

SOUTH NATION
CONSERVATION
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Forest Cover and Trends Analysis

September 2016



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Executive Summary

The digital analysis of aerial photography of Eastern Ontario from 2008 and 2014 provides South Nation Conservation (SNC) and member municipalities with accurate data on forest cover status. Development and land conversion to sustain increased populations and agricultural production in Eastern Ontario is impacting the presence of forest cover and its ecological benefits for a healthy environment. The changes in forest cover from 2008 to 2014 can be attributed to residential land development, industrial/commercial development, agriculture, solar farms, unsustainable harvest practices, and other causes. This report is intended to provide updated forest cover information in order to guide future stewardship programs, services and decision-making.

Forest cover in the jurisdiction, which is closely linked to ecological health, has fallen below Environment and Climate Change Canada's minimum recommended level of 30 percent. In 2014, the forest cover across SNC's jurisdiction was 28.1 percent. Approximately 5,321 hectares (13,148 acres) of forests were lost between 2008 and 2014. This represents a 4.1 percent decrease in forest cover.

There is approximately 123,000 hectares of forested land within the SNC jurisdiction. In order to achieve the 30 percent minimum forest cover guideline within our jurisdiction, over 131,000 hectares of total forest land is needed. SNC is a partner in the management of over 8,000 hectares of land, including SNC and Stormont Dundas and Glengarry (SDG) owned land. SNC's forested land acquisition program has acquired over 50 hectares of land annually since 2009. In addition, 2.8 million trees have been planted since 1990 through SNC's tree planting programs.

Natural forests accounted for the majority of forest types with 85 percent followed by 12 percent for plantations and 3 percent for hedgerows. In terms of physiographic units, the Winchester Clay Plain and the Ottawa Valley Clay Plain, both containing productive clay soils, had the lowest forest cover.

In addition to carbon sequestration, oxygen release, water absorption, water filtration, and erosion prevention, forests play a critical role in providing habitat for amphibians, mammals, birds and plants. The loss of forest and connectivity between forest patches creates isolated forest stands that affect species diversity, abundance, and richness. Further research and analysis to identify existing and potential wildlife corridors and interior forest in a fragmented forested landscape would better inform future site selections for stewardship efforts. SNC continues to work with property owners, municipalities, and partners to effectively address the issues impacting forests and local forest cover.

A significant increase in tree planting, forested land acquisition programs and landowner outreach initiatives is needed to address the loss in forest cover across the SNC jurisdiction. SNC has been communicating the preliminary results of this report broadly with many agricultural, environmental and community groups. Comments from stakeholders included both concern and support for forest conservation By-laws, support for stewardship and forested land acquisition programs and future opportunities to work with partner organizations to promote the value and benefits of forests.

1.0 Introduction

Throughout the province of Ontario, 36 Conservation Authorities (CA) manage natural resources and deliver services and programs that protect the natural environment. In partnership with municipalities, government agencies, private landowners and other organizations, CAs promote an integrated watershed approach to conservation based on balancing social, environmental, and economic needs. Established under the Conservation Authorities Act of Ontario in 1947, SNC works to protect the local environment, in partnership with 16 member municipalities, and a 12-member Board of Directors that govern the budget, programs and services [1]. These programs and services include:

- Conducting science based monitoring to identify environmental needs, set targets, and restore natural areas;
- Protecting people and property;
- Promoting sustainable development; and
- Delivering educational and stewardship programs to connect residents and communities with their local environment.

Prior to European contact, the First Nations inhabited the South Nation River area; their hunter-gather lifestyle in the area had minimal impact on the forest [2]. Post-European settlement dramatically altered the landscape with incentives for newcomers to clear forested land for settlement. White pine was the preferred timber used for ship masts which led to severe cutting of both softwoods and hardwoods [3]. White pine represented 50 percent of the old-growth forest cover pre-settlement in the Great Lakes St-Lawrence (GLSL) forest region [4].

By the late 19th century, Eastern Ontario experienced severe flooding, droughts and erosion due to a declining forest cover of less than 30 percent in 32 townships, and in some, a forest cover of less than 10 percent [5]. Severe deforestation (the permanent removal of trees from an area and conversion of land for other uses,) in addition to land management practices and flooding, led to the creation of CAs. With the support of

member municipalities and provincial funding, the CAs and the Ministry of Natural Resources (MNR) began extensive tree planting, woodlot advisory service and land acquisition efforts throughout eastern Ontario. CAs have since been involved in both reforestation, defined as the establishment of trees on recently harvested sites, and afforestation, the establishment of trees on lands that have not had trees for an extended period of time. The 50 Million Tree Program, administered by Forests Ontario, defines suitable planting areas as:

“Land that is open, or mostly open, and has not been defined as a woodland since December 31, 1989, per the Forestry Act” [6]. Given that the majority of SNC’s jurisdiction was historically deforested and subsequently used for other purposes, afforestation accounts for the majority of tree planting efforts with most of the woodland additions from natural regeneration.

In 2008 and 2014, the MNR, in partnership with various other stakeholders, acquired high-resolution aerial photos for Eastern Ontario, known as the Digital Raster Acquisition Project for the East (DRAPE). Prior to 2008 and 2014 DRAPE, high-resolution imagery accurate up to 50 cm on the ground was not available to map forest cover within SNC’s jurisdiction. The digital analysis of this imagery was used to create an accurate forest cover layer for Eastern Ontario. This analysis was conducted in partnership with the MNR, Ontario Woodlot Association (OWA), Raisin Region Conservation Authority (RRCA), United Counties of Stormont Dundas and Glengarry (SDG), United Counties of Prescott Russell (UCPR), United Counties of Leeds and Grenville (UCLG) and the City of Ottawa. Through digital analysis using Geographic Information Systems (GIS), SNC and partners can identify the total forest cover for SNC’s jurisdiction in addition to neighboring areas within the project area.

Previous forest cover analysis from 2008 identified the total forest cover in the SNC watershed to be below Environment and Climate Change Canada’s minimum 30 percent forest cover guideline needed for environmental health [7]. This Environment and Climate Change Canada report outlines the 30 percent forest cover threshold guidelines as high risk, stating that forest cover at this level may not be enough to sustain even half of potential species richness and cannot ensure aquatic system health. Two additional benchmarks for forest cover have been outlined by Environment and Climate Change Canada. Whereas 30 percent cover would only support half of the potential overall ecosystem health, 40 percent forest cover would be a medium-risk benchmark that could support over half of the potential species richness and would promote a healthier watershed. The lowest risk approach recommended is 50 percent; this amount of forest cover would best support maximum species richness and watershed health.

Currently, support from member municipalities and Forests Ontario have enabled SNC to continue to deliver a tree planting program to private landowners throughout the jurisdiction. Additionally, funding from partners such as UCPR and Ontario Power Generation has supported the implementation of forest landowner outreach programs. While SNC has several programs in place, current land use pressures have triggered a downward trend in the proportion of the landscape that is forested. SNC's jurisdiction, which contains approximately 200,000 people, is particularly subject to agricultural, residential and commercial/industrial land development pressures [8]. With more than half of the highest quality farming soil found in Ontario, agriculture is the predominant land use within the jurisdiction representing approximately 60 percent of total lands [9].

