Public Report

To:	Community and Operations Services Committee
From:	Kevin Alexander, Commissioner, Community and Operations Services Department
Report Number:	CO-25-22
Date of Report:	May 7, 2025
Date of Meeting:	May 12, 2025
Subject:	Update to the Oshawa Second Marsh Management Plans
Ward:	Ward 5
File:	03-05

1.0 Purpose

The purpose of this report is to seek Council endorsement of the updated Oshawa Second Marsh Management Plan dated September 2023, the Oshawa Second Marsh Invasive Species Management Plan dated August 2024 and the Oshawa Second Marsh Forestry Management Plan dated September 2024.

Attachment 1 contains the updated Oshawa Second Marsh Management Plan.

Attachment 2 contains the Oshawa Second Marsh Invasive Species Management Plan.

Attachment 3 contains the Oshawa Second Marsh Forestry Management Plan.

2.0 Recommendation

That the Community and Operations Services Committee recommend to City Council:

That based on Report CO-25-22, dated May 7, 2025, the Oshawa Second Marsh Management Plan, the Oshawa Second Marsh Invasive Species Management Plan and the Oshawa Second Marsh Forestry Management Plan be endorsed.

3.0 Input From Other Sources

- Parks & Roads Operations Services
- Facility Management Services
- Legislative Services
- Legal Services

4.0 Analysis

4.1 Background

Oshawa Second Marsh ("Second Marsh" or "the Marsh") is a 137-hectare Provincially Significant Wetland ("P.S.W.") and a provincially significant Life Science Area of Natural and Scientific Interest ("A.N.S.I.") located on Lake Ontario in the City of Oshawa. As one of the best remaining examples of coastal wetlands in Southern Ontario, Second Marsh has considerable social and ecological significance. The Marsh and its surrounding lands include a wide variety of habitat types that form a complex biological and hydrological system for a diversity of species. Oshawa Second Marsh is situated within the City's urban boundary and well connected to road, trail and transit systems. The majority of users visit Second Marsh to engage in nature-based activities.

4.2 Second Marsh Management Plan

As part of the 2018 capital budget, City Council approved Project 18-51-0079 Second Marsh Management Plan Update with a budget of $175,000. The scope of this project was to update the 1992 version of the Oshawa Second Marsh Management Plan ("O.S.M.M.P.") and consider approximately 20 years of changes and management activities that have occurred in the Marsh, providing updated and relevant goals and objectives. The O.S.M.M.P should be read and implemented in conjunction with the Oshawa Second Marsh Invasive Species Management Plan (Attachment 2) and the Oshawa Second Marsh Forest Management Plan (Attachment 3). These are supplementary reports which support the O.S.M.M.P. (collectively referenced as "Management Plans").

The O.S.M.M.P. includes sixteen (16) goals across six management zones and includes general themes of protecting and restoring vegetation communities, maintaining or increasing biodiversity, maintaining the existing dyke, reducing invasive species and improving water quality. There are four (4) key management priorities, which are overarching management themes with related objectives, actions and strategies for Second Marsh. These four (4) key management priorities are ecological restoration; hydrology and water quality; community education, awareness and stewardship; and public access and operational maintenance.

4.2.1 Ecological Restoration

Ecological restoration will be a key management approach to improve the ecological integrity in Second Marsh. Active ecological restoration includes the management of invasive species and select planting of native vegetation. Ecological restoration should also include restoring wetland bathymetry in the Marsh. Further details on this key management priority can be found in Table 7 of the O.S.M.M.P.

4.2.2 Hydrology and Water Quality

The valuable ecosystems at Second Marsh are reliant on maintaining and improving water quality to support and maintain the ecosystem and high diversity of habitats at the Marsh. Additionally, water level management is also key to managing the habitat of Second

Marsh, and drawdowns are recommended, when feasible. Opportunities to improve water quality through best management practices and maintenance of the fish barrier are also recommended to improve water quality in Second Marsh. Further details on this key management priority can be found in Table 8 of the O.S.M.M.P.

4.2.3 Community Education, Awareness and Stewardship

Education and outreach play an important role in the management of Second Marsh, providing information on the functions and values of the Marsh to the public. Educating the broader community on the sensitivities of the Marsh and the role everyone can play in protecting and enhancing the ecological integrity of the Marsh is an important management priority. Further details regarding community education, awareness and stewardship opportunities can be found in Table 9 of the O.S.M.M.P.

