

NATURAL CAPITAL VALUATION OF ECOSYSTEMS ASSOCIATED WITH THE PROPOSED HIDDEN QUARRY AREA

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INTRODUCTION

There is both global and national recognition of the irreplaceable value of ecosystem services and the impact of human development on them. “One of the main reasons for ecosystem degradation is the exclusion of natural capital in our current measures of progress and decision-making.” and “Values not reflected in market prices [non-market values] are considered externalities (Wilson, 2008b). The term ‘natural capital’ refers to the Earth’s natural ecosystems as stocks or assets that provide resources and a flow of services or benefits. It includes natural resource capital, ecosystems or environmental capital, and the land itself (Olewiler, 2004). Unfortunately, non-market values for natural capital are mostly ignored in the determination of socio-economic benefits (Wilson, 2008b). Consequently, the true cost of removing a forest, for example, is not usually reflected in the price of the land sold for the development of a subdivision. Costs accruing from that woodland loss may well be borne by others. For example, a 2002 U.S. study that included 27 water utilities using surface water supplies as the primary source, found that for every 10% increase in forest cover in the watershed, treatment costs decreased by about 20%; however, with every 10% loss in forest cover area, these costs increased by 25 % (Ernst *et al.*, 2007).

Non-market ecosystem service values are obtained by a number of means and survey methods including: 1) assessing economic damages; 2) the willingness of individuals to pay for goods and services; 3) the willingness to accept compensation for losses; and 4) the cost of replacement by human infrastructure (e.g., water treatment plant).

SOME ONTARIO ECOSYSTEM VALUES

Natural capital accounting has been used to evaluate the economic contribution of environmental components of a number of areas in Canada, including Ontario. In fact, this concept is recognized by the Ontario Ministry of Natural Resources and Forestry as of potential use for natural capital accounts for forests (<https://www.ontario.ca/page/natural-capital-and-ecosystem-services#section-1>). Table 1 summarizes the total ecosystem service values, in terms of dollar value per hectare per year, from a number of studies of southern Ontario rural areas. These studies provide information on the non-market system values of forests, grasslands, wetlands (open water, bog, marsh, swamp and fen), agricultural lands (cropland, idle land, hedgerows and orchards), grasslands, open water (rivers) and beaches, where appropriate to the area. These values likely represent conservative estimates, since our knowledge of all the benefits provided by nature and the impacts of human land use is incomplete and the value of natural capital and its services will increase over time (Wilson, 2008b).

With the exceptions of water valuations, there is an overall similarity in ecosystem service valuations between the different geographic areas evaluated, particularly for forest, wetland and agricultural

Table 1. Summary of Some Ontario Ecosystem Values (dollars/hectare/year)

<i>Study Area</i>	<i>\$ Year</i>	<i>Forest</i>	<i>Wetland</i>	<i>Crop-land</i>	<i>Idle Land/Pasture</i>	<i>Hedge-rows</i>	<i>Grass-lands</i>	<i>Water</i>
Lake Simcoe Basin (Wilson, 2008a)	2005	\$5,194	\$11,172	\$529	\$1,479	\$1,453	\$2,727	\$1,428
Southern Ontario Greenbelt (Wilson, 2008b)	2005	\$5,414	\$14,257	\$477	\$1,667	\$1,678	\$1,618	\$335
Southern Ontario (Troy & Bagstad, 2009)	2008	\$4,443	\$15,171	\$291	\$353	\$1,023	\$353	\$55,553
Muskoka/L. Simcoe Watershed (Austin <i>et al.</i> , 2012)	2012	\$4,652	\$17,968		\$1,785			\$13,079
Muskoka/Georgian Bay Ecoregion (Daigineault <i>et al.</i> , 2012)	?		\$12,283					
Rouge Nat'l. Park area. (Wilson, 2012)	2011	\$5,149	\$9,648	\$378	\$1,728	\$3,110		\$1,241
Whitebelt/Halton Region (Wilson, 2013)	2005	\$5,129	\$14,794	\$476	\$1,667	\$1,680		\$957

- Notes: 1) Values are in Canadian dollars, uncorrected for inflation;
2) '\$ Year' indicates valuation year;
3) Values for Halton Region (Wilson, 2013) are derived from total \$ values and areas.
4) Empty cells indicate that no data is available.

Table 2. Southern Ontario Greenbelt Ecosystem Service Values (dollars/hectare/year)

Source: Wilson (2008b).

<i>Ecosystem Service</i>	<i>Forest</i>	<i>Wetland</i>	<i>Cropland</i>	<i>Idle Land</i>	<i>Hedgerows</i>
Air Quality	\$377				
Climate Regulation (stored carbon)	\$919	\$677	\$333	\$317	\$328
Climate Regulation (annual carbon uptake)	\$39	\$13		\$29	\$29
Flood Control		\$4,039			
Water Regulation (runoff control)	\$1,523				
Water Filtration	\$474	\$474			
Erosion Control & Sediment Retention				\$6	\$6
Soil Formation	\$17		\$6	\$6	\$6
Nutrient Cycling				\$23	\$23
Waste Treatment	\$58	\$3,017			
Pollination (agriculture)	\$1,109			\$1,109	\$1,109
Natural Regeneration	\$537				
Biological Control	\$26			\$40	\$40
Habitat / Refugia		\$5,831			
Recreation & Aesthetics	\$335	\$335			
Cultural/Spiritual			\$138	\$138	\$138
Total Value	\$5,414	\$14,257	\$477	\$1,667	\$1,678

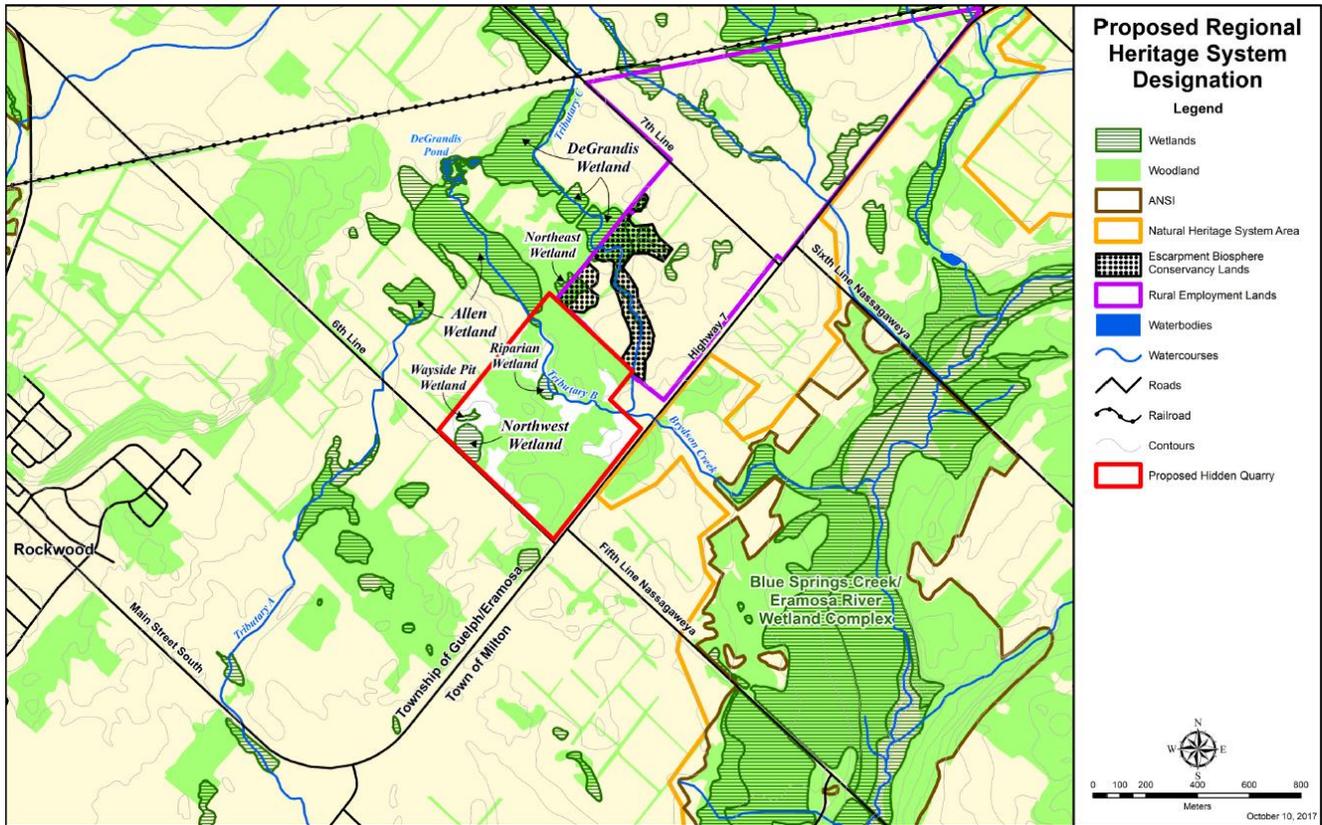
- Notes: 1) Values are in 2005 Canadian dollars, uncorrected for inflation.
2) Wetland values are the average of open water, marsh and swamp data
3) Empty cells indicate that no data is available or applicable.

lands. The larger variation for water may be related to the number of beneficiaries and scarcity of the ecosystem resource as well as the geographic area, i.e., urban vs. rural.

Valuations for the Greenbelt in Southern Ontario and Halton Region in the Whitebelt (Greater Toronto Golden Horseshoe Area) (Table 1) were felt to be most applicable to the proposed Hidden Quarry area's location in Wellington County. In Halton Region, the three main land types in terms of area are 81% agricultural, 6% forest and 2% wetland (Wilson, 2013), whereas in the SOG they are 63%

agricultural, 24% forest and 12% wetland (Wilson, 2008b). Nevertheless, the values for these ecosystem components are virtually identical for the two areas (Table 1). Since the SOG data also provides a breakdown of various ecosystem services applicable to the three major ecosystem components in the area, this data source was chosen for valuation calculations for the proposed Hidden Quarry and surrounding area.

HIDDEN QUARRY AREA ECOSYSTEM VALUES



The area around the proposed James Dick Construction Limited (JDCL) Hidden Quarry area is encompassed by 6th Line Guelph/Eramosa, Highway 7, 7th Line Guelph/Eramosa and the rail line (Figure 1). It is part of an area recently suggested by CRC (2017) for addition to mapping of the Proposed Regional Natural Heritage System for the Growth Plan for the Greater Golden Horseshoe (Environ. Registry, EBR 013-1014). The proposed 39.9 hectare quarry site is located in Rockwood, along 6th Line and Highway 7, and is outlined in red in Figure 1.

Valuation of the three SOG ecosystem components lands is broken down into the sixteen ecosystem service functions listed in Table 2. Note that agricultural land is subdivided into cropland, idle land and hedgerows. Considering total ecosystem values as well as the individual service functions of flood control, waste treatment, and species habitat, it is evident that wetland far exceeds the valuations of forest and agricultural land. [Information was not available for the area occupied by Tributary B on the proposed quarry site, or for other watercourses in the area, so their ecosystem value is not currently available.]

Forests

Before European settlement in the 1800s, forest was the predominant habitat across southern Ontario's Mixedwood Plains, but it is now mainly present in a fragmented state. Forests are important for pollinators, providing natural cover, nesting habitat and food, and as a result are also beneficial to neighbouring agricultural croplands (Wilson, 2008b).

Using the total ecosystem component value for forest (Table 2), the yearly environmental value of the 35.5 hectares (ha) of woodland on the proposed Hidden Quarry site (Stovel, 2016b) is \$192,197. The annual loss in environmental value of the 21.07 ha of coniferous woodland that would be removed from the site for quarrying (GWS, 2012) would be valued at \$114,073.

In addition to habitat, forests are important in terms of climate regulation (e.g., carbon fixation, air quality, oxygen production) and water regulation. Net annual carbon sequestration (uptake minus losses) by the site's 35.5 ha of forest, at an average of 0.75 tonnes/ha/yr, is equivalent to 26.63 tonnes of carbon per year (Wilson, 2008b). Note that the reverse process occurs when a forest is removed: the disturbance of natural vegetation and soil results in the rapid release of carbon as carbon dioxide to the atmosphere (Wilson, 2008b). Average forest carbon content in the SOG is estimated at 220 tonnes per hectare. Applying this value yields 7,810 tonnes of carbon stored in the forest of the proposed quarry site (ibid). Removal of forest and overburden from 21.07 ha for bedrock extraction would remove 4,635 tonnes of fixed carbon and the release carbon dioxide to the atmosphere.

Wetlands

Since extensive European settlement began, wetland losses have exceeded 70% in many jurisdictions of southern Ontario (Environment Canada, 2013). Much of this loss is due to the clearing of land for agriculture. The remaining wetlands provide vital habitat for birds, amphibians and reptiles; these include over one third of Ontario's 245 species at risk (Wilson, 2008b; (COSSARO, 2018).

The total ecosystem component value of the 2.00 hectares of on-site wetlands (Northwest Wetland, wayside pit wetland and Tributary B riparian wetland) is \$28,514 per year. Additionally, the yearly value of the 26.29 ha of Allen Wetland, De Grandis Wetland and Northeast Wetland (LIO, 2009) that are located off-site and up-gradient of the proposed quarry is estimated at \$374,817 per year. Down-gradient, within the Greenbelt south of Highway 7, the 115.54 ha portion of the Blue Springs Creek Wetland Complex situated between 5th and 6th Lines Nassagaweya (LIO, 2009) would be valued at \$1,647,254 per year. These valuations reflect the importance of the wetland areas in and adjacent to the proposed Hidden Quarry and also recognition of their important role: "...in supporting Ontario's rich biodiversity and providing essential ecosystem services on which Ontarians depend for health and well-being." (MNRF, 2017).

At a conservative carbon sequestration rate of 0.25 tonnes/ha/yr (Wilson, 2008b), the 145.84 ha of on-site and surrounding wetlands fix at least 36.46 tonnes of carbon per year. It is noteworthy that in the Greenbelt, the land use that is of greatest concern from a carbon-storage and sequestration point of view is aggregate mining (Tomalty, 2012). Although aggregates are an essential component of our modern infrastructure, their extraction has a dramatic ecological footprint and results in the release of substantial amounts of stored carbon from the affected areas (ibid).

Wetlands are vitally important not only in flood control but also in water filtration and waste treatment, which includes the absorption (removal) of nutrients (e.g., nitrogen and phosphorus) and other

contaminants, as well as the breakdown of human and animal wastes. For example, the amount of nutrients that a wetland can absorb varies on the type, size, plants, and soils. Estimates range from 80 to 770 kg/ha/year for phosphorus removal, and 350 to 32,000 kg/ha/year for nitrogen removal in SOG riparian wetlands (Wilson, 2008b). Using the low end of the ranges, even the small 'unevaluated' 0.47 hectare riparian wetland associated with Tributary B on the proposed quarry site is capable of removing at least 37.7 kg of phosphorus and 164.5 kg of nitrogen per year (Wilson, 2008b). The 145.84 ha of the on-site and surrounding wetlands could remove a minimum of 11.67 tonnes of phosphorus and 51.04 tonnes of nitrogen per year. Consequently, maintaining the integrity of wetlands is important to the associated ecosystems.

Agricultural Lands

A detailed breakdown by area was not available for the various agricultural land uses in the area around the proposed quarry site. However, the conservative JDCL Agricultural Impact Assessment (Stovel, 2016a) estimated that half of the 600 hectare area surveyed is utilized for agriculture. Using 300 ha, and assuming that it is all cropland, yields a total annual ecosystem service value of \$143,100r. This is a minimum value, since this area contains some grazing lands (perennial croplands), idle land, and also several kilometers of hedgerows (shelterbelts) between the fields which have higher valuation (Table 2). For example, along just the 6th Line and northern border of the site, hedgerows occupy 0.3 ha of land (GWS, 2012) and would be assigned a total ecosystem value of \$494 per year. A large part (66 %) of this valuation for hedgerows (as well as of idle land) is due to their importance as habitat and nectar resources for pollinators for crop production and for natural pest control species (Wilson, 2008b).

AGGREGATE LEVY VALUE

It is worthwhile calculating some of the 'socio-economic benefit' which would serve to destroy habitat and deplete the natural capital of the proposed Hidden Quarry area in order to supply aggregate mainly to the Greater Toronto Area. Presently, with the Ontario aggregate levy of \$0.198 per tonne for a Class A license and a projected annual extraction rate of 700,000 tonnes from the Hidden Quarry (Explotech, 2014), a total of \$138,600 would be paid yearly by James Dick Construction Limited (JDCL) to the various levels of government. [\$84,546 to Guelph/Eramosa Township, \$20,790 to Wellington County; \$29,106 to the Crown, and \$4,158 to the Aggregate Trust for rehabilitation and research] (<https://www.ontario.ca/page/aggregate-resources>), This total annual levy is still less than the yearly environmental value of forest and wetland on the site: \$142,587.

CONCLUSIONS

Although ecosystem values have been presented here for woodland, wetland and agricultural land separately, it is important to recognize that these components are linked and do not function in isolation from each other. As noted above, woodlands and agricultural lands provide important habitat for pollinators and wetlands are very important in nutrient and waste treatment which benefits aquatic species in associated waters.

The sum of the yearly values of the forest, wetland and agricultural ecosystem components (\$2,307,758) located in and around the proposed Hidden Quarry that could be adversely impacted by

the quarry operation is of far greater value than the aggregate levy. In fact, it is over 16 times greater than the projected annual income from the present aggregate levy. This huge difference will be maintained over the expected 20 year lifespan of the quarry. However, even if the aggregate fee income were equal to the ecosystem valuation, the comparison would be meaningless, since many of the ecosystem services could probably not be replaced if badly damaged or destroyed. In short, "...the degradation of ecosystem services represents loss of a capital asset." (MEA, 2005).

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