The purpose of this report is to determine forest cover changes in the SNC jurisdiction and identify attributes of areas associated with high and low forest cover. The vast majority of land in the SNC jurisdiction, forested and un-forested, is privately owned. By pursuing this, SNC can promote constructive dialogue amongst various stakeholders – public, government, industry and agriculture – throughout SNC's jurisdiction on issues concerning forest cover loss and overall environmental health. The specific objectives of the Forest Cover Report include:

- Provide forest cover information based on 2014 DRAPE imagery; and
- Identify forest cover trends from 2008 and 2014 DRAPE imagery to guide future stewardship programs, services and decision-making.

2.0 Methodology

2.1 Study Area

The SNC jurisdiction encompasses a total area of 4,384 km. From the headwaters north of Brockville, the South Nation River flows northeast for 175 km, and empties into the Ottawa River near Plantagenet. SNC's 16 member municipalities include: City of Ottawa; Russell; Clarence-Rockland; The Nation; Casselman; Alfred Plantagenet; Champlain; North Stormont; South Stormont; North Glengarry; North Dundas; South Dundas; North Grenville; Edwardsburgh/Cardinal; Augusta; and Elizabethtown-Kitley.

The project area is part of the GLSL forest region, known as a transitional zone between the boreal forest and the southern deciduous forest. This mixed wood zone is mostly comprised of hardwoods, such as maple, birch and poplar, with a minor component of coniferous tree cover with species such as eastern white cedar, red and white pine, and white spruce [10] [11]. The majority of the forest is second growth, due to the

widespread cuttings in the past, with an average tree age of 80 to 90 years old. Privately owned forests, which represent the majority of forested land, are both upland and lowland sites [10].

This report presents the total forest cover for the entire municipal boundary of the municipalities within the SNC jurisdiction with the exception of the City of Ottawa, Elizabethtown-Kitley, Augusta and North Grenville where only the area within SNC's jurisdiction was available for analysis. Total forest cover is also summarized by jurisdiction and by upper-tier municipality. UCLG is the only upper-tier municipality summarized just by total area within jurisdiction as a result of available data.

2.3 Analysis

The Southern Ontario Land Resource Information System (SOLRIS) was used as the standard protocol for the interpretation of wooded areas in 2014. Data specifications from the aforementioned document were used to standardize forest data analysis with other jurisdictions and organizations throughout Ontario, See Appendix A – Data Specifications. ArcMap, a component of ArcGIS for analyses of geospatial data, was used to edit and create forested areas through visual interpretation of DRAPE imagery.

Based on the SOLRIS specifications, polygons representing forested areas were either created or deleted on digital maps to create an accurate representation of forest cover. Wooded areas were populated as woodlands or natural treed areas, forest plantations and hedgerows (Table 1).

Table 1. SOLRIS Forest Type Description.

Classification name	Description
Woodland – Treed Natural	Tree cover 60 percent or greater; canopy cover 75 percent or greater; trees minimum 2 meters in height; greater than 0.25 hectares
Plantations – Tree Cultivated	Tree cover 60 percent or greater; trees minimum 2 meters in height, linear organization, uniform tree type, greater than 0.25 hectares
Hedgerow	Tree cover 60 percent or greater; trees minimum 2 meters in height; linear arrangement; minimum 10 meters width; maximum 30 meters width; greater than 0.25 hectares

Forest cover in this report is represented as a percentage of the total land base within the SNC jurisdiction, See Appendix B & C - Forest Cover Maps and Graphs. Forested areas were identified by type across the entire SNC jurisdiction, and also broken down within municipalities. Additionally, forest cover was assessed beyond just regions/municipalities, and was looked at in relation to physiographical unit within the SNC jurisdiction.

3.0 Results

3.1 Forest Cover Trends

A report produced by SNC in 2014 on forest cover, based on 2008 DRAPE, identifies forest cover for the SNC watershed area only [12]. The DRAPE imagery used to assess forest cover in 2014 addresses forest cover for the entire SNC jurisdiction. This increased area includes parts of: South Dundas, Edwardsburgh-Cardinal, Augusta, The Nation, and Alfred-Plantagenet, in addition to the original watershed area.

Between 2008 and 2014, the forest cover across the SNC jurisdiction decreased from 29.3 percent to 28.1 percent in 2014. That forest cover change equates to a total forest cover loss of approximately 5,321 hectares or 4.1 percent of forests lost between 2008 and 2014 within the SNC jurisdiction (Table 2). The 2014 DRAPE analysis provided a higher level of accuracy for forest cover when compared to 2008 due to the higher resolution, boundary updates and a more comprehensive capture of attribute data. Any differences in the interpretation of forest cover changes between the 2008 and 2014 may be attributed to the following factors:

1. Imagery:
 - a. Less shadow effect in stand boundary delineation;
 - b. Higher resolution imagery.
2. Boundary changes:
 - a. Significant change to SNC jurisdictional boundary;
 - b. Changes to municipal boundaries due to data updates.
3. Aerial photo interpretation and digitizing:
 - a. Aerial photo interpretation and digitizing was undertaken by several individuals within the partnership group.
4. Attributes:
 - a. A more comprehensive capture of attribute data.

Overall, more forest cover was lost in SDG and UCPR than in UCLG (Table 3) and each municipality experienced some level of decrease in forest cover (Table 4).

Table 2. Total forest cover in 2014 and trend (percent) from 2008 to 2014 by jurisdiction.

Jurisdiction	Total Forest Cover (percent)	Forest Cover Change (percent)
South Nation Conservation	28.1	-4.1

Table 3. Total forest cover in 2014 and trend (percent) from 2008 to 2014 by upper-tier municipality.

Upper-tier Municipality	Total Forest Cover (percent)	Forest Cover Change (percent)
Stormont, Dundas and Glengarry	29.0	-4.3
Leeds and Grenville	47.4	-1.1
United Counties of Prescott and Russell	24.8	-4.5

Table 4. Total forest cover in 2014 and trend (percent) from 2008 to 2014 by municipality (lower and single-tier).

Municipality	Total Forest Cover (percent)	Forest Cover Change (percent)
Alfred-Plantagenet	25.5	-3.0
Augusta	46.4	-0.2
Casselman	3.4	-6.5
Champlain	24.1	-5.3
Clarence-Rockland	37.6	-1.4
Edwardsburgh/Cardinal	48.9	-1.9
Elizabethtown-Kitley	46.8	0.0
Nation	25.4	-4.6
North Dundas	13.3	-2.1
North Glengarry	33.6	-2.1
North Grenville	44.9	-0.6
North Stormont	25.6	-6.5
Ottawa	26.2	-3.7
Russell	12.7	-11.3
South Dundas	31.5	-4.1
South Glengarry	28.7	-3.9
South Stormont	41.1	-3.7

3.2 Forest Cover Composition

Within the entire jurisdiction, forest cover was predominately treed/woodland area, plantations were second most common, and hedgerows were the least common cover type (Table 5).

Table 5. Percentage of forest cover by type in the SNC jurisdiction.

Treed (percent)	Plantation (percent)	Hedgerow (percent)
85	12	3

When forest cover type was assessed by upper-tier municipalities, treed areas were still most common, but UCPR had a higher amount of plantation cover compared to the other two upper-tier municipalities (Table 6). Larose Forest, within UCPR, is comprised of plantations amounting to approximately 26, 000 acres, which contributes to the higher plantation coverage.

Table 6. Percentage of forest cover by type by upper-tier municipality.

Upper-tier Municipality	Treed (percent)	Plantation (percent)	Hedgerow (percent)
Stormont, Dundas and Glengarry	90	6	4
Leeds and Grenville	97	1	2
United Counties of Prescott and Russell	75	24	2

*Numbers may not add up to 100% due to rounding of percentages.

When looking at lower and single-tier municipalities, treed area is again extremely predominant, however the occurrence of plantation and hedgerows are more varied amongst the areas (Table 7).

Table 7. Percentage of forest cover by type by municipality (lower and single-tier).

Municipality	Treed (percent)	Plantation (percent)	Hedgerow (percent)
Alfred-Plantagenet	89	9	2
Augusta	97	1	2
Casselman	86	5	10
Champlain	93	5	2
Clarence-Rockland	68	31	1
Edwardsburgh/ Cardinal	97	2	1
Elizabethtown-Kitley	99	1	1
Nation	59	39	1
North Dundas	83	8	9
North Glengarry	91	5	5
North Grenville	96	1	3
North Stormont	90	7	3
Ottawa	89	3	9
Russell	82	6	13
South Dundas	91	3	6
South Glengarry	89	6	5
South Stormont	91	3	6

*Numbers may not add up to 100% due to rounding of percentages.

3.3 Forest Cover by Physiographic Unit

Overall forest cover was highest in the Edwardsburgh Sand Plain and Smith Falls Limestone Plane physiographic regions, and was lowest in the Ottawa Valley and Winchester Clay Plains (Table 8).

Table 8. Percentage of forest cover by physiographic region within the SNC jurisdiction.

Physiographic Unit	Total Forest Cover (percent)
Edwardsburgh Sand Plain	45.4
Glengarry Till Plain	35.0
North Gower Drumlin Field	21.0
Ottawa Valley Clay Plain	16.5
Russell and Prescott Sand Plains	38.6
Winchester Clay Plain	7.9
Smith Falls Limestone Plain	46.0

3.4 Improvements

While extensive forest cover information was obtained for this study, due to mild discrepancies between 2008 and 2014 methodology, it's worth considering how future forest cover studies could be improved to obtain the best, most representative information possible. The 2014 DRAPE aerial photography was captured during leaf-off season. The 2008 DRAPE aerial photography was captured with approximately 80 percent leaf-off and 20 percent leaf-on. This condition did not affect the identification of the woodland polygons in 2008, but did affect boundary delineation due to the shadow effect of edge trees. Aerial photography in leaf-off conditions is recommended for all forest cover studies.

Additionally, ground verification of the data did occur in some of the areas, but not all. This was not a requirement within the methodology for the 2008 and 2014 study, but methodology should be updated for all future studies to include ground verification as a required component. This would ensure a representative sample area is field surveyed throughout the study area.

Forest types (treed, plantation, hedgerow) were rounded to the nearest percentage for the 2014 data due to inherent errors with aerial photo interpretation of boundary delineation and classification from a distance. Photo interpretation and digitizing undertaken by one organization would help to maintain quality control, reducing discrepancies in polygon and boundary delineation and forest type classification.

4.0 Discussion

With the steady rate of economic growth in Eastern Ontario, assessing current forest cover trends is crucial for encouraging conversation and garnering stewardship support that can appropriately address regional forest loss. In the SNC jurisdiction, 4.1 percent of forest cover was lost between 2008 and 2014, leaving just 28 percent total forest cover in the jurisdiction. This value falls below the minimum forest cover threshold of 30 percent recommended by Environment and Climate Change Canada [8]. Even at 30 percent forest cover, Environment and Climate Change Canada stresses that potential species richness and aquatic system health is seriously limited and at risk.

Overall, the jurisdiction's 4.1% loss of forests was estimated to equate to approximately 890 hectares (2,200 acres) of lost forested land, annually. Based on the definition set by Ontario Nature, forested land is considered an area in which at least 1000 trees exist, of any size, per hectare [13]. Based on this definition, the total annual forest loss would equate to nearly 1 million trees lost in the SNC jurisdiction every year.

Population and economic growth in Eastern Ontario is impacting land use in this region. Agricultural development has increased throughout municipalities within SNC's jurisdiction and in 2011 the leading land use for farms in Eastern Ontario was cash crops [14]. Eastern Ontario's population between 2006 and 2011 grew by 5.9 percent, accounting for 13.6 percent of provincial growth [15]. In the SNC jurisdiction, UCPR is the only upper-tier municipality with an estimated growth in population from 2008 to 2014 [16]. This suggests that with little population growth in the area, and given enough community support, there is promising capability for stewardship action that will allow SNC to promote sustaining the current forest cover in the region. Within the upper-tier municipalities, SDG experienced a 4.3 percent loss; UCPR saw a 4.5 percent decrease, and Leeds and Grenville's forest cover decreased 1.1 percent (Table 2). By addressing land attributes such as soil quality and drainage, forest composition, and current land use practices, stewardship tools can be suggested that are specific to each region.

4.1 Forest Cover by Physiographic Unit

Land topography, soils, and drainage are natural features that influence forest cover and land use. SNC's jurisdiction is made of seven physiographic units, and these units each have unique topography, soil attributes, and drainage. These units include the Edwardsburgh Sand Plain, the Glengarry Till Plain, the North Gower Drumlin Field, the Ottawa Valley Clay Plain, the Russell and Prescott Sand Plains, the Winchester Clay Plain, and the Smiths Falls Limestone Plain [17]. Table 8 shows the percent forest cover for each physiographic unit within SNC's jurisdiction, with the highest forest cover on the Smith Falls Limestone Plain at 46.0 percent, followed by Edwardsburgh Sand Plain and Russell and Prescott Sand Plains at 45.4 percent and 38.6 percent, respectively. Areas with sand plains tend to have higher forest cover because they are not suitable for agricultural production. These sites are characterized as having low soil fertility and are vulnerable to water and wind erosion when cleared. Additionally, the Smith Falls Limestone Plain is likely associated with a higher forest cover due to limited land use suitability associated with shallow soils over limestone and poor drainage [3]. The municipalities within UCLG have the highest amount of forest cover with a total of 47.4 percent and had the least amount of forest cover decline between 2008 and 2014 (Table 3) this is likely explained by their location upon the Smith Falls Limestone Plain and the Edwardsburgh Sand Plain.

The lowest forest cover was on the Ottawa Valley Clay Plain with 16.5 percent, and the Winchester Clay Plain with 7.9 percent. The low forest cover on the clay plains is indicative of its land capability and agriculture is the dominant land use in the area. The clay plains represent approximately 37 percent of the jurisdiction and are ideal lands for agricultural production due to the high soil productivity (See Appendix B – Forest Cover Maps Figure 8.) SDG has a forest cover of 29.0 percent and is a region mainly characterized by the Winchester Clay Plain and the Glengarry Till Plains; two regions that are highly productive when properly drained.

UCPR has a forest cover of 24.8 percent characterized by the Winchester Clay Plain (which, as noted above, contains soil effective for agricultural purposes and has low forest cover), the Russell and Prescott Sand Plains which are acidic and nutrient deficient and contain 38.6 percent forest cover, and the North Gower Drumlin Field. The drumlin field has a forest cover of 21 percent, and is a type of clay plain that is well drained and surrounded by clay soils that are poorly drained.

Generally, forest cover is higher in areas with less productive soil, poorer drainage and high perceptibility to erosion. Understanding land use potential and the corresponding forest cover can help guide future forest projects and take into account agricultural potential in the area to seek out balance.

4.2 Forest Composition

Important differences among types of woodlands can affect species diversity, richness and abundance. Forest cover within SNC's jurisdiction is primarily natural treed area, representing 85 percent of total forest cover; 12 percent is plantation and 3 percent is hedgerows. Natural treed areas account for greater than 80 percent of forest cover by municipality, with the exception of the Nation and Clarence-Rockland municipalities. The Nation maintains the highest percentage of plantations with 39 percent while Augusta, Elizabethtown-Kitley and North Grenville have much less plantation cover with only 1 percent. Casselman has the highest percentage of hedgerows with 10 percent, followed by North Dundas with 8 percent.

Forest cover is often categorized as interior forest and edge forest. Interior forested area, which could be found in natural forests and plantations, are defined as the portion of forest inside a 100 meter buffer from the outer edge of a forest [13]. Forest interior is important habitat and is important to maintain wherever possible. Forest edges are considered the transitional zone between forested and non-forested areas [18]. They tend to be homogenous in nature with less species diversity and this type of forest is vulnerable to predation, invasive species and has less protection from both natural and anthropogenic threats [19].

Interior forests are at risk of forest fragmentation caused by a variety of factors including: roadways, urban settlements, agriculture and other land uses. This in turn creates "island habitats" that isolate wildlife populations, limit genetic variability of declined populations due to inbreeding, provide poor habitat and increase species vulnerability to both natural and anthropogenic disturbances [19]. As such, with decreasing total forest cover, more focus is needed on increasing both the size and connectivity of interior forests [7]. Protecting and establishing new forested corridors (and thus increasing connectivity) help to facilitate the migration and dispersal needed for plants and animals to survive and thrive. Hedgerows can act as effective corridor between interior forest habitats and is a popular land sharing technique across North America and Europe [7] [20]. Areas that take advantage of strategic hedge planting can improve forest connectivity without extensively impacting current land uses.

Plantations are a common forest cover type across the SNC jurisdiction. Plantations have been demonstrated as extremely beneficial forest habitat when established on degraded land; however it isn't a replacement for the intrinsic value of natural forest ecosystems [21]. For this reason, priorities should first be to preserve current natural forest areas, and plantations should be encouraged when this primary preservation is not possible. By attending to the unique benefits of hedgerows, plantations, and natural

forests, steps can be taken to promote diversity, limit landscape fragmentation, and lessen the negative effects of habitat isolation.

Currently, the minimum forest cover target suggested by Environment and Climate Change Canada or 30 percent is necessary to monitor the condition of forests and provide performance measures. In addition to these minimum targets, incorporating further target measures, with a higher level of detail, could provide greater direction for forest cover management. Differences in forest cover potential, land cover use, future trends, and other variables could be taken into account to better outline achievable forest cover targets in addition to the 30 percent benchmark throughout the jurisdiction. For example, areas such as UCLG could benefit from more detailed target measures, other than minimum forest cover. This would more accurately reflect the geology, topography and land use pressures specific to the area. Targeted approaches to forest cover could also be developed by land use type in addition to geographic and physiographic regions. This multi-faceted approach to creating forest cover targets may provide information better suited to the needs of different stakeholders in order to maintain and improve forest cover.

Additionally, further site specific analysis to identify existing wildlife corridors, interior forests and gaps between forest patches would support strategic land acquisition and restoration efforts to have the greatest ecological impact. GIS analysis and modeling could also be used to indicate forested areas at risk of land clearing based on a series of physical and environmental factors that are conducive to deforestation, such as soil classification; drainage; accessibility to land; proximity to land development, among others [22]. Doing so could provide insight on areas where tree planting services and outreach are most needed to prevent further forest loss.

4.3 Existing Programs and Services

SNC together with member municipalities, Forests Ontario, industry groups, developers and other community partners have facilitated the planting of over 2.8 million trees over the past 27 years. Over 95,000 trees were planted on private land in 2016. The majority of tree planting projects focus on revitalizing previously idle land, or agricultural land, with native trees to create forested areas.

Acting as the first point of contact, the Woodlot Advisory Service (WAS) serves as an educational program to inform private woodlot owners of the various functions and benefits of woodlots. Through the WAS, woodlot owners are put into contact with various forestry resources and local woodlot owner organizations. The WAS provides woodlot owners with information on government programs such as the Managed Forest

Tax Incentive Program (MFTIP) which provides 75 percent tax relief on the municipal rate for property owners. Since 2009, over 220 woodlot site visits have been conducted on approximately 4,000 hectares. This program is made possible through support from member municipalities, UCPR, OWA, Boisés Est and Ontario Power Generation.

Since the 1960's, SNC has been purchasing land for conservation purposes with the support of local and provincial governments and other funding agencies. To-date, SNC has acquired 157 properties totaling over 4,500 hectares of land to secure and manage the long-term ecological benefits of these properties. Since 2000, SNC has secured approximately 1,200 hectares of land. There are several methods of land securement such as direct purchase, donation, split-receipt (partial donation) and conservation easements. In 2013, SNC developed a Land Securement Strategy to provide direction for future land purchases and donations. As a member of Ontario Land Trust Alliance, SNC is approved to accept donations of land through Canada's Ecological Gifts Program. Donors can benefit from significant tax incentives and preserve their natural heritage legacy. Every year, approximately 20 hectares of forested land is donated to SNC.

Community outreach initiatives are needed to engage all stakeholders (general public, municipalities, agricultural sector, residential and commercial/industrial developers and green energy producers) on the importance of maintaining forest cover and overall environmental health. This outreach is also valuable in raising awareness for the ongoing programs and projects SNC delivers. In 2015, over 100 volunteers supported 8 tree planting events, 1,200 students participated in maple syrup educational programs; and 63,000 flyers were disbursed promoting tree planting and WAS services. This also complements presentations to municipalities and the general public, which provides staff an opportunity to discuss available stewardship programs, services and funding. See Appendix E for a list of public presentations regarding forest cover and a summary of general comments. These initiatives promote other programs, such as Alternative Land Use Services, where marginal or fragile land is reverted back to its natural state and compensation on a per acre basis is returned to the participant. The overall economic, social, and environmental value of forests needs to continue to be portrayed to the community in order to continue support for these valuable conservation and management programs.