4.2.4 Public Access and Operational Maintenance

Oshawa Second Marsh provides the public with valuable opportunities to enjoy nature-based activities and recreation. However, negative impacts to this environmentally sensitive area can occur when the public accesses areas outside of the designated trail system. Opportunities to enhance public use while mitigating adverse effects on the Marsh environment include improved wayfinding, establishing formalized entry points, enhancements to the trail system including connections to the McLaughlin Bay Wildlife Reserve, implementation of an interpretive signage program, repairing or replacing lookout structures, as examples. All the recommendations for this key management priority can be found in Table 10 of the O.S.M.M.P.

4.3 Second Marsh Management Technical Committee

Four (4) major stakeholders have comprised the Second Marsh Technical Management Committee for the past 29 years:

- City of Oshawa
- Central Lake Ontario Conservation Authority (“C.L.O.C.A.”)
- Friends of Second Marsh (“F.S.M.”)
- Ducks Unlimited Canada (“D.U.C.”)

Together, these stakeholders provide technical guidance and have collaborated in operational maintenance, environmental monitoring, education, interpretation and stewardship, and restoration efforts in Second Marsh. By maintaining these partnerships, the City of Oshawa continues to leverage expertise, volunteer engagement and support in the successful management and restoration of the Marsh. The following is a summary of the various roles and responsibilities of each partner agency:

- **Restoration Management**: D.U.C. manages water levels and Marsh restoration, including infrastructure like dykes, pumps, and fish gates, with support from C.L.O.C.A. They also engage volunteers and seek grant funding when appropriate.
- **Environmental Monitoring**: C.L.O.C.A. developed protocols to monitor ecosystem changes and guide management decisions, with support from F.S.M. volunteers.

The City currently funds C.L.O.C.A. to undertake annual monitoring and analysis at Oshawa Second Marsh.

- **Education/Interpretation/Stewardship**: F.S.M. provides educational and interpretive programs to raise public awareness about Second Marsh and its environment.
- **Operational Maintenance and Public Access**: The City of Oshawa handles general maintenance, such as grass cutting and tree maintenance, as well as planning future improvements to public access including connections to McLaughlin Bay Wildlife Reserve.

The Technical Committee will use the Management Plans to prioritize and guide restoration activities as funding and resources are available.

4.4 Stakeholder and Public Engagement

The development of the Management Plans for Second Marsh involved extensive stakeholder and public engagement. Key insights and priorities were gathered through meetings, interviews, a public information centre, and an online survey, highlighting the community's values and concerns for the Second Marsh's future. The outcomes are summarized below:

- **Stakeholder Engagement**:
  - Conducted four meetings with the Marsh Management Committee and ten one-on-one stakeholder interviews.
  - Stakeholders provided insights into Marsh characteristics, issues, and future management aspirations.
  - Identified values: preservation of nature, educational and recreational opportunities.
  - Key themes: diverse habitats, water filtration, educational opportunities, safe wildlife observation, and addressing challenges (maintenance, tree dieback, public access, etc.).
- **Public Information Centre**:
  - Held one public engagement session and conducted an online survey.
  - Identified key findings, vision, objectives, and management options.
  - Emphasized natural heritage protection and passive, nature-based recreation.
  - Highlighted the importance of ecosystem protection and limited public access.
  - Concerns: vandalism, off-leash dogs, littering, vehicle access, fires.
  - Suggested better signage for deterring inappropriate use, aiding wayfinding, and supporting public education.

4.5 Public Use Concept Plan

The O.S.M.M.P includes a concept plan that illustrates various initiatives that are proposed to facilitate public access and enhance the appreciation of Second Marsh. A key initiative proposed in the concept plan includes the trail system, which advises decommissioning trails, creating new trails and improvements to existing trails. Parking improvements are also considered in the concept plan as well as enhancing the educational and visitor

experience. Recommendations on how to improve the visitor experience include installing new viewing platforms and improving those that already exist, creating angling nodes, installing interpretive signage and the establishment of new “gateways” as points of entry into Second Marsh. Additional details on the public use concept plan, including the schematic plan can be found in Section 4 of the O.S.M.M.P.

5.0 Financial Implications

There are no financial implications directly related to this report.

Future capital projects and operating budgets to implement the Management Plans and improve public access, including connections to the McLaughlin Bay Wildlife Reserve, will be submitted for consideration as part of the annual budget process. Staff will collaborate with partners to prioritize implementation of the Management Plans as funding and resources are available. Council-endorsed Management Plans will support grant funding applications as they become available and pursued through a collaborative process involving partners.

6.0 Relationship to the Oshawa Strategic Plan

This report responds to the Oshawa Strategic Plan Priority Area, “Care: Safe and Sustainable Environment” with the goal to manage impacts on natural assets such as wetlands and waterways and enhance tree canopy.

