, groundwater in this area can be easily polluted.

Protection of rare species and wetlands

Special consideration should be given to the 145 ha of wetlands, 300 ha of significant ecosystems, and five rare species sightings present in this zone.

9.3.4 Remediation

Natural succession of clear-cut areas and cart roads

The large number of disturbance patches and cart roads in the northeastern section of Conservation Priority Zone 3 should re-incorporated into the forest matrix. This process of restoration is possible because these areas are already in the early stages of succession, and if left alone will re-form forest structures. The areas of more recent disturbance are surrounded by the forest matrix which will provide the seed source needed for natural reforestation to take place.

9.3.5 Implementation

Public education

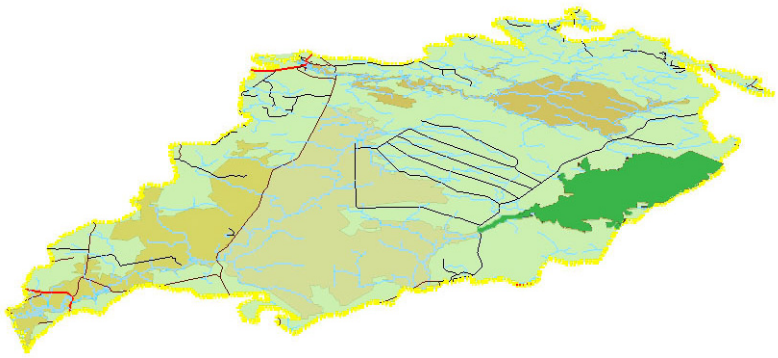
Campaigns through organizations such as the Ecology Action Centre, provincial woodlot owners organization, or local stewardship organization can promote a greater understanding of environmental issues and landscape functions within the zone.

Land trusts

Organizations that provide long-term stewardship of environmental resources by acquiring full or partial interest in property, or through conservation easements which restrict the use of real property. The owners of woodlots containing conservation values should be approached by land trust organizations to encourage the adoption of conservation easements for the protection of those values.

Municipal policy

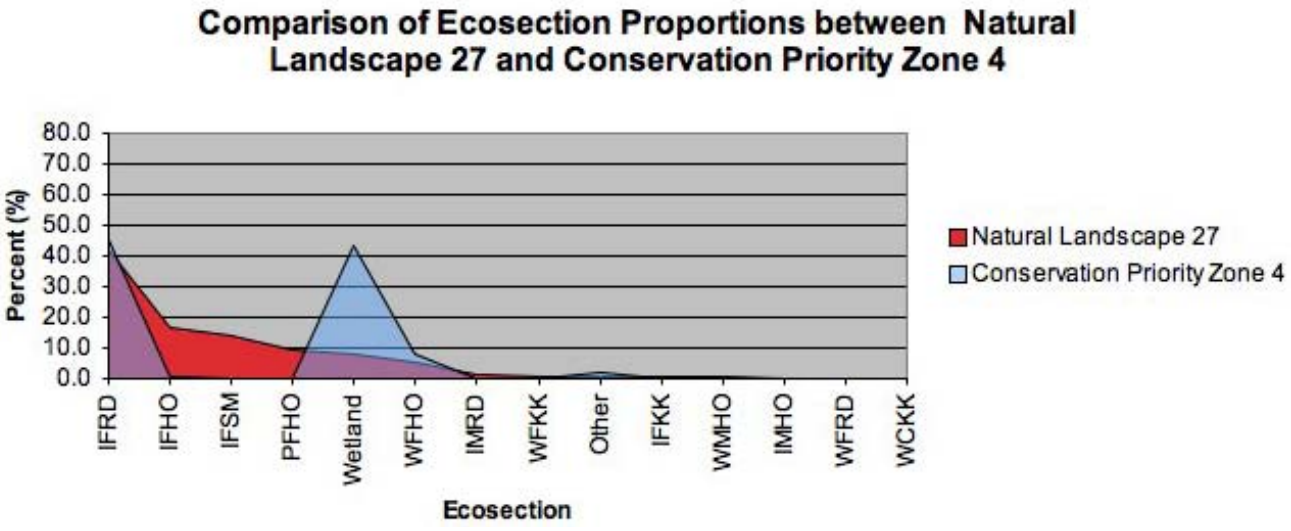
Land use and development controls in the Municipality of the District of West Hants should be reviewed to ensure they provide adequate protection of environmental values, and preserve and promote ecological integrity of the area. Specific measures should be taken to protect water quality in areas of karst topography.



9.4 Conservation Priority Zone 4

This 2243 ha parcel of land is located in the south-western section of the study area, just north of Highway 236 (see Figure 18, Appendix A). The dominant ecosections found in this zone includes 46 percent imperfectly drained, fine textured soils on ridges and 43 percent wetlands.

