

Study of Aggregate Site Rehabilitation in Ontario

Consolidated Report: 2010-2013

Part II



ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Aggregate resources are non-renewable, natural resources that are extracted from the ground in industrial operations known as pits and quarries. Mineral aggregate resources are essential in both the construction and manufacturing industries, and the demand for these resources remains constant in Ontario. The availability of high-quality, close-to-market aggregate resources in Ontario is essential for supporting economic growth and prosperity in Ontario, particularly within the Greater Toronto and Hamilton Area.

With ongoing population growth occurring in Southern Ontario, greater demand and constraint is placed on competing land use values. The need to extract, transport, and secure access to high-quality aggregate resources has resulted in ongoing land use conflicts. Once aggregate materials are depleted, the land is restored to its former state or an alternative compatible condition that can achieve ecological, social, and/or economic objectives. Rehabilitation is a necessary step in this process and the extraction of aggregate materials is considered an interim use of the land. Rehabilitation also plays an essential role in mitigating the potential social and environmental impacts of the extraction process. However, there has been limited information available about the final land use condition of rehabilitated aggregate sites across Ontario.

The first rehabilitation study was initiated by the Ontario Stone, Sand, & Gravel Association (OSSGA) to address this shortcoming in 2010. Part I of the report surveyed 337 fully extracted and rehabilitated aggregate sites in Southern and Eastern Ontario and determined that rehabilitated aggregate sites can successfully be integrated into rural or urban landscapes. In addition, the collected data also found that rehabilitated aggregate sites are compatible with adjacent land uses and overarching provincial land use plans, thus demonstrating that aggregate extraction is accurately described as an interim use of the land.

This report forms Part II of the OSSGA rehabilitation study initiative and gathered field data on an additional 231 sites across Southern Ontario during the summer months of 2013. Part II of this study initiative combines the collected data from 2010 and 2013 to form a comprehensive representation of rehabilitated aggregate sites across the Province of Ontario (a total of 568 sites). An analysis of the combined data reveals that:

- The four most common land uses for rehabilitated aggregate sites was determined to be Natural (25%), Agriculture (18%), Open Space (13%), and Water (12%).
- Rehabilitated aggregate sites were observed to adequately integrate into the surrounding landscape and represented productive final land uses.

Several recommendations are suggested based on these results, including the need to: 1) Continue to collect data on rehabilitated aggregate sites across Ontario; 2) Monitor rehabilitated sites to assess long term change and quality; and 3) Improve data collection standards for recently surrendered aggregate licences.

1 INTRODUCTION

Ontario's high quality mineral aggregate resources are essential non-renewable resources that help drive economic growth in the province. However, aggregate extraction is also a highly regulated activity that has experienced increasing land use conflict. As a result, the establishment of new pits and quarries is often contested by local residents and environmental groups. Although aggregate extraction has changed significantly over the past 40 years, little information has been available on the current condition of former extraction sites. This study was undertaken by the Ontario Stone, Sand & Gravel Association (OSSGA) to address this shortcoming. ***This report forms Part II of this study initiative.***

In both Part I and Part II of this study, the research team compiled a list of formerly licensed extraction sites in southern and eastern Ontario. These sites were then visited in order to assess their current site and land use condition. The objectives of this study were to document and analyze field data in order to develop informed conclusions and recommendations regarding the rehabilitated state of former aggregate sites in Ontario.

1.1 Mineral Aggregate Resources in Ontario

The term "mineral aggregate resources" is defined by Ontario's Provincial Policy Statement of 2005 to encompass a variety of naturally occurring material including gravel, sand, clay, earth, shale, stone, limestone, dolostone, sandstone, marble, granite, rock, and other natural materials prescribed by Ontario's *Aggregate Resources Act* as suitable for construction, industrial, manufacturing, and maintenance purposes. The term excludes metallic ores, asbestos, graphite, kyanite, mica, nepheline syenite, salt, talc, wollastonite, mine tailings, and other materials prescribed by Ontario's *Mining Act*.

Aggregate is used in the construction of houses, apartments, roadways, airports, dams, and institutional, commercial, and industrial buildings; thereby making a significant contribution to Ontario's infrastructure and economy. Although it is environmentally and economically preferable for the resource supply to be close to its market, extraction has shifted further from settlement areas as population continues to grow and the demand for aggregate increases.

Ontarians all use aggregates in their everyday lives, yet the public perception of natural resource extraction tends to be negative. Aggregate extraction is often thought of as causing irrevocable damage to the landscape, rather than as an economically valuable industry and temporary use of the land that can be restored to a productive land use post-extraction.

The rehabilitation of extraction sites usually includes the grading of slopes, replacing the topsoil and subsoil on the new post-extraction surface, and planting vegetation on the site. During the extraction process, the site is sequentially restored and transitioned back to its original state, or a condition that may even be superior in quality and value.

This ensures that depleted areas can be restored while extraction continues in other areas of the site. This restoration process is known as *progressive rehabilitation* and is one of the most important provisions of the *Aggregate Resources Act*.

1.1 Aggregate Management Legislation & Policy

Provincial aggregate legislation was enacted in Ontario to address public, industry, and provincial concerns regarding: ongoing supply and demand issues, unregulated resource management activities, better rehabilitation, and the desire to establish standards for the operation and rehabilitation of pits and quarries.

With the introduction of the *Pits and Quarries Control Act* in 1971, aggregates resources have been regulated by provincial and municipal legislation to ensure more sustainable management of the resource. The *Pits and Quarries Control Act* was designed to govern site rehabilitation, among many other regulatory matters, and minimize the environmental impact of pit and quarry operations, while enabling Ontario to meet its own aggregate requirements.

The *Aggregate Resources Act* (ARA) was enacted in 1990 and replaced the *Pits and Quarries Control Act* of 1971 with comprehensive new standards for the licensing, operation, and the progressive and final rehabilitation of pits and quarries. It is administered by the Ministry of Natural Resources (MNR) and is the primary legislation governing aggregate extraction and resource management in the province.

The purposes of the *Aggregate Resources Act* are defined within Part 1, Section 2 of the Act:

- to provide for the management of the aggregate resources of Ontario
- to control and regulate aggregate operations on Crown and private lands
- to require the rehabilitation of land from which aggregate has been excavated
- to minimize adverse impact on the environment in respect to aggregate operations

The ARA requires every licensee and/or permittee to perform both progressive and final rehabilitation on the site to the satisfaction of the Ministry of Natural Resources. This must be done in accordance with the Act, corresponding regulations, the site plan, and the conditions of the licence or permit. If the Ministry is not satisfied that adequate rehabilitation has been performed on the site, MNR may issue a rehabilitation order under Section 48(2) of the Act to perform the progressive or final rehabilitation as deemed necessary.

Current aggregate legislation also ensures that extraction is only a temporary land use, and that rehabilitation is undertaken to return each extracted site to its initial use or to a use compatible with the surrounding landscape.

Additional legislative and policy tools in Ontario also view aggregate extraction as an interim land use and require that both progressive and final rehabilitation occur:

- The Provincial Policy Statement (2005)
- The Greenbelt Plan (2005), The Niagara Escarpment Plan (2005), Oak Ridges Moraine Conservation Plan (2002), Lake Simcoe Protection Plan (2009).
- Municipal Official Plan Policies and Zoning By-laws

1.2 Previous Research

Prior to the initiation of this study, there was very little up-to-date information available on the final rehabilitation and subsequent use of former aggregate sites in Ontario.

In the 1980s the Ministry of Natural Resources completed considerable research into the rehabilitation of aggregate sites, including: “Rehabilitation of Pits and Quarries for Forest Production (1988)”, “Rehabilitation of Sand and Gravel Pits for Fruit Production in Ontario (1985)”, “Agriculture and the Aggregate Industry: Rehabilitation of Extracted Sand and Gravel Lands to an Agricultural After-Use (1982)”, “Rehabilitation of Pits and Quarries for Fish and Wildlife (1987)”, and “Sand and Gravel Pit Rehabilitation in Northern Ontario (1985)”. In 1979 (revised in 1992), the Ministry of Natural Resources conducted a research study examining the rehabilitation of 82 pits within historical Metropolitan Toronto (i.e., as defined prior to 1967, when the boundaries were expanded to their current limit), and published the results in “From Pits to Playgrounds”. This was the first study conducted in Ontario to demonstrate that aggregate properties are not left as abandoned lands, as previously speculated, but are transformed and integrated into the landscape through rehabilitation activities. Also in 1979, the MNR completed “Trees and Shrubs for the Improvement and Rehabilitation of Pits and Quarries in Ontario “

In 1992, a study on aggregates in Ontario was published as *Aggregate Resources of Southern Ontario: A State of the Resource Study*. In 2007, the Ontario government announced that it would undertake a study to update available information on aggregates in the province, part of which would involve updating this 1992 publication.

In 2010, the Ministry of Natural Resources released a series of six papers comprising *The State of the Aggregate Resource in Ontario Study*, a report that addressed aggregates demand, availability, alternatives, recycling and reuse, supply, and rehabilitation in Ontario. *Paper 6: Rehabilitation* addressed provincial objectives within a scientific and political framework, assessing both progressive and final rehabilitation. The 50 most recently surrendered and completely rehabilitated sites were assessed to identify after-use trends in site rehabilitation. These recent examples were assumed to give the best indication of current rehabilitation trends. However, the research did not represent all rehabilitation outcomes across the entire province.

There are many outstanding rehabilitation achievements in Ontario. One of the earliest is located along the Niagara Escarpment. In 1929, rehabilitation began on the sunken rock garden that is renowned today as the Royal Botanical Gardens in Hamilton. In 1979, it was the first aggregate

property to be recognized for outstanding rehabilitation results, and was presented with the first Bronze Plaque Award from the Aggregate Producers Association of Ontario (predecessor to OSSGA).

There are also many lesser known examples of successful aggregate site rehabilitation in Ontario. However, the public is generally unaware of these exemplary sites and is inclined to believe that depleted aggregate operations are simply abandoned as “open scars” on the landscape that results in irrevocable loss of natural and cultural heritage values.

As a result of this misconception, OSSGA initiated a comprehensive research study in 2010 to determine the current status and land use condition of surrendered aggregate sites in Ontario. Part I of this study was completed in 2011 and examined rehabilitated sites located in the Greenbelt Plan Area (including the Niagara Escarpment Plan Area, Oak Ridges Moraine Plan Area and the Protected Countryside), Lake Simcoe Protection Plan Area, unlicensed sites within historical Metropolitan Toronto, and the City of Ottawa. This study found that the current land use for the total of 337 sites that were surveyed in this phase of the study initiative were: Natural (32%), Residential (15%), Recreational (15%), Water (11%), and Open Space (12%) with some additional occurrences of Industrial, Agriculture, Commercial, Institutional, and other land uses.

1.3 Objectives of Study

The objectives of the ongoing OSSGA rehabilitation study initiative are to investigate, assess, and document the rehabilitation status and final land use condition of surrendered aggregate licensed sites across Ontario. This will be achieved by completing the following tasks:

- Conducting individual field assessments to identify the current condition and land use on each site
- Assessing each site’s current use within the context of surrounding land uses and current zoning for the site
- Identifying the current vegetation type and percentage of cover on each site to determine the ecological succession patterns for vegetative communities on the site
- Locating and creating baseline data on the status of rehabilitation efforts in Ontario
- Identifying overall land use trends for rehabilitated aggregate sites in Ontario
- Developing recommendations for the aggregate industry and governing bodies

1.2 Scope of Study

This study includes only those former aggregate sites for which rehabilitation had been completed and the licence surrendered by the owner/operator of the site. Progressive and/or final rehabilitation occurring on active site licenses was excluded from this study. Sites that may have been abandoned or where the licence was revoked were also not assessed or included in this study.

Aggregate site licenses that were issued and managed by the Ministry of Natural Resources under the *Pits and Quarries Control* (1971) and/or the *Aggregate Resources Act* (1990) were included in

the scope of this study. Several older sites, that were predated licensing requirements, were known by MNR staff or The Ontario Aggregate Resources Corporation and were also included in this study.

This study did not compare the current land use condition with the rehabilitation plans prepared by aggregate producers, as required by the licensing and site planning process. Therefore, this study did not determine whether the completed rehabilitation corresponded with the proposed rehabilitation plan as approved by the MNR under the *Pits and Quarries Control Act* or *Aggregate Resources Act*.

Part II of this study initiative serves as an addendum to Part I of the OSSGA rehabilitation study completed in 2011 and adds to the growing body of knowledge on the condition of rehabilitated aggregate sites across Ontario. Part II of this study initiative combines the collected data from both the 2010 and 2013 field study periods in order to form a comprehensive rehabilitation profile for the Province of Ontario.

1.3 Study Areas

This study initiative examined rehabilitated aggregate sites primarily in south-central and south-western Ontario. In addition, the City of Ottawa in eastern Ontario was also included in this study (see Figure 1 on next page). Rehabilitated sites were surveyed in approximately 86 municipalities that are organized into 17 sub-geographic study areas, generally represented by upper-tier municipal boundaries (note: The City of Hamilton, The City of Kawartha Lakes, The City of Ottawa, and The City of Toronto are represented by single-tier municipal boundaries). This study area includes the top producing aggregate municipalities in the Ontario and also encompasses a high concentration of both active and surrendered aggregate extraction sites.

In this report, study results are organized into 17 sub-geographic categories (referred to as “*Geographic Areas*” in this study), primarily represented by upper-tier municipal boundaries which are labeled as follows (see

Appendix A for a map of the geographic areas):

- | | | |
|--------------|-------------------|--------------|
| • Brant | • Huron | • Waterloo |
| • Dufferin* | • Kawartha Lakes* | • Simcoe* |
| • Durham | • Niagara | • Toronto |
| • Haldimand* | • Ottawa | • Wellington |
| • Halton | • Peel | • York |
| • Hamilton | • Perth | |

* Not all known rehabilitated sites in this sub-geographic study area were surveyed in 2010 or 2013. These additional sites will be captured in subsequent study reports.

