

South Nation Conservation: *Watersheds for life.*



SOUTH NATION
CONSERVATION
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Forest Cover and Trends Analysis

February 2014



TABLE OF CONTENTS

1. INTRODUCTION	1
2. OBJECTIVES	1
3. CONSTRAINTS	1
4. METHODOLOGY	2
5. RESULTS	2
5.1. FOREST COVER	3
5.2. FOREST FRAGMENTATION	5
6. COMPARISON OF FOREST COVER	7
7. RECOMMENDATIONS	9
8. REFERENCES	10
APPENDIX A	A-1
DISTRIBUTION OF FOREST BY 6 TH ORDEER WATERSHED	A-2
DISTRIBUTION OF FOREST BY MUNICIPALITY	A-3
DISTRIBUTION OF FOREST BY PHYSIOGRAPHIC UNIT	A-4
APPENDIX B	B-1

LIST OF TABLES

TABLE 1: PERCENT FOREST COVER BY WATERSHED	3
TABLE 2: PERCENT FOREST BY MUNICIPALITY AND FOREST TYPE	4
TABLE 3: PERCENT FOREST COVER BY PHYSIOGRAPHIC UNIT	5
TABLE 4: FOREST FRAGMENTATION ANALYSIS	6

LIST OF FIGURES

FIGURE 1: FOREST COVER TRENDS 1947-2008	8
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1. INTRODUCTION

In the South Nation Watershed, observations by local forestry professionals and the public suggest that the rate of decline in forest cover has increased in recent years. For this reason, the SNC Forest Advisory Committee initiated the forest cover and trends analysis project.

2. OBJECTIVES

The following objectives were established:

- Coordinate training to SNC staff and upper tier municipal partners related to the OMNR methodology to allow for an update of the Natural Resource Values Information System (NRVIS) Woodlands GIS layer.
- Analysis of the updated layer to determine the proportion of the South Nation Watershed that was under forest cover in 2008. The data shall be summarized at the watershed, sub-watershed and municipal scales.
- Forest cover will be summarized by
 - a) interior vs. edge
 - b) proportion of core interior forest
 - c) patch size
 - d) proportion of shoreline in forest
 - e) public vs. private ownership
 - f) proportion of Provincially Significant Wetlands (PSW) in forest.
- Compare updates to existing data sources.
- Provide recommendations to enhance targeted delivery of SNC forest-related programs within the watershed and SNC jurisdiction
- Provide recommendations to enhance SNC's ability to secure grants to bolster existing and new program delivery.
- Provide the collected information to other SNC departments to be incorporated into public and municipal education avenues related to the state of the forest and its impact on communities within our Watershed (e.g. drought and flood events, soil stability and productivity, etc.).

3. CONSTRAINTS

The following constraints to the project were identified:

- Undertake the analysis using established data sources and standards. For the study area, orthophotography acquired under the Digital Raster Acquisition Project East (DRAPE) 2008 was the most recent data source available.
- Use accepted data management analysis tools relevant to the study area.

4. METHODOLOGY

The project team consisted of GIS staff from the OMNR (2), SNC (4), UCPR (2), and UCSDG (1). A project coordinator was hired by SNC to schedule work and provide quality control/quality assurance throughout the project. In June 2012, a training session was held to familiarize staff with project data standards and procedures.

The editing of wooded areas was captured to the same standard used during Southern Ontario Land Resource Information System (SOLRIS) Phase 2, which was documented in the SOLRIS Woodland Editing Guide (OMNR. 2008). This provided a standardized method of capturing woodland boundaries through orthophotography that was consistent with other jurisdictions in Ontario. The current analysis utilized 2008 DRAPE imagery to create a new forest cover layer for the study area.

The process relied on visual interpretation of monoscopic imagery (DRAPE) viewed from a monitor and used the editing capability of ArcMap. The editing functions for the mapping of accruals and depletions of forest are very simply represented as new polygons or deleted polygons. Depletions are most often manifested through clear cutting which is usually the result of urban, industrial, or agricultural pressures. Accruals are most often manifested as tree plantations or natural regeneration due to idle land use.