Conservation Priority Zone 4 captures 58 percent of the representative ecosection distribution of Natural Landscape 27 (as seen in the red/blue overlap of Graph 4). A comparison between the distribution of ecosections found within Conservation Priority Zone 4 and Landscape 27 reveals a shortfall of 42 percent (red portion with no blue overlap). This shortfall includes ecosections of imperfectly and poorly drained, fine textured soils on hummocky terrain (IFHO and PFHO); and imperfectly drained, fine textured soils on flat terrain (IFSM). Surpluses of 42 percent (blue portion) are largely made up of imperfectly drained, fine textured soils on ridges (IFRD); and wetlands. Graph 4 illustrates the comparison between Conservation Priority Zone 4 and Natural Landscape 27.



Graph 4: Representation Comparison for Conservation Priority Zone 4

9.4.1 Opportunities

Situated in an area characterized by poorly drained soils, shallow slopes, and hydrological richness, Conservation Priority Zone 4 is also defined by large significant wetlands, including the 300 plus hectare MacDonald Bog. In addition to providing valued wildlife habitat, the wetlands of this zone makeup the headwaters of the Tomcod River and as such serve many hydrological and biological functions including: short-term and long-term water retention, water filtration, sediment trapping, flow and speed moderation, and flood and erosion control.

9.4.2 Constraints

With the decrease in forestry extraction in the Walton Clay Plain following Hurricane Juan, one of the only existing economic activities in the study area is peat extraction from MacDonald Bog. The extraction of peat for peat moss production is an intensive activity which requires the alteration of hydrological function to drain the site, and the removal of all surface vegetation. The removal of sphagnum moss and stored organic matter from the site, greatly reduces the capacity of the bog to suspend sediments, process waste, and moderate the speed and flow of water entering the Tomcod River and its tributaries. In sum, peat extraction could have negative effects on downstream water quality and quantity, and greatly modify ecological processes and exchanges in the area. In addition to the constraints posed by peat extraction in Conservation Priority Zone 4, mining exploration has intensified at this location in recent years pointing to a potential land-use conflict.

9.4.3 Recommendations

Continued peat extraction

Recognizing that a development lease is presently held for the entire MacDonald Bog and that this remains one of the only economic activities in the study area it is recommended that peat extraction be allowed to continue in the area.

Renegotiation of development lease conditions

The Government of Nova Scotia should renegotiate the terms of the development lease on MacDonald Bog to require remediation of the site once peat extraction operations have ceased.

9.4.4 Remediation

Landscape aftercare and monitoring, habitat restoration and the restoration of hydrological function and ecological integrity are encouraged once peat extraction on the site has ceased. This Zone also provides an excellent opportunity to research the effectiveness of peatland restoration techniques following peat harvesting operations in Nova Scotia. Furthermore, new Provincial policies on no net loss of wetlands will require the development of local wetland creation or remediation methods. Experimental work could be carried out within this Zone for such purposes, particularly in consideration of the protection of environmental values located within it.

9.4.5 Implementation

Crown Land Act

This legislation can be drawn upon by the Government of Nova Scotia to renegotiate the terms of the development lease to the MacDonald Bog to require remediation following the completion of extraction operations.

Future 'No Net Loss of Wetlands' Regulations

These regulations are expected by 2009 as part of the Environmental Goals and Sustainable Prosperity Act, these regulations could be used as an opportunity to test and evaluate whether wetlands can be successfully regenerated in Nova Scotia.

9.5 Implications For Resource Management

Although specific impacts to resources uses have been highlighted in the description of each conservation priority zone, the context of crown land management in Nova Scotia, as one that is focused on resource extraction, provides cause for some additional discussion. It should first be highlighted that although the research question posed by the client was focused on conservation goals, the approach taken in this work made full consideration of resource interests. Specifically, an analysis was carried out specifically to discover resource values and the final synthesis included criteria aimed at minimizing impacts to existing resource access. Resource values have only been superceded by conservation goals in areas where very high environmental values exist, where resource values where particularly low, or where resource extraction would have a high risk of environmental damage. In all these cases resource extraction is considered to be an unsuitable activity, and if occurring should be controlled regardless of protected areas development.

It should also be noted that because of the synthesis process used, the inverse of the area identified on Figure 18 (Appendix A) represents areas that are not only available for resource extraction, but are also highly advantageous for resource extraction. However, areas open for resource uses should not necessarily be considered suitable for high intensity extraction. It was beyond the scope of this study to allocate the full land use pattern in the study area, but future study should be carried out into the mitigation of displaced resource values through increased forestry intensity at suitable locations. This would be a necessary component of the multi-stakeholder negotiations needed for designation of protected areas in the Walton Clay Plain.

10. CONCLUSION

The Walton Clay Plain has often been overlooked for conservation values. Upon investigation and research, however, the Environmental Planning Studio has uncovered a landscape that is hydrologically complex, and rich in natural history and ecological value. The clustering of bogs, fens and forests support the headwaters of three river systems. Forest compositions contain surprising diversity, ranging from early successional habitats to potential old growth forests. Areas have also been identified containing significant ecosystems and rare species habitat.

The Conservation Priority Zones that resulted from the project synthesis represent the most advantageous location on this landscape for protected areas. A variety of implementation mechanisms and recommendations have also been given for the achievement of land protection in a variety of contexts.