Adam Grant, Commissioner,
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CO-25-22
Attachment 1

September 27, 2023

Oshawa Second Marsh

Management Plan

Prepared for

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Executive Summary

Oshawa Second Marsh is a coastal wetland on Lake Ontario located in the City of Oshawa. Oshawa Second Marsh has been designated as a Provincially Significant Wetland and provincially significant Life Science Area of Natural and Scientific Interest and includes a wide variety of habitat types forming a complex biological and hydrological system. Oshawa Second Marsh is considered the “best” representation of coastal barrier beach wetland on clay plain within Ecodistrict 6E-13 in terms of representation, condition, size, diversity, ecological functions and special features.

Oshawa Second Marsh is located in the Black/Harmony/Farewell Creek watershed, which has a low (25%) proportion of natural cover. Intensive urban development has increased the disturbance to the Marsh features. However, the Marsh continues to support important habitats and ecological functions. Oshawa Second Marsh is situated within the City’s urban core and well connected to road, trail and transit systems with the majority of users visiting the Marsh for nature-based activities.

The Marsh has been impacted by various historic and current anthropogenic activities and natural disturbances. Threats to the ecological integrity of the Marsh include poor water quality, reduction in quality of wildlife habitat, exotic species, recreational activities, vandalism, adjacent development, fluctuating water levels and climate change. Challenges include, but are not limited to acquiring funds and resources to implement actions, regulating the marsh water levels for management activities, balancing public use and enjoyment with protection of environmental features and wildlife, maintaining biodiversity, and ensuring public safety. A number of opportunities to enhance public use and mitigate effects on the environment exist.

This Management Plan is intended to guide efforts to address impacts and implement actions to enhance the ecological integrity of the Marsh and manage recreational use of the Marsh as part of enhancing the user experience. This Management Plan replaces the 1992/1999 management plan / strategy in consideration of approximately 20 years of changes and management activities, increased urbanization, and potential future impacts (e.g., climate change). A history of previous management actions is provided in the Background Report and not summarized in this Management Plan. Ecological information gathered since the Background Report has been included in Appendix 1 of this document. The Management Plan proposes management for approximately the next decade; until 2035 depending on the commencement date of the management plan.

Stakeholders for the Oshawa Second Marsh include City of Oshawa, Central Lake Ontario Conservation Authority, Friends of Second Marsh and Ducks Unlimited. Stakeholder

engagement identified a broad range of values in the Marsh, related to preservation and appreciation of nature, education and recreational opportunities. General themes were protection of natural features, maintaining wetland function and health, providing educational and stewardship opportunities to the public, providing safe and ecologically sustainable access to users and addressing current challenges.

The Vision Statement that guides the updated Management Plan is as follows:

> "That the Oshawa Second Marsh Area is a healthy, diverse ecological system whose significant features and functions are valued and protected to provide ecosystem services for present and future generations."

Six ecosystem Management Zones have been identified within Oshawa Second Marsh, within which specific management recommendations have been developed. Ecosystem conservation targets include the marsh, swamp, marsh/swamp, riparian forest and meadow, barrier beach, constructed dyke and adjacent lands. For each ecosystem conservation target, attributes have been identified that best represent whether a target is in good condition or functioning. Attributes are then measured with indicators – specific measurable characteristics or collections of characteristics combined into indices. Targets, attributes and indicators are the basis for setting goals, carrying out actions and measuring the success of the management plan.

The management plan includes sixteen goals across the six management zones including general themes of protecting and restoring vegetation communities, maintain or increasing biodiversity, maintaining the constructed dyke, reducing invasive species and improving water quality. There are four key strategies for the management of Second Marsh:

- Ecological restoration;
- Hydrology and water quality;
- Community education, awareness and stewardship; and
- Providing public access, while reducing impacts of public use, and continuing operational maintenance

These four general key strategies have more focused strategies, objectives and actions identified for the management zones.

Monitoring has been and should continue to be undertaken to inform the status and ecological integrity of the Marsh. Recommended monitoring includes water quality parameters, water levels, aquatic vegetation (submerged and emergent), diversity and abundance of amphibians, breeding birds, muskrats, migrating waterfowl, migrating shorebirds and invasive species. Citizen science can contribute to informal monitoring and provide valuable data; however,

coordination of efforts and establishment of protocols is necessary to ensure this is completed accurately, effectively and in a standard manner. Citizen science can promote public appreciation and be advertised through public events, outreach or education programing to increase participation.

Management actions that are a priority within the next five years include a temporary drawdown of the water levels in the marsh to provide habitat for species that require exposed shorelines, removing the existing boardwalk, removing hazard trees, restoration planting, and improving public access and trail systems in consideration of protecting sensitive vegetation communities, managing public safety, and managing invasive species. Management actions that should be completed in the future include continuing to manage water levels, implementing invasive species management, investigating how to improve bathymetry and further improving the trail system routes and linkages.