4.4 Future Stewardship Directions

Results from this study suggest that a significant increase in tree planting, forested land acquisition, and landowner outreach initiatives are needed to address the loss in forest cover across the SNC jurisdiction. Currently, approximately \$300,000 is spent by SNC

annually on tree planting and land acquisition throughout the jurisdiction. To maintain the forest cover percent of 28, over 1.7 million trees would need to be planted or 887 hectares of forested land secured, annually; based on the current rate of forest decline.

Based on the current tree-planting and land acquisition costs, \$2.6 million annually would be required to maintain the current forest cover percent of 28, through a coordinated approach between SNC's forested land acquisition and tree planting programs. This target would require a high level of landowner participation, continued funding, as well as available land and seedlings to be attainable.

However, even if this funding existed, there may not be enough current landowner interest or enough available private land for tree planting efforts to occur at the required scale. Based on current levels of interest combined with the development of a targeted program, an approach of planting 150,000 trees on private land and securing approximately 140 hectares of forested land could be achieved annually. This would require approximately \$690,000 in annual funding. This potential target, however, would not be enough to help maintain forest cover in the jurisdiction, as the rate of decline is too high. Additional funding and community support could be gained from partnerships with developers, farmer organizations, green energy producers, and industry to leverage even more progress towards mitigating future forest cover decline. This would also include subsidies for strategic planting of windbreaks, riparian buffers and forest connectivity at a reduced cost. Given that 90 percent of forested land is under private ownership, it is important that landowners have access to financial and technical resources.

Further analysis of forest cover is recommended as it would provide additional information which would also benefit local planning departments in assessing the impact of proposed land development projects, and provide opportunities to integrate forested areas in natural space planning. Science-based data could help SNC identify future areas with the greatest ecological benefit from stewardship projects to increase forest cover and forest connectivity. This important data can support policy and management decisions, and regulatory tools for forest conservation. The legislative authority to enact forest conservation By-laws are delegated to the local municipal government. See Appendix D for a summary of legislative tools. By reaching out to municipalities, offering up the most detailed data possible, and a more multi-faceted approach to forest cover protection, SNC can approach specialized programs to help limit the current rate of forest cover decline.

5.0 Conclusion

Forests offer many important economic, social and environmental benefits including carbon sequestration, oxygen release, water absorption, water filtration and erosion prevention, in addition to providing critical habitat for many different species. The overall importance of forests has lead Environment and Climate Change Canada to recommend 30 percent forest cover as a minimum to support diversity and these ecosystem services. Both 40 percent and 50 percent forest cover have been further recommended as better benchmarks to maintain better biodiversity and aquatic ecosystem health.

The digital analysis of aerial photography of Eastern Ontario from 2008 and 2014 has provided an update on the status of forest cover within the jurisdiction. In 2014, forest cover across SNC's jurisdiction was 28.1 percent. Approximately 5,321 hectares of forests were lost between 2008 and 2014, this represents a 4.1 percent decrease in forest cover and nearly one million trees lost every year. Therefore, forest cover in the jurisdiction has fallen below the Environment and Climate Change Canada recommended 30 percent for minimum environmental health. Changes in forest cover from 2008 to 2014 can be attributed to residential land development, industrial/commercial development, agriculture, solar farms, unsustainable forest harvest practices and other causes. Forest cover is also closely linked to land topography, soils, and drainage. Within the seven physiographic units within the SNC jurisdiction, forest cover was lowest in the Winchester Clay Plains and the Ottawa Valley Clay Plain, and the highest forest cover on the Smith Falls Limestone Plain.

In order to reach the 30 percent threshold for forest cover within the SNC jurisdiction, over 131,000 hectares of forest cover is needed. SNC's tree planting and forested land acquisition programs are helping curb this downward trend in forest cover, with over 2.8 million trees planted since 1990. In addition, SNC's forested land acquisition program acquires over 50 hectares of land annually. Despite these noteworthy accomplishments, a long-term plan is required to increase funding for tree planting, forested land acquisition and landowner outreach initiatives to counter forest cover loss across the SNC jurisdiction.

More analysis of forest cover data using GIS software would facilitate a more coordinated approach in both conservation and restoration efforts. The data presented in this report is meant to guide future stewardship programs, services and decision-making. SNC is committed to working with member municipalities, community groups, industry, government and private landowners to help build awareness and financial support on the importance of forest cover in order to sustain a healthy environment for future generations.

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Appendix A – Data Specifications

Southern Ontario Land Resource Information System

The SOLRIS [22] is a landscape level inventory of natural, rural and urban areas. SOLRIS follows a standardized approach to ecosystem description, inventory and interpretation known as the Ecological Land Classification for Southern Ontario.

Specifications for forest types as defined by the OMNRF SOLRIS Image Interpretation Manual Reference:

1. a) *Coniferous/Mixed/Deciduous Forest*, Description: a terrestrial vegetation community with at least 60 percent tree cover which more than 75 percent is either coniferous or deciduous canopy cover to be considered coniferous or deciduous forest, respectively. A mixed forest class has at least 60 percent tree cover, with than 25 percent conifer canopy cover, and also more than 25 percent deciduous canopy cover. A tree is defined as a woody plant usually with a single main stem capable under the right condition, of reaching heights of several meters or more. Cover is described as the area of ground cover or the relative proportion of coverage a particular plant species, vegetation layer or plant form represents.
2. *Plantation*, Description: A treed community with at least 60 percent tree cover in which the majority of trees have been planted. A tree is defined as a woody plant usually with a single main stem and capable, under the right conditions, of reaching heights of several meters or more. Cover is described as the area of ground covered or the relative proportion of coverage a particular plant species, vegetation layer or plant form represents.
3. *Hedgerow*, Description: A terrestrial vegetation community of at least 60 percent tree cover that is naturally occurring or planted as a linear feature, with a minimum width of 10 meters and a maximum of 30 meters. Hedgerows not connected to existing forested areas were to be excluded. A tree is defined as a woody plant usually with a single main stem and capable, under the right condition, of reaching heights of several meters or more. Cover is described as the area of ground covered or the relative portion of coverage that a particular plant species, vegetation layer or plant form represents.

*For detailed technical information on mapping scale, source data and limitations refer to SOLRIS Data Specifications 2015, Version 2.0.

Appendix B – Forest Cover Maps

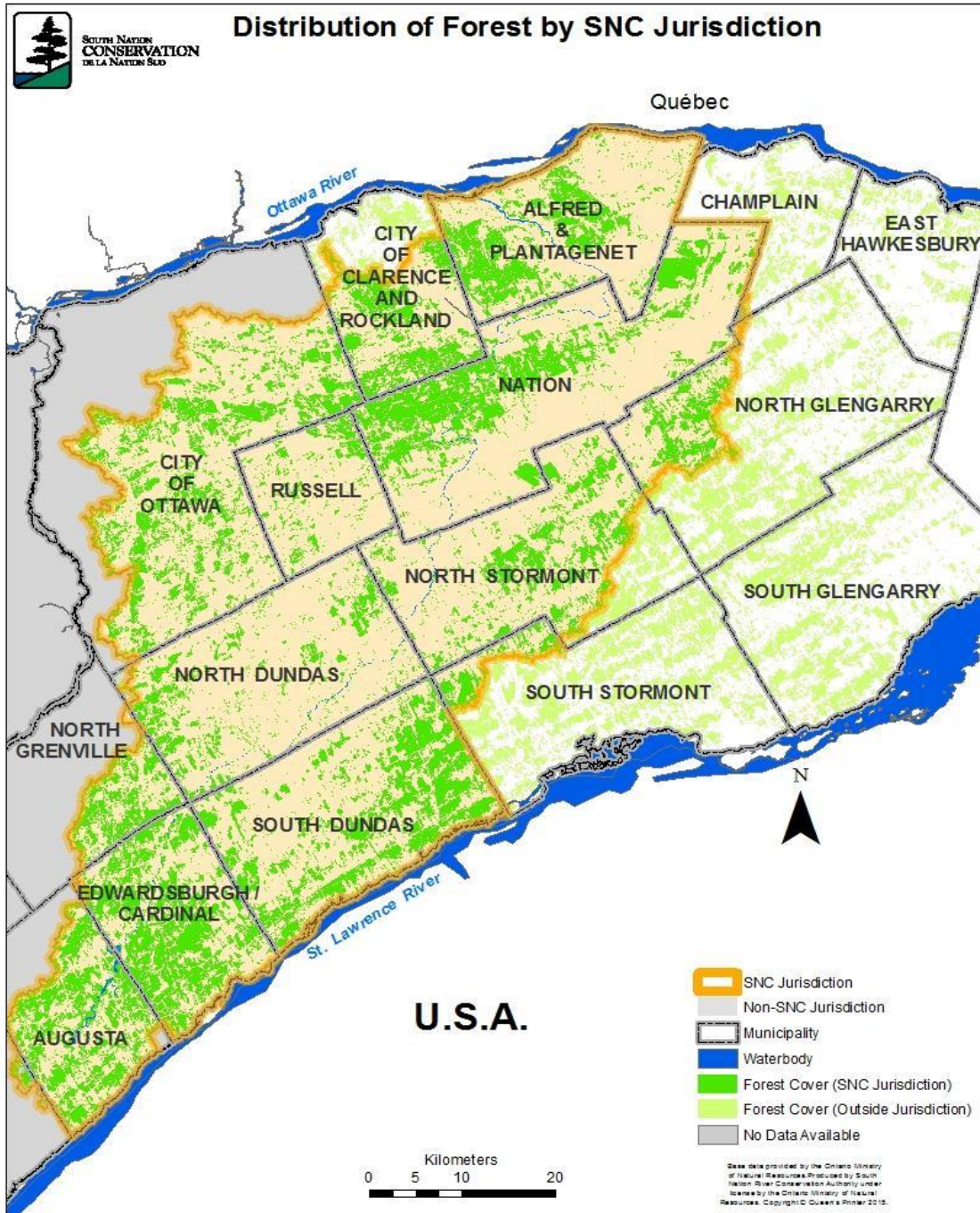


Figure 1. Distribution of forest by SNC jurisdiction.

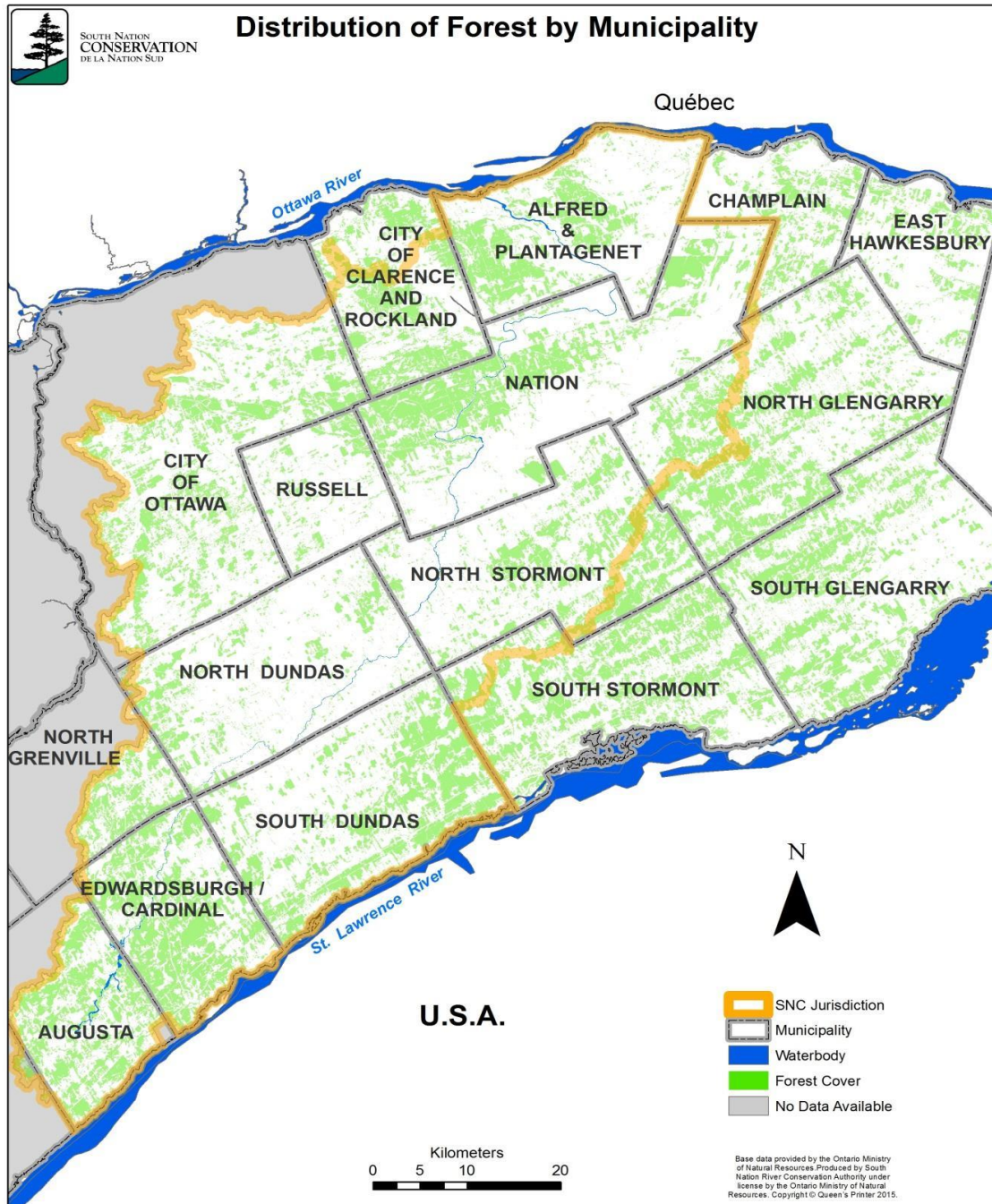


Figure 2. Distribution of forest by municipality.

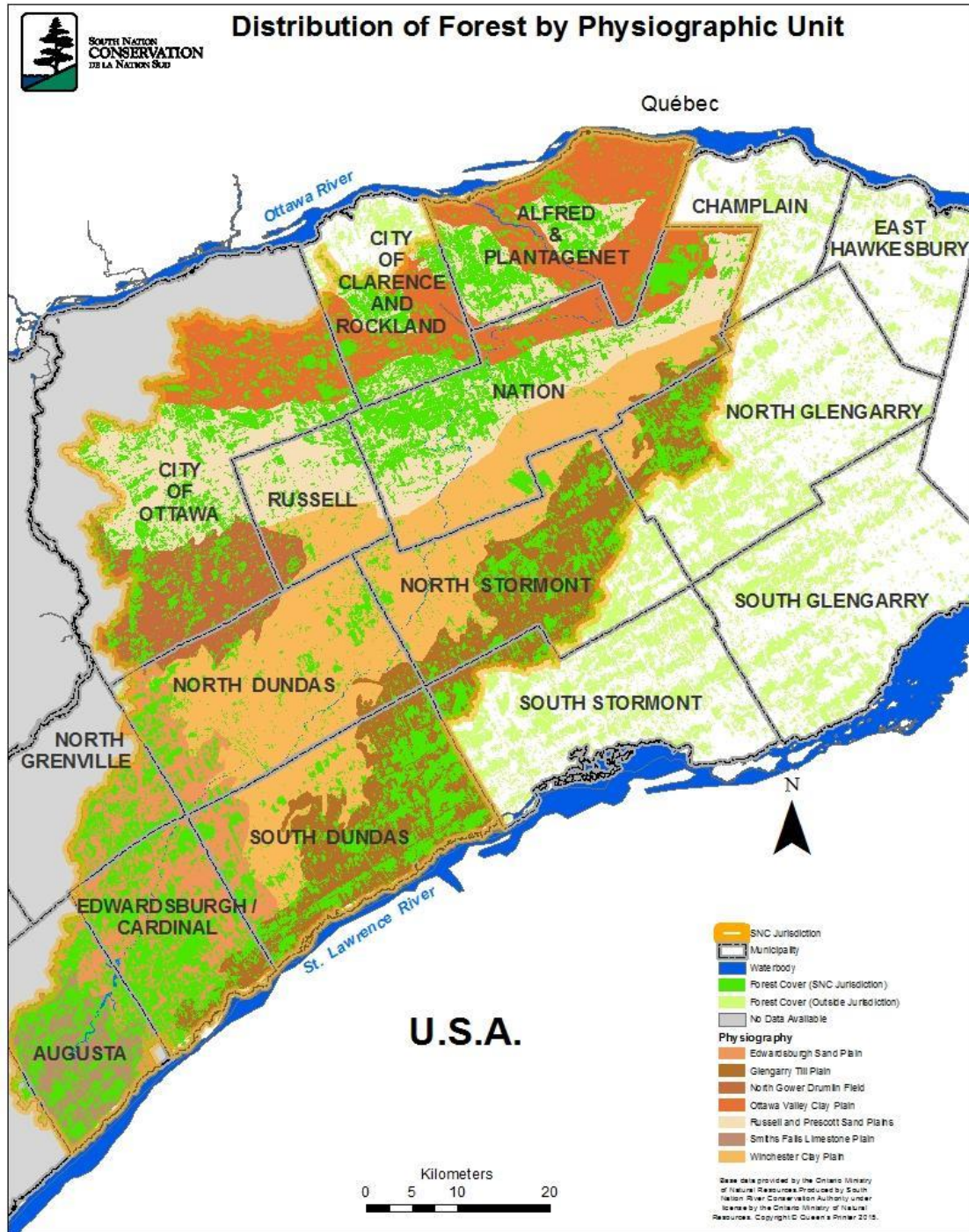


Figure 3. Distribution of forest by physiographic unit by SNC jurisdiction.

Appendix C – Forest Cover Graphs

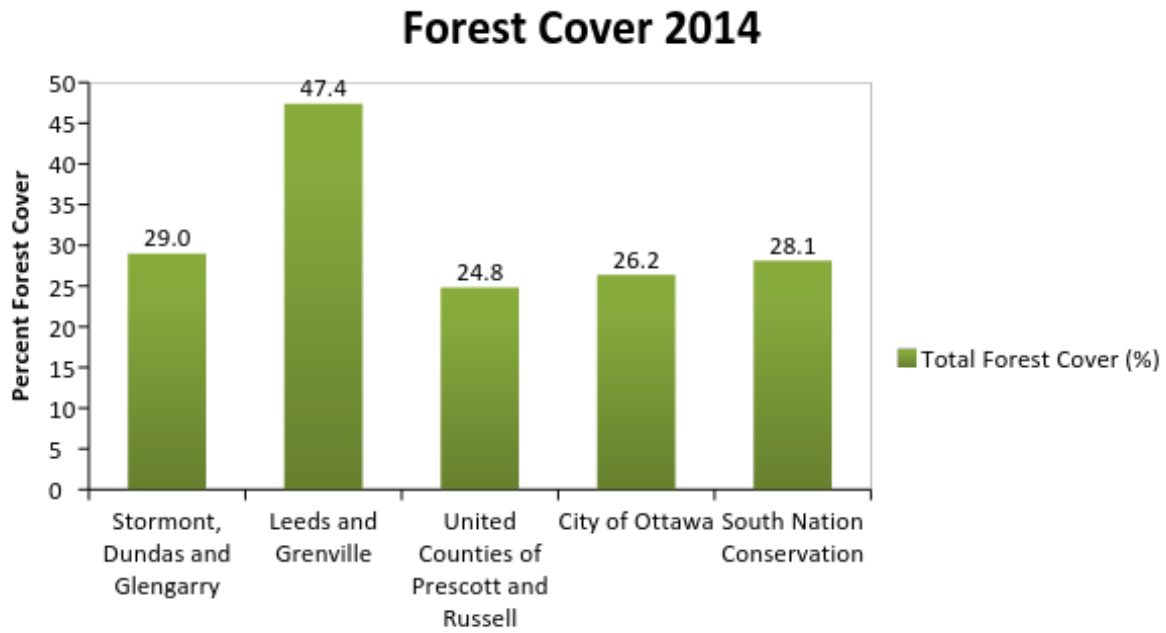


Figure 4. Total forest cover in 2014 (percent) by upper-tier municipality and the SNC jurisdiction.

Forest Cover by Type - SNC Jurisdiction 2014

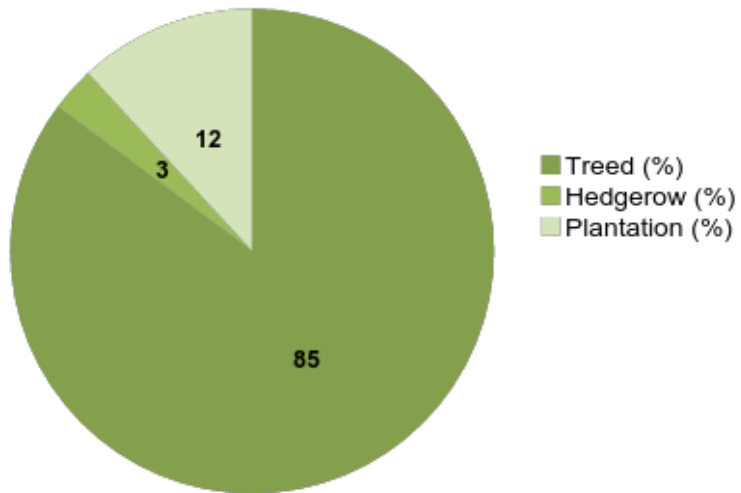


Figure 5. Forest cover by type in 2014 (percent) in the SNC jurisdiction.

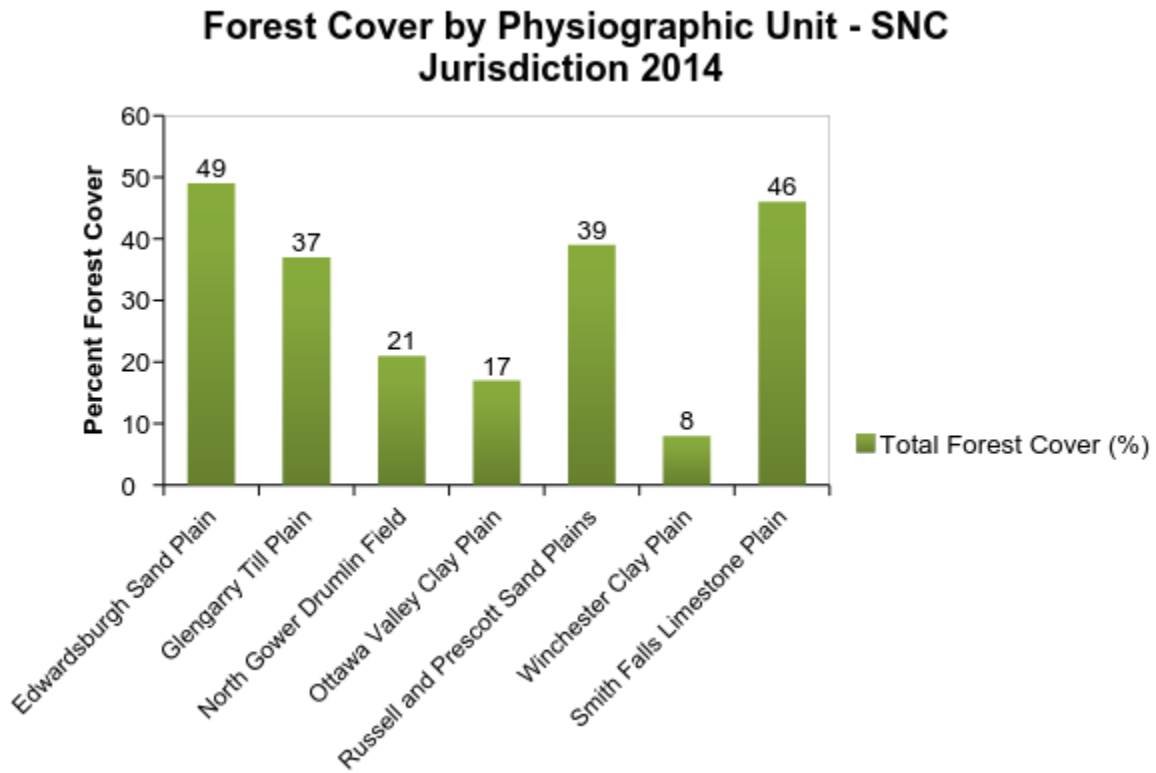


Figure 6. Percentage of forest cover by physiographic region within the SNC jurisdiction.

Appendix D – Summary of Legislative Tools

The Municipal Act (2001), in effect as of January 1st, 2003, enables all municipalities (upper tier, lower tier and single tier) to pass and enforce tree by-laws. Upper tier municipalities can regulate/prohibit tree cutting of woodlands that are 1ha or greater, whereas lower-tier municipalities can regulate/prohibit the cutting of individual trees in areas up to 1 ha in size. Delegation of responsibilities can occur from lower tier municipality to upper tier municipality and vice-versa. Single-tier municipalities have jurisdiction over both trees and woodlands.

The Official Municipal Plan and Zoning By-Laws, enacted under the Planning Act (1990), must be consistent with Provincial Policy Statements (PPS) which address the protection of natural heritage, which includes natural heritage features such as significant woodlands. Significant woodlands are designated and protected from negative impacts from development and site alterations in its area. Significant cultural landscape features must also be designated and protected, which includes trees associated with built heritage.

Renewable energy projects are subject to tree by-laws in the area through the Municipal Act, however are not subject to the Planning Act. Projects require a Renewable Energy Approval (REA) through the Ministry of Environment and Climate Change (MOECC), under the Environmental Protection Act. A natural heritage assessment is part of the REA to MOECC and is reviewed and confirmed by the MNRF, including woodlands; in addition, municipal consultation is also required.

Appendix E – List of Public Presentations and Summary of General Comments

2015 Forest Cover Presentations			
Date	Presentation Subject	Audience/Location	Municipality
December 12, 2015	Preliminary Forest Cover Analysis Presentation	Dundas Soil and Crop Improvement Association	North Dundas
December 16, 2015	Preliminary Forest Cover Analysis Presentation	Eastern Ontario Model Forest	North Grenville
2016 Forest Cover Presentations			
January 20, 2016	Preliminary Forest Cover Analysis Presentation	Upper St Lawrence River Protection Network	Cornwall
January 25, 2016	Preliminary Forest Cover Analysis Presentation	Prescott County Federation of Agriculture	La Nation
February 5, 2016	Preliminary Forest Cover Analysis Presentation	S.D.&G. Chapter of the Ontario Woodlot Association – Annual General Meeting	North Stormont
February 10, 2016	Preliminary Forest Cover Analysis Presentation	RRCA Water Quality Group	Cornwall
February 11, 2016	Forest Cover in Eastern Ontario	Upper Canada District School Board - Program of Excellence workshop	North Grenville
March 2, 2016	Preliminary Forest Cover Analysis Presentation	Russell Soil and Crop Improvement Association	Russell
March 31, 2016	Forest Cover in Eastern Ontario	Landowner Stewardship Lunch & Learn	North Stormont

April 1, 2016	Preliminary Forest Cover Analysis Presentation	Christian Farmers Association	South Dundas
April 6, 2016	Preliminary Forest Cover Analysis Presentation & Forestry Programs and Services	Environmental Advisory Committee of Russell Township	Russell
April 16, 2016	Preliminary Forest Cover Analysis Presentation (part of presentation on forest history of SDG)	Ontario Woodlot Association Annual General Meeting	Ottawa
April 18, 2016	Preliminary Forest Cover Analysis Presentation	St. Lawrence River Restoration Council	Cornwall
June 22, 2016	Preliminary Forest Cover Analysis Presentation	Forests Ontario: post-plant partner meeting	Milton

The 2016 Forest Cover and Trends Analysis Report have been communicated broadly with many agricultural organizations and community groups. Comments expressed during these events are addressed in the following four main points:

- Concern from the agricultural community regarding forest conservation by-laws and the need for compensation (environmental goods and services);
- Opportunity to work with community organizations on the value and benefits of forest, and the need to protect sub-agricultural lands for forest;
- Support for stewardship programs and forested land acquisition; and
- Support for forest conservation by-laws expressed by the general public