It was planned to map only changes to existing available woodland layers; however, changes were significant to warrant creation of a new forest cover layer. In future, as new imagery becomes available it will be unnecessary to re-map all of the forest within the study area. This will enable resource managers and planners to establish forest cover trends in the future.

Forest area was summarized for the study area based on watershed and sub-watershed units; administrative units (municipalities) within the Watershed; and physiographic units within the Watershed. For the administrative and physical units mentioned above, the project examined total forest cover as a percentage of total area per unit. Forest area includes three components: woodland or natural treed areas, forest plantations, and hedgerows. Specifications for these sub-units are included in Appendix B.

5. RESULTS

Work on the project began in July 2012 and was completed by February 2013. The project area was approximately 6,700 square kilometers. The project team processed nearly 5,200 tiles (photographs) and made over 23,000 edits to the woodland layer, essentially completing a new forest cover layer for much of Eastern Ontario.

5.1. FOREST COVER

SOUTH NATION RIVER WATERSHED

Table 1 shows forest cover by watershed with corresponding maps in Appendix A. Forests occupy 28.1% of the land within the South Nation River Watershed. The sub-watersheds, the Bear Brook, Castor River, Lower South Nation River and Upper South Nation River have 37.6%, 19.9%, 28.3% and 28.8%, respectively.

TABLE 1 : PERCENT FOREST COVER BY WATERSHED

WATERSHED	
South Nation River Watershed	28.1 %
SUBWATERSHED	
Bear Brook	37.6 %
Castor	19.9 %
Upper South Nation	28.3 %
Lower South Nation	28.8 %

Within the South Nation River watershed, riparian forest, determined as forest within 30 meters of a watercourse, was assessed at 2.1 % of the total forest area.

MUNICIPAL

Municipal forest cover is shown in Table 2. Watershed forest cover by municipality is generally high, ranging from 13.3% to 54.0%. Municipalities with the highest percent forest cover include Alfred-Plantagenet, Augusta, Nation, Clarence-Rockland, City of Ottawa, Edwardsburgh-Cardinal, Elizabethtown-Kitley, North Glengarry, North Grenville, and South Stormont. The remaining municipalities have a high percentage of prime agricultural lands and as a result contain less forest cover; they include North Dundas, Russell, South Dundas and North Stormont.

Table 2: Percent Forest by Municipality and Forest Type

MUNICIPALITY	FOREST TYPE			TOTAL
	NATURAL	PLANTATION	HEDGEROW	
Alfred-Plantagenet	<i>30.7</i>	<i>3.2</i>	<i>0.6</i>	34.5
Augusta	<i>45.6</i>	<i>1.3</i>	<i>0.9</i>	47.8
Casselman	<i>4.0</i>	-	-	4.0
Clarence-Rockland	<i>24.1</i>	<i>15.1</i>	<i>0.5</i>	39.7
Edwardsburgh-Cardinal	<i>48.6</i>	<i>1.6</i>	<i>0.8</i>	51.0
Elizabethtown-Kitley	<i>53.5</i>	<i>0.3</i>	<i>0.2</i>	54.0
Nation	<i>14.5</i>	<i>11.1</i>	<i>0.3</i>	25.9
North Dundas	<i>11.2</i>	<i>0.9</i>	<i>1.2</i>	13.3
North Glengarry	<i>40.9</i>	<i>0.7</i>	<i>0.9</i>	42.5
North Grenville	<i>42.8</i>	<i>1.1</i>	<i>1.3</i>	45.2
North Stormont	<i>19.5</i>	<i>1.6</i>	<i>1.0</i>	22.1
Ottawa	<i>23.9</i>	<i>2.6</i>	<i>0.9</i>	27.4
Russell	<i>11.7</i>	<i>1.9</i>	<i>1.0</i>	14.6
South Dundas	<i>20.3</i>	<i>1.9</i>	<i>1.0</i>	23.2
South Stormont	<i>38.5</i>	<i>2.0</i>	<i>1.5</i>	42.0

There is considerable variation in the distribution of forest cover within a municipality, between the portion of the municipality in and out of the South Nation River watershed and among municipalities.

PHYSIOGRAPHIC UNIT

The South Nation River Watershed is made up of seven physiographic units: the Edwardsburgh sand plain, the Glengarry till plain, the North Gower drumlin field, the Ottawa clay flats, the Prescott-Russell sand plain, the Winchester clay plain, and the Smiths Falls limestone plain. The physical geography or physiography of an area greatly influences land use. Table 3 shows forest cover by physiographic unit.

TABLE 3: PERCENT FOREST COVER BY PHYSIOGRAPHIC UNIT

Edwardsburgh Sand Plain	45.4 %
Glengarry Till Plain	32.5 %
North Gower Drumlin Field	21.8 %
Ottawa Clay Flats	17.2 %
Prescott-Russell Sand Plain	40.4 %
Winchester Clay Plain	8.7 %
Smith Falls Limestone Plain	46.8 %

Forest cover is highest on the Smiths Falls limestone plain at 46.8%. Shallow soils associated with this physiographic unit limit other land uses.

The Prescott-Russell and Edwardsburgh sand plains have 40.4% and 45.4% forest cover, respectively. The sand plains are subject to water and wind erosion when cleared of forest. Much of the public forest land is situated on these sand plains, including the Larose Forest (UCPR) and the South Nation Forest.

The North Gower drumlin field and Glengarry till plain have 21.8% and 32.5% forest cover, respectively. Physically similar, the North Gower drumlin field has additional pressure from urban influences as compared to the Glengarry till plain.

The clay plains exhibit the lowest forest cover. The Ottawa Valley clay flats have 17.2% forest cover while the Winchester clay plain has 8.7% forest cover. The clay plains have the highest land capability classes for agriculture within the South Nation River watershed and agriculture is the dominant land use.

5.2. Forest Fragmentation

Fragmentation of the forest is a contributing factor to the loss of habitat and biodiversity in forests. Forest fragmentation occurs when large forest areas are divided into smaller parcels through human development, such as, building roads, agriculture, urbanization, or industrial development.

Forests can also be fragmented through natural processes of disturbance, including fire, storm damage, and the occurrence of insect and disease damage. Forests have evolved responses to natural disturbances and quickly regenerate. Modern forestry practices attempt to emulate

these natural disturbance patterns to initiate planned changes to the characteristics of the forest.

Table 4: Forest Fragmentation Analysis

Municipality	Forest Area (ha.)	Fragmentation Class (%)					
		Patch	Edge	Perforated	Small	Medium	Large
Alfred-Plantagenet	7,800	5.4	43.5	13.5	20.0	15.2	2.4
Augusta	8,410	6.4	52.4	5.7	15.8	9.5	10.2
Casselman	20	100.0	-	-	-	-	-
Clarence-Rockland	7,840	7.8	43.8	12.5	22.8	2.8	10.3
Edwardsburgh-Cardinal	13,050	4.5	44.5	5.7	18.7	2.7	23.9
Elizabethtown-Kitley	480	1.7	50.6	7.5	10.2	30.0	0.0
Nation	15,390	8.5	40.2	8.6	18.2	6.1	18.4
North Dundas	6,640	21.3	48.9	3.0	20.2	6.6	0.0
North Glengarry	5,140	7.4	52.4	5.8	20.3	11.3	2.8
North Grenville	4,370	7.1	56.0	5.0	26.0	2.0	3.9
North Stormont	9,590	12.9	51.1	4.6	18.0	9.0	4.4
Ottawa	17,710	16.2	51.6	6.0	18.7	6.0	1.5
Russell	2,900	29.3	48.4	3.6	18.7	0.0	0.0
South Dundas	7,560	10.4	47.2	3.5	14.2	7.3	17.4
South Stormont	2,080	9.1	47.4	3.5	18.8	4.9	16.3
Watershed	108,960	10.6	47.6	6.7	18.8	6.7	9.6

The analysis of forest cover examined forest fragmentation as a result of human activity by utilizing a computer model, the Forest Fragmentation Tool Version 2.0, developed by the University of Connecticut Center for Land Use Education and Research (CLEAR). The model classifies forest into four main categories: patch, edge, perforated and core forests. Core forests are further divided into small (less than 100 hectares), medium (100 to 200 hectares) and large core forest (greater than 200 hectares) based on area of the core. Forest ecology studies have

found that the habitat for certain species and the number of species is directly proportional to the size of the forest area.

Forest *patches* are small, autonomous parcels of forest that have no core forest area. *Edge* forest is the forest area within 100 meters of the forest edge and must include a core forest area. An edge width of 100 meters is commonly used for general purpose analyses (Environment Canada. 2013).

Perforated forests are forest areas within 100 metres of an opening in a core forest area.

Table 4 shows the dominance of edge forest throughout the watershed which ranges from 40 % to 56 % by municipality. The core forest associated with this edge forest is typically in the small core forest size class (less than 100 hectares) ranging from 10 % to 26 % of the forest. In areas exhibiting the lowest forest cover, the percentage of patch forest increases and large core forests are negligible. The forest can be characterized as highly fragmented and provides the greatest opportunity for improvement in forest cover.

Across the Watershed, large core forest areas represent 9.6 % of the forest. The large core forest areas are typically associated with crown, municipal, or conservation organization land holdings.

6. COMPARISON OF FOREST COVER

The annual rate of deforestation in Canada has declined since 1990. Deforestation in Canada is primarily the result of forest land conversion to agriculture, industrial development or urban expansion (Canada. 2012)

Despite the national trend in declining forest loss, after decades of increasing forest cover, local forest cover has begun to decline.

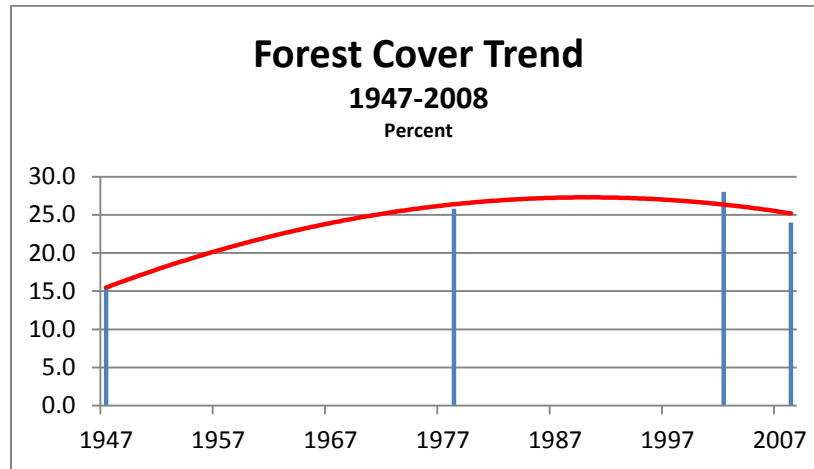
Early trends in forest cover of the South Nation River Watershed were chronicled in the South Nation Valley Interim Report (Ontario. 1948). At the beginning of the twentieth century forest cover ranged from 7% to 14% across the watershed. These early estimates were based on landowner assessments of their woodland holdings as reported in the Census of Canada.

Figure 1 shows local trends in forest cover since 1947 (SNRCA.1948; SNRCA.1978; OMNR.2002; SNRCA.2008).

In 1946, the first systematic assessment of forest cover commenced and was completed the following year. The result of this survey indicated that forest cover in the South Nation River Watershed was 15.6 %.

In 1957, the Province launched the Forest Resource Inventory (FRI) Program to provide statistical forest data on a 10-year cycle. The earliest of these inventories was not available for digital analysis; however, in 1983 forest cover in the South Nation River watershed was reported as 25.8 %. The FRI program in Southern Ontario was terminated in the early 1990's.

Figure 1



The 2002 forest cover was derived from the Southern Ontario Land Resource Information System (SOLRIS). The SOLRIS inventory is a compilation of data from various sources including topographic maps, aerial photos and satellite imagery. Computer modelling, visual interpretation and field validation are used to create a seamless inventory for Southern Ontario, including the current study area.

Locally the woodland layer was created using both Quick Bird and Landsat satellite imagery, the latter being augmented with the use of infrared orthophotography (Pers. Comm.A.Bibby). Hedgerows would not be included in 2002 SOLRIS estimates of forest cover. Narrow sinuous features, such as hedgerows and narrow riparian forests, are beyond the resolving power of the satellite imagery used in eastern Ontario. For comparison, that portion of the forest that was not evaluated in 2002 was removed from the 2008 results in order to assess change in forest cover

For the six years between 2002 and 2008, forest cover has declined by 510.9 hectares per year or 3,065.5 hectares.

Since 1947, increases in forest cover have been the direct result of programs to educate landowners and provide forest management advice, the acquisition of land by public agencies, and afforestation programs. The SNC Forest, together with the County Forests, contributed

significantly to the magnitude and success of early afforestation efforts through the 20th century (OMNR.2001).

7. RECOMMENDATIONS

SNC has all the elements for a successful forest land use strategy: an active land acquisition program; tree planting program; private land forest advisory program. Combined these programs protect existing forest through acquisition or landowner education and awareness, or provide for afforestation of non-forested areas. SNC needs to develop strategic objectives within these programs and programs influenced by forest cover, to enhance forest cover. The next step is to share the information contained within this report with program managers to develop targeted programs.

Future analysis via successive aerial photography missions (i.e. DRAPE) will provide information to evaluate effectiveness of programs and adapt to changing socio-economic and environmental conditions in the watershed.

8. REFERENCES

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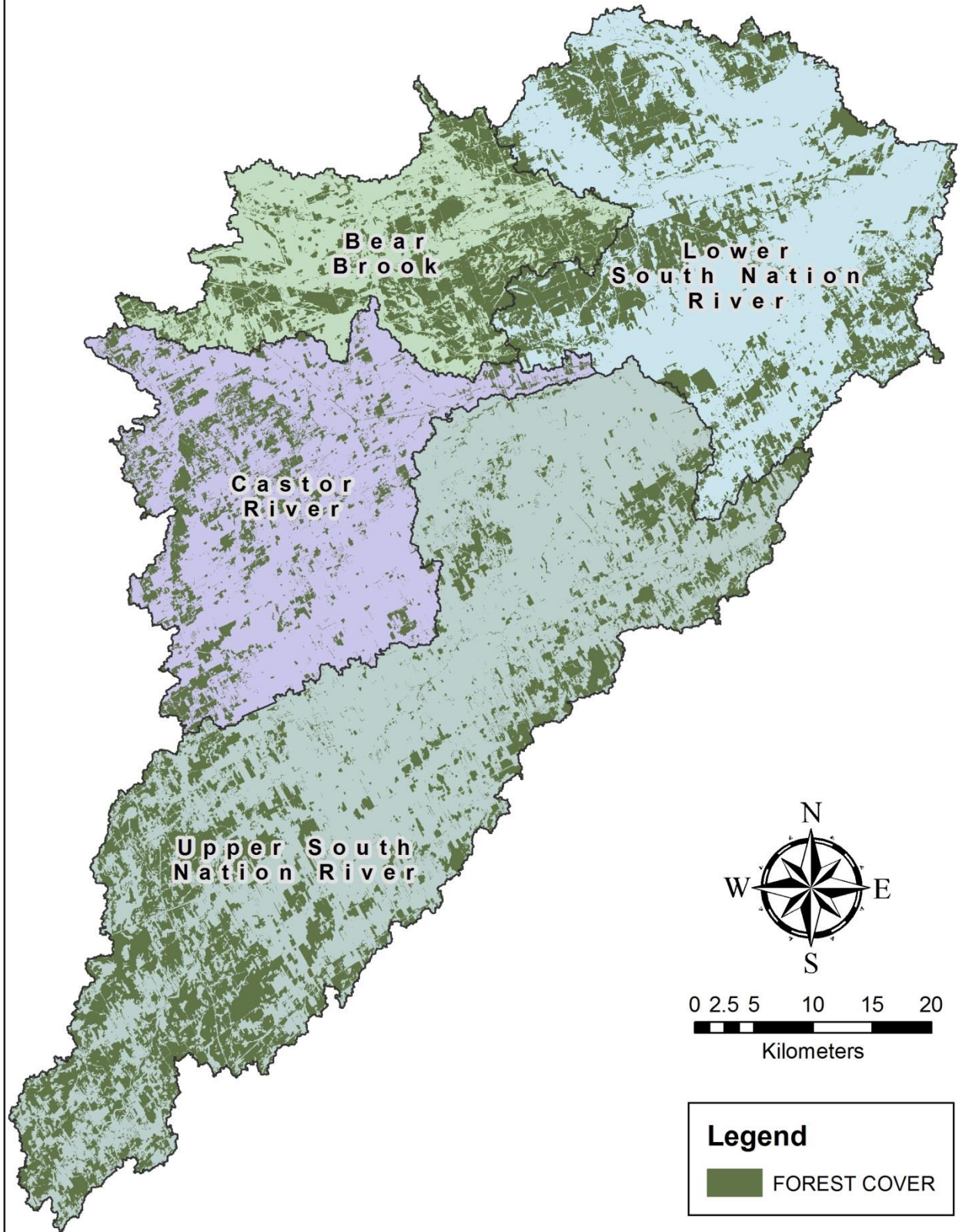
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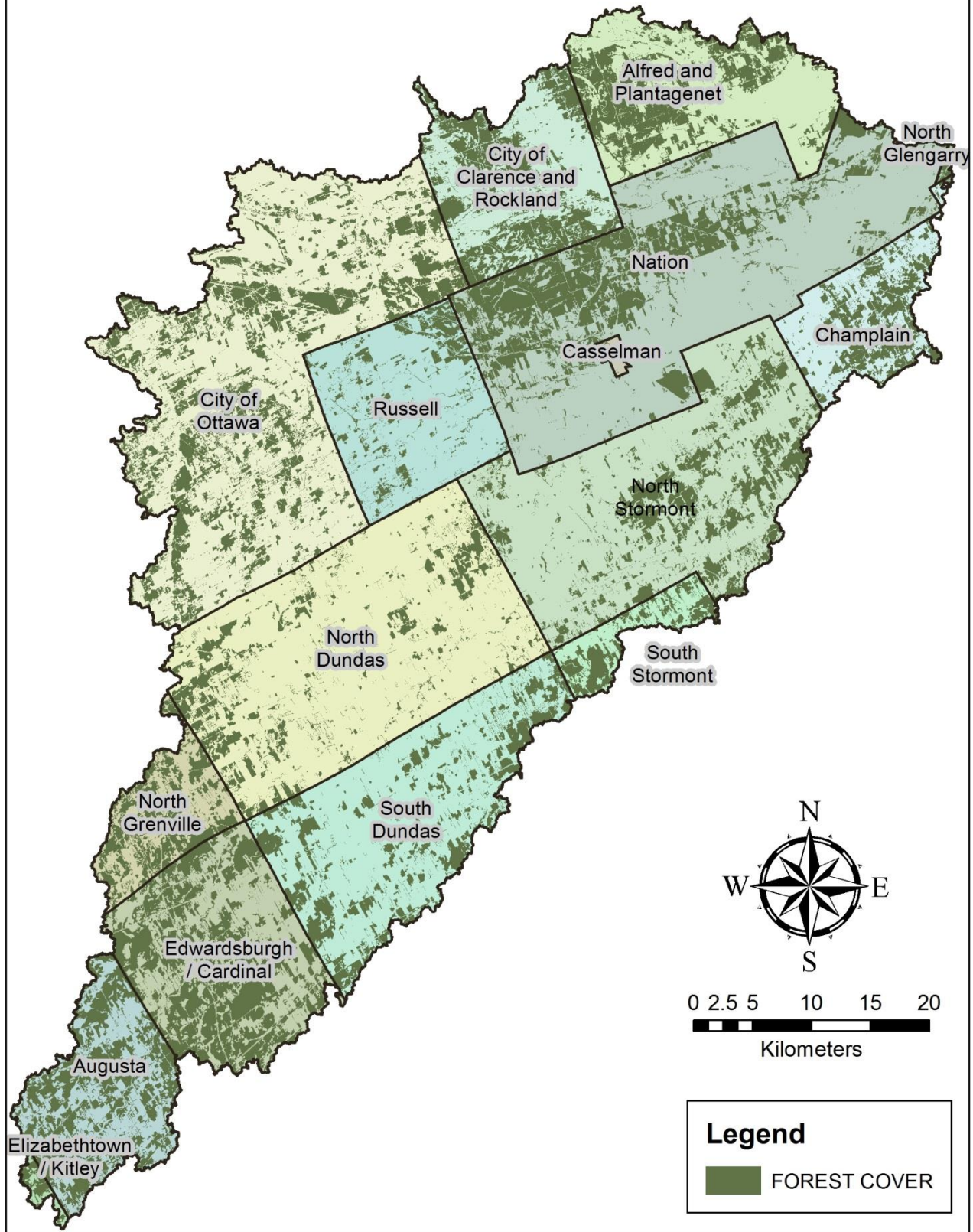
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APPENDIX A
MAPS

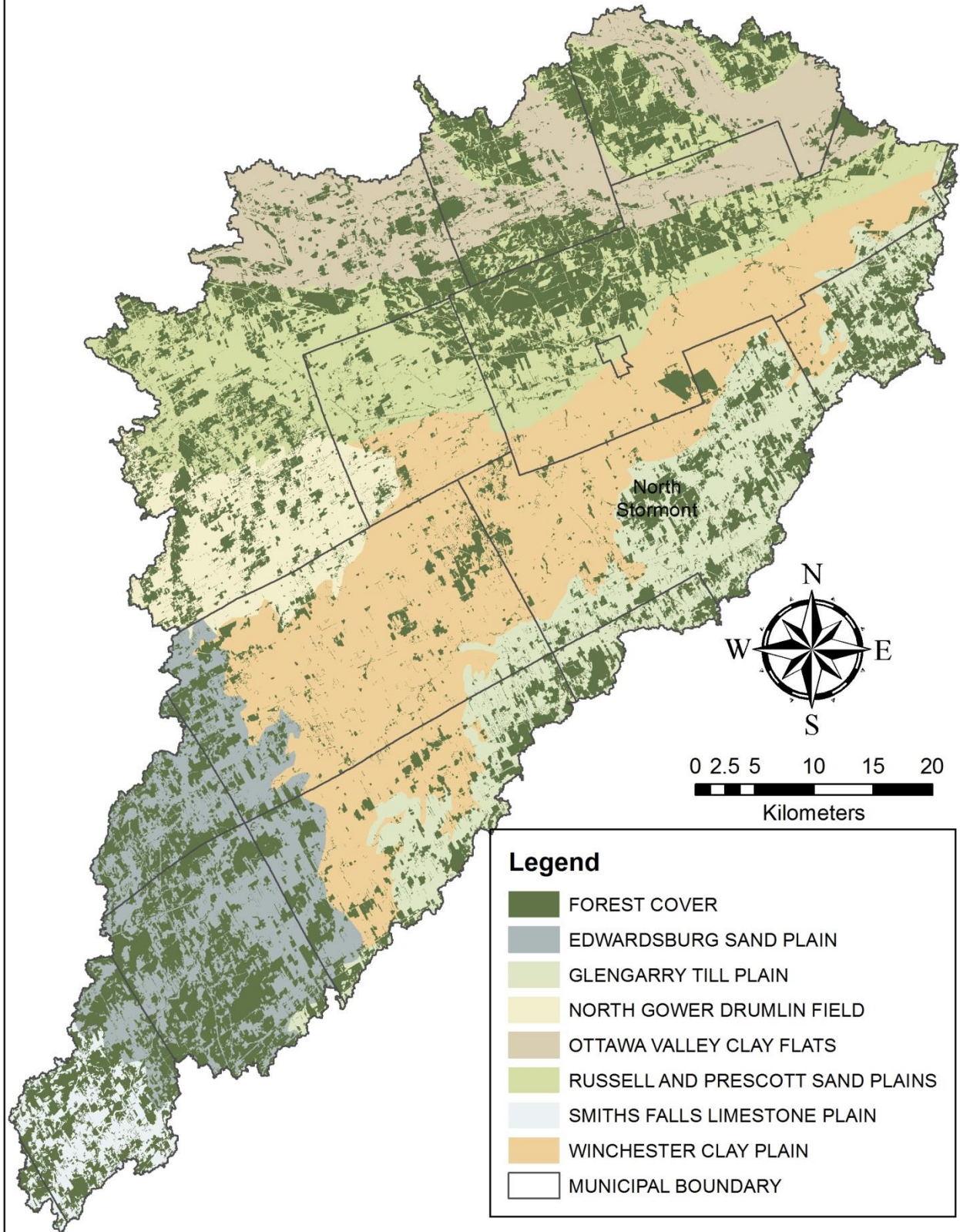
Distribution of Forest by 6th Order Subwatershed



Distribution of Forest by Municipality



Distribution of Forest by Physiographic Unit



Appendix B

SOLRIS Mapping Standards

Minimum Mapping Unit (MMU)	0.25 hectares
Woodland/ Treed Area	<p>Woodland must be contiguous and be 0.25 hectares or larger in size.</p> <p>Woodlands must represent greater than 60% tree cover and greater than 2 metres in height.</p> <p>Woodland should be separated (split) if crossed by non-woodland features greater than 20 metres in width (i.e. roads, power lines).</p> <p>Woodlands should be merged if separated by non-woodland feature less than 20 metres in width (i.e. roads, water bodies, power lines).</p> <p>Treed swamps are to be mapped as wooded features.</p>
Hedgerow	<p>Minimum width 10 metres, maximum width 15 metres.</p> <p>Hedgerows that consist of 2 contiguous tree rows are often greater than 15 metres wide but should still be captured.</p> <p>Minimum length 250 metres of contiguous hedge row.</p> <p>Contiguous does not mean straight.</p> <p>Not horticultural crops such as Christmas trees, orchards, nurseries and plantations.</p> <p>Can be any naturally occurring or planted line of trees.</p> <p>Should be split away from existing woodland polygons.</p>
Plantation	<p>A plantation is a homogeneous grouping of trees, usually in planted rows, for cultivation purposes.</p> <p>Same basic rules as woodland.</p> <p>Do not include horticultural crops such as Christmas trees, orchards, or nurseries.</p> <p>Plantations should be split away from existing wooded polygons.</p> <p>The 20 meter split rule applies when divided by water bodies, roads or any other linear features.</p>