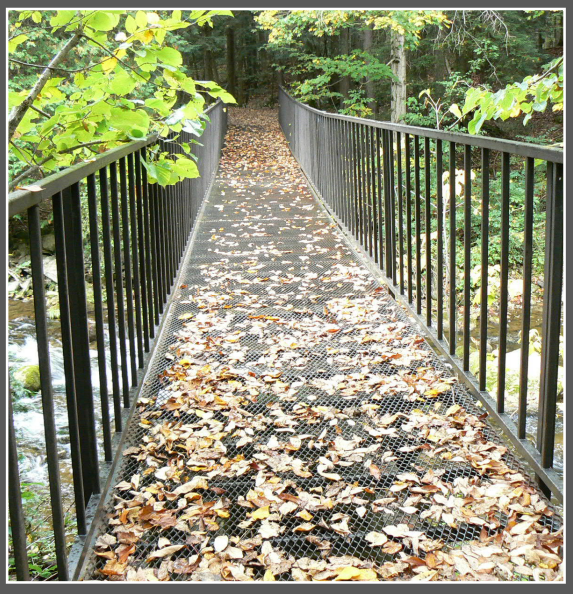
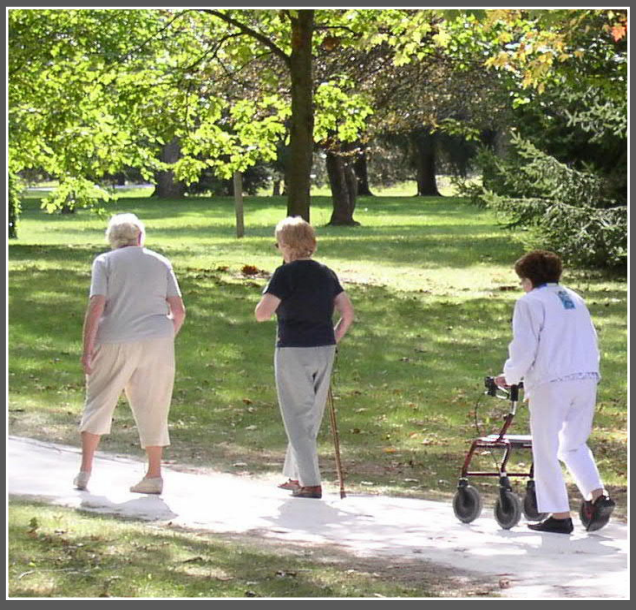
The Value of Our Natural Areas



A Cursory Valuation of Ecosystem Services Provided by Grey Sauble Conservation Properties



Grey Sauble Conservation
Tim Lanthier
2018

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Introduction

Grey Sauble Conservation (GSC) has been actively protecting the natural landscape of Grey and Bruce Counties for over 60-years through property acquisition and sustainable land management efforts.

GSC's Mission Statement is, "In partnership with stakeholders of the watershed, to promote and undertake sustainable management of renewable natural resources and to provide responsible leadership to enhance biodiversity and environmental awareness".

This report will provide a preliminary evaluation of the value of the benefits provided to our residents and visitors by the more than 11,000 hectares of land within the GSC's land portfolio.

Defining and Valuating Ecosystem Services

The ecosystem in which we all live provides us with numerous goods and services. The goods provided by these ecosystem areas can easily be quantified utilizing standard valuations, by determining the value for which the item or items can be sold for within a given market. These goods include items such as food, water, and timber.

The ecosystem services provided by a given area are a little more obtuse, and the value of the services provided by the ecosystem are more difficult to understand and account for. Ecosystem services are items such as aesthetic enjoyment, recreational opportunities, flood attenuation, drought moderation, climate regulation, wildlife benefits, educational opportunities, freshwater supply, nutrient sequestration, carbon sequestration, etc. These ecosystem goods and services can be considered our "natural capital", which should be considered as assets with value similar to our other capital investments.

Simple market analysis could review items such as local tourism, real estate, or recreational sales to try to account for the values provided by these services. More specifically, this could include how much money people are spending or are willing to spend to visit a natural area, how much property values are affected by proximity to certain natural features, and how much money is spent annually on outdoor activities such as boating, hiking, hunting, and fishing.

The flaw with a market analysis approach is that it undervalues, or fails to consider, the services provided by natural ecosystems in terms of the non-market benefits they provide associated with ecosystem services, including water quantity and quality regulation, air filtration, wildlife habitat, pollinator habitat, erosion prevention, nutrient cycling, and aesthetic enjoyment.

Table 1-1 was taken from "*Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services*" (Wilson, 2008) and does a good job of defining the various ecosystem services provided by the natural and agricultural areas in southern Ontario. Some of these may be defined as intermediate services that ultimately lead to a final ecosystem service (eg: pollination leading to food production).

Functions	Ecosystem Processes	Ecosystem Services
Gas Regulation	Role of ecosystems in bio-geochemical cycles (e.g. CO_2/O_2 balance, ozone layer	Uvb protection by ozone, maintenance of air quality
Climate Regulation	Influence of land cover and biological mediated processes on climate	Maintenance of a favourable climate, carbon regulation, cloud formation
Disturbance Prevention	Influence of ecosystem structure on environmental disturbances	Storm protection, flood control, drought recovery
Water Regulation	Role of land cover in regulating runoff and river discharge	Drainage, natural irrigation, transportation
Water Supply	Filtering, retention and storage of fresh water	Provision of water by watersheds, reservoirs and aquafers
Soil Retention	Role of vegetation root matrix and soil biota in soil retention	Prevention of soil loss/damage from erosion/siltation; storage of silt in lakes, and wetlands; maintenance of arable land
Soil Formation	Weathering of rock, accumulation of organic matter	Maintenance of productivity on arable land; maintenance of natural productive soils productive soils
Nutrient Cycling	Role of biota in storage and re-cycling of nutrients (e.g. nitrogen)	Maintenance of healthy soils and productive ecosystems; nitrogen fixation
Waste Treatment	Role of vegetation and biota in removal or breakdown of xenic nutrients and compounds	Pollution control / detoxification, filtering of dust particles, abatement of noise pollution
Pollination	Role of biota in the movement of floral gametes	Pollination of wild plant species and crops
Biological Control	Population and pest control	Control of pests and diseases, reduction of herbivory (crop damage)
Habitat	Role of biodiversity to provide suitable living and reproductive space	Biological and genetic diversity, nurseries, refugia, habitat for migratory species
Food Production	Conversion of solar energy, and nutrient and water support for food	Provision of food (agriculture, range), harvest of wild species (e.g. berries, fish, mushrooms)
Genetic Resources	Genetic materials and evolution in wild plants and animals	Improve crop resistance to pathogens and crop pests, health care
Medicinal Resources	Biochemical substances in and other medicinal uses of biota	Drugs and pharmaceuticals, chemical models & tools
Recreation	Variety in landscapes	Ecotourism, wildlife viewing, sport fishing, swimming, boating, etc.
Education, Culture & Spirituality	Variety in landscapes, natural features and nature	Provides opportunity for cognitive development: scenery, cultural motivation, environmental education, spiritual value, scientific knowledge, aboriginal sites

Table 1-1: Excerpt from Wilson, S.J. 2008. "Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services"

Significance of Ecosystem Services

Ecosystem services are generally considered from an anthropogenic perspective, since we as humans, intrinsically find the most value in things as they relate to us. As such, some of the seemingly non-human related ecosystem services considered within this report may indeed have societal benefits. For example, wildlife habitat provided by certain cover types assists in biodiversity and provides natural areas for wildlife to live out their life cycles. These services hold value independent of human interest. However, this same wildlife habitat also provides humans with opportunities for hunting, fishing, and nature appreciation.

An example of the significance of ecosystem services as it relates to the natural world and to humans is the importance of pollinators. The Government of Ontario states that, "in Ontario, managed honey bees and bumble bees generate approximately $897-million of the roughly $6.7-billion in sales for agricultural crops grown in the province each year".[1] Although this is astounding, it does not account for all the wild pollinators that also make significant contributions to food production, the natural product industry, and the natural environment within the province.

Another example of the significance of ecosystem services affecting the GSC watershed area is the value of the Great Lakes, as well as our inland lakes, rivers, and wetland features to the local tourism industry. These values, to some degree, can be quantified in monetary terms by considering the influx of money to the local economy from events such as the Owen Sound Salmon Spectacular. A 2015 news article by CTV News Barrie stated that it is "*estimated that the event injects more than a million dollars into the local economy every year*"[2]

Other obviously observable means of quantifying the value of ecosystem services can be related to the amount of money people are willing to pay to travel to the area, increased values in real estate that border on natural areas, or the costs associated with creating an engineered solution to replicate a natural one, such as a flood storage reservoir. A listing of some eco-system functions, processes and services, taken from the Wilson, S.J. (2008) study, is presented in Table 1-1.

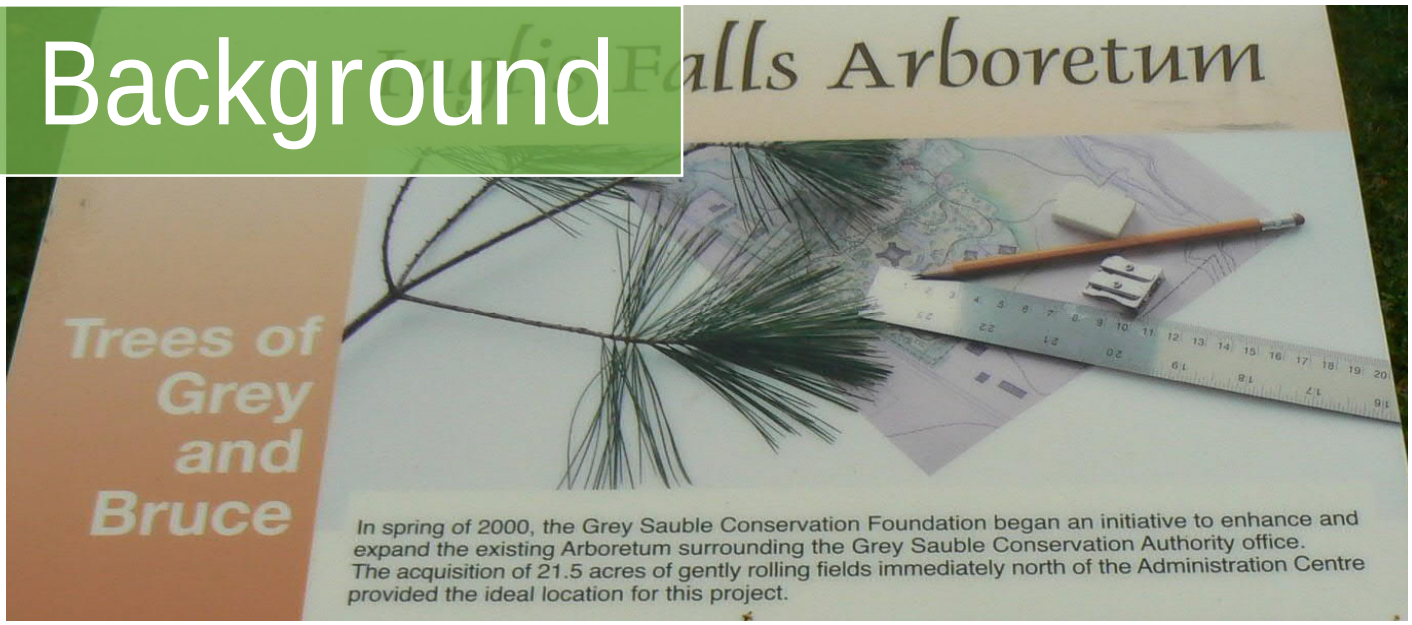
Purpose of Reviewing Ecosystem Services within GSC Watershed

Grey Sauble Conservation has decided to undertake a valuation of ecosystem services provided by its properties as a pilot toward further review of the natural capital present within the GSC watershed area, both publicly and privately owned. The intent of this further review is two-fold. The review of publicly owned (municipal and Conservation Authority) lands within the watershed demonstrates an added level of service being provided to the public which is currently undocumented. The broader review of privately held lands provides a benchmark by which changes in the natural environment can be measured, tracked, and evaluated.

[1] www.ontario.ca/page/pollinator-health

[2] http://barrie.ctvnews.ca/salmon-spectacular-reels-in-big-bucks-for-local-economy-1.2539272

Background



The Grey Sauble Conservation Authority was established by an Order-in-Council on January 1, 1985, following the amalgamation of the North Grey Region and Sauble Valley Conservation Authorities. The North Grey and Sauble Valley Conservation Authorities were established under the Conservation Authorities Act in 1957 and 1958, respectively.

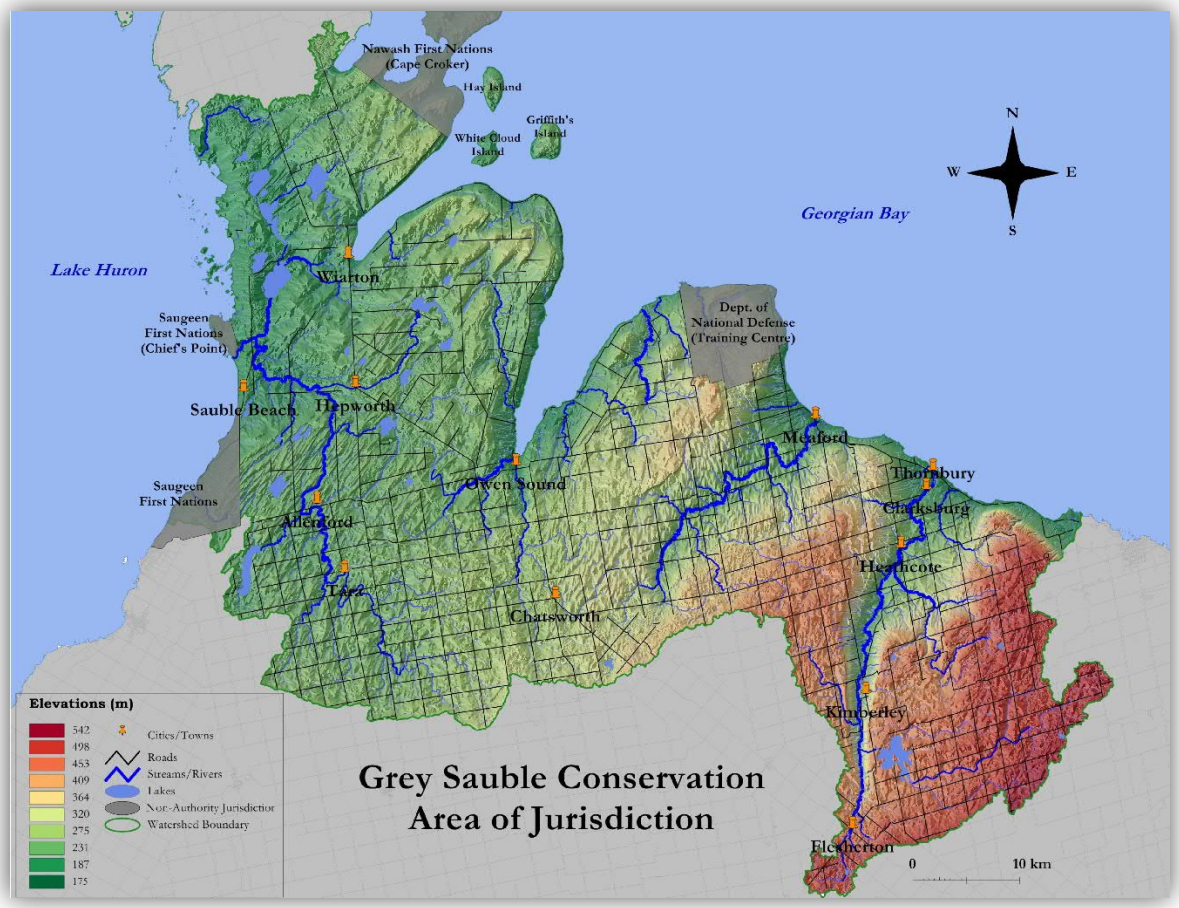


Figure 2-1: Grey Sauble Conservation Area of Jurisdiction

Geographic Context of this Review

Grey Sauble Conservation's watershed jurisdiction covers a 3146 square kilometre area within northern Grey and Bruce Counties, and includes approximately 155 kilometres of shoreline on Lake Huron and Georgian Bay. This jurisdictional watershed area drains five major watersheds and myriad smaller watershed areas. The five major watershed areas drain to Lake Huron and Georgian Bay via the Sauble River, the Pottawatomi River, the Sydenham River, the Bighead River, and the Beaver River. The area encompassed by the GSCA watershed jurisdiction is illustrated on Figure 2-1.

Included within GSC's watershed area is a substantial portion of the Niagara Escarpment world biosphere reserve. The Niagara Escarpment extends 725 kilometers from Queenston to Tobermory.[1] Of the total Niagara Escarpment Plan area, approximately 35 percent occurs within the GSCA's watershed area. Many of GSC's properties occur within the Niagara Escarpment Plan area and make up a substantial portion of the Niagara Escarpment Parks and Open Space System (NEPOSS). Figure 2-2 illustrates this relationship.

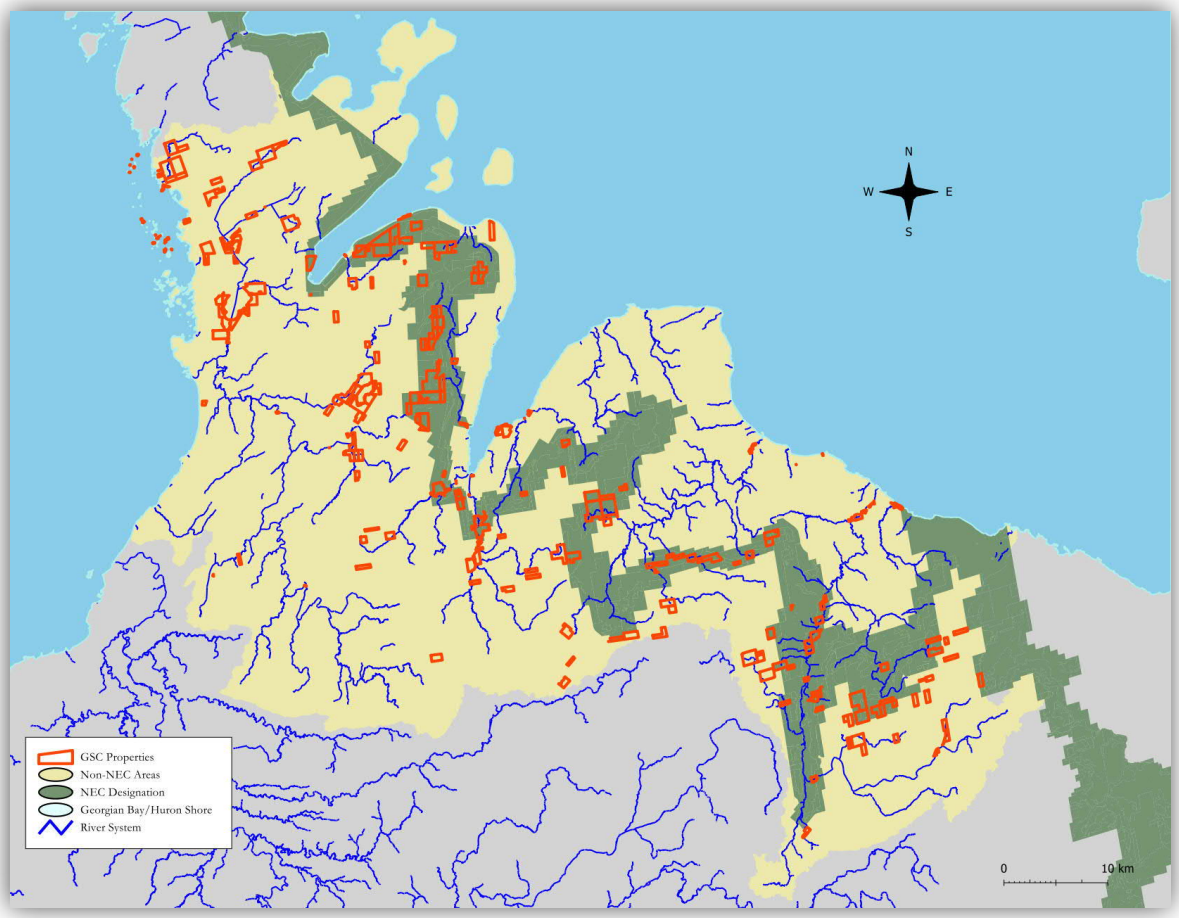


Figure 2-2: NEC Plan Area within GSC Jurisdictional Area

Land Cover Classes

Grey Sauble Conservation's properties provide a broad mix of the various ecosystem types occurring within the watershed area. These areas include upland and lowland, deciduous, coniferous, and mixed

[1] Niagara Escarpment Plan, 2017

forest types. All four wetland types, including marsh, bog, fen, and swamp are represented on GSC properties. Additionally, our property portfolio includes shorelines, alvars, cliff faces, talus slopes, meadows, and even a small portion of agriculture and grasslands.

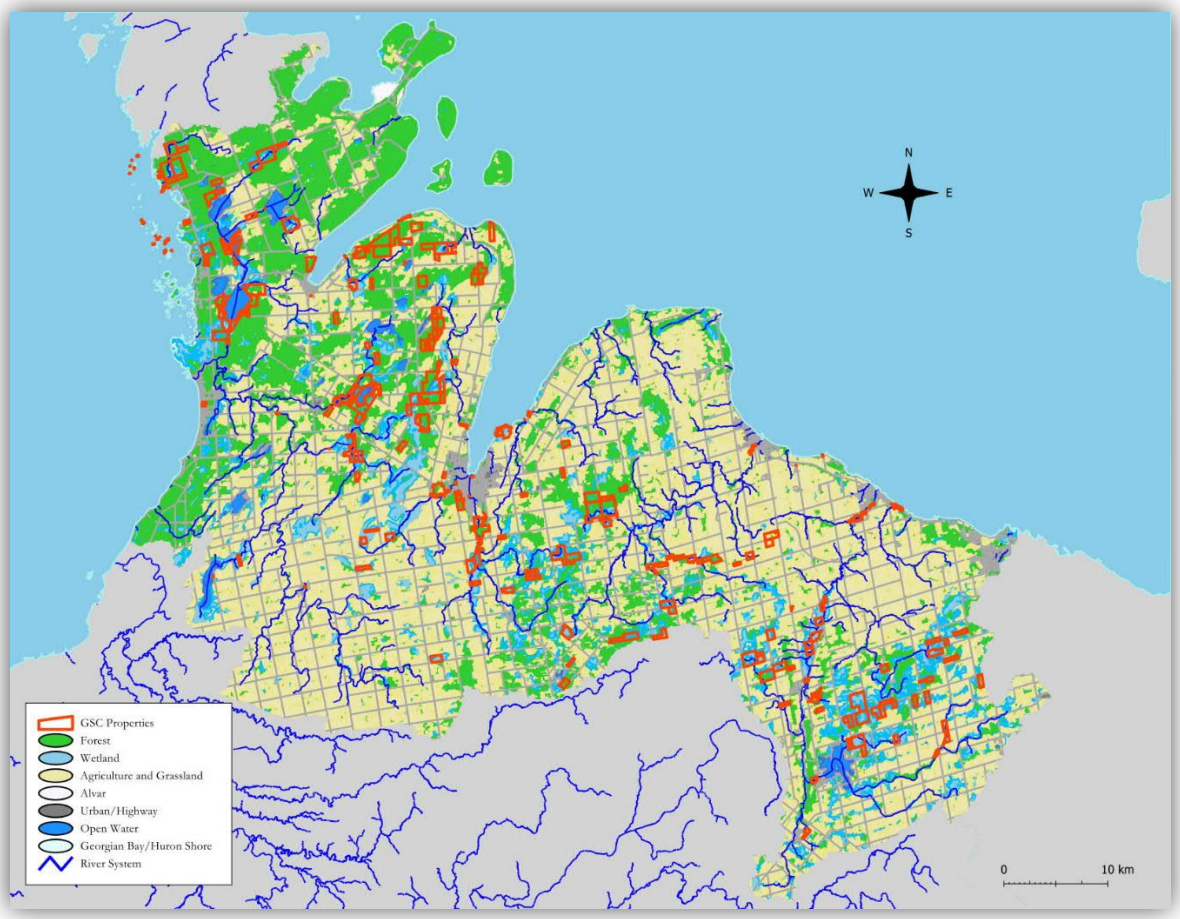


Figure 2-3: Land Cover Mapping within Watershed Area

By way of this property ownership, GSCA provides the public with access to a variety of recreational and aesthetic opportunities.

For the purpose of this report, the various ecosystem types occurring on GSCA properties were amalgamated into a handful of broader land cover classes. These include forest, wetland, agriculture/cropland, pasture/grassland, idle land/sparse forest, rivers, open water, and other.

FOREST

For the purposes of this evaluation we amalgamated all of our forest types into a single category. This includes upland, lowland, coniferous, deciduous, and mixed woodlands. The studies that we utilized in this evaluation also did not distinguish between forest types. One of the studies that we reviewed utilized an urban and suburban forest classification. However, based on the scale requirements of urban and suburban, these categories were not considered a good fit for the GSCA watershed area.

Forests provide several ecosystem services, including carbon sequestration, air purification, water quality and quantity regulation, soil preservation, nutrient cycling, wildlife habitat, pollinator habitat, recreational services, traditional resource use, and aesthetic appreciation opportunities.

WETLAND

The wetland land cover class encompasses all four wetland types: bog, fen, marsh, and swamp. Wetland areas can include both coastal and inland wetland features. One of the studies utilized does differentiate between coastal and inland wetland areas, affording inland wetlands a slightly higher valuation than coastal wetlands. It is assumed that this discrepancy can be attributed to the flood attenuation and baseflow supply that the inland wetlands provide. For the purposes of our review, we did not distinguish between coastal and inland wetlands, as most of the coastal wetlands on or adjacent to GSC properties are not explicitly mapped as such in our existing land use data.

The ecosystem services provided by wetlands includes: climate regulation; air purification; water quality and quantity regulation, including flood attenuation, baseflow supply, and groundwater recharge; shoreline protection; wildlife habitat; pollinator habitat; refuge for migratory birds; recreational services; traditional resource use; and, aesthetic appreciation opportunities.

AGRICULTURE / CROPLAND

Agriculture makes up a relatively small portion of GSC's total land holdings. For the purposes of this review, agriculture is being defined as row crop. It is acknowledged that a row crop field may be periodically planted for hay, wheat, or other grassland type crops. However, this variation is generally balanced out between the studies utilized for this report.

Although not as prevalent as with some other cover types, agricultural land does provide some ecosystem services, in addition to the goods provided. These include potential climate regulation, wildlife habitat, and potential pollinator habitat, depending on crop type. There are also important cultural heritage values associated with this land cover on the landscape.

PASTURE / GRASSLANDS

Pasture and grasslands, although also a form of agriculture, have been differentiated for the purposes of our review. As noted above, the same farmed property may switch between "grasslands" and "cropland" on any given year. For the purposes of our review, we utilized aerial photographs and made a judgement call on the use. As these areas only account for a small portion of our overall land holdings, and they are not valuated very highly, this potential variance does not dramatically affect the outcomes of our review.

These areas offer similar ecosystem services to agricultural land, but typically to a greater degree as they may more closely mimic a natural meadow environment. As such, pasture and grassland areas have been afforded a higher value within the studies utilized in this report.

IDLE LAND / SPARSE FOREST

These two land cover classes have been amalgamated for the text portion of this report. Lands placed into these categories were defined slightly differently in each of the studies utilized, but generally seemed to be geared towards the same type of land cover. For the purposes of this definition, we have combined marginal lands, idle lands, and sparse forest, with the understanding that the natural progression of idle lands is to eventually regenerate into a forest cover type. As with the agricultural and pasture lands, these areas do not account for a large percentage of GSCA's land holdings.

The ecosystem services provided by idle lands and sparse forest include climate regulation, wildlife habitat, pollinator habitat, water quality and quantity regulation, and recreational opportunities.

RIVERS

When we consider size of a stream or river, we utilize a stream order system. Within this system, a first order stream is a headwater tributary. When two first order streams converge, they form a second order stream. Many first order stream can enter a second order stream without changing the stream order. However, when a two second order streams converge they form a third order stream. Two third orders create a fourth order, and so on. When assessing rivers for this report, we focused on those portions of rivers that are fifth order or greater. The rationale for this is that one of the studies that informed this report utilized only fifth order and higher streams due to the scale of digital data utilized. As such, we restricted our data to these same criteria. Thus, the ecosystem values presented in this report for riverine systems generally represent a lower bounded value.

Ecosystem services provided by riverine systems include moderation of local climate, drinking water supply, wildlife habitat, fish habitat, refuge for migratory birds, agricultural resource, recreational services, traditional resource use, and aesthetic appreciation opportunities

OPEN WATER

Open water features are those which are typically too deep to support emergent vegetation, thereby separating them from marshes and other wetland land cover types.

The ecosystem services provided by open water areas include: localized climate regulation; flood attenuation; wildlife habitat; refuge for migratory birds; recreational services; traditional resource use; and, aesthetic appreciation opportunities.

BEACH

A beach system within the context of this report falls into one of three categories: sand barrens and/or dunes located within one kilometer of the Great Lakes coast; open sandy beach along a Great Lake within 200 metres of a structure; and, open sandy beach along a Great Lake not within 200 metres of a structure. This classification and valuation was developed for the MNRF study utilized by this report. The majority of the beaches within our watershed area are not sand beaches, thus, these valuations again likely represent a lower bounded value.

Ecosystem services provided by beaches include: wildlife habitat; recreational services; traditional resources use; and, aesthetic appreciation opportunities.

OTHER

Those areas identified as other within the report are areas that are developed and do not represent an ecosystem type land cover. No ecosystem service values have been afforded to these areas.

Methodology and Limitations

Valuation Methodology

Several primary studies have been completed to assess ecosystem service values throughout the world. Based on these studies, several literature reviews and data refinements have been undertaken by organizations within Ontario to apply these values to the Canadian, and more specifically, to the Ontario landscape.

The methodology utilized for this report consisted of the following steps:

1) Literature review of these secondary studies;
2) Review and amalgamation of GSC's existing land cover type information;
3) Initial best fit of GSC's cover type information to the reviewed studies;
4) Mapping and refinement of some cover types, such as beaches, agricultural lands, pastures, idle lands, and fifth order or greater stream systems occurring on or adjacent to GSC lands;
5) Total value calculations;
6) Mapping and reporting.

The literature review conducted for this report primarily utilizes these secondary reports which apply a screening tool to apply global and national valuations to the Ontario landscape. Specifically, this report utilizes the land cover class valuations from the following reports:

- Estimating Ecosystem Services in Southern Ontario, Troy and Bagstad, 2009
- Valuing Natural Capital and Ecosystem Services, Austin et al., 2012
- Ontario's Wealth, Canada's Future: Appreciating the Values of the Greenbelt's Eco-Services, Wilson, 2008

GSC has previously undertaken cover type mapping for forestry uses, which identifies various broad land cover classes on GSC properties. The current GSC land cover classes include bog, agricultural land, fen, lowland coniferous, lowland deciduous, lowland mixed, marsh, open land, other, open water, plantation, treed swamp, upland coniferous, upland deciduous, and upland mixed.

These categories were more broadly grouped into the following classes to better fit the study valuations:

- Agriculture: Row Crop
- Agriculture: Pasture/Grassland
- Forest
- Other: Development Areas
- Other: Open Land
- Other: Open Water
- Wetland: Inland

Based on the information collected, it was identified that in order to fully complete the valuations, more information was required. As such, preliminary mapping of the following land cover classes was undertaken:

- Wetland: Coastal
- Beach Area: General
- Beach Area: Near Structure
- Beach Area: Not Near Structure
- Bay or Cove
- Stream: Fifth Order of Greater

Upon completion of the initial mapping review, the combined areas were analyzed in an excel spreadsheet to apply the class valuations from each of the three studies utilized into the appropriate land cover class. This analysis was followed up with this preliminary report.

Limitations

The literature used for this report is specific to Ontario, and in the case of the Greenbelt study includes the Niagara Escarpment. This provides a reasonable correlation to GSC's land holdings. However, the literature review utilized was limited to secondary study types. No primary research was conducted, and no primary research studies were utilized to develop specific ecosystem valuations for the GSC land holdings. Therefore, our calculations are limited by the findings and the data presented in the literature review, with those valuations assigned to GSC's natural assets.

Further, the studies utilized for the valuation of GSC natural capital range from 2008 through 2012. The dollar values listed in those studies were utilized without accounting for inflation to 2017 dollars.

Ecosystem Values by Cover Type

As noted above, three different valuation methods were utilized to analyze ecosystem services provided by GSC's properties. Since GSC is utilizing a benefit transfer approach from a secondary study literature review, it was deemed appropriate to utilize more studies to validate the results. The tables below show the dollar value per hectare per year afforded to each land cover type in each study. It should be noted that not all land cover classes were utilized in this report.

The Troy and Bagstad (2009) study was completed for the Ontario Ministry of Natural Resources and Forestry (MNRF) and is intended to provide a valuation for ecosystem services in southern Ontario. This report describes ecosystem services as the "goods and services provided by functioning ecosystems (that) contribute to human welfare, both directly and indirectly, and (that) therefore represent a significant, yet often uncounted, portion of the total economic value of the landscape". This study utilizes a "value

transfer" approach that utilizes land cover class values from primary study ecosystem service valuations with comparable ecological resource types, and transfers these values into the study area.

GSC, in turn, utilized these values to assess the land cover classes on our own properties. As the Grey Sauble watershed areas occur within southern Ontario, this study serves as a direct fit for valuating GSC's natural capital.

The Troy and Bagstad (2009) study placed more value on those areas that were in or adjacent to urban centers. The report defined urban and suburban as densely populated areas with a population greater than 50,000 people. Therefore, this report is limited to "non-urban" areas, as there are no areas within the GSC watershed boundary that meet these criteria. 'Table 3-1' identifies the land cover types from the Troy and Bagstad (2009) study that were utilized by GSCA in assessment our own properties. The table also shows the associated annual per hectare value provided by that land class.

Land Cover Type	Value Per Hectare ($/ha/Year)
Agriculture	$291
Grassland/Pasture/hayfield	$353
Forest: non-urban	$4,443
Open Water: River	$55,553
Open Water: Inland Lake	$5,050
Open Water: Estuary / Tidal Bay	$1,852
Wetlands: non-urban, non-coastal	$15,171
Wetlands: Great Lakes Coastal	$14,761
Beach (general)	$89,608
Beach near structure	$130,068
Beach not near Structure	$49,150
Undifferentiated Poor Agriculture	$0
Other Unvalued Terrestrial	$0

Table 3-1: Estimating Ecosystem Services in Southern Ontario, Troy and Bagstad, 2009

This study afforded the highest valuation to urban areas. In general, the urban areas were valued between four and ten times higher than non-urban areas. As noted above, the GSC watershed area does not meet the "urban" or "suburban" classification, and therefore is limited to the lower value. Within the scope of the areas that GSC utilized, beaches and riverine systems were provided the highest valuations. This is represented by the following chart which demonstrates the comparable land value per hectare.

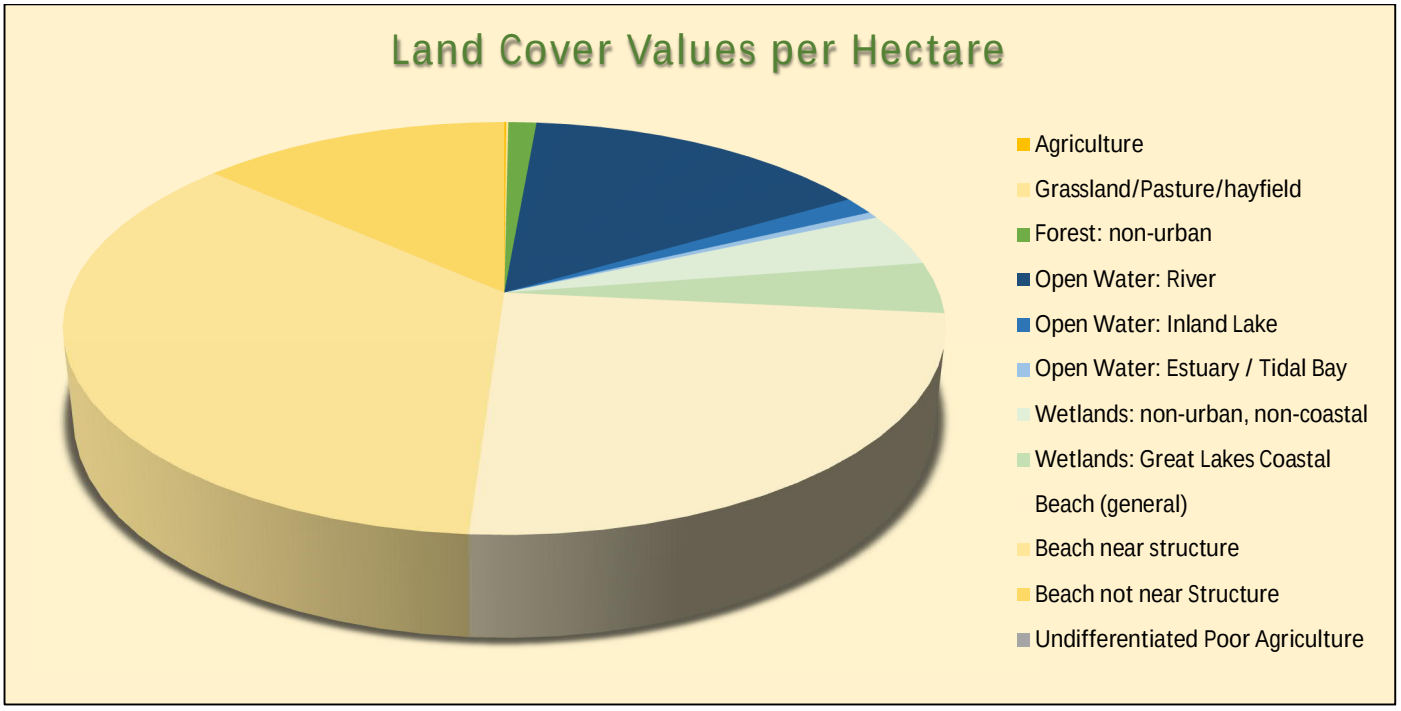


Figure 3-1: Land Cover Values per Hectare based on Troy and Bagstad (2009) Study

The second study that we utilized, Austin et al. (2012), was prepared for the Muskoka Watershed Council to provide a valuation of the ecosystem services and natural capital within the Muskoka River Watershed and the northern portion of the Black River – Lake Simcoe Watershed. Although this watershed area is not exactly the same as the GSC watershed jurisdiction, a lot of similarities are shared in terms of global, national, and latitudinal location. Additionally, the climate between the two watersheds is very similar. A climate comparison is presented in "Appendix II". Thus, this study was deemed to be appropriate to utilize in terms of evaluating GSC's natural capital.

Similar to the Troy and Bagstad (2009) study, the Austin et al. (2012) study also utilizes a value transfer approach that utilizes land cover class values from primary study ecosystem service valuations with comparable ecological resource types, and transfers these values into the study area. The Austin et al. (2012) study appears to have supplemented the value transfer approach with specific recreational data for the Muskoka area. The Austin et al. study did yield the highest values when applied to GSC properties. This may be the result of the Muskoka recreation and tourism data. 'Table 3-2' identifies the land cover types utilized and the associated annual per hectare value provided by the Austin et al. study.

Land Cover Type	Value Per Hectare ($/ha/Year)
Forest	$4,651.69
Wetland	$17,968.32
Pasture	$1,785.26
Sparse Forest	$2,616.75
Open Water	$13,079.22

Table 3-2: Valuing Natural Capital and Ecosystem Services, Austin et al., 2012

This study afforded the highest valuation to wetland and open water features. Figure 3-2 demonstrates the relationship, per hectare, between the various land cover types in the Austin et al. study.

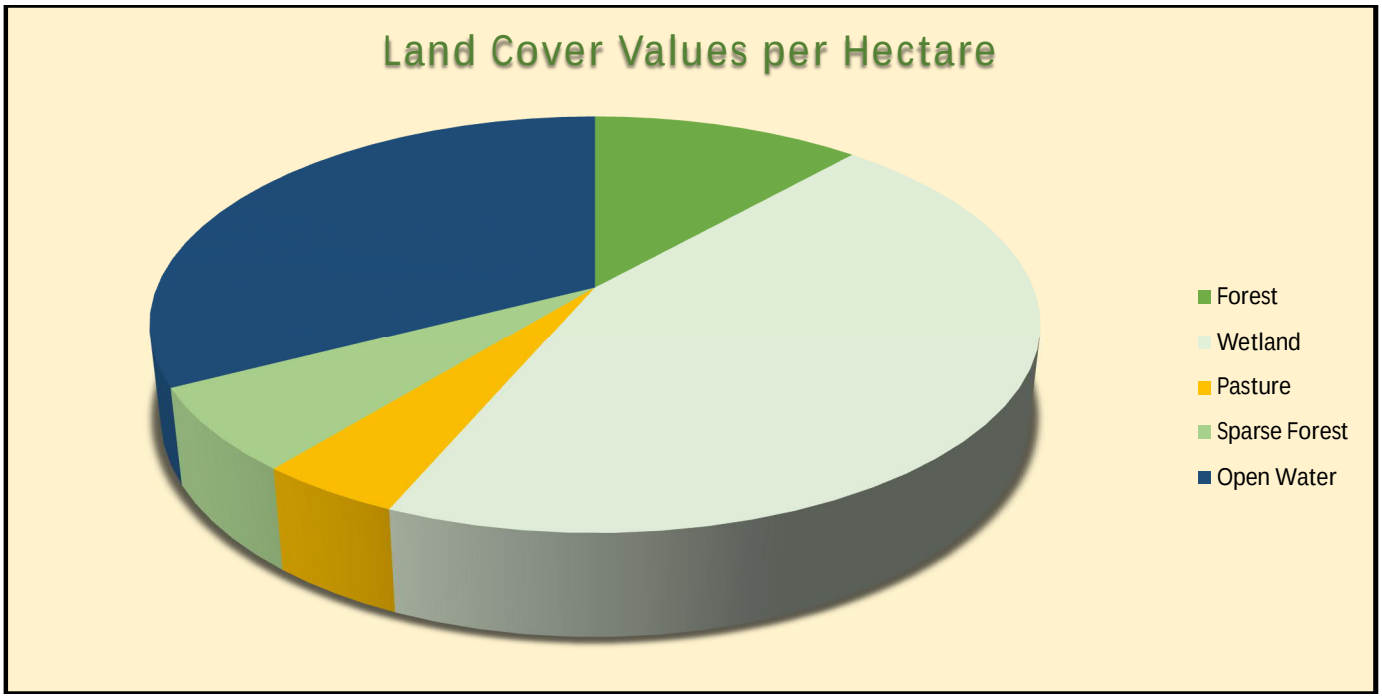


Figure 3-2: Land Cover Values per Hectare based on Austin et al. (2012) study.

The final study that we utilized, Wilson, S.J. (2008), was prepared for the Friends of the Greenbelt Foundation and the David Suzuki Foundation to provide a valuation of the ecosystem services and natural capital of the Southern Ontario Greenbelt. This study defined natural capital as "*the earth's natural ecosystems as stocks or assets that provide resources and a flow of services. Natural capital and ecosystem services are the foundation of life – including human life*".

The Greenbelt as a planning mechanism, is an extension of the Niagara Escarpment Plan and the Oak Ridges Moraine Plan. As many of GSC's properties occur within the Niagara Escarpment Plan area, this study was considered a natural fit for inclusion in the review of GSC's natural capital.

As opposed to the value transfer method utilized in the other studies utilized, the Wilson (2008) study provided a monetization for each of the ecosystem services provided by each land cover type. These ecosystem service values are then aggregated back into land cover type values as shown on 'Table 3-3'.

Land Cover Type	Value Per Hectare ($/ha/Year)
Forest	$5,414
Wetlands	$14,253
Grasslands	$1,618
Cropland	$477
Orchards	$494
Hedgerows	$1,678
Idle Land	$1,667
Rivers	$335
Other	$0

Table 3-3: Ontario's Wealth, Canada's Future: Appreciating the Values of the Greenbelt's Eco-Services, Wilson, 2008

This study afforded the highest valuation to wetland features. Figure 3-3 demonstrates the relationship, per hectare, between the various land cover types in the Wilson study.

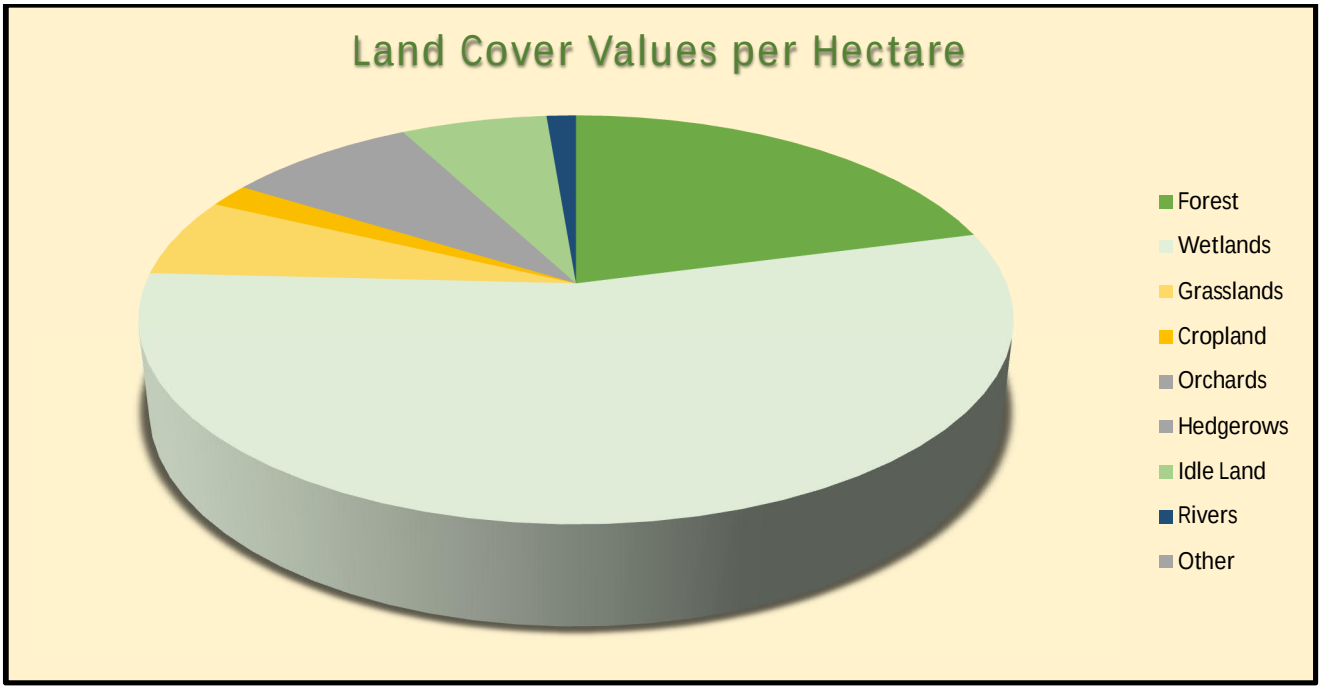


Figure 3-3: Land Cover Values per Hectare based on Wilson, S.J. (2008) study

Discussion

Distribution of Ecosystem Service Values on GSC Lands

In an effort to provide the most accurate overview of the value of ecosystem services provided by GSC's properties, this report utilizes three separate studies, all based in Southern Ontario, to provide this quantification. The three reports were conducted for southern Ontario, the Muskoka River Watershed, and the Greenbelt, respectively.

Although there are some differences in the land class categories that were utilized by each of the source studies, some key comparable categories were identified. As previously noted, a review of GSC's current land-use mapping was utilized and aggregated into the appropriate categories to allow us to populate the relevant fields from each of the source studies. This data is presented in 'Appendix I' to this report.

Forested lands account for approximately 80 percent of GSC's land holdings. Wetland areas account for approximately 12 percent. The remaining eight percent is divided among the remaining land use classes used in each study. As such, most of the ecosystem services provided by GSC properties are from wetlands and woodlands. This was most evident in the Greenbelt study (Wilson, 2008), for which woodlands (forest) and wetlands accounted for 99.5 percent of the ecosystem services.

Figure 4-1 illustrate the relative comparison in GSC's land cover types based on each of the studies' classification criteria.

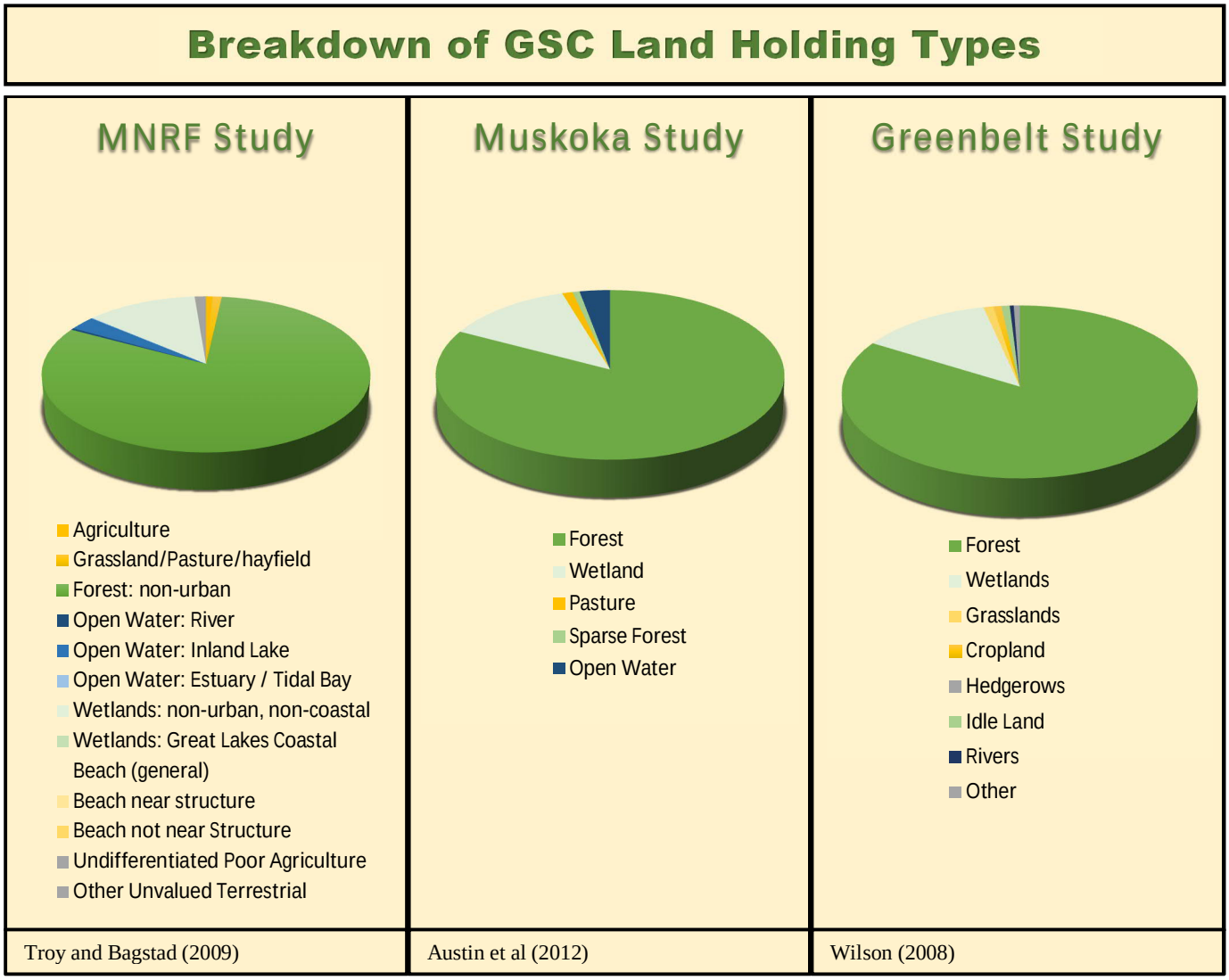


Figure 4-1: Breakdown of GSC Land Holding Types based on each of the studies' classification types

Although each study weighted the various land use classes differently, a review of GSC's lands in each table revealed similarities in terms of overall land values. As noted above, woodlands account for approximately 80 percent of GSC's land holdings. The annual ecosystem services provided by these woodlands is valued at $41.9-million, $43.8-million, and $51-million, respectively. Thus, the average annual ecosystem service values provided by these woodland features is approximately $45.6-million.

Wetlands were valued annually at $21.9-million, $25.9-million, and $20.5-million, respectively. The average annual ecosystem values provided by these wetland features is approximately $22.8-million.

Figure 4-2 illustrate the relative comparison in ecosystem service values provided by GSC's properties based on each of the studies' classification criteria.

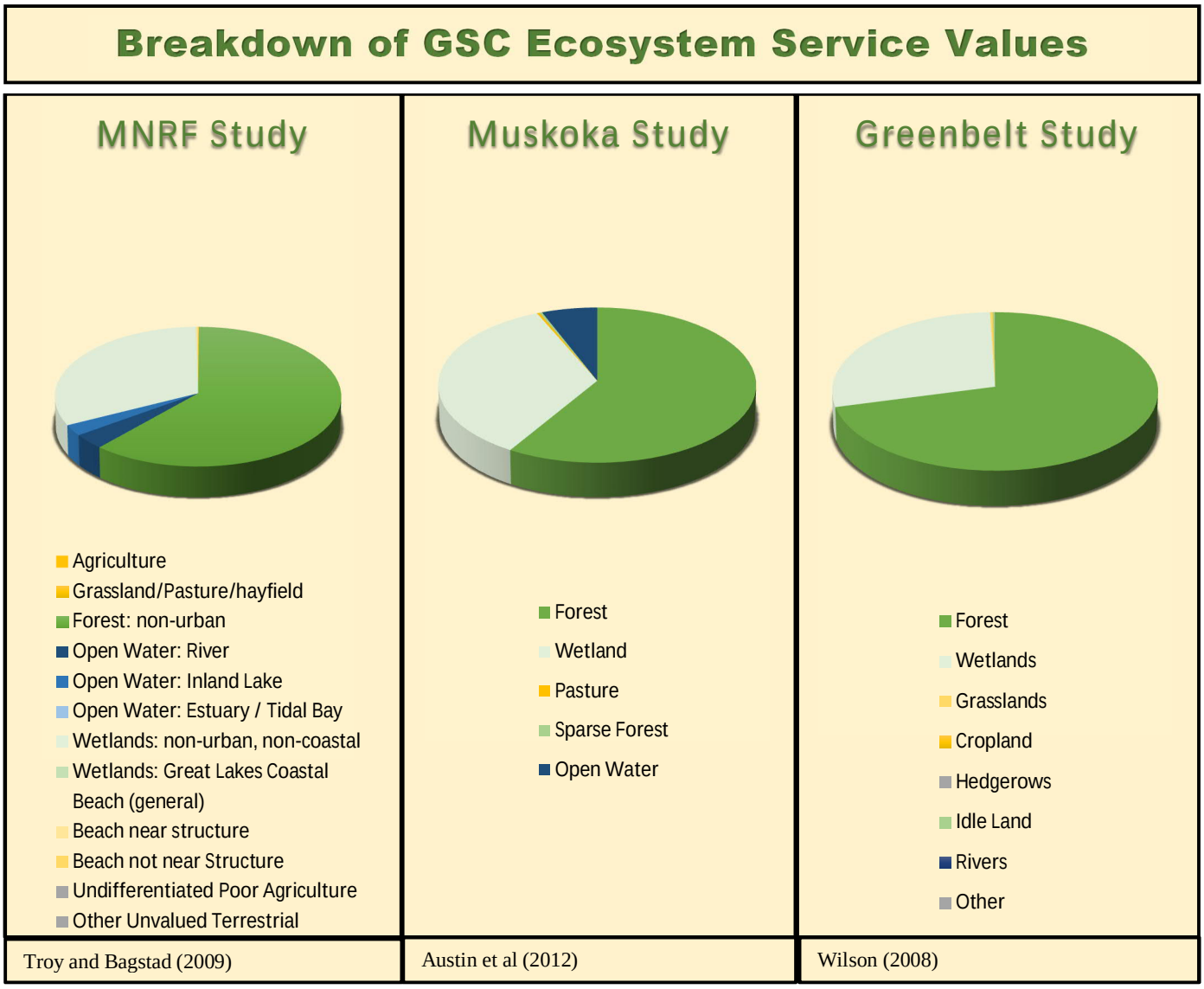


Figure 4-2: Breakdown of GSC Ecosystem Service Values based on each of the studies' valuation method.

Calculations for many of these services are included in the Wilson (2008) study. Although the GSC report is not utilizing primary data sources to calculate the total ecosystem service values, some specific services were reviewed to demonstrate how the individual pieces can add up.

Based on carbon sequestration calculations presented in the Wilson (2008) study, the value of carbon stored by GSC's forests equals approximately $131-million in 2017 dollars. When considered as an annuity investment over 20-years, this value would equate to $7.65-million per year, or $813/hectare/year.

The Wilson (2008) study estimates that the annual new uptake of carbon by trees is approximately 0.75 tonnes of carbon per hectare. During the September 6, 2017 auction conducted under the Province of Ontario's Cap and Trade Program, carbon credits traded for a mean value of approximately 21 dollars per tonne. If we consider this in terms of GSC's 9400 hectares of woodland, the annual carbon sequestration value provided by GSC's woodland properties is in the order of $148,000 per year.

Removal of other atmospheric pollutants by GSC's forest properties was calculated to be approximately $3.5-million per year.

Based on this cursory review of atmospheric related services, we can see that the ecosystem services provided by GSC's woodland properties equate to more than $11-million per year. This does not account for all of the other services provided by woodlands, or the remainder of GSC's natural areas.

Conclusions and Recommendations

Conclusions

Based on a review of the land cover type values provided in the three source studies utilized, the total calculated annual ecosystem service values for GSC's properties amounted to $68-million, $75-million, and $72-million per year, respectively. This provides a mean value of $71.7-million per year. The total calculations for the three studies were within a range of $7-million of each other, or within $4-million of the median. Given the high number of variables being considered, this is considered to provide a reasonable estimate.

This cursory review of the ecosystem services provided by GSC's properties illustrates the understated value of the natural areas that are so important for the human and natural well-being of Ontario and, more specifically, the Grey Sauble watershed areas. GSC protects these areas from future development by holding them as conservation lands.

GSC's Vision Statement is, "A healthy watershed environment in balance with the needs of society". The properties owned and managed by GSC provide a tremendous value to both the residents of Grey-Bruce, but also to the myriad visitors that our area sees each year. The importance and value of these properties will only increase as development pressures within the Grey-Bruce area intensifies.

Recommendations

It is intended that GSC will act as a model for our stakeholders and member municipalities in starting to place a value on the services provided by our natural areas. The following recommendations are considered to be appropriate next steps to ensure that this value is fully conveyed.

1. It is recommended that this report is updated in five years time to include changes to land cover types, changes to GSC land holdings, and an updated literature review to include new studies and methods.

2. It is recommended that the updated report should consist of a more robust primary research study for the GSC land holdings based on locally specific data and final ecosystem goods and service valuations.

3. At the time of the writing of this report, there was not sufficient quantifiable data available on the benefits of greenspaces to mental health. It is hopeful that by the time a new report is prepared that the interaction between mental health and greenspace will have a more measurable value. It is recommended that at the time of the next report, that this information is incorporated if available.

4. It is recommended that a similar report be prepared for all of the Grey Sauble watershed area, or on a watershed by watershed basis to complement the 2023 watershed report card.

5. It is recommended that management plans be created and/or updated for each of GSC's land holdings to ensure the protection and sustainability of our natural resources.

6. It is recommended that GSC's land cover mapping be updated and further refined utilizing the Ecological Land Classification (ELC) system for southern Ontario.

7. It is recommended that GSC continue with property acquisition activities, with a specific goal of targeting those properties with higher ecological and ecosystem service values.

8. It is recommended that GSC develop policy which ensures the protection of its natural capital and which promotes a safe environment for public enjoyment of the benefits and services provided.

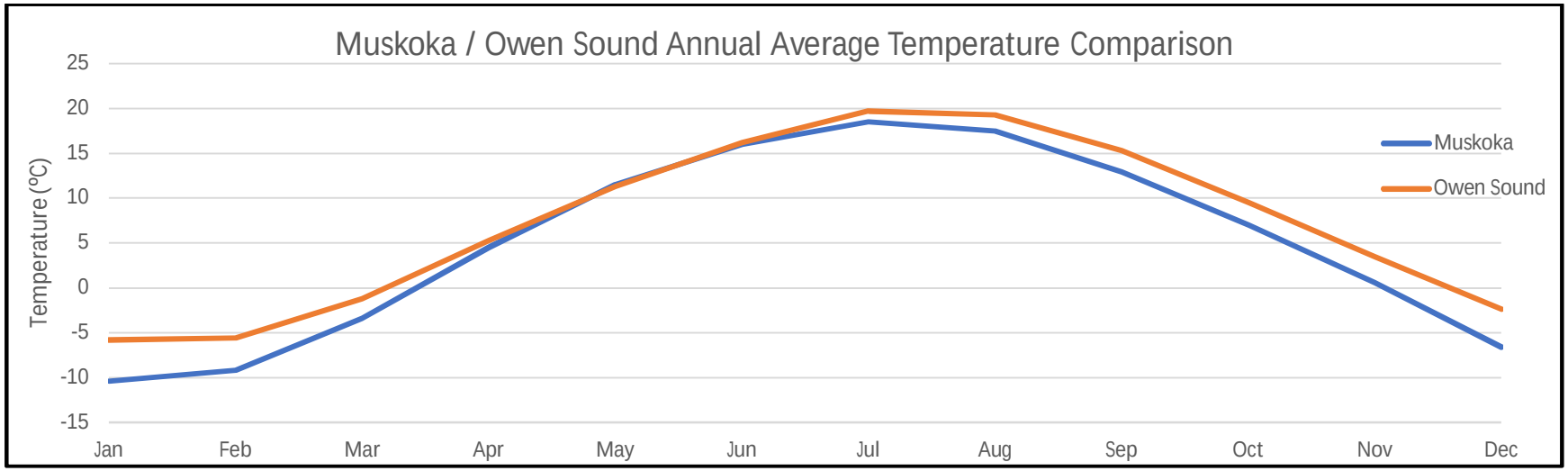
APPENDIX – I: DATA RESULTS FOR GSC LAND HOLDINGS

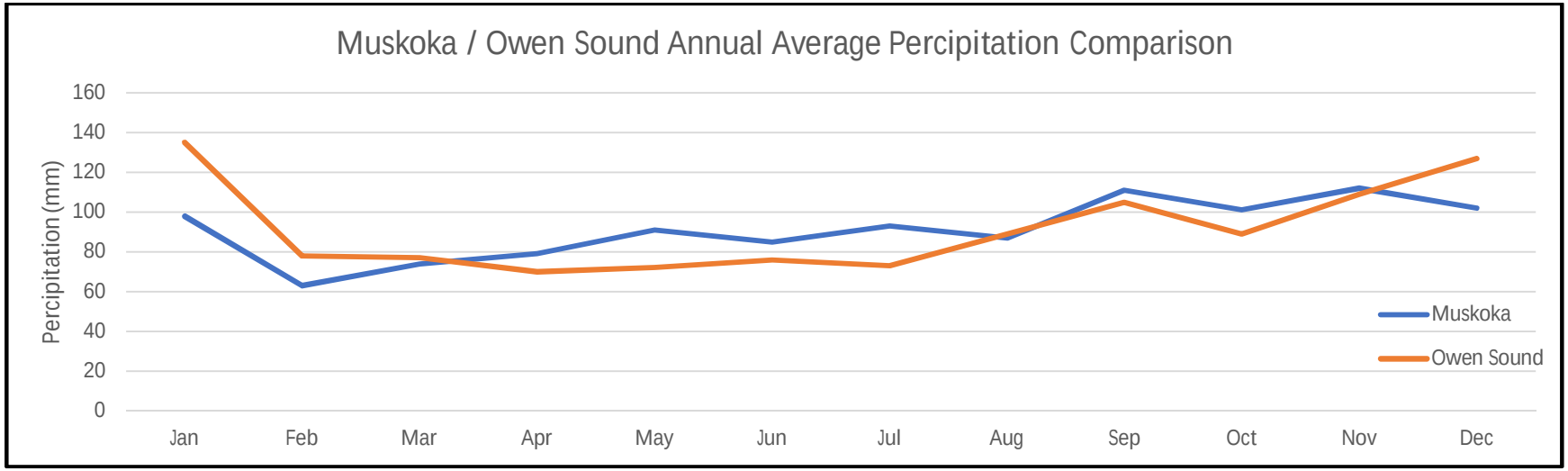
MNRF Study (Troy and Bagstad, 2009)					
Land Cover Type	Dollar Value per Hectare per Year	GSC Property Areas (ha)	Percent of Land Holding	Service Value per Year	Percent of Total Land Value
Agriculture	$291	86.9	0.7%	$25,288	0.0%
Grassland/Pasture/hayfield	$353	117	1.0%	$41,301	0.1%
Forest: non-urban	$4,443	9424	80.3%	$41,870,832	61.5%
Open Water: River	$55,553	42.8	0.4%	$2,377,668	3.5%
Open Water: Inland Lake	$5,050	340.7	2.9%	$1,720,535	2.5%
Open Water: Estuary / Tidal Bay	$1,852	13.6	0.1%	$25,187	0.0%
Wetlands: non-urban, non-coastal	$15,171	1442.7	12.3%	$21,887,202	32.1%
Wetlands: Great Lakes Coastal	$14,761	1.2	0.0%	$17,713	0.0%
Beach (general)	$89,608	0	0.0%	$0	0.0%
Beach near structure	$130,068	1.1	0.0%	$143,075	0.2%
Beach not near Structure	$49,150	0.3	0.0%	$14,745	0.0%
Undifferentiated Poor Agriculture	$0	61.7	0.5%	$0	0.0%
Other Unvalued Terrestrial	$0	84.6	0.7%	$0	0.0%
Total				$68,123,546	

Muskoka Watershed Study (Austin et al, 2012)					
Land Cover Type	Value Per Hectare ($/ha/Year)	Area (ha)	Percent of Land Holding	Total Value	Percent of Total Land Value
Forest	$4,651.69	9424	80.3%	$43,837,526.56	58.7%
Wetland	$17,968.32	1442.7	12.3%	$25,922,895.26	34.7%
Pasture	$1,785.26	117	1.0%	$208,875.42	0.3%
Sparse Forest	$2,616.75	80.2	0.7%	$209,863.35	0.3%
Open Water	$13,079.22	340.7	2.9%	$4,456,090.25	6.0%
Total				$74,635,250.85	

Greenbelt Study (Wilson, 2008)					
Land Cover Type	Value Per Hectare ($/ha/Year)	Area (ha)	Percent of Land Holding	Service Value per Year	Percent of Total Land Value
Forest	$5,414	9424	80.3%	$51,021,536.00	70.9%
Wetlands	$14,253	1442.7	12.3%	$20,562,803.10	28.6%
Grasslands	$1,618	107.4	0.9%	$173,773.20	0.2%
Cropland	$477	86.9	0.7%	$41,451.30	0.1%
Orchards	$494	0	0.0%	$0.00	0.0%
Idle Land	$1,667	89.6	0.8%	$149,363.20	0.2%
Rivers	$335	42.8	0.4%	$14,338.00	0.0%
Other	$0	66.1	0.6%	$0.00	0.0%
Total				$71,963,264.80	

APPENDIX – II: CLIMATE COMPARISON BETWEEN MUSKOKA AND OWEN SOUND





Source: www.theweathernetwork.com