Cultural and resource values have also played a primary role in the identification of conservation areas. Through analysis and synthesis methods, the studio has worked to minimize the potential conflicts between the achievement of conservation goals and valued cultural landscape features. This effort demonstrates a balanced planning approach, as an example for the expansion of the Provincial Protected Areas Strategy.

The detailed inventories and analysis layers created during this project also provide a valuable working tool. This tool is meant to assist the project client, the Ecology Action Centre, in their protected areas advocacy work. The information contained in this report will also provide a strong basis for the multi-stakeholder negotiations to be carried out for the establishment of a protected areas system for the Walton Clay Plain.

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Appendix A

Map Figures (see attached)

Figure 1: Site Location
Figure 2: Study Area Boundary
Figure 3: Elevation
Figure 4: Slope
Figure 5: Bedrock Geology
Figure 6: Surficial Geology
Figure 7: Soils
Figure 8: General Habitats
Figure 9: Hydrology
Figure 10: Land Use
Figure 11: Jurisdiction
Figure 12: Resource Value
Figure 13: Recreation Value
Figure 14: Hydrogeologic Sensivity
Figure 15: Environmental Values
Figure 16: Disturbance
Figure 17: Synthesis Results
Figure 18: Synthesis Results with Ownership Boundaries

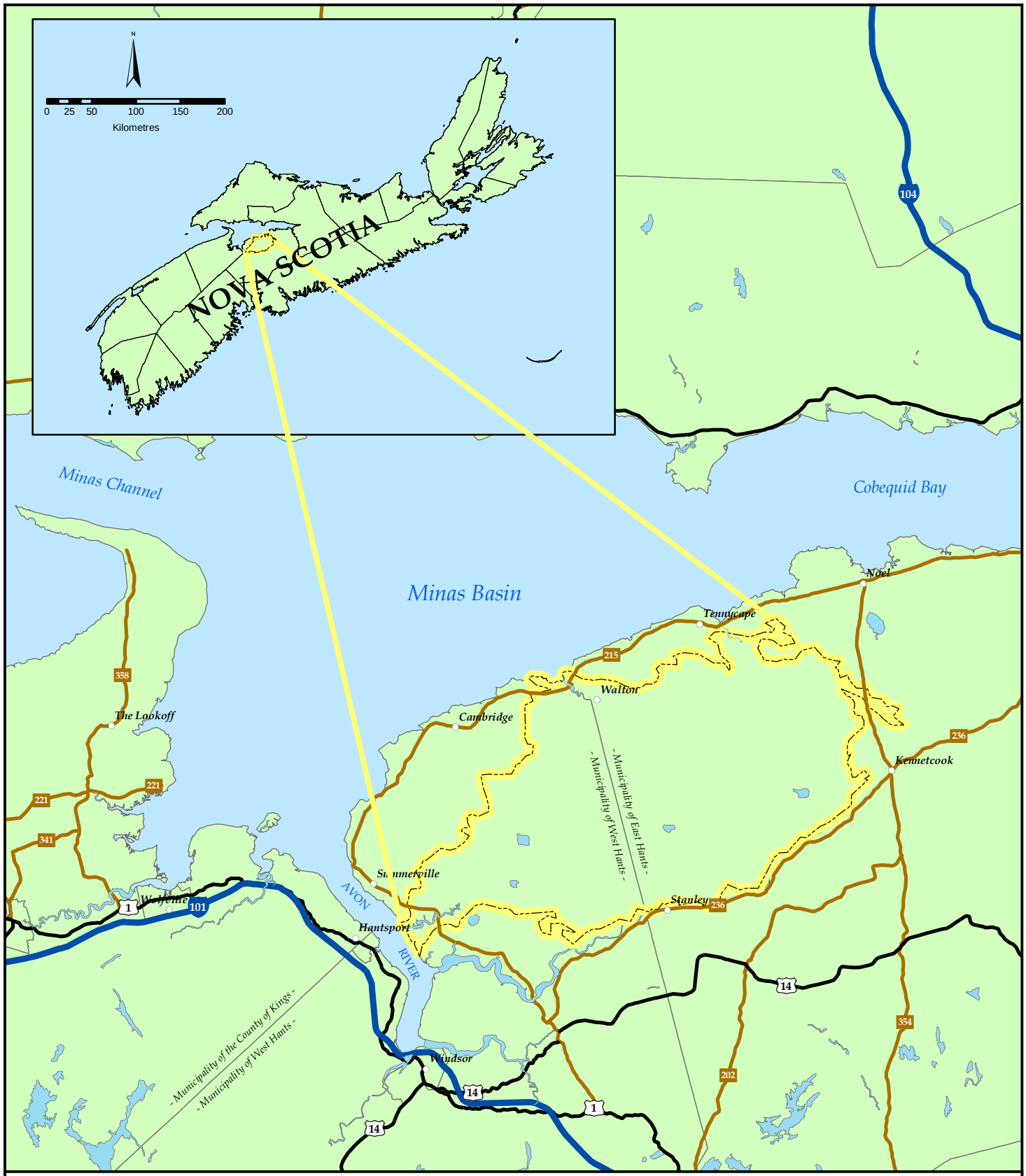

Figure 1

Site Location

Legend

Study Area

N

0 2.5 5 10 15 20

Kilometres

Projection: Zone 20 UTM NAD83
Source: Nova Scotia Topographic Datatbase
SNSMR - NS Geomatics Centre