There will continue to be uncertainties regarding future management of Second Marsh, including magnitude and character of changes in vegetation and wildlife due to climate change, the decline in insects and bird populations, high Great Lakes water levels, and new invasive pests and diseases. Analysis of the monitoring data, as well as review of broader trends reported in the literature will help document and compare the local trends within Second Marsh to further an understanding of regional trends in the Great Lakes Basin and inform future management decisions. Review of the current management strategies is recommended to commence in the two years prior to the expiration of the current management plan in 2035. Preparation of a formal revised management plan should be completed in the two years following 2035, incorporating an assessment of the actions completed and if the objectives were met in order to determine if management objectives or actions should be revised.

1. Introduction

Oshawa Second Marsh (herein referred to as the 'Second Marsh' or 'the Marsh'; while the lower-case word "marsh" refers more specifically to the marsh vegetation community) is a coastal wetland located along the north shore of Lake Ontario in the City of Oshawa. As one of the best remaining examples of coastal wetlands in southern Ontario, Second Marsh has considerable social and ecological significance. The Marsh and its surrounding lands include a wide variety of habitat types that form a complex biological and hydrological system for a diversity of species. Oshawa Second Marsh has been designated as a Provincially Significant Wetland (P.S.W.) and provincially significant Life Science Area of Natural and Scientific Interest (A.N.S.I.).

Anthropogenic disturbance within the Marsh has been ongoing since the 1900s and has included agricultural land conversion and urbanization of much of the Harmony Creek subwatershed, the dumping of dredgeate into the wetland, development adjacent to the wetland, and various other stresses including impacts from non-native pests and invasive species (Scientific and Technical Committee 2000).

The City of Oshawa has retained North-South Environmental Inc (NSE) to prepare this Management Plan to guide efforts to address impacts and implement actions to enhance the ecological integrity of the Marsh and manage recreational use of the Marsh as part of enhancing the user experience. NSE has documented the disturbances within the Marsh in the Second Marsh Background Report (2019a). Background information on the fauna and flora of Oshawa Second Marsh, prior to the information collected during the 2018 field season, has also been documented in the Second Marsh Background Report (N.S.E. 2019a). In addition to reviewing background information as part of the Second Marsh Background Report, stakeholder (Appendix 2) and public engagement (Appendix 3) were conducted to inform the current management plan; results of these consultations are included in the Background Report (N.S.E. 2019a).

Additional field studies were conducted in 2018 following the completion of the Background Report (N.S.E. 2019a) to inform this management plan. These included:

- a review of classification of vegetation communities and their boundaries,
- inventories of dominant flora species within vegetation communities and incidental identification of rare species,
- incidental surveys of fauna within communities,
- drone surveys of the marsh, which helped to characterize vegetation community boundaries and identified probable locations of waterfowl nests, and

- comparison of past and present results of inventories of marsh-dependent taxonomic groups (amphibians, birds and turtles) and species at risk.

Methods and results of those surveys are provided in Appendix 1. Non-native invasive species were mapped and the results provided in the Invasive Species Management Plan (N.S.E. 2019b).

1.1. Purpose of the Management Plan

The purpose of the management plan is to outline the overarching vision, goals, objectives and strategies to mitigate current and potential threats to the Marsh and the public while also enhancing user experience. This management plan will direct future management actions, user experience, educational programing, restoration and monitoring.

This management plan replaces the previous Oshawa Second Marsh Management Plan, which was developed in 1992 (City of Oshawa 1992) and built upon with further details regarding implementation in 1999 (Bobolink Enterprises 1999). This management plan uses the most current information, and recent consultation to inform the management of this important natural heritage resource in its present urban context. This management plan considers approximately 20 years of changes and management activities that have occurred in the Marsh to provide updated and relevant goals and objectives.

This Management Plan has been prepared to replace the 1992/1999 management plan / strategy through the following process:

- reviewing the progress and setbacks encountered in implementing the previous management plan;
- integrating the knowledge of the current state of Second Marsh, analyzing the changes that have taken place in the fauna and flora of Second Marsh since the previous management plan;
- taking a view of potential future challenges; and
- creating a management plan that strives to achieve the vision for the Marsh by implementing management strategies developed from the goals and objectives for Oshawa Second Marsh.

Appendix 1 of this management plan provides an update on natural features and ecological functions, including the vegetation communities of Second Marsh, with locations of significant flora and fauna where possible, and builds on differences between current and past observations of flora and fauna to inform management recommendations for the future.