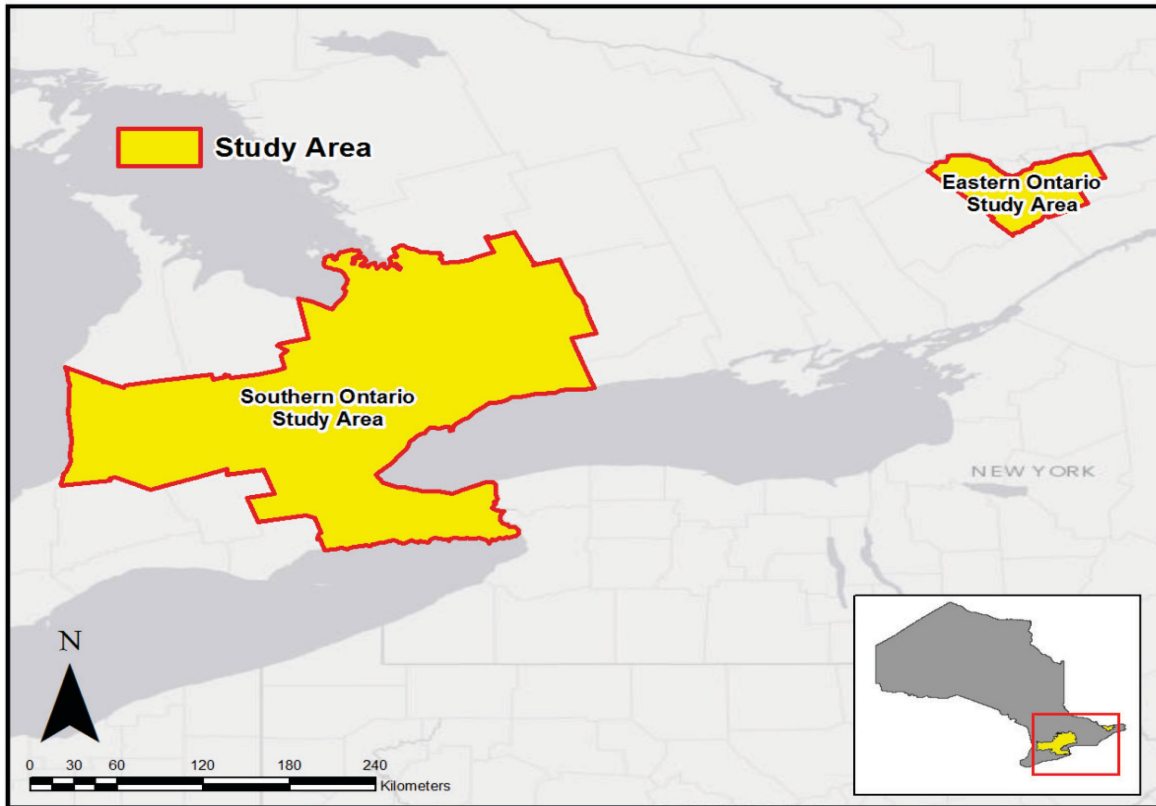


Figure 1: Location and boundaries for the Southern and Eastern Ontario Study Areas.

1.4 Study Limitations

Although several challenges were encountered during this study, the most significant constraint was the limited availability of data regarding surrendered aggregate licences.

The database currently used by the Ministry of Natural Resources (MNR)—the Aggregate Licensing and Permitting System (ALPS)—was created to record and store licence and permit data related to the *Aggregate Resources Act*. It should be noted that once the licence for a site is surrendered, these sites are no longer regulated or managed by the MNR under the ARA. Accordingly, ALPS was not designed to track post-surrender data.

Unfortunately, data retention challenges since the inception of the *Pits and Quarries Control Act* in the 1970's has resulted in the loss of some important data on surrendered aggregate licences.

Problems with data retention include:

- incomplete records
- loss of some data
- incorrect or inaccessible site location information
- unknown rehabilitation information
- poor or no licence modification data

The available ALPS data was supplemented with valuable information provided by Ministry of Natural Resources Aggregate Inspectors in many regions. However, there is clearly a need for a standardized central database to retain this information. This is highlighted as a recommendation in both Part I and Part II of the OSSGA rehabilitation study initiative. Closing the gap for this missing information is regarded as a future and ongoing goal for the Ontario Stone, Sand & Gravel Association.

In addition, some of the sites were inaccessible (i.e. gated) or landowner permission for access was not granted. Because the majority of sites are located on private property, conducting comprehensive site assessments was a challenge and some sites were only surveyed from a public road and using aerial images. Honouring landowners' decisions regarding access meant that the study team could not visit and quantify some of the sites identified for assessment.

2 STUDY METHODOLOGY

The study of past aggregate site rehabilitation in Ontario involved preliminary assessments, field visits, and aerial photograph interpretation. All information collected is stored in a *Aggregate Site Rehabilitation Database* established and managed by OSSGA. Generally the same methodology was employed for Part II of this study that was used in Part I of the *Study of Aggregate Site Rehabilitation in Ontario 1971-2009* completed by OSSGA in 2010-2011. A few minor modifications were made for ease of data organization and collection.

2.1 Database Development & Mapping

Organization of the OSSGA rehabilitation database and mapping of the study site locations using aerial imagery was completed as the initial step in the study process. This phase of the study was completed in preparation for field visits.

2.1.1 OSSGA Rehabilitation Database

During the initial phases of this study, a database was created using the preliminary information collected by MHBC Planning Limited (contracted by OSSGA in 2010) and included geographic and technical information for each surrendered site licence. The database includes the following information:

- site ID number
- site name
- licensee name
- surrender date
- annual tonnage limit
- extraction area (ha)
- licensed area (ha)
- license class
- excavation type (pit or quarry)
- geographic township
- upper- or lower-tier municipality
- lot and concession location
- MNR inspector notes

This preliminary information was used to build the OSSGA Aggregate Site Rehabilitation Database and serves as the study team's primary tool for summarizing and organizing the information that is obtained throughout the study process (i.e. field data collection). Surrendered licence numbers were organized in the database in a manner that facilitated the querying and isolation of data by protection plan area, upper- or lower-tier municipality, geographic township, and MNR district. Within the internal OSSGA network, individual folders were created to store the data on each licence (i.e. site maps, site photos, field data collection sheet etc.) and these folders were organized in the same terms as the database itself ensuring ease in managing and retrieving data.

2.1.2 Mapping of study sites

Aerial imagery was used to create maps showing each surrendered site licence boundary within the identified land parcel (i.e. lot and concession). Site locations and site license boundaries for

surrendered sites that were licensed under the *Aggregate Resources Act* (ARA) were obtained from Land Information Ontario (Aggregate Site Authorized geospatial database). Site licence boundaries were not available for all study locations and in some cases the exact location of the rehabilitated aggregate extraction site was unknown.

XY coordinates were determined for each of the study sites and added as a field to the OSSGA rehabilitated database. This geographic information was used to find the exact location of the study sites in the field.

Maps of the overall study area and of individual licence boundaries were created and used to plan site visits and conduct preliminary aerial assessments (see Figure 2).

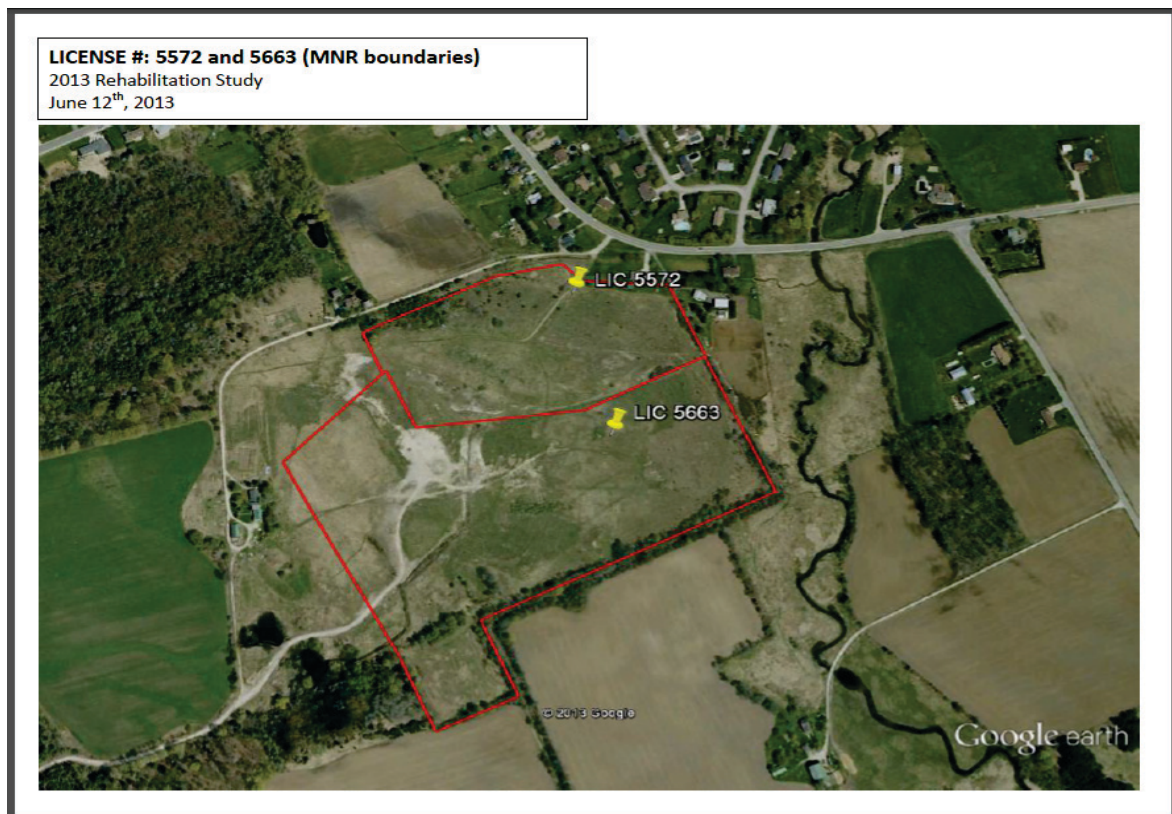


Figure 2: Example of a map generated for each survey site identifying the site location and site licence boundaries

Site locations and site licence boundaries for surrendered aggregate sites licensed under the *Pits and Quarries Control Act* were estimated and digitized using maps contained in older versions of *Aggregate Resources Inventory Papers* (published by the Ontario Geological Survey). All study site locations were digitized, mapped and stored in a Google Earth file (KML).

Site licence boundaries and exact locations could not be determined for some study sites due a lack of geographic information. If a precise location could not be identified, aerial photographs and lot

and concession information was used to identify unique disturbance features or discontinuity within the landscape in an attempt to locate the former aggregate extraction site.

2.2 Field Assessments

Field visits were completed for each of the rehabilitated aggregate sites identified and listed in the OSSGA rehabilitation database. Field visits were conducted in order to document the final land use(s) and site condition of the rehabilitated aggregate extraction sites. This information was added to the OSSGA rehabilitation database.

2.2.1 Field Visits

During the summer months of 2010 and 2013, field visits were made, or attempted, at a total of 597 surrendered sites by one member of the study team. During the field data collection phase, 22 sites were removed from the study because of landowner and accessibility issues, and 7 sites were removed as they could not be located. Therefore, field assessments were completed on a total of 568 sites – 337 sites in the summer of 2010 and an additional 231 sites in 2013. The results of these field visits are consolidated in this report.

Unlike Part I of this study completed in 2010-2011, Part II did not include the collection of data using field assessment sheets and instead the same data was collected using an electronic data collection system and a laptop computer. This eliminated the need to transfer data from paper records to the electronic OSSGA rehabilitation database.

Site visits and field assessments were completed for each site and the following information was collected:

- Surrounding land use(s)
- The estimated percentage of tree coverage on a site
- Primary type of vegetative cover
- Current rehabilitated final land use(s)
 - Primary land use of site (percentage of site)
 - Secondary land use of site (percentage of site)
 - Tertiary land use of site (percentage of site)
- Number of photographs taken
- Field observation notes

For each study site, a Garmin GPS unit was used to precisely determine the location of the site. Observations about the use of the surrounding lands (*see section 2.2.3 - Surrounding Land Uses*) were recorded to describe the general landscape and assist in determining the appropriateness of the rehabilitated site's current use.

In the field, visual assessments and aerial photograph interpretation were used to estimate the amount of tree coverage (% *tree coverage*) and to determine the dominant vegetation type on each site (*native, non-native, agricultural, seeded, or not applicable*). Several photographs were taken of each site to visually document the land use at the time of the field assessment.

Data was recorded on the current land use (*current land use – %*) using the categories specified on the following pages (*see section 2.2.4 - Current Land Use Categories*). For some sites, multiple current land uses were observed and recorded.

2.2.2 Type of Vegetation Categories

During the field assessments, the predominant type of vegetation was determined for each of the study sites and documented using the following categories:

- Agriculture: Vegetation used for crop production such as corn, soy, wheat or hay.
- Native: Vegetation that is primarily native to Southern Ontario.
- Non-native: The primary vegetation type on the site is not native to Southern Ontario and can be considered an invasive species or ornamental planting for landscaping purposes.
- Not Applicable: The site does not contain any vegetation or the vegetation type does not fit into one of the other vegetation type classification categories.
- Seeded: The site was seeded with a grass/legume mixture and further ecological assessments are needed to determine whether the species are native or non-native.

2.2.3 Surrounding Land Use Categories




During field assessments, the study team determined the surrounding land uses for each sites of interest using the following categories:




- Aggregate Extraction: Land area licensed under the *Aggregate Resources Act* for the excavation of crushed stone, sand, and/or gravel.
- Agriculture: Land area used to produce food and goods through farming practices (e.g., pasture, field crop, livestock, orchard, vineyard etc.).
- Commercial: Area used for the buying and selling of goods and/or services by commercial businesses.
- Conservation Area: Land area with protection status that ensures the preservation of natural features, cultural heritage, or biota; may be nature





- Industrial: reserve, parkland, or other area maintained by Ontario Conservation Authorities or provincial or territorial government. Land area used for the manufacturing and production of goods.
- Institutional: Land area used by an establishment, association, or foundation that is funded and united for a specific purpose.
- Natural: Naturalized land area that contains a vegetated terrestrial or aquatic ecosystem (i.e. woodlot, unmaintained open space, riparian ecosystem etc.).
- Recreational: Land area used for active and passive recreational purposes.
- Residential: Land area primarily used for housing, typically zoned residential, and with existing residences on the property.





2.2.4 Current Land Use Categories





The current land use categories and sub-classifications used for the sites visited during this study are outlined below.




Current Land Use Category	Sub-Classification	Key	Photo Example
Natural Category for vegetated, terrestrial ecosystem maintained by environmental disturbances, not by human influence.	Cultural Thicket	Land dominated by shrub species (more than 25%) and having less than 25% tree coverage.	
	Woodland	Land with tree coverage in amounts typically between 35% and 60%.	
	Other	Meadow, grassland, prairie, or mature forest.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Open Space Category for vegetated, terrestrial ecosystem with predominantly low lying vegetation and less than 5% tree coverage, maintained through anthropogenic disturbances.	Natural	Ditch or unmaintained lawn.	
	Maintained	Manicured lawn and/or maintained garden.	
	Other	Exposed sand, stone, gravel, pavement stone, or roadway.	



Current Land Use Category	Sub-Classification	Key	Photo Example
Water Category for land that is either permanently flooded or periodically and seasonally inundated with water.	Storm Water Management	Pond designed to capture water run-off in developed areas where flooding can occur because of impermeable substrates.	
	Pond	Body of isolated standing water, typically smaller than a lake, in which water accumulates from rain and snow melt or is naturally spring-fed, and where wetland and aquatic plant species are present.	
	Restored Watercourse	Stream or river connected to neighbouring waterways that were altered by human influence and restored through site restoration.	
	Other	Lake, wetland, marsh, swamp, or bog.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Agriculture Category for land used to produce food and goods through farming practices.	Vineyard	Land used for grapevine cultivation.	
	Livestock	Land used for animal cultivation.	
	Orchard	Land used for fruit crop cultivation.	
	Pasture	Land dedicated to growing low-lying vegetation for grazing animals.	
	Field Crop	Large field area dedicated to cultivation of vegetation for human consumption (e.g., vegetables) or agricultural purposes (e.g., hay or grain).	
	Other	Land or water body used for aquaculture—i.e., farming of aquatic species, usually fish.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Recreational Category for land used for purposes or activities that provide enjoyment to community members.	Private	Recreational area located on privately owned land.	
	Golf Course	Public or privately-owned golf course.	
	Conservation Area	Land that has protected status to ensure the preservation of natural features, cultural heritage, or biota; may be nature reserve, parkland, or other area maintained by Ontario Conservation Authorities.	
	Public Park, Sports Field, or Playground	Municipally-owned recreational area.	
	Other	Land used for a sportsplex, swimming pool, indoor skating rink, national or international sports facility, or physical fitness centre.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Commercial Category for land used for the buying and selling of goods and/or services by commercial businesses.	Professional or Financial Services	Land on which professional or financial services are sold.	
	Restaurants	Land on which prepared food, beverages, and dining services are sold.	
	Grocery/ Retail	Land on which food and other general goods are sold.	
	Hotel	Land on which temporary accommodation and related services are sold.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Industrial Category for land used for the manufacturing and production of goods.	Office	Land on which business, clerical, and/or professional duties are carried out.	
	General Industrial	Land with a variety of uses ranging from light manufacturing to heavy manufacturing plants.	
	Waste Disposal Site	Land used for a waste disposal site, landfill, recycling centre, compost facility, or similar activity.	
Institutional Category for land used by an establishment, association, or foundation that is funded and united for a specific purpose.	School	Land used for a public or private educational facility.	
	Government Office	Federal, provincial, or municipal properties and buildings used to provide public services.	
	Other	Land used for hospitals or non-governmental offices.	

Current Land Use Category	Sub-Classification	Key	Photo Example
Residential Category for land that is typically zoned residential, is primarily used for housing, and has existing residences or established residential lots.	Apartment	Land used for a suite of rooms occupied by more than one household, typically a multi-storey building.	
	Single-Detached	Land used for a single-family dwelling or detached home or for a free-standing residential building on a property that is divided into defined lots.	
	Semi-Detached	Land used for a pair of houses built side-by-side and attached on one side.	
	Townhouses	Land used for terraced, rowed, or linked houses.	
	Rural	Land in a low-density area that is zoned "rural" and typically has a single-detached home on several acres of agricultural, open space, or wooded land.	
	Other	Land used for a senior residence.	

3 STUDY RESULTS

A total of 568 rehabilitated aggregate sites throughout southern and eastern Ontario were examined as part of this study. Within the study area, 22 sites could not be accessed and 7 sites could not be located; these sites are not included in the following study analysis. Of the 568 study sites, 528 sites were previously pit operations, 20 surveyed sites were former quarry operations, and 20 sites were unknown to be either former pits or quarries. Rehabilitated sites surveyed as part of this study initiative were located in both urban and rural landscapes as well as areas that can be classified as the urban-rural fringe (defined as the boundary area outside of an urban area where urban and rural land uses intermix. The analysis and discussion of the collected data is organized into 17 specific geographic areas in order to provide regional rehabilitation profiles and subsequent comparisons. The overall study results (i.e. the assessment of all sites combined) is also presented in order to broadly characterize rehabilitation across the Province of Ontario.

Table 1: Number of surveyed sites in each of the geographic areas for the entire study area

Geographic Area	# of Sites Surveyed	Not accessible	Could not locate	TOTAL
Brant County	9	1	0	10
Dufferin Region*	4	0	0	4
Durham Region	53	2	4	59
Haldimand County*	7	1	0	8
Halton Region	10	1	0	11
Hamilton, City of	9	2	0	11
Huron County	56	1	0	57
Kawartha Lakes*	27	1	0	28
Niagara Region	12	0	1	13
Ottawa, City of*	50	5	0	55
Peel Region	39	0	2	41
Perth County	23	0	0	23
Region of Waterloo	39	0	0	39
Simcoe County*	74	5	0	79
Toronto, City of	82	0	0	82
Wellington County	39	1	0	40
York Region	35	2	0	37
TOTAL	568	22	7	597

**data collection not complete for geographic area*

It is important to consider that many rehabilitated aggregate sites in Ontario can represent more than one final land use on any given site. For example, a rehabilitated aggregate site with a

predominant land use classification of *Agriculture* can also include *Residential* and *Water* land uses on the same site. The **predominant land use** classifications for the entire study area, as detailed in Figure 3, represent the final land use that best characterizes the use of the land on the site (i.e. 50 per cent or more of the site is used for the classified land use). The data collected revealed that, frequently, rehabilitated aggregate sites also contain secondary or tertiary land uses which are not represented in the figure below. ***Pie charts included in this study report are expressed in number of sites surveyed, represented by percentages.***

3.1 Overall Study Area

The **predominant current land uses** (see Figure 3) of the **568** rehabilitated sites in the study area was determined to be: Natural (142 sites), Agriculture (102 sites), Open Space (72 sites), Water (66 sites), Recreational (60 sites), Residential (56 sites), Industrial (32 sites), Commercial (18 sites), Other (11 sites), and Institutional (9 sites).

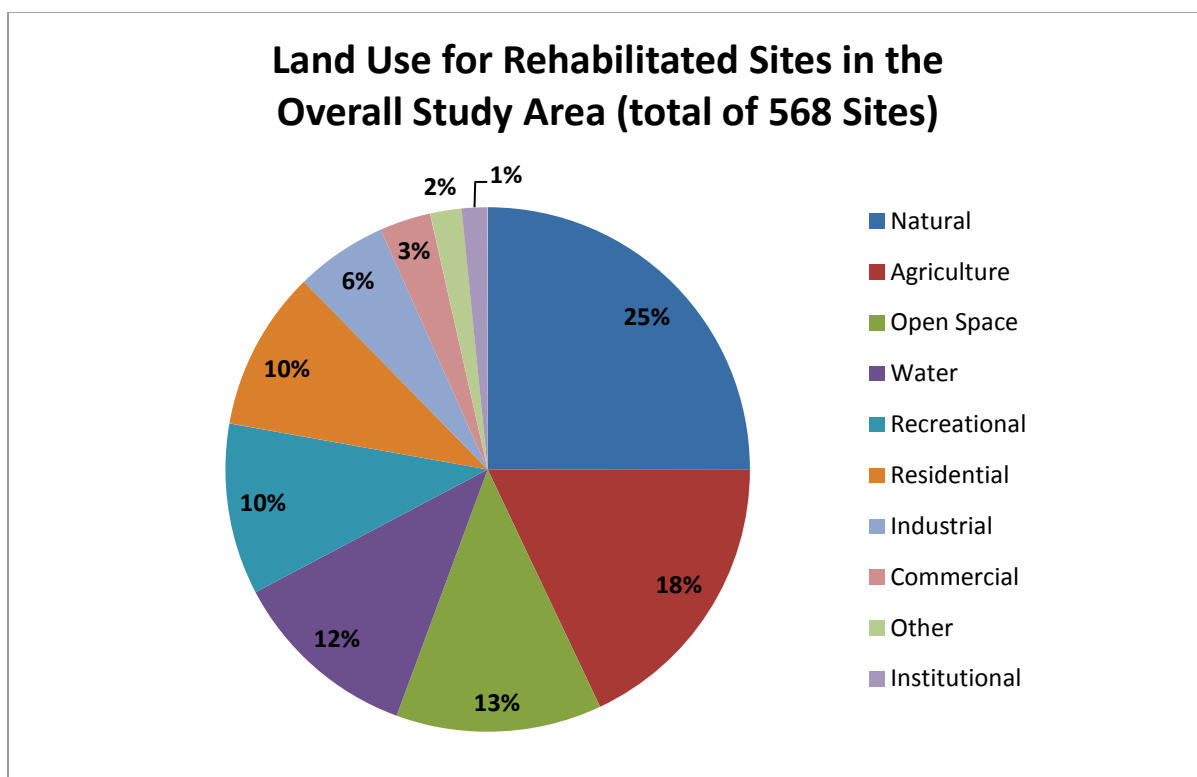


Figure 3: Predominant land use for rehabilitated sites surveyed in the Overall Study Area.

Most sites surveyed had a variety of surrounding land uses. Frequently, sites in rural areas were found to have rural abutting land uses such as agricultural, natural heritage, and rural estate housing. Rehabilitated aggregate sites in more urban areas were found to have surrounding and adjacent land uses that are more characteristic of urban built form, including single-detached residential, industrial, and commercial. Rehabilitated aggregate sites located within a cluster of

active aggregate operations were frequently located adjacent to or in close proximity to an active extraction operation.

Site assessments revealed that rehabilitated aggregate sites throughout the study area were generally consistent with the character of the adjacent land uses as well as the broader landscape area. Many sites were unrecognizable as previous aggregate extraction operations and were sufficiently integrated with the rural or urban character of the area. A further discussion of these overall study findings is included in Section 4 of this report.

An analysis of the data revealed that the average **percentage of tree coverage** for rehabilitated sites is 20% for the overall study area (total of 568 sites). This relatively low estimated percentage of tree coverage for rehabilitated aggregate sites can be attributed to the high percentage of surveyed sites being classified as agricultural, open-space, and water land uses in the study area. Sites classified as “open-space” included primarily low-lying terrestrial vegetation with less than 5% tree coverage. Sites classified as “agriculture” or “water” would have little to no tree coverage due to the nature of the land use.

Within the overall study areas, there are several exceptional examples of aggregate site rehabilitation, for example: the Elora Quarry Conservation Area in Elora; the Guelph Arboretum, in Guelph; Kolb Park in the City of Kitchener; and the Heritage Green Community Sports Park in Hamilton (see photographs in Figure 4).



Figure 4: Elora Quarry Conservation Area (top left), Guelph Arboretum (top right), Kolb Park in Kitchener (bottom left), Heritage Green Community Sports Park in Hamilton (bottom right).

Summary of results for the Overall Study Area:

- The four predominant land uses for rehabilitated aggregate sites in the overall study area are: Natural, Agricultural, Open Space, and Water.
- Rehabilitated aggregate sites located in urban areas are returned to a final land use that is appropriate for urban built form. Sites located in rural areas are rehabilitated to final land uses that suits the rural characteristics of the landscape (see examples in Figure 5).
- Surrendered aggregate sites licenses in Ontario can be rehabilitated to a variety of productive final land uses. These final land uses are sufficiently rehabilitated to a subsequent land use and successfully integrate into the surrounding urban and rural landscape.



Figure 5: Examples of different types of rehabilitation located in rural (top-left photo), urban (centre photo), or urban-rural fringe (bottom-right photo) landscapes.

3.2 Brant County

A total of 9 rehabilitated aggregate sites were surveyed in Brant County.

The predominant **final land use** for surrendered aggregate sites in Brant County (see Figure 6) was observed to be: Open Space (3 sites) and Agriculture (2 sites). Other observed final land uses included: Natural, Industrial, Recreation, and Residential.

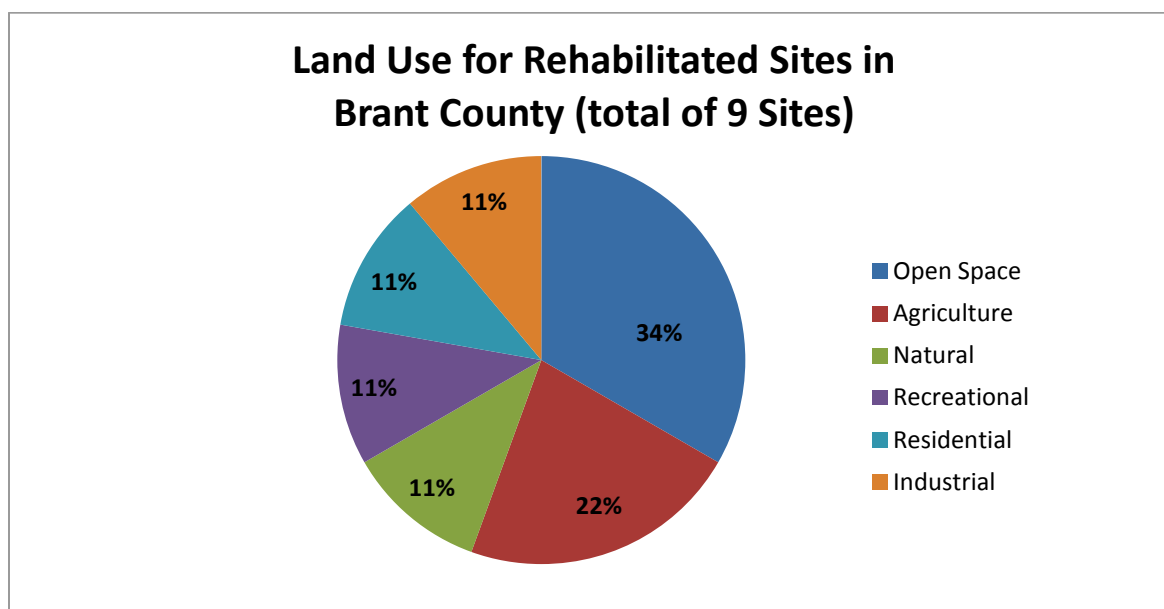


Figure 6: Predominant land use for rehabilitated sites surveyed in Brant County

The average **percentage of tree coverage** was estimated to be 8%; vegetative cover was primarily seeded and agricultural.

Sites rehabilitated to an agricultural final land use in Brant County were observed to be primarily specialty crops including tobacco and orchard. In addition, the 34% of Open Space area was observed to be maintained landscaping and can be attributed to large rural estate, residential lots and green space area surrounding industrial land uses.

Summary of results for Brant County:

- Agriculture and Open Space are the predominant land uses for rehabilitated aggregate sites in Brant County.
- The rehabilitated aggregates sites in Brant County are successfully integrated into the surrounding landscape and are compatible with both the urban, rural, and urban-rural fringe land uses.

3.3 Dufferin County

A total of **four** rehabilitated aggregate sites were surveyed in Dufferin County. Additional rehabilitated aggregate sites in this geographic area will be surveyed in the future.

Of the four sites surveyed in Dufferin County, each was classified as having a different predominant land use. The following **primary land uses** were identified for rehabilitated aggregates sites in the Dufferin geographic area: Agriculture, Natural, Open Space, and Water.

The average **percentage of tree coverage** for these sites was calculated to be about 14%. All sites were observed to have a land use character compatible with the surrounding rural landscape.

Summary of results for Dufferin County:

- A small number of sites were surveyed in Dufferin County. More sites in this geographic area will be surveyed in the future.
- All surveyed rehabilitated sites are compatible with adjacent land uses and the rural character of Dufferin County.

3.4 Durham County

A total of **53** rehabilitated aggregate sites were surveyed in Durham County. Two sites were not accessible and were not surveyed. An additional four sites could not be located. These sites are not included in this analysis.

The predominant **final land use** for surrendered aggregate sites in Durham County (see Figure 7) was observed to be: Natural (26 sites), Open Space (8 sites), Industrial (5 sites), Commercial (4 sites), Recreational (3 sites), Water (3 sites), Agriculture (2 sites), and Residential (2 sites).

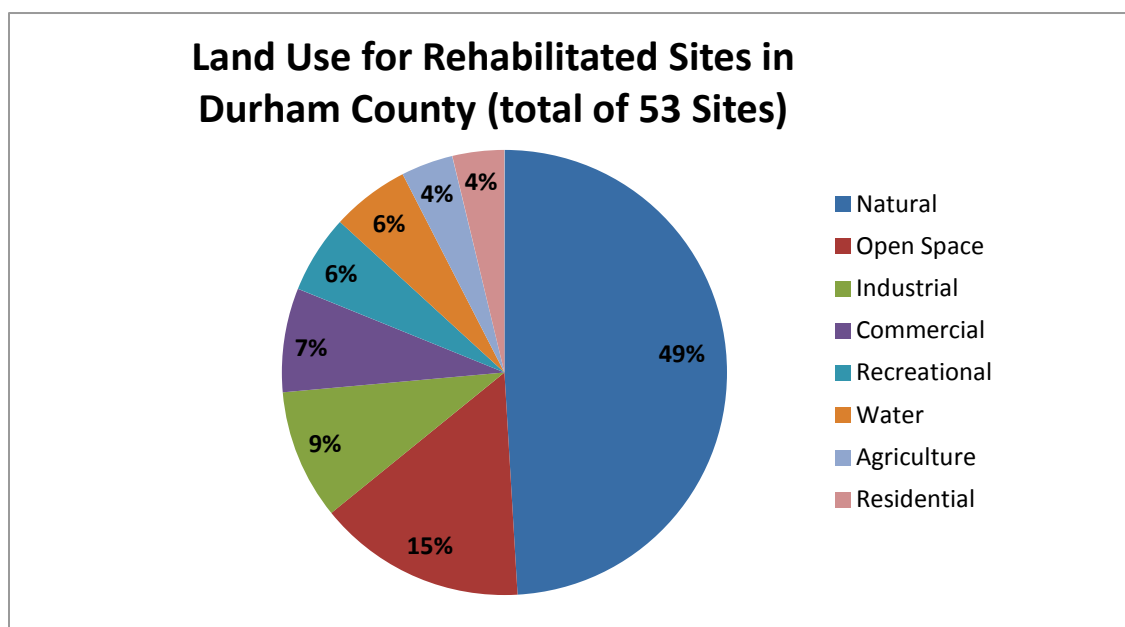


Figure 7: Predominant land use for rehabilitated sites surveyed in Durham County.

The average **percentage of tree coverage** for the surveyed sites was calculated to be approximately 18%. All sites were observed to have a land use character compatible with the surrounding landscape. This higher estimated tree coverage can be attributed to the higher percentage of naturalized final land uses (e.g. cultural thicket and woodland) observed in Durham County.

Summary of results for Durham County:

- In Durham County, Natural and Open Space are the primary final land uses for rehabilitated aggregate sites.
- Durham County is characterized by both urban and rural land uses and worked out aggregates sites are rehabilitated to a diversity of different land uses that integrate successfully into the surrounding landscape.

3.5 Haldimand County

A total of **7** sites were surveyed in Haldimand County, with one site being removed from the study due to access issues imposed by the landowner.

Figure 8 illustrates the breakdown of **final land uses** in Haldimand County. Of the seven surveyed sites, 6 were observed to be used for agricultural purposes and 1 site was primarily a water feature.

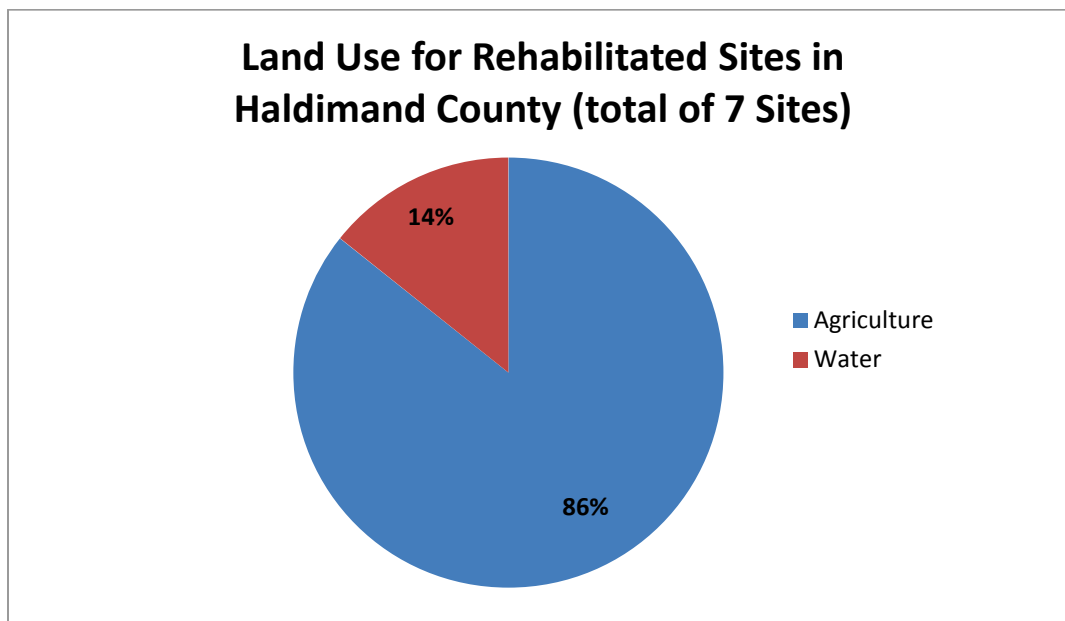


Figure 8: Predominant land use for rehabilitated sites surveyed in Haldimand County.

The average **percentage of tree coverage** was estimated to be about 6%. This low percentage of tree cover is acceptable given the use of these sites for primarily agricultural purposes.

All agricultural land uses supported field crops, except for one site which included several greenhouses. The one site observed to be primarily water was surrounded by agricultural field crops. All rehabilitated aggregate sites were determined to be cohesive with the rural and agricultural landscape of Haldimand County.

Summary of results for Haldimand County:

- The majority of sites surveyed in Haldimand County were classified as having an agricultural final land use.
- The low percentage of tree coverage is due to the use of the land for agricultural purposes.
- All rehabilitated sites were observed to be compatible with adjacent land uses and the rural character of Haldimand County.

3.6 Halton Region Geographic Area

A total of **10** sites were surveyed in Halton Region. One additional site was not included in this study due to access restrictions imposed by the landowner.

As illustrated in Figure 9, there were three **primary land uses** for rehabilitated aggregates sites in Halton Region. Five sites were observed to be a Natural land use, three sites were determined to be used for Agriculture, and two sites were classified as Open Space.

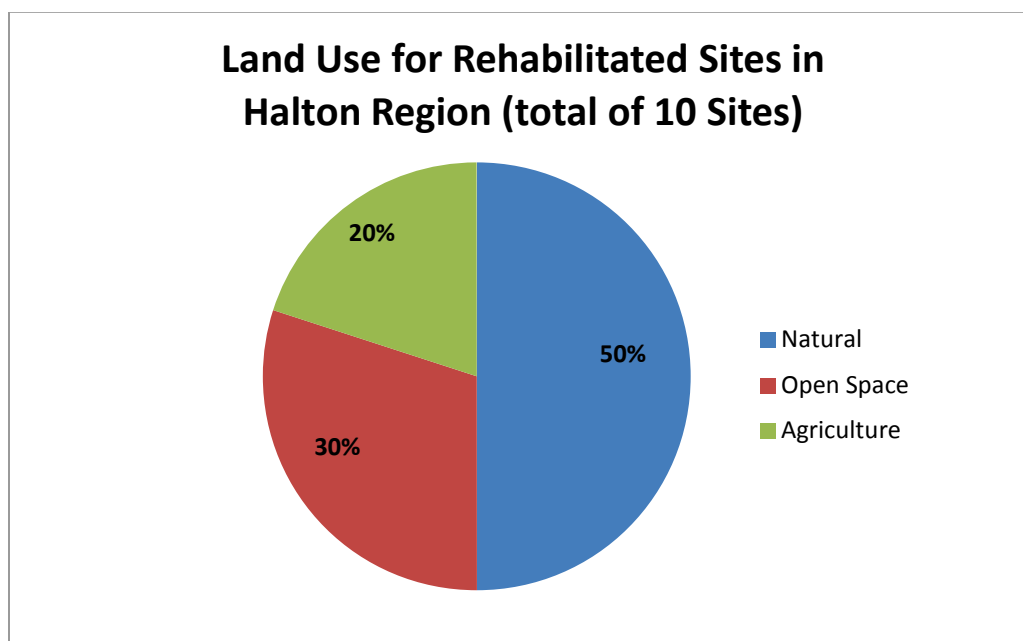


Figure 9: Predominant land use for rehabilitated sites surveyed in the Halton Region.

The average **percentage of tree coverage** for the surveyed sites in Halton Region was calculated to be approximately 26%. This is higher than the overall study average and can be attributed to the majority of sites being classified as having a Natural (e.g. cultural thicket and woodland) final land use.

In addition, all surveyed sites are located in the Niagara Escarpment Plan Area and have a “protected” zoning classification.

Summary of results for the Halton Region:

- The majority of sites surveyed in Halton Region are classified as having a naturalized final land use.
- All surveyed sites in Halton Region have final land uses that are compatible with the rural character and protected zoning of the Niagara Escarpment Plan Area.
- One site is publicly accessible – Kelso Quarry Park, operated by Conservation Halton

3.7 Hamilton (the City of)

A total of 9 sites were surveyed in the City of Hamilton. Two sites were removed from the study due to restricted access imposed by the landowner.

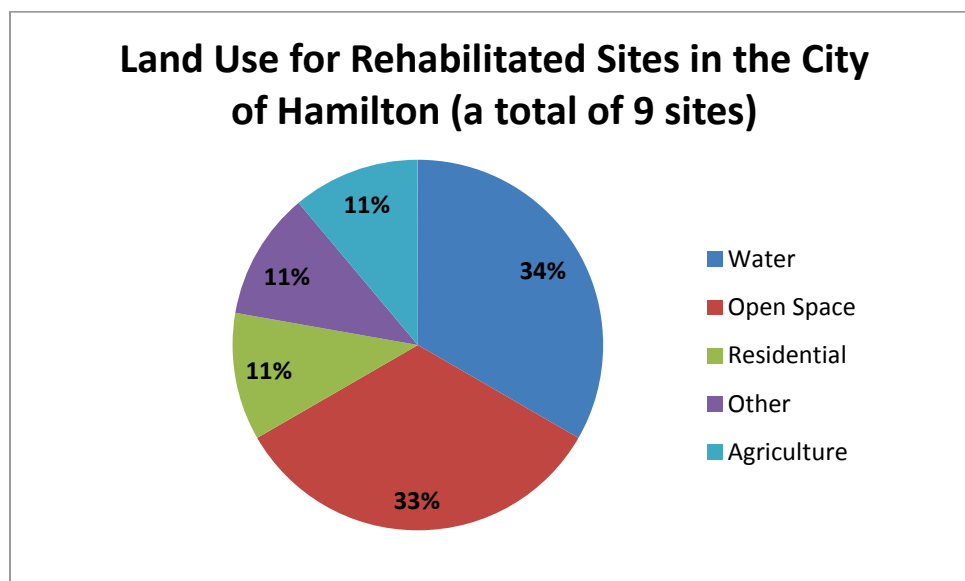


Figure 10: Predominant land use for rehabilitated sites surveyed in the City of Hamilton

The **predominant final land uses** (see Figure 10) for surrendered aggregate sites in the City of Hamilton was calculated to be: Water (3 sites) and Open Space (3 Sites). Other land uses included single detached housing, agricultural land, and one site that was currently under development and will likely be converted to an urban residential land use.

One site in the City of Hamilton was previously a quarry and, interestingly, did not contain any open water features. Instead, the site was converted to passive recreational open-space (i.e. walking trails) as well as outdoor sports facilities (see photographs in Figure 11).



Figure 11: Pictures of Heritage Green Community Sports Park.
Example of a rehabilitated quarry in the City of Hamilton.

All former rehabilitated aggregate sites within the City of Hamilton were rehabilitated to a final land use that was observed to be cohesive with the surrounding landscape. About half of the sites were located on the urban fringe of the City of Hamilton and were rehabilitated in a manner that suits the expanding urban surroundings (i.e. residential development and public recreational facilities). The remaining sites were located in the rural areas of the Hamilton area and were rehabilitated to appropriate rural land uses (i.e. rural estate housing and agriculture).

The average **percentage of tree coverage** was determined to be about 14% for rehabilitated sites in the City of Hamilton. The majority of sites in this study have minimal tree coverage due to the nature of the corresponding land use.

Summary of results for the City of Hamilton:

- The majority of sites surveyed in the City of Hamilton were classified as Open Space or Water. These observed land use categories were observed to be part of larger rural estate residential developments that contain several different land use classifications on a single rehabilitated site (i.e. Residential, Open Space, Water, Natural etc.).
- The low percentage of tree coverage is due to the use of the land for maintained open space and large water features.
- One site is publically accessible (Heritage Green Community Sports Park) and all other sites are privately owned.

3.8 Huron County

A total of **57** sites were surveyed in Huron County. One site was removed from the study analysis as it was not accessible and could not be sufficiently assessed.

The predominant **current land uses** (see Figure 12) of the 57 rehabilitated sites for Huron County was determined to be: Agriculture (31 sites), Water (10 sites), and Natural (9 sites). In addition, Open Space and Industrial land uses were also observed.

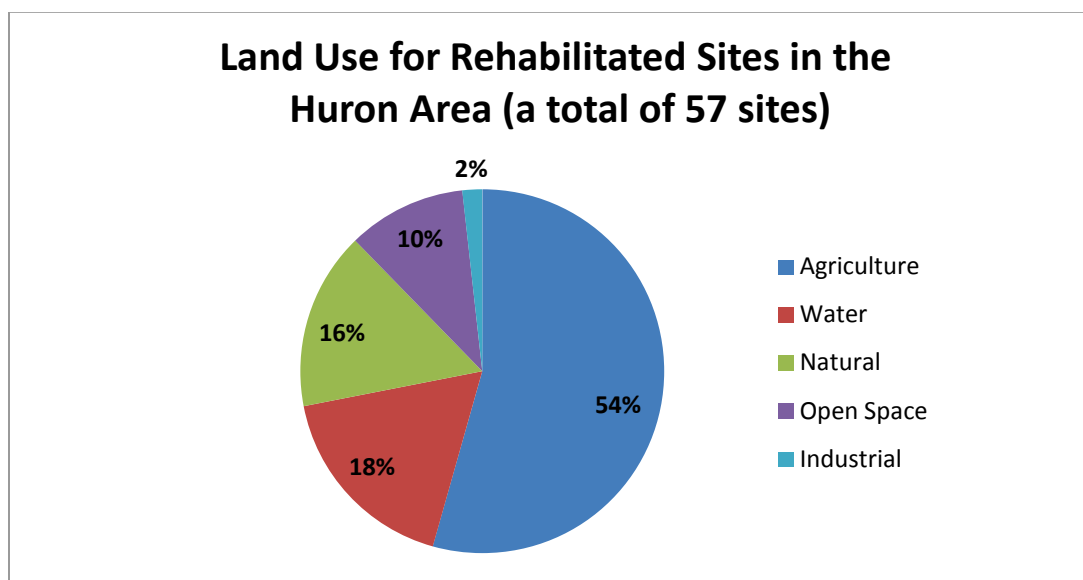


Figure 12: Predominant land use for rehabilitated sites surveyed in Huron County

Huron County had an average **percentage of tree coverage** of 12% for rehabilitated aggregate sites. This low percentage of tree coverage can be attributed to the use of the land for agricultural purposes.

Huron County is primarily rural and the predominantly agricultural final land use for rehabilitated aggregate sites in this geographic area successfully integrates with the surrounding landscape. Sites classified as having “Water” as the predominant land use frequently also contained Natural or Open Space land uses on the same site adjacent to the water feature. Often sites classified as Water were used for private residential purposes.

Summary of results for Huron County:

- The predominant land use for rehabilitated sites in Huron County is agriculture. Water body land uses are generally part of private land uses located on residential properties.
- Rehabilitated aggregates sites in Huron County integrate successfully with the rural character of the surrounding landscape.

3.9 City of Kawartha Lakes

A total of **27** sites were surveyed in the City of Kawartha Lakes. One site was removed from the study analysis as it was not accessible and could not be sufficiently assessed.

The predominant **current land uses** (see Figure 13) of the 27 rehabilitated sites for the City of Kawartha Lakes were: Natural (13 sites), Residential (5 sites), Industrial (3 sites), Water (2 sites), and Commercial (1 site).

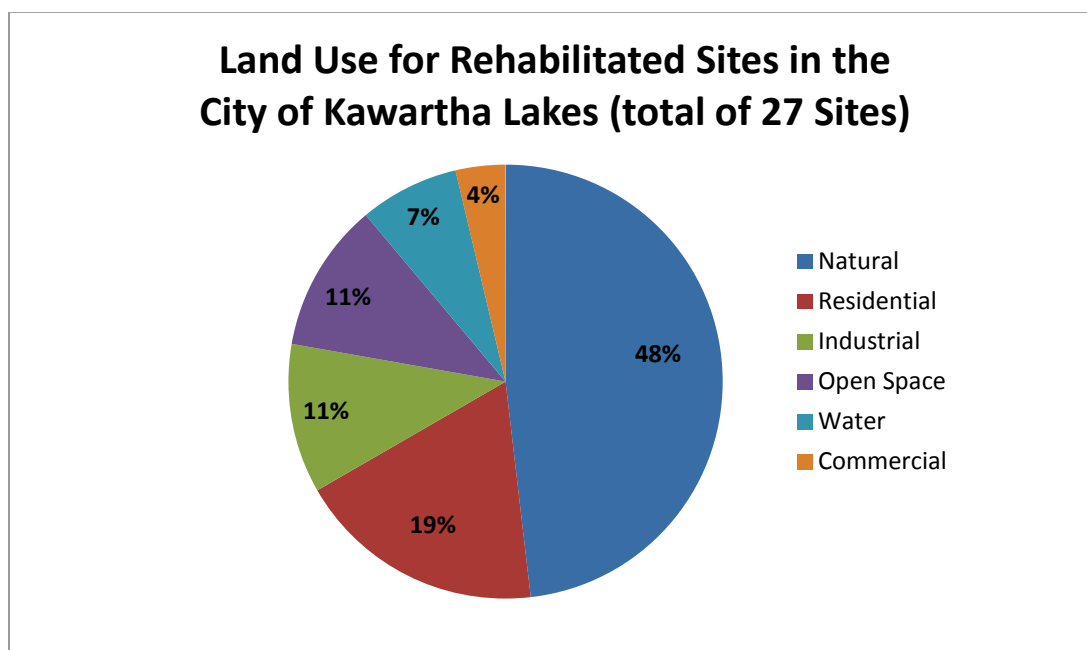


Figure 13: Predominant land use for rehabilitated sites surveyed in the City of Kawartha Lakes

The average **percentage of tree coverage** was calculated to be about 22%. This is higher than the overall study area average and is due to the high percentage of Natural (cultural thicket and woodland) final land uses.

The City of Kawartha Lakes is a primarily rural area. The majority of sites were rehabilitated to either Natural or Residential final land uses which are cohesive with the character of the surrounding landscape.

Summary of results for the City of Kawartha Lakes:

- The City of Kawartha Lakes is primarily rural and the majority of rehabilitated aggregate sites are used for natural or residential purposes.
- Rehabilitated aggregate sites in the City of Kawartha Lakes integrate successfully with the surrounding landscape.

3.10 Niagara Region

A total of **12** sites were surveyed in Niagara Region. An additional two sites could not be located due to insufficient geographic data and were removed from this study.

The **current land uses** (see Figure 14) of the 12 rehabilitated sites for Niagara Region were: Natural (5 sites), Recreational (2 sites), Residential (2 sites), Industrial (1 site), Water (1 site), Agriculture (1 site).

The one industrial site determined to be a large-scale industrial waste disposal site. Previously, this site was an operating quarry and the site licence was surrendered in 2008.

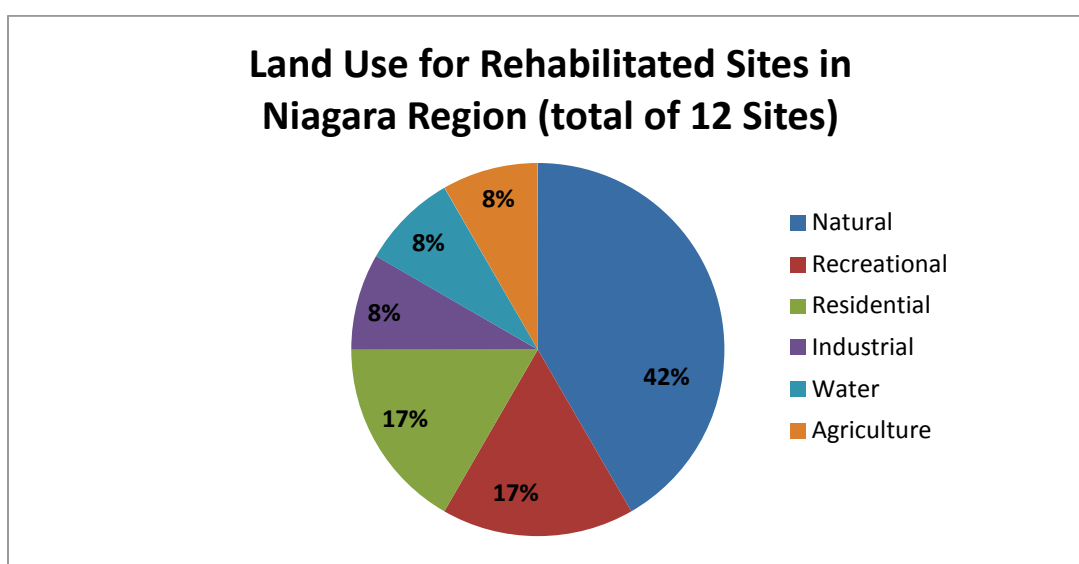


Figure 14: Predominant land use for rehabilitated sites surveyed in Niagara Region

The average **percentage of tree coverage** in Niagara Region was calculated to be about 21%. This is slightly higher than the overall study area due to the higher percentage of Naturalized (i.e. cultural thicket) final land uses.

Niagara Region is characterized by urban-rural fringe land uses. Rehabilitated aggregate sites conform to this landscape character. Natural, Recreational, and Residential land uses are most common for rehabilitated aggregates sites in this geographic area and are further sub-classified as golf courses, single-detached housing, and cultural thickets. These land uses integrate well into an urban-rural fringe landscape.

Summary of results for Niagara Region:

- Aggregate sites in Niagara Region are rehabilitated to land uses that are characteristic of urban-rural fringe developments. This is cohesive with the surrounding landscape.

3.11 Ottawa (the City of)

A total **50** sites were surveyed in the City of Ottawa. An additional five sites were identified, but could not be accessed and are not included in the following analysis.

The predominant **current land uses** (see Figure 15) observed in the City of Ottawa were Natural (18 sites) and Water (12 sites). Additional observed land uses included: Open Space (5 sites), residential (5 sites), Other (5 sites), Recreational (3 sites), and Industrial (2 sites).

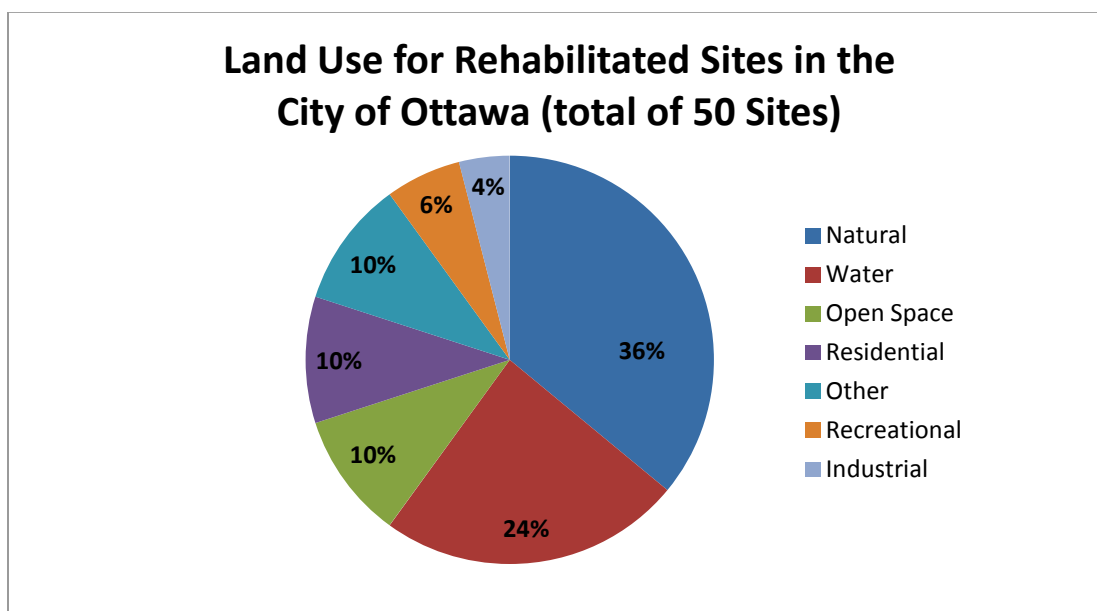


Figure 15: Predominant land use for rehabilitated sites surveyed in the City of Ottawa

The City of Ottawa was calculated to have an average **percentage of tree coverage** of about 14%.

In addition, the City of Ottawa is characterized by a mixture of urban and rural land uses as well as urban-rural fringe land uses. The diversity of different land uses for rehabilitated aggregate sites in this part of the province is cohesive with the corresponding landscape profile. Worked out aggregate sites were determined to be converted to both urban and rural land uses.

Summary of results for the City of Ottawa:

- There is a diversity of final land uses for rehabilitated aggregate sites in the City of Ottawa. Natural and Water final land uses are most common.
- The City of Ottawa contains both rural and urban landscapes as well as urban-rural fringe areas. Rehabilitated aggregate sites are successfully integrated within this landscape profile.

3.12 Peel Region

A total of **39** sites were surveyed in Peel Region. An additional two sites in Peel Region could not be located and were removed from this study.

Recreational (11 sites), Water (10 sites), and Natural (7 sites) were determined to be the **predominant land uses** for rehabilitated sites in Peel Region (see Figure 16). Additional land uses were also observed, including: Residential (5 sites), Agriculture (2 sites), Open Space (2 sites), and Industrial (2 sites).

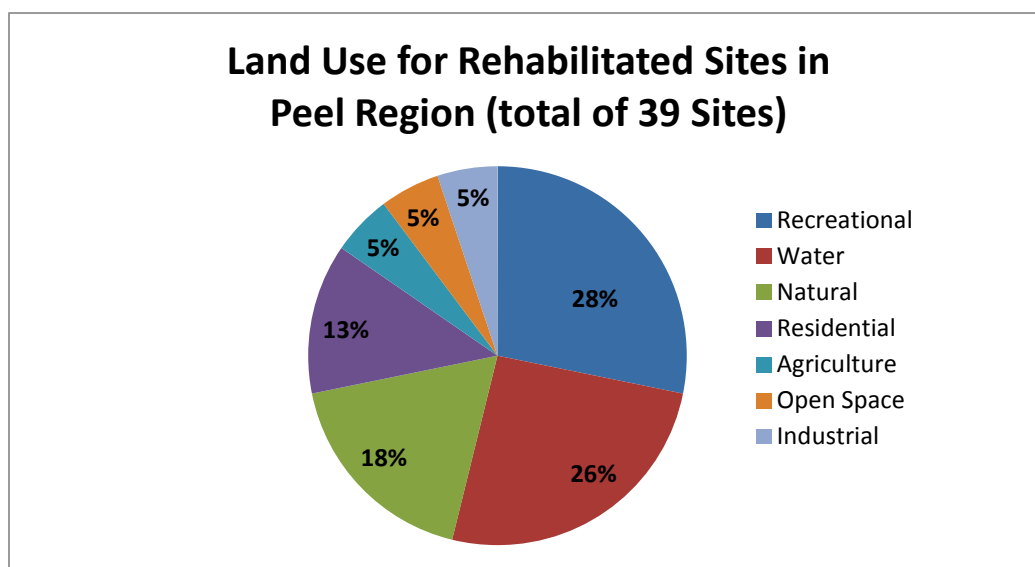


Figure 16: Predominant land use for rehabilitated sites surveyed in Peel Region

The average **percentage of tree coverage** for Peel Region was calculated to be 20%. The Recreational (e.g. conservation areas) and Natural (e.g. woodland) land uses will account for this observed percentage of tree coverage.

Peel Region is characteristic of the urban-rural fringe area of the Greater Toronto Area. In this region, the southern half is largely made up of urban built form (i.e. the cities of Brampton and Mississauga). The northern half of the geographic area transitions to more rural-type settlements (i.e. the Town of Caledon) and landscapes. Final land uses for rehabilitated aggregate sites follow this pattern.

Summary of results for Peel Region:

- Common rehabilitated aggregate site land uses in Peel Region are: Recreation, Water, and Natural.
- Urban land uses are located in the southern portion of the geographic area and more rural land uses are observed in the northern portion of the study region.

3.13 Perth County

A total of **23** rehabilitated aggregate sites were surveyed in Perth County.

The **predominant final land use** for sites surveyed in Perth County (see Figure 17) was observed to be Agriculture (12 sites) followed by Natural (5 sites), Open-Space (3 sites), and Water (3 sites).

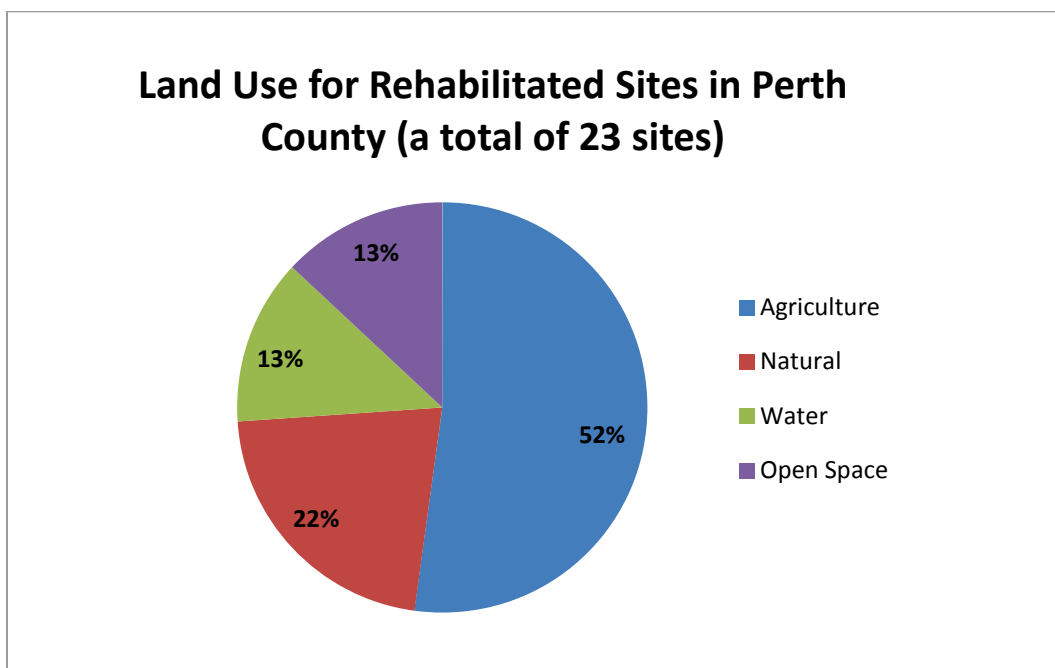


Figure 17: Predominant land use for rehabilitated sites surveyed in Perth County.

The average **percentage of tree coverage** for Perth County was calculated to be approximately 18%.

Perth County largely represents a rural and agricultural landscape form. Primarily the sites rehabilitated for agricultural land uses were observed to be growing field crops such as corn, wheat, or soy. Some rehabilitated lands were also used for hay production or livestock pasture. Additional agricultural land uses were also noted, including farm buildings, equestrian facilities, and equipment storage. All sites surveyed were observed to be a final land use that successfully integrated with the rural character of the surrounding landscape.

Summary of results for Perth County:

- Agriculture is the primary land use for rehabilitated aggregate sites in Perth County.
- All 23 surveyed sites were observed to be rehabilitated to a land use that is cohesive with adjacent lands and the surrounding rural landscape.

3.14 Region of Waterloo

A total of **39** sites were surveyed in the Region of Waterloo.

The Region of Waterloo contains both urban and rural regions and this is reflected in the diversity of the observed final land uses. The **predominant final land use** for sites surveyed in the Region of Waterloo (see Figure 18) included: Agriculture (6 sites), Open Space (8 sites), Commercial developments (6 sites), Water (5 sites), Recreational (4 sites), Natural (3 sites), Industrial (3 sites), and one site each for Institutional and Residential land uses.

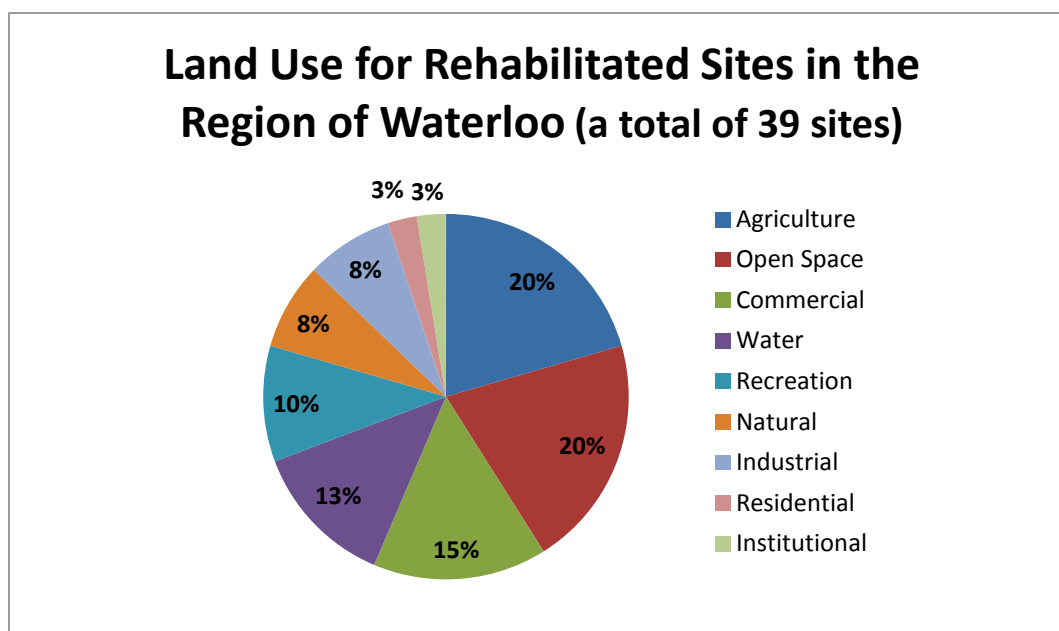


Figure 18: Predominant land use for rehabilitated sites surveyed in the Region of Waterloo

The average **percentage of tree coverage** was calculated to be about 11% for the Region of Waterloo. A variety of vegetation types were also observed and corresponded with the range of final land uses observed.

The Region of Waterloo is characteristic of a mixture of both rural and urban landscape form. Rehabilitated aggregate sites in the Region of Waterloo were sufficiently integrated with the surrounding rural and urban landscape.

Summary of results for the Region of Waterloo:

- The Region of Waterloo has a diverse mix of final land uses for rehabilitated aggregate sites.
- This diverse mix of land uses is cohesive with the rural and urban landscape within this geographic region.

3.15 Simcoe County

A total of **74** sites were surveyed in Simcoe County. Five sites were not surveyed due to accessibility issues.

The **predominant land use** for rehabilitated aggregate sites in Simcoe County (see Figure 19) was observed to be: Natural (37 sites), Water (13 sites), and Open Space (7 sites). Additional land uses included: Agriculture (4 sites), Residential (4 sites), Industrial (3 sites), Recreational (3 sites), Commercial (2 sites), and Other (1 site).

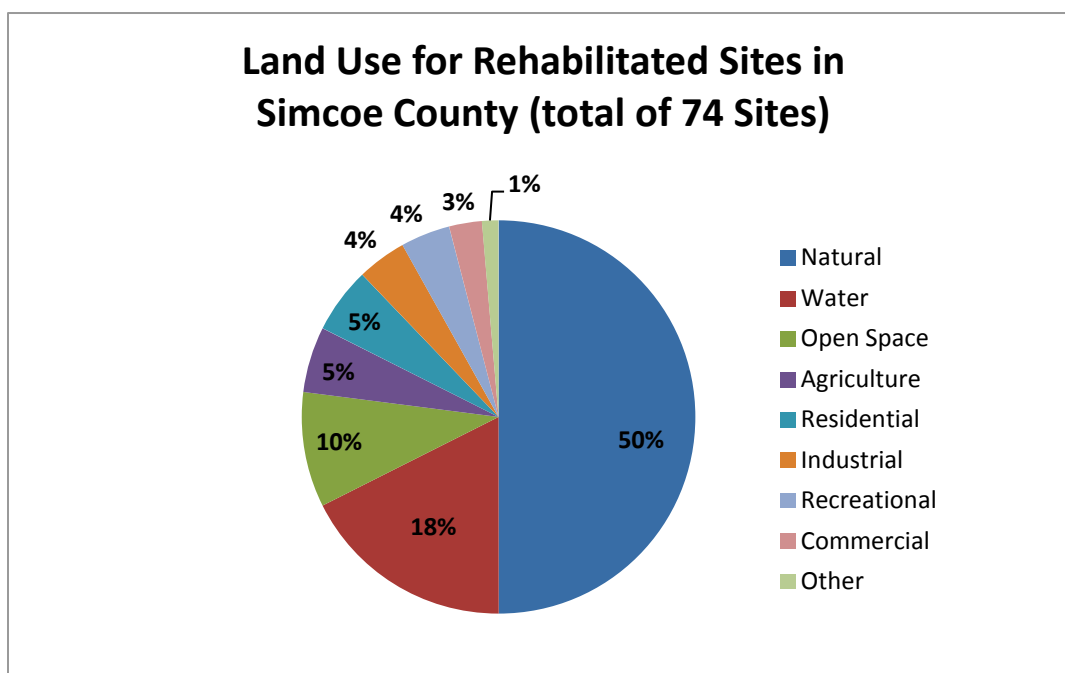


Figure 19: Predominant land use for rehabilitated sites surveyed in Simcoe County

The average **percentage of tree coverage** was calculated to be about 14% for Simcoe County.

Simcoe County is primarily rural, but does contain some smaller and mid-sized urban areas (e.g. Cities of Barrie and Orillia). Rehabilitation of worked out sites to primarily Natural, Water, or Open-Space final land uses is cohesive with the character of the surrounding landscape.

Summary of results for Simcoe County:

- Natural, Water, and Open Space are the most common final land uses for rehabilitated aggregate sites in Simcoe County.
- Simcoe County contains a diversity of final land uses for rehabilitated sites. This is a result of the combination of urban and rural landscapes in this region of the Province.

3.16 Toronto (the City of)

A total of **82** sites were surveyed in the City of Toronto.

The **predominant final land use** for sites surveyed in the City of Toronto (see Figure 20) area included: Residential (27 sites), Recreation (27 sites), Institutional (8 sites), and Industrial (7 sites). Natural (4 sites), Commercial (4 sites), Other (3 sites), and Open Space (2 sites) were less common.

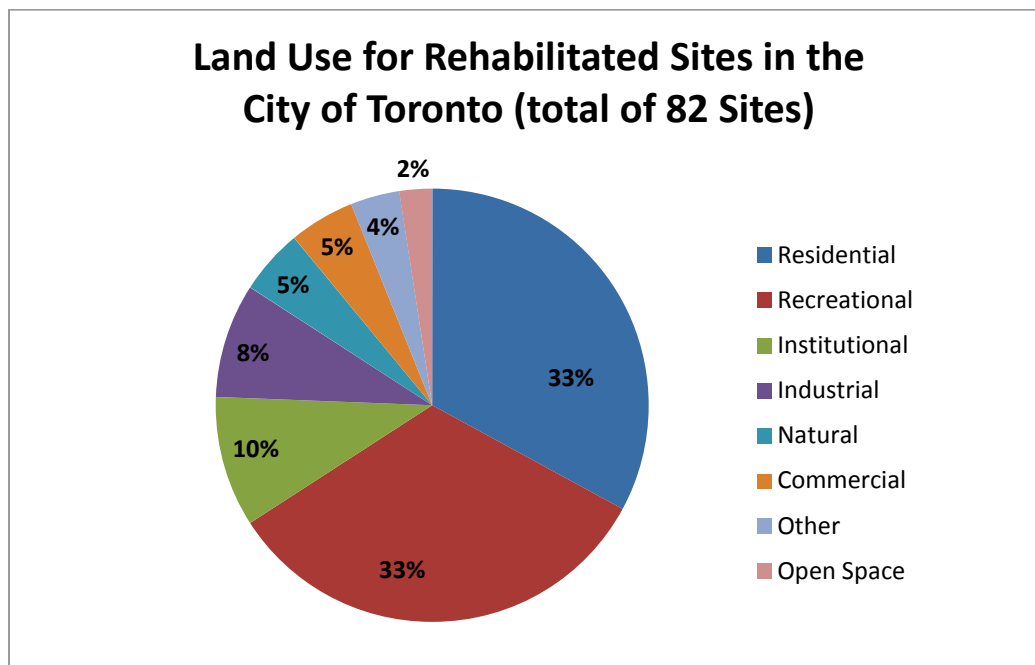


Figure 20: Predominant land use for rehabilitated sites surveyed in the City of Toronto

The City of Toronto geographic area is characterized by primarily dense, urban form. Although there is a diversity of final land uses for rehabilitated aggregate sites in the City of Toronto, residential and recreational land uses are most common. As illustrated in this study, as well as in *From Pits to Playgrounds* (Yundt & Augaitus, 1979), former extraction sites in the City of Toronto were frequently rehabilitated to public parks and recreational facilities. These important public spaces are significantly contributing to the green space network in Ontario's largest metropolitan area. In addition, former extraction sites were also converted to residential land uses as the City of Toronto continued to expand rapidly during the past 50 years. The historical profile of aggregate site rehabilitation in the City of Toronto demonstrates how former extraction sites, once located on the outskirts of the city, are redeveloped to meet the land use needs of a growing urban community.

The average **percentage of tree coverage** for the City of Toronto was calculated to be about 16%. This fairly low percentage of tree coverage is representative of the urban character of the metropolitan area.

Summary of results for the City of Toronto:

- Rehabilitated aggregate sites in the City of Toronto were integrated into the urban built form as the city experienced rapid urban growth and expansion over the past 50 years.
- Former aggregate sites were frequently rehabilitated to either recreational (see Figure 20) or residential final land uses.
- Aggregate sites rehabilitated to public parks in the City of Toronto, contribute significantly to the city's network of public green space.



Figure 21: Example of rehabilitated aggregate sites in the City of Toronto. Both sites are now public parks and recreational facilities

3.17 Wellington County

A total of **39** sites were surveyed in Wellington County. One site was not accessible.

Similarly to Waterloo County, Wellington County also included a diverse range of final land uses for rehabilitated aggregate sites (see Figure 22) representative of both urban and rural landforms. However, Agriculture (23 sites) was observed to be the **predominant land use**. Other land uses included: open space (4 sites), Natural (3 sites), Industrial (3 sites), Recreational (2 sites), Residential (2 sites), Other (1 site), and Water (1 site). The one site classified as “other” was currently being redeveloped and the final land use is unknown.

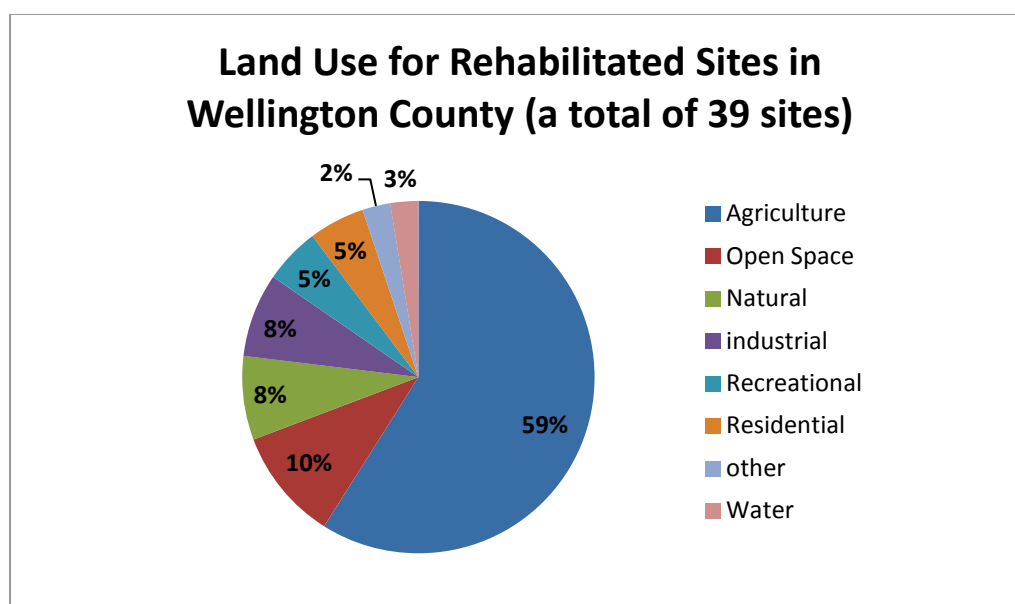


Figure 22: Predominant land use for rehabilitated sites surveyed in Wellington County

The average **percentage of tree coverage** for Wellington County was estimated to be an approximately 11%. Vegetation was assessed to be Native (38%), Agriculture (28%), Non-native (21%), and Seeded (13%).

The diverse range of different land uses for rehabilitated aggregate sites in Wellington County coalesced with the mix of urban and rural land uses in the Wellington area. However, rural and primarily agricultural land characterizes the majority of the landscape within the region.

Summary of results for Wellington County:

- Agriculture is the most common final land use for rehabilitated aggregate sites in Wellington County. Rehabilitated aggregate sites in Wellington County are cohesive with the surrounding landscape.

3.18 York Region

A total of **35** sites were surveyed in York Region. Two sites were not accessible.

The **predominant land uses** for rehabilitated aggregate sites in York Region (see Figure 23) were observed to be: Open Space (14 sites), Natural (6 sites), Agriculture (6 sites), Recreational (4 sites), Industrial (2 sites), Residential (1 site), Water (1 site), and Commercial (1 site) were also observed.

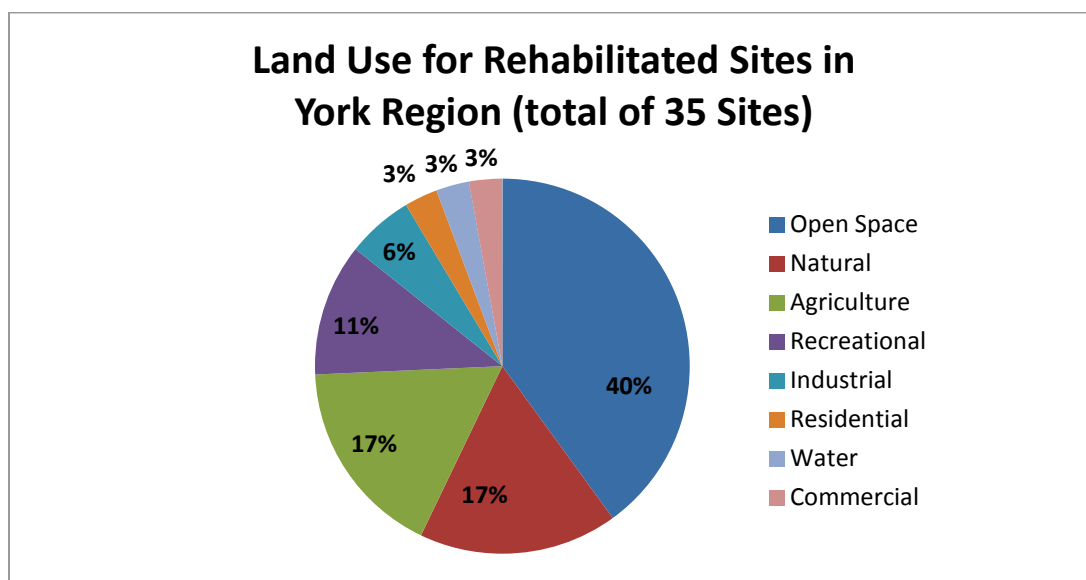


Figure 23: Predominant land use for rehabilitated sites surveyed in York Region

The average **percentage of tree coverage** for York Region was estimated to be an about 17%.

York Region includes both urban settlements (the City of Markham, and the City of Vaughan), regions of urban-rural transition (e.g. Town of Whitchurch-Stouffville), as well as predominately rural areas (e.g. Township of Uxbridge). Most of the surveyed rehabilitated aggregate sites were located in the urban-rural fringe areas as well as the more rural parts of this geographic area. The primarily Open Space, Natural, and Agricultural final land uses create a rehabilitation profile that is cohesive with the landscape trends observed in this part of the south-central Ontario.

Summary of results for York Region:

- Open Space, Natural, and Agriculture are the most common final land uses for rehabilitated aggregate sites in York Region.
- The rehabilitation profile for York Region fits the diverse landscape character (i.e. urban, rural, and urban-rural transition areas) for this part of the province.

4 DISCUSSION OF STUDY RESULTS

Good quality rehabilitation plays an essential role in responsible aggregate extraction. However, there is a shortage of data and knowledge on the condition of rehabilitated aggregate sites across Ontario. As part of the OSSGA rehabilitation study initiative started in 2010, additional data was collected in the summer of 2013 on the state of rehabilitated aggregate sites across Ontario. The results of both Part I and Part II of this study initiative are combined in this report and illustrate that the rehabilitation of surrendered aggregate site licenses is occurring satisfactorily. A more in-depth discussion of the consolidated findings of the study initiative are included in this section of the report.

4.1 Most Common Land Uses for Rehabilitated Aggregate Sites in Ontario

Natural and Agriculture were the most commonly observed **predominant final land uses** for rehabilitated aggregate sites in the overall study area. These final land uses represent 43% of the total number of sites surveyed from both 2010 and 2013. Good quality aggregate resources located in Ontario often coincide with environmentally sensitive features (i.e. Niagara Escarpment, Oak Ridges Moraine, Carden Plain etc.) or prime agricultural land areas. The data collected as part of this study initiative reveals that aggregate developments are commonly returned to Natural or Agricultural land uses once extraction activities are complete, therefore, not resulting in the irrevocable loss of agricultural or natural heritage values.

A. Natural

Natural final land uses (a total of 142 sites) were observed to account for 25% of the rehabilitated aggregate sites in the overall study area. Many of these naturalized sites were observed to be young successional woodlots or meadows (e.g. Ecological Land Classifications of Cultural Meadow and Cultural Savannah) and older rehabilitated sites were observed to represent mature terrestrial ecosystems (e.g. Cultural Woodland and Riparian). As natural ecological processes and succession continues to progress on these sites, they will evolve overtime into important natural areas that provide floral and faunal biodiversity as well as habitat linkages and connectivity. However, additional and ongoing research is needed to assess the ecological value and function of these restored sites. Data collected as part of this study initiative indicates that former aggregate operations are frequently returned to functioning terrestrial ecosystems.

Further, 13% of the overall study area was rehabilitated to Open Space and 12% of sites were converted to a Water feature. These final land uses also contribute to natural heritage values, especially water features such as lakes or ponds which form aquatic ecosystems and perform additional environmental services.

The findings of this study indicate that ***aggregate extraction sites are rehabilitated to a final land use condition that supports the provincial priority of restoring and improving natural heritage values in the Province of Ontario.***

B. Agriculture

Agriculture was determined to be the predominant final land use for 18% of the total number of sites surveyed (102 sites). Agricultural operations including corn, soy, and wheat cash crops were frequently observed. Additional agricultural activities were also common and included hay cultivation, fallowed land, pasture and livestock grazing. In the Niagara and Brant geographic areas specialty crops were observed to be growing on rehabilitated extraction sites, including grapes, tobacco, and fruit trees. In the Simcoe geographic area additional specialty crops such as sod and vegetable production were also noted. Other agricultural uses were also documented across the study area, including: greenhouses, equestrian facilities, farm equipment storage, feed and fodder storage, and farm buildings and structures.

Over the past several decades, growing competition and pressures on rural lands has increased the need for the protection, adequate management, and stewardship of agricultural land. Prime agricultural land can often also contain primary and secondary aggregate deposits. This occurrence of good quality aggregate deposits and good quality agricultural land in the same location can create land use conflict between the aggregate and agricultural industries. Rehabilitation can help to alleviate this conflict by restoring the land to a state of agricultural productivity, after extraction has taken place.

Prior to the implementation of stricter legislation and improved industry standards, agricultural rehabilitation encountered common problems such as the absence of topsoil, poor drainage, excessive stoniness, and compaction. These problems limited the success of agricultural rehabilitation and subsequent crop productivity (see Mackintosh & Mozuraitis, 1982). Today, these challenges have been rectified through stricter rehabilitation standards, improved rehabilitation practices, and the increased education of aggregate producers.

Data collected in this study reveals the range of agricultural land uses that can be successfully restored on former aggregate extraction sites. ***The results of this study indicate that aggregate extraction activities do not result in the permanent conversion of agricultural land in the Province of Ontario.*** More research is needed to assess the quality of land rehabilitated for agricultural practices.

4.2 Regional Rehabilitation Profiles

The regional rehabilitation profiles outlined in this study suggests that ***aggregate rehabilitation is conducted in a manner that is cohesive with the surrounding landscape and accommodating of local land use planning objectives.***

Former aggregate sites located on the edge or centre of urban geographic areas (e.g. the City of Toronto) are frequently converted to a land use that is compatible with the adjacent urban built form, such as a Recreational or Commercial land uses. Once valuable aggregate resources are extracted from a site, the land can then be redeveloped to accommodate urban area growth and expansion. This land use planning strategy increases the overall productivity, intensive use, and economic value of the land (e.g. aggregate extraction followed by a residential plan of subdivision).

Aggregate sites located in predominately rural geographic areas (e.g. Perth County and Huron County) were primarily returned to rural land uses such as Agriculture, Natural, and Water. Therefore, aggregate rehabilitation in rural parts of the province generally maintain the cultural heritage, aesthetic, and agronomic landscape values of rural areas in southern and eastern Ontario.

Strategic land use planning is particularly important in urban-rural fringe regions (e.g. the City of Hamilton and York Region geographic areas) that may undergo landscape transition during the lifetime of the aggregate operation. Regions of the province that included a combination of both rural and urban landforms (e.g. the Region of Waterloo geographic areas) included the greatest diversity of land uses for aggregate site rehabilitation. This increased diversity of rehabilitated sites conforms to the changing landscape mosaic in these parts of the province.

In summary, the findings of this report confirm that extracted and rehabilitated aggregate lands can retain their landscape character and value over the long term.

4.3 Land Use Condition & Landscape Integration of Rehabilitated Aggregate Sites

Results of this study illustrate how previous aggregate extraction sites can be rehabilitated and successfully reintegrated into a rural or urban landscape. Aggregate sites located on the urban fringe of a town or city often assimilate into the surrounding urban area and are rehabilitated to commercial, residential, or industrial land uses. Aggregate sites located in rural areas are often rehabilitated to agriculture, open space, natural, or rural residential land uses.

Frequently, rehabilitated aggregate sites contain more than one final land use within the previous extraction boundaries. Sites that contain large water features such as a lake or pond (as a result of below water table extraction) are often bordered by residential or natural land uses. This illustrates the diversity and range of final land uses that can be established on depleted aggregate extraction sites.

Observations made during field assessments determined that rehabilitated aggregate sites often are unrecognizable as former extraction operations. Agricultural sites, specifically in southwestern Ontario (e.g. Huron County, Perth County, and Wellington County geographic areas) were often the same grade and of similar topographic form as the adjacent lands. These sites often lacked any visible evidence of prior extraction activities (e.g. slopes, bare gravel, roads etc). Naturalized berms and permanent water features were usually the only remaining indicator that aggregate extraction had previously occurred on the site. This observation illustrates that the final rehabilitation occurring on surrendered aggregate site licenses results in a final land condition that blends with adjacent lands and conforms to the varied landscape characteristics in Southern and Eastern Ontario.

It is possible that some older sites, to some extent, may have regenerated naturally due to the antiquated rehabilitated standards of the time. Some sites were noted to have visible signs of prior extraction, such as poorly vegetated slopes, remnants of old stockpiles, and areas of bare gravel. These old licences have not undergone any additional disturbance since they were originally extracted (in some cases 20 or more years ago) and have continued to naturalize on their own.

The information collected as part of this study initiative indicates that aggregate extraction sites are successfully rehabilitated to a range of productive final land uses. Nonetheless, more research is needed to evaluate the ecological condition of sites rehabilitated for natural and environmental conservation purposes. Additional work is also required to determine the productivity and quality of land rehabilitated for agricultural purposes (e.g. soil structure and quality, crop production etc.).

4.4 Percentage of Tree Cover

The average percentage of tree coverage across the study area was calculated to be moderately low (overall average of 20%). This is likely due to the high percentage of agricultural and open space land uses which included agricultural crops and low lying terrestrial vegetation.

Some sites did contain mature woodlot features and it is likely that these areas of the site were never extracted. However, further research and data on the amount of land extracted is needed for confirmation.

Sites that were rehabilitated to naturalized land uses were observed to contain young trees and saplings that would have either have been planted as part of the rehabilitation plan or regenerated naturally over time from local seed sources. Native tree species were most often observed; however, non-native species were common as ornamental and/or landscape plantings.

4.5 Vegetative Cover Type

Vegetation cover on a rehabilitated aggregate site can be an indicator of the ecological processes that have occurred on the site since the land was disturbed. In addition, vegetative cover can also be used to assess the condition of the site and gauge how it blends with adjacent lands. The following

four vegetation cover categories were used in this study and some general observations are included below.

- ➔ **Native** vegetation was predominantly found on sites with more mature ecosystems (i.e. woodlands) that may not have been disturbed during extraction activities. Post-extraction tree and shrub planting was not observed to contribute significantly to the occurrence of mature vegetation on the site. In addition, some older sites with mature vegetation (i.e. riparian, cultural thicket etc.) may have naturally regenerated from local seed sources on adjacent lands or from the topsoil source. More research and comprehensive field assessments are needed to better evaluate ecological integrity and the composition of vegetative communities on rehabilitated aggregate sites.
- ➔ **Agricultural** vegetative cover was commonly observed on rehabilitated aggregate sites across southwestern Ontario. The predominant vegetative cover found on these sites was neither native nor non-native and instead represented a type of vegetation grown for agricultural purposes (e.g. corn, soy bean, hay etc.).
- ➔ **Non-Native** vegetative cover was most often observed in the form of ornamental landscape plantings within residential land uses or as common invasive species on naturalized sites (i.e. woodland, cultural thicket, riparian etc.). Examples of commonly observed non-native vegetation included: Scots pine (*Pinus sylvestris*), Norway Maple (*Acer platanoides*), Common buckthorn (*Rhamnus cathartica*), Purple Loosestrife (*Lythrum salicaria*), Miscanthus grasses (*M. sinensis* and *M. sacchariflorus*), and European Common Reed (*Phragmites australis subsp. australis*).
- ➔ The **Not Applicable** vegetative classification was used for rehabilitated sites that contained little or no vegetative cover, for example: industrial, commercial, and urban residential land uses.
- ➔ The **Seeded** vegetative cover classification characterized sites that were rehabilitated to a predominantly naturalized or open space land use classification where the site was sloped, graded and seeded with a grass mixture (e.g. MTO grass seed mixtures). Sites that were seeded and classified as Open Space were commonly observed in south-central Ontario. Because of the variability and diversity of grass, forage, and groundcover species contained in seed mixtures used for rehabilitation activities, this type of vegetative cover could not be classified as either native or non-native. More comprehensive ecological site assessments would be required for more specific classification.

5 STUDY CONCLUSIONS & RECOMMENDATIONS

This study assessed the final land use condition of 568 aggregate sites across Southern Ontario. The information collected and analyzed in this study will help to address the lack of data and knowledge regarding rehabilitated aggregate sites in Ontario. This study consolidates all data collected between 2010 and 2013 and determined that the most common final land uses for rehabilitated aggregate sites in the overall study area were: Natural (25%), Agriculture (18%), Open Space (13%), and Water (12%). ***The results of this study disprove the preconception that aggregate extraction activities leave “open scars” on the landscape.***

5.1 Study Conclusions

1. State of Final Rehabilitation in Ontario

The 568 surrendered aggregate sites evaluated as part of this study had all undergone some form of final rehabilitation. Additionally, the bulk of the sites surveyed were observed to be fully rehabilitated and supporting a diversity of productive final land uses that hold social, economic, and/or environmental value. Many sites surveyed were unrecognizable as previous extraction operations.

Aggregate extraction is a common and sometimes a controversial land use in southern and eastern Ontario. The data presented in this report shows that former aggregate sites can be successfully rehabilitated and reintegrated into rural or urban landforms. The data also demonstrates that rehabilitated sites are compatible with their surrounding land uses and that aggregate extraction is an interim use of the land.

2. Land Use Planning & Policy

This information presented in this report should be considered in the creation of future land use policy and planning documents that guide aggregate resources management in the province of Ontario. Although “slope and seed” is the rehabilitation approach traditionally used in the past by aggregate producers, this study revealed that former aggregate sites can be successfully rehabilitated to a variety of final land uses that can achieve a number of land use objectives. Furthermore, this study also determined that innovative approaches by aggregate producers and planning staff can result in superior examples of rehabilitation outcomes. These areas can provide a variety of long term benefit to host communities. Numerous examples across Ontario illustrate high quality aggregate site rehabilitation beyond the original “slope and seed” model. This confirms that aggregate extraction sites can be successfully returned to a prior land use condition or an alternative condition that is compatible with the character of the surrounding landscape.

Although additional work is needed to integrate aggregate site rehabilitation into broader landscape level planning initiatives, the results of this study support the notion that aggregate extraction and subsequent rehabilitation can achieve economic, social, and/or environmental priorities. This can be done for both urban and rural communities. This information should be used to guide future land use planning policy at the provincial and local level.

New and innovative approaches to aggregate site rehabilitation can also serve additional non-traditional land use planning objectives, such as increased community involvement and consultation, landscape improvement, and collaborative decision making.

3. Quality of Site Rehabilitation:

The study data indicated that many former aggregate extraction sites in Southern Ontario have been rehabilitated to naturalized or agricultural land uses; the ecological condition or agricultural productivity of these sites is poorly documented and largely unknown.

On a number of sites, re-vegetation is sparse or dominated by species that are not native and invasive to the area. There is excellent potential for most sites to be transformed for beneficial uses, including desirable green spaces within urban settings, restored ecosystems that are biodiverse, and specialty agricultural crops. Aggregate site rehabilitation does offer the opportunity to provide a net gain or net benefit in ecological, social or economic values in comparison to the original condition of the land. However, basic rehabilitation standards will continue to perpetuate, unless all stakeholders involved understand the benefits of completing high quality and comprehensive aggregate site rehabilitation.

This study and similar investigations can contribute to the emerging science on aggregate site rehabilitation. Industry, municipal, community, and NGO stakeholders should focus on continual learning and adaptive management strategies. This will result in the strengthening of site rehabilitation techniques and the advancement of industry standards.

New and contemporary rehabilitation practices are beginning to become standard in the aggregate industry, such as the use of local seed sources and native plantings, alternate sloping mechanisms, soil amending, and comprehensive rehabilitation planning. However, these innovative approaches are only a few techniques that contribute to the overall long term success of current and future rehabilitation efforts. Many success stories that remain untold could reveal the strengths and weaknesses of past and present approaches to aggregate site rehabilitation.

Continued research into the ecological condition and agricultural productivity of rehabilitated aggregate sites should remain a priority for the aggregate industry and associated stakeholders.

5.2 Study Recommendations

Based on the key findings highlighted in this report, several recommendations are suggested for alleviating ongoing data collection and management challenges. In addition, ensuring the long term ecological integrity and agricultural productivity of rehabilitated lands is also a priority. These recommendations were also presented in Part I of this study initiative and are carried forward in Part II.

5.2.1 Data Management Recommendations

- 1. Use Baseline Data:** It is recommended that the data collected during this study be used as baseline data for further research into aggregate site rehabilitation in Ontario. It is important to centralize the database and data sets for rehabilitated sites and gather the data in a collaborative manner. It is necessary to bring different partners together in a data sharing agreement. In addition, due to data management challenges, it is recommended that one agency be responsible for creating and managing the central database on rehabilitated aggregate sites in Ontario.
- 2. Improved Data Collection Standards:** Develop standards for the collection of data for all future surrendered licences in order to establish protocols for proper data retention. For example: lot, concession, municipality, licence reference number, copy of the site plans, licensed area, extracted area, final land use, rehabilitation photos, etc.
- 3. Refine Aggregate Site Rehabilitation Best Practices:** The study team discovered that many organizations and individuals have valuable knowledge and data that are generally not available. Additionally, older rehabilitation practices, such as the slope and seed model, continue to prevail. It is recommended that a collaborative effort be made by industry, government, non-governmental organizations, conservation authorities, and academic institutions to research and refine best practices for aggregate site rehabilitation.
- 4. Continue Research:** In this study, rehabilitated sites were assessed only within specific geographic areas and field visits were completed using broad assessment criteria. It is recommended that all rehabilitated sites in Ontario be studied over time, and that the data be added to the centralized database. This will maintain key data on the state of rehabilitated aggregate sites in the province and improve our overall knowledge of rehabilitation patterns in Ontario.
- 5. Monitor Land Use:** It is recommended that an ongoing program be implemented for monitoring post-extraction land uses and record the data in the central database. This will involve measuring changes in post-extraction land use over a defined period of time and

analyzing the rehabilitation patterns that emerge. This information will increase the understanding of how the use of former aggregate sites evolves and will help to support better land use policy and planning.

5.2.2 *Recommendations for Improving Rehabilitation Quality*

- 1. Develop Best Management Practices:** Site-specific rehabilitation practices and standards, such as soil storage and vegetative planting, can be used to enhance the quality of completed rehabilitation activities. Rehabilitation should consistently be designed and implemented in a manner that takes into account natural ecological processes (i.e. ecological succession) as well as sustainable agricultural land management. Lasting site degradation may result if good quality rehabilitation is not conducted. The ecology and topography of the surrounding landscape should be used to guide the development of ecosystem and land use objectives for a surrendered site licence. These principles should be incorporated into a series of pragmatic best management practices for the aggregate industry.
- 2. Use Native and Local Seed Sources:** Appropriate native vegetation and local seed mixtures should be selected on a site-by-site basis, based on the ecology and land use objectives for the site. Species not suited to the area will more easily fail or create undesirable outcomes. Non-native and potentially noxious or invasive species should be avoided entirely.
- 3. Research Site-Specific Ecology and Agricultural Productivity:** More research is required to determine and compare the success rates for specific rehabilitation techniques. Baseline site condition data (i.e. benchmark data) should be collected from a representative sample of sites across Ontario in specific physiographic settings. This data will form baseline information and can be used to measure the progress and success for rehabilitated sites over the long term.
- 4. Measure Ecological & Agricultural Success:** Progress toward the achievement of ecological and agricultural rehabilitation objectives should be measured (against baseline conditions) through the use of predetermined performance indicators. These performance indicators should drive the creation of rehabilitation designs. Examples of performance indicators could include: percentage of plant cover, species richness, crop productivity etc. More research is needed to develop better indicators that can be linked to the rehabilitation design.

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APPENDIX A