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Figure 2

Study Area Boundary

Legend

- Study Area Boundary
- Crown Land
- Walton Clay Plain

N

0 0.5 1 2 3 4 5
Kilometres

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Projection: Zone 20 UTM NAD83
Source: Nova Scotia Topographic Datatbase
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Figure 3

Elevation

Elevation Features

- <10m
- 10 - 20m
- 20 - 30m
- 30 - 40m
- 40 - 50m
- 50 - 60m
- 60 - 70m
- 70 - 80m
- 80 - 90m
- 90 - 100m
- 100 - 110m
- 110 - 115m
- Contour (25 metres)

Project Features

- Study Area Boundary

Map Features

- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
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Figure 4

Slope

0 - 3% (Flat)
3+ - 8% (Moderate)
8+ - 15% (Moderate/Steep)
15+ - 25% (Steep)

Project Features
Study Area Boundary

Map Features
Water course

N

0 1 2 3 4
Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
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Figure 5

Bedrock Geology

Bedrock Features

- Cumberland Group
- Fundy Group
- Horton Group
- Mabou Group
- Meguma Group
- Windsor Group

Project Features

- Study Area Boundary

0 1 2 3 4

Kilometres

1:100,000

Projection: UTM Zone 20N NAD83

Source: Nova Scotia Topographic Database
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Figure 6

Surficial Geology

Surficial Geology Features
- Silty Till Plain
- Stony Till Plain
- Alluvial Deposits
- Glaciofluvial Deposits
- Marine Deposits
- Organic Deposits

Project Features
- Study Area Boundary

0 1 2 3 4
Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Source: Nova Scotia Topographic Database
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Figure 7

Soils

Soil Features

- Poorly drained
- Poorly drained (Bog)
- Moderately drained
- Well drained (Queens)
- Well drained (Hansford)
- Good to excessive drainage

Project Features

- Study Area Boundary

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Source: Nova Scotia Topographic Database
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Figure 8

General Habitats

Habitat Features

- Early Succession Forest
- Softwood Forest
- Mixedwood Forest
- Hardwood Forest
- Open Bog
- Treed Bog
- Fen / Marsh / Swamp
- Barrens

Project Features

- Study Area Boundary

Map Features

- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000

Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
SNS&MR - NS Geomatics Centre

Nova Scotia Department of Natural Resources - Forest Inventory Database

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Figure 9

Surface Hydrology

Hydrology Features

- Floodplain area
- Flood prone area
- Recharge and/or discharge area
- Walton watershed
- Tomcod watershed
- Cogmagun watershed
- Overland flow
- Gullies
- Water course

Project Features

- Study Area Boundary

N

0 1 2 3 4

Kilometres

1:100,000

Projection: UTM Zone 20N NAD83

Source: Nova Scotia Topographic Database
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Figure 10

Land Use

- Agricultural
- Urban
- Blueberries
- Gravel Pit
- Abandoned Mines

Active Forestry Features

- Clearcut
- Plantation
- Peat Resource
- Treated Area

Project Features

- Study Area Boundary

Map Features

- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
SNS&MR - NS Geomatics Centre

Nova Scotia Department of Natural
Resource Forest Inventory Database

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Figure 11

Legislative Jurisdiction

Jurisdiction Features
- East Hants area
- West Hants area
- Crown Land

Project Features
- Study Area Boundary

Map Features
- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4
Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
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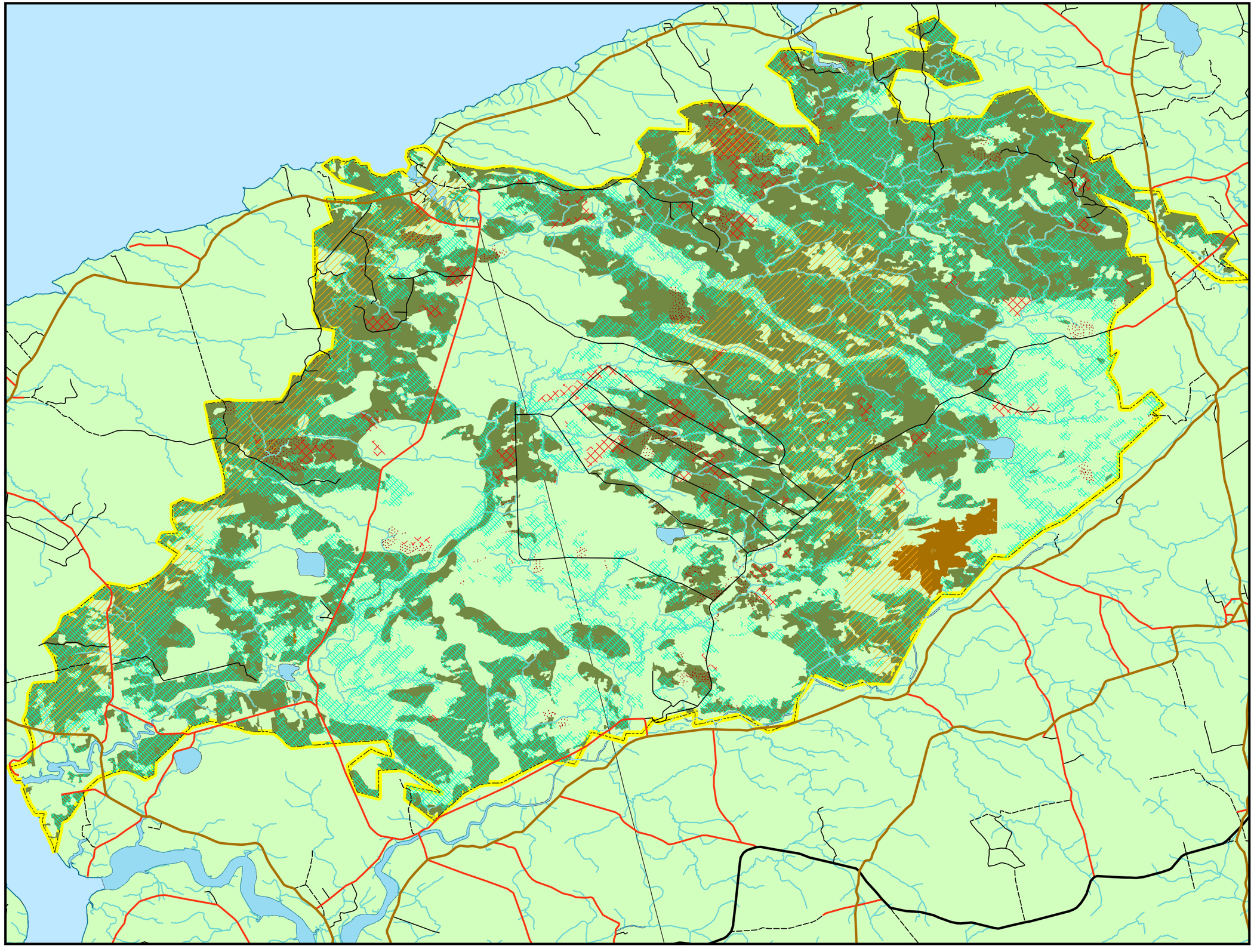
Figure 12

Analysis - Resource Values



Resource Features
- Mineral Rights
- Peat Resource
- Plantation
- Treated Area
- Forestry Value Short Term
- Forestry Value Long Term

Project Features
- Study Area Boundary

Map Features
- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
SNS&MR - NS Geomatics Centre

Nova Scotia Department of Natural Resources - Forest Inventory Database

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Figure 13

Analysis - Recreation Values

Hunting Values
- Unlikely Occurrence of Hunting
- Possible Occurrence of Hunting
- Most Probable Occurrence of Hunting
- Preferential Roaded Areas
- Roaded Areas (Non-preferential)

Project Features
- Study Area Boundary

Map Features
- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

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Figure 14

Analysis - Hydrologic Sensitivity

Hydrology Features

- Wetlands
- Water bodies
- 20 m water course buffer
- Floodplain
- Flood Prone Areas
- Sink holes area
- Well-drained on 8-15% slope
- Well-drained karst
- Walton Watershed
- Tomcod Watershed
- Cogmagun Watershed
- Water Course

Project Features

- Study Area Boundary

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Source: Nova Scotia Topographic Database
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Figure 15

Analysis - Environmental Values

Environmental Features

- Rare/Extremely Rare Species
- Uncommon Species
- Wildlife Movement
- Significant Habitats
- Significant Ecosystem
- High value wetland
- Viable Old Growth

Project Features

- Study Area Boundary

Map Features

- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
SNS&MR - NS Geomatics Centre

Nova Scotia Department of Environment and Labour - Protected Areas Branch

Nova Scotia Department of Natural Resources
Wetlands and Habitat Inventories and Forest Inventory Database

Atlantic Canada Conservation Dataset

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Figure 16

Analysis - Disturbance

Disturbance Features
- Disturbed areas

Project Features
- Study Area Boundary

Map Features
- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Cart Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
SNS&MR - NS Geomatics Centre

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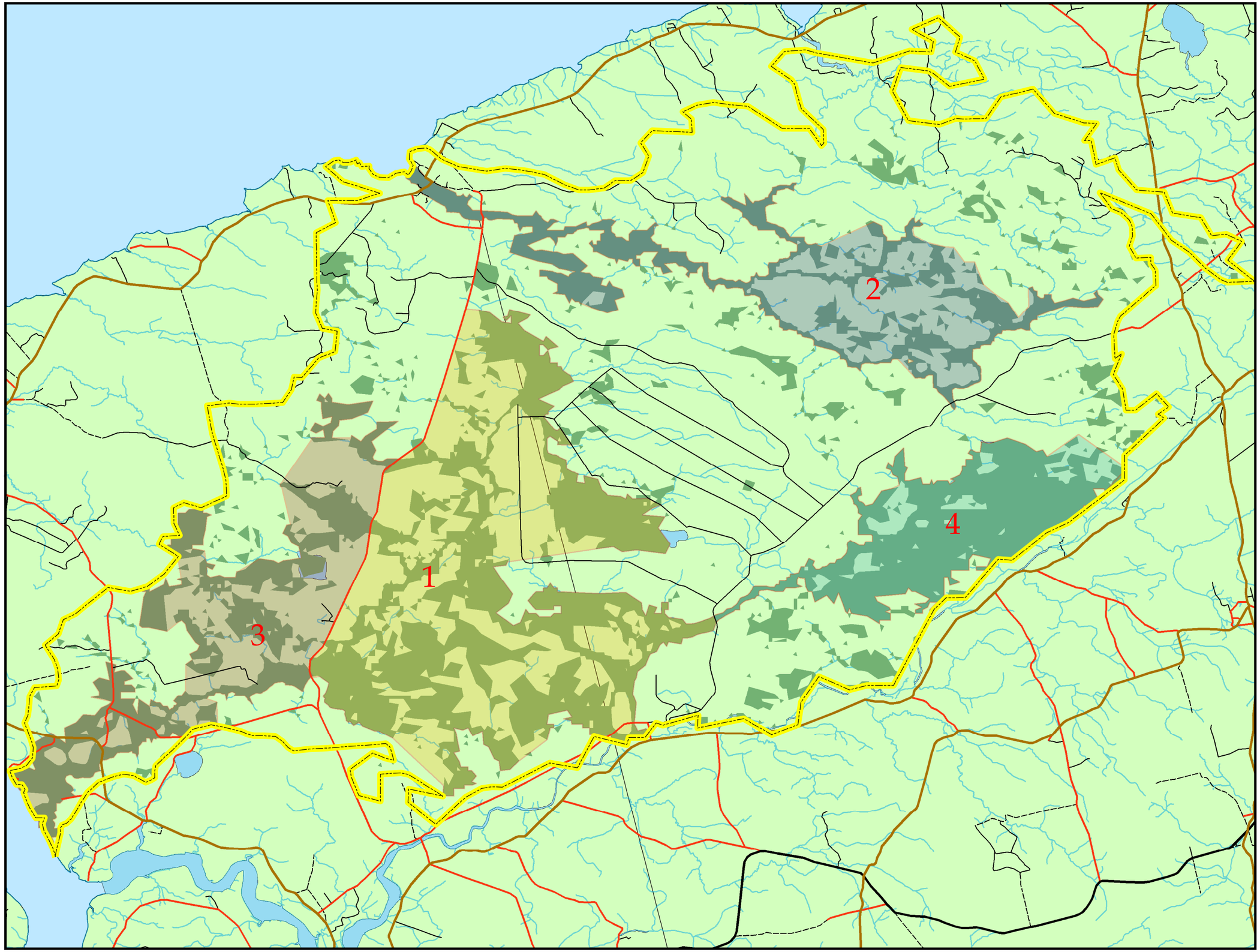

Conservation-Based Land Use Plan for the Walton Clay Plain

Figure 17

Synthesis - Conservation priority zones with environmental values

Conservation Features

Conservation priority zones

- Zone 1
- Zone 2
- Zone 3
- Zone 4

Environmental Values

Project Features

Study Area Boundary

Map Features

- Collector Highway
- Trunk Highway
- Local Highway
- Local Road (may not be paved)
- Loose Surface Road
- Water course
- Water

N

0 1 2 3 4

Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
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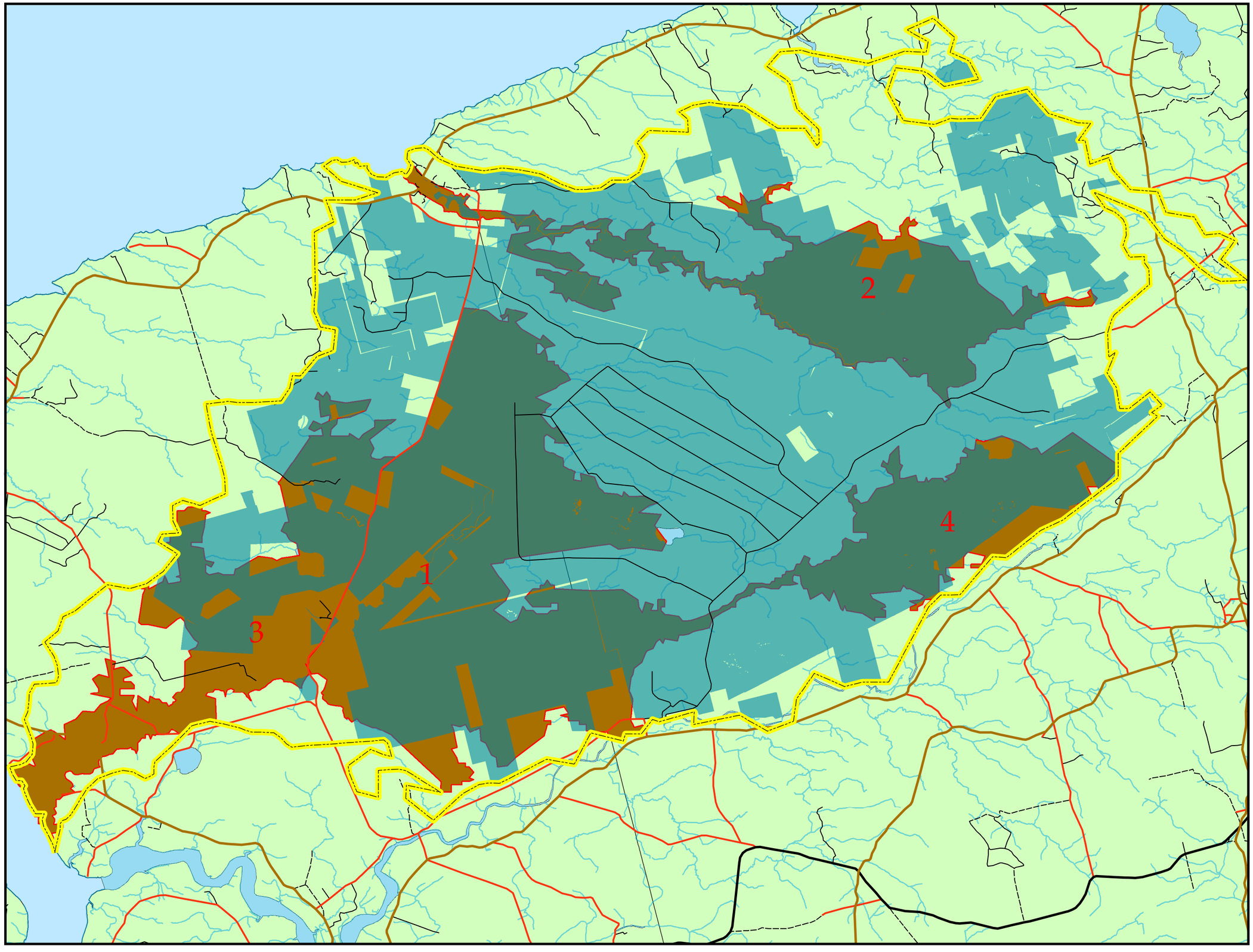

Conservation-Based Land Use Plan for the Walton Clay Plain

Figure 18

Synthesis - Conservation priority zones with land ownership

Conservation Features
- Conservation priority zones

Project Features
- Study Area Boundary

Map Features
- Collector Highway
- Trunk Highway
- Local Highway
- Water course
- Local Road (may not be paved)
- Loose Surface Road
- Crown land
- Water

N

0 1 2 3 4
Kilometres

1:100,000
Projection: UTM Zone 20N NAD83

Sources: Nova Scotia Topographic Database
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Appendix B

Table 8: Relevant Policy Statements from the Municipality of East Hants Municipal Planning Strategy (MPS)

Section of MPS	Policy Statement Number	Issue Addressed	Section of MPS
8.1 Environmental Sustainability	P8-1	Sustainable development	(East Hants MPS 8-2)
8.1 Environmental Sustainability	P8-3	Site controls to mitigate environmental impacts	East Hants MPS 8-2
8.1 Environmental Sustainability	P8-4	Joint planning for portection/restoration of natural environmental	East Hants MPS 8-3
8.1 Environmental Sustainability	P8-5	Pollution reduction	East Hants MPS 8-3
8.1 Environmental Sustainability	P8-7	Promotion/protection of ecosystem integrity	East Hants MPS 8-3
8.1 Environmental Sustainability	P8-9	Protection and enhancement of natural habitats and vegetation	East Hants MPS 8-3
8.1 Environmental Sustainability	P8-11	Environmental education and conservation programs	East Hants MPS 8-3
8.2 Environmental Conservation	P8-12	Criteria for environmentally sensitive lands (ES) designation	East Hants MPS 8-4
8.2 Environmental Conservation	P8-13	Permitted uses within (ES) designation	East Hants MPS 8-4
8.2 Environmental Conservation	P8-15	Wetlands to be considered for (ES) designation	East Hants MPS 8-5
8.2 Environmental Conservation	P*-16	Controls on removal and alteration of topsoil in (ES) designated lands	East Hants MPS 8-5
8.2 Environmental Conservation	P8-22	Criteria for determining lands of environmental risk (ER)	East Hants MPS 8-5
8.2 Environmental Conservation	P8-24	controls for topsoil removal ad placement	East Hants MPS 8-8
8.3 Soil Erosion Controls	P8-25	Criteria for flood plain protection in HF zones	East Hants MPS 8-8
8.3 Soil Erosion Controls	P8-30	Criteria for flood plain protection in Moderate Potential Floodplain (MF) designated lands	East Hants MPS 8-9
8.3 Soil Erosion Controls	P8-33	Development controls for MF designation	East Hants MPS 8-9

8.3 Soil Erosion Controls	P8-36	Regulation for alteration of land levels	East Hants MPS 8-10
8.3 Soil Erosion Controls	P8-40	Regulation for preservation of water quantity/quality through Water Supply (WS) future designation	East Hants MPS 8-11
8.3 Soil Erosion Controls	P8-42	Process for establishing a Watershed Management Plan	East Hants MPS 8-11
8.3 Soil Erosion Controls	P8-52	Watercourse setbacks	East Hants MPS 8-12
8.3 Soil Erosion Controls	P8-53	Pollution control in municipal water system	East Hants MPS 8-12
8.3 Soil Erosion Controls	P8-56	Willingness to establish inter municipal Watershed Management Strategy	East Hants MPS 8-13
8.3 Soil Erosion Controls	P8-57	Policy on Community Watershed groups	East Hants MPS 8-13
8.3 Soil Erosion Controls	P8-60	Policy on monitoring of local water quality	East Hants MPS 8-14
9.4 Tourism and Economic Development	P9-92	Policy on eco-tourism	East Hants MPS 9-16
12.1 Open-Space and Recreation Development	P12-1	Policy on parkland access	East Hants MPS 12-2
12.1 Open-Space and Recreation Development	P12-2 (e)	Policy on development of conservation areas	East Hants MPS 12-2
12.1 Open-Space and Recreation Development	P12-11	Policy on acquiring ES/ER lands for Recreation/Open-Space	East Hants MPS 12-2

Table 9: Relevant Policy Statements from the Municipality of West Hants Municipal Planning Strategy (MPS)

Section of MPS	Policy Statement Number (Chapter, Section, Policy, Number)	Issue Addressed	Section of MPS (Page number, Document)
4.2.1 Watercourses	4.21.1	Minimum separation distances from watercourses	(Pg. 20, West Hants Draft MPS)
4.21 Watercourses	4.21.2	Lakes and rivers public access policy	(Pg. 20, West Hants Draft MPS)
8.4 Removal of Topsoil	8.4.1	Policy on topsoil removal	(Pg. 64, West Hants Draft MPS)
9.0 Resource	9.0.1	Criteria for identification of Resource (R) Designation lands	(Pg. 76, West Hants Draft MPS)
9.1 General Resource	9.02	Development controls in (R) lands to protect natural resources and services	(Pg. 76, West Hants Draft MPS)
9.1 General Resource	9.1.1	Criteria for identification of General Resource (GR) Designation lands	(Pg. 77, West Hants Draft MPS)
9.1 General Resource	9.1.5	Permitted uses within (GR) designated lands	(Pg. 77, West Hants Draft MPS)
9.1 General Resource	9.1.8	Policy regardng separation/ buffers between different land uses	(Pg. 79, West Hants Draft MPS)
12.1 Dykeland Areas	9.1.11	Policy regarding provision of subdivision and private roads	(Pg. 81, West Hants Draft MPS)
12.1 Dykeland Areas	12.1.1	Development agreement conditions for grouped dwellings in (GR) designation	(Pg. 91, West Hants Draft MPS)
12.1 Dykeland Areas	12.1.4	Policy regarding flooding overlay in dyke marshlands	(Pg. 91, West Hants Draft MPS)
12.1 Dykeland Areas	12.1.7	Topographic control (fill) in dyke marshlands	(Pg. 92, West Hants Draft MPS)
12.1 Dykeland Areas	12.1.8	Permissible infilling of dyke marshlands	(Pg. 92, West Hants Draft MPS)

Appendix C

Table 10: ELC codes descriptions for Ecosections

Part A

Soil Drainage (_XXX)		
ELC Code	**Description**	**Definition**
W	Well-drained soils	soils >60% well-drained
P	Poorly-drained soils	soils >60% poorly-drained
I	Imperfectly-drained soils	soils not well- or poorly-drained

Part B

Soils Texture (X_XX)		
ELC Code	**Description**	**Definition**
C	Coarse-textured soils	gravel, coarse sand, sand, loamy sand, and coarse sandy loam
M	Medium-textured soils	sandy loam, fine sandy loam, very fine sandy loam, loam
F	Fine-textured soils	silt, sandy clay loam, clay loam, sandy clay, silty clay, clay

Part B

Topographic Pattern (XX_ _)		
ELC Code	**Description**	**Definition**
SM	Smooth or flat (Level)	land with no particular pattern, flat or very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 1%.
HO	Hummocky	a series of small rounded hills with a gentle slope usually never exceeding 15%
KK	Hills	a series of knobs and knolls with moderate to steep slopes between 5-30%. Relief amplitude ranges from 15-60 m.

DM	Drumlinoid	a pattern of elongated landforms caused by glacial ice movement (drumlins and flutes) often occuring in clusters
R	Ridges	a pattern of linear or curvilinear ridges
DS	Canyons and steep slopes	sharply sloped terrain along rivers/ streams or associated with hilly topography. Slopes are usually between 20-80%.

Note: The “OTHER” category includes unclassified areas, in addition to watercourses, and water-bodies.