1.2. Background

Changes to the form and function of features and ecological functions within the Marsh since the 1992/1999 management plan (City of Oshawa 1992; Bobolink Enterprises 1999) necessitates the preparation of an updated Management Plan to respond to current conditions and guide the management of the Marsh for the coming decades. There are changes in the landscape surrounding the Marsh, most importantly increased urbanization, and an increased number of people in the surrounding areas. There have also been changes to the Marsh itself as a result of implementing recommendations from the 1992/1999 management plan (City of Oshawa 1992; Bobolink Enterprises 1999). Major management actions supported by substantial financial commitments that were undertaken for the 1992/1999 management plan relied on engineered and active management to improve water quality and habitat. One of the most significant of these was the construction of an earthen dike to isolate the marsh from Farewell Creek and isolation of the marsh from Lake Ontario in 2001. In addition, an outlet/gate structure was installed to exclude Common Carp (*Cyprinus carpio*) from the marsh.

NSE documented information from the previous management plan and strategy (City of Oshawa 1992; Bobolink Enterprises 1999) including previous management actions in the Background Report (N.S.E. 2019). Information from ecological studies conducted since the 2019 background report is located in Appendix 1.

1.3. Study Area and Scope

The study area includes City-owned lands that extend north of Colonel Sam Drive to the railway line, to federally-owned land on the west side of the Marsh, south to Lake Ontario and east to McLaughlin Bay Wildlife Preserve. The scope of this project focuses on the Second Marsh itself but also briefly discusses the importance of upland areas that surround Oshawa Second Marsh and trail connections to adjacent lands.

The process used for this update is similar to that used in the previous management plan and strategy (City of Oshawa 1992; Bobolink Enterprises 1999). A history of previous management actions is provided in the Background Report (N.S.E. 2019). The current management plan has considered the results of management actions to the present, taking into account the successes and failures of the past approaches and provides suggestions for management strategies that are to continue or be modified. The suggestions are informed by the data obtained through monitoring (indicated by trends throughout the years of past management and current conditions). In addition, the management plan has been informed by the results of the stakeholder and public engagement, also included in the Background Report (N.S.E. 2019a).

The approach to this management plan also considers future impacts such as climate change, increasing urbanization of the surrounding landscape and the increasing dominance of the Marsh by invasive species.

1.4. Marsh Management Committee Team and Responsibilities

Four major stakeholders have comprised the Second Marsh Management Committee for the past 29 years (as described in detail in the Background Report [N.S.E. 2019a]):

- City of Oshawa
- Central Lake Ontario Conservation Authority (C.L.O.C.A.)
- Friends of Second Marsh (F.S.M.); and
- Ducks Unlimited Canada (D.U.C.).

Together, these stakeholders have been responsible for operational maintenance, environmental monitoring, education, interpretation and stewardship, and management of restoration in Second Marsh.

The following describes the current roles and responsibilities for each stakeholder:

Restoration Management – the physical management of various components of the marsh with the goal to restore the wetland to a healthy functioning ecosystem. D.U.C. is responsible for the water level and marsh restoration work including specialized infrastructure associated with water quality and water level management such as the Constructed Dyke, pumps and fish gate with support from C.L.O.C.A. There is an existing agreement with D.U.C. for the maintenance of the infrastructure, e.g. Constructed Dyke, fish gate and pump. D.U.C. also engages volunteers and seeks out funding to assist with this work.

Environmental Monitoring – carried out to track ecosystem changes and guide adaptive management decisions to be done with established monitoring protocols aimed at identifying environmental changes on a larger scale as well as an indicator of success of management and restoration activities. C.L.O.C.A. developed and implemented the monitoring protocol with support from F.S.M. volunteer activities where appropriate. This includes synthesizing data, highlighting areas of concern, and identifying new monitoring related to restoration efforts. The City of Oshawa is in the process of creating an agreement with C.L.O.C.A. to carry out annual monitoring of the health of the Marsh; which currently includes fish surveys, sediment, turbidity and water quality collection and analysis, macroinvertebrate, and submerged aquatic vegetation surveys and breeding

bird and amphibian surveys. The City leverages their expertise as it relates to monitoring, the synthesis of data collected and any recommendations where feasible.

Education/Interpretation/Stewardship – aimed at increasing public awareness of Second Marsh, surrounding watershed and the environment. F.S.M. has been delivering education and interpretive programing including stewardship activities where feasible and practical.

Operational Maintenance – The City of Oshawa carries out general maintenance activities as would be typically be performed in most passive parks, when and if required, including grass cutting, tree maintenance, infrastructure and asset maintenance, way-finding or signage consistent with municipal by-laws and standard operating practices. Additionally, future trail system improvements or capital projects to improve public access would be implemented by the City where feasible. This would include any public consultation as required.

1.5. Stakeholder and Public Engagement

The development of the Management Plan has been informed through four meetings with members of the Marsh Management Committee, ten stakeholder interviews, a public information centre, and an online survey.

1.5.1. Stakeholder Engagement

Stakeholders were invited to participate in one-on-one interviews to assist in developing the updated Management Plan. The purpose of this engagement exercise was to gain a better understanding of the characteristics of the Marsh, specific issues of concern and the aspirations for the future management and use from those that are familiar with Second Marsh and its history. The Stakeholders interviewed are, or were, active participants in maintenance and stewardship within Second Marsh.

The stakeholder interviews provided additional background information and feedback on issues and challenges facing the Marsh, as well as management efforts completed to date. A list of questions used to facilitate discussions and key points provided by committee representatives is provided in Appendix 2. In summary, participants identified a broad range of values in the Marsh, related to preservation and appreciation of nature, education and recreational opportunities. These could be separated into the following general themes:

- Maintain an open and natural green space with a diversity of habitats, that supports a high diversity of birds and other wildlife, including obligate wetland species and migratory birds;

- Foster the Marsh's important role in water filtration and contribution to watershed health;
- Provide educational and stewardship opportunities for a variety of users (i.e., school groups, naturalist clubs, summer camps, ornithologists, nature photographers, etc.);
- Provide an accessible, safe and ecologically sustainable opportunity to observe birds and other wildlife in proximity to large urban centres that is close to other desirable trail systems and natural areas (e.g., Waterfront trail, McLaughlin Bay, Darlington Provincial Park)
- Address the current challenges that affect the Marsh such as considerable maintenance costs, tree dieback, difficulty of public access, ad-hoc trails, lack of interpretation and amenities, public safety, flooding, poor water quality, vandalism, and invasive species.

1.5.2. Public Information Centre

A public information centre (P.I.C.) was held to afford the public the opportunity to review the key findings set out in the Background Report, the vision and objectives and key themes and preliminary management options. Members of the public were encouraged to provide comments and ideas by affixing notes to a map of Oshawa Second Marsh.

Natural heritage protection and enhancement emerged as a priority. Passive, nature-based recreation was identified as the most appropriate use. Participants in the P.I.C. exercise and respondents to the online survey emphasized the protection of the ecosystem as paramount and noted that limiting public access to protect natural features is appropriate given the diversity and sensitivity of Second Marsh. Concerns expressed related primarily to vandalism, the prevalence of dogs (most notably off-leash dogs) and inappropriate behaviour (littering, access by vehicles, fires, etc.). The installation of better signage throughout Second Marsh was encouraged to deter inappropriate use, aid in wayfinding and support public education/awareness of the attributes of Second Marsh.

A summary report on public engagement for the development of this management plan is included in Appendix 3.

1.6. Public Access and Use

The Waterfront Trail connects Second Marsh to the larger Lake Ontario shoreline and is a key means of access to the Marsh. **Figure 1** illustrates the location of Second Marsh within the Waterfront Trail and open space system. **Figure 2.** illustrates the relationship between the Marsh and the local trail network. Parking is available along Colonel Sam Drive for users that choose to travel to Second Marsh by car or access can be gained using the connecting trail at McLaughlin Bay with parking available at the GM Canada headquarters and at a small, informal parking area that is located at the eastern most terminus of Colonel Sam Drive.

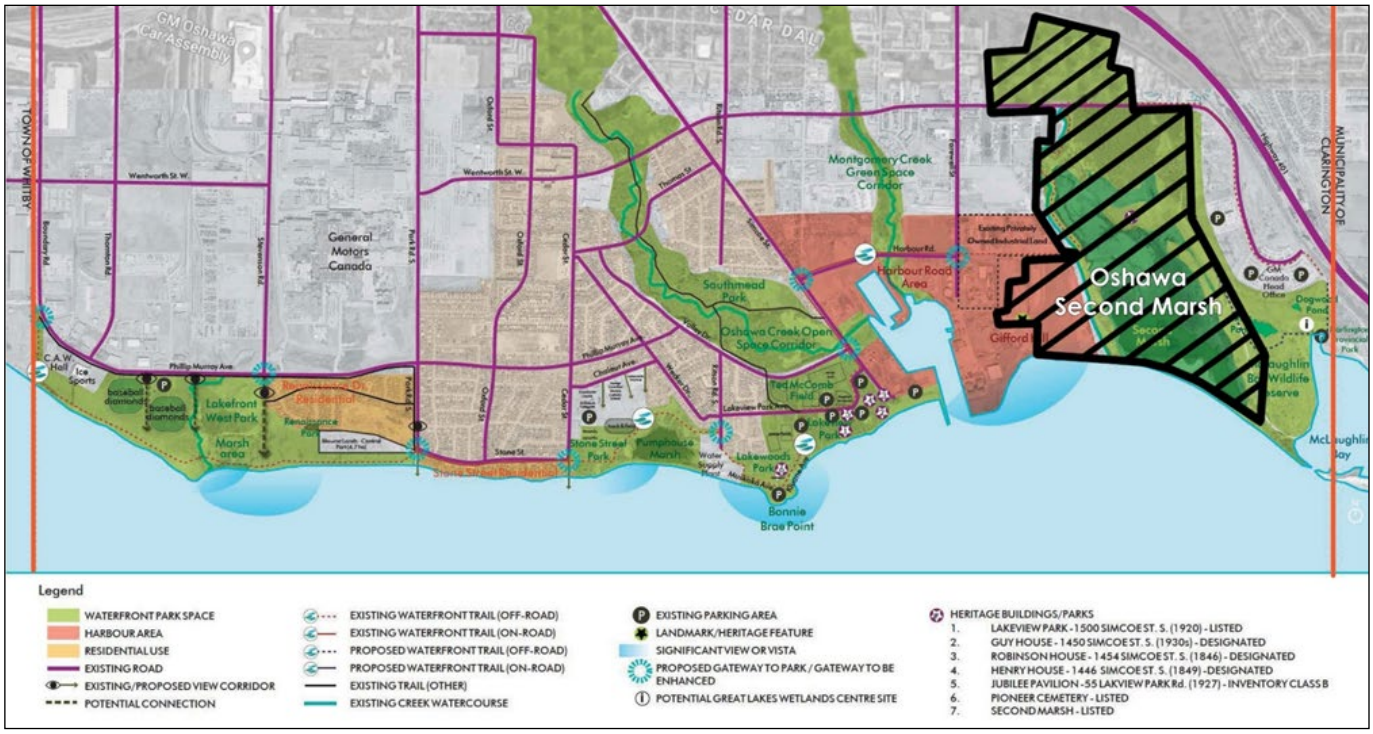


Figure 1. Open Space and Waterfront Trail
City of Oshawa: Waterfront Master Plan, May 2011; please refer to Figure 6 for the current study area boundary.

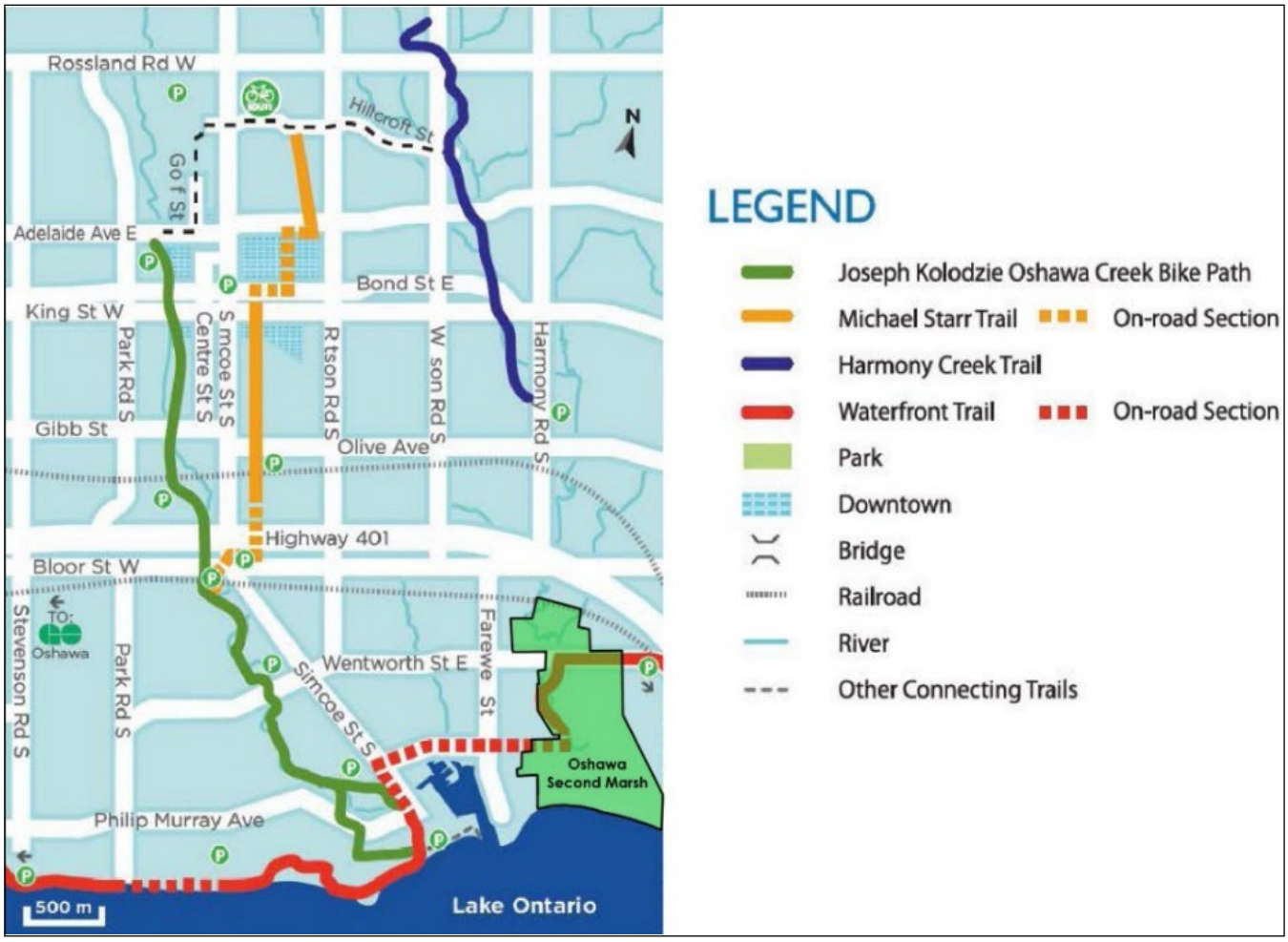


Figure 2. Trails and Access
City of Oshawa, Oshawa Trails Map; please refer to Figure 6 for the current study area boundary.

While Second Marsh is situated within the City of Oshawa's urban core and is well-connected to the City's road, trail and public transit systems (**see Figure 3**), public use of Second Marsh is not as intensive as one might expect. The community engagement and stakeholder consultation provided important insights related to the patterns of existing public use. The input received from the public engagement process revealed that the majority of users visited Second Marsh to pursue nature-based activities. Key users of the Marsh, as identified through consultation with the public and various stakeholder groups, include bird watchers, nature enthusiasts, photographers, dog-walkers, anglers and hikers. School groups visit the Marsh in the spring and fall, and Scouts/Guides use the marsh for outdoor activities

Figure 3. Public Transit Routes
Durham Region Transit, 2023; please refer to Figure 6 for the current study area boundary.

According to Friends of Second Marsh, use has declined since the trails were closed because of the danger of hazard ash trees (killed by Emerald Ash Borer). The majority of users access Second Marsh though the McLaughlin Bay area. However, there are limitations in the availability of parking. Nature-based groups such as The Durham Field Naturalists, Toronto Field Naturalists and the Toronto Ornithological Club still utilize Second Marsh for birdwatching and wildlife observation. Angling in Farewell Creek south of Colonel Sam Drive is also a popular pursuit.

Bus service provides transit to Colonel Sam Drive. Cyclists can access Second Marsh using the Waterfront Trail or via a bike route on Colonel Sam Drive. The Waterfront Trail is a popular attraction for cyclists and is a renowned attraction for cyclists and users from around the world. The Waterfront Trail stretches over 3000km and connects 140 communities, including Oshawa, along the perimeter of the Great Lakes. Through Oshawa the Waterfront Trail connects to Second Marsh over the Farewell Creek and provides an on-road portion for cyclists. The Waterfront Trail also connects Second Marsh to McLaughlin Bay Wildlife Centre and Darlington Provincial Park which is located at the boundary between Oshawa and Clarington. The Waterfront Trail provides connection to Second Marsh, McLaughlin Bay and the Joseph Kolodzie Oshawa Creek Bike Path. The Joseph Kolodzie Oshawa Creek Bike Path bike path links to downtown Oshawa. The Michael Starr Trail leads to the downtown core from its intersection with the Joseph Kolodzie Oshawa Creek Bike Path, providing an alternate linkage between Second Marsh and Oshawa's downtown.

There are two formal access points into Second Marsh. Both are located on the south side of Colonel Sam Drive, one at the east side of the marsh connecting to McLaughlin Bay and the other on the west side of Farewell Creek off the Waterfront Trail. The former trail network through Second Marsh was a naturalized trail for walking (cyclists were prohibited). The trails consisted of boardwalk and grass with a bridge from the Waterfront Trail across Farewell Creek. This portion of the trail network was closed in 2010 due to flooding which made maintenance difficult. The trail through Ghost Road Bush towards McLaughlin Bay on the east side of Farewell Creek was closed to users in 2015 due to the hazards posed by trees infested with Emerald Ash Borer. At the present time, the Ghost Bush Trail and boardwalk have been closed to the public due to risk concerns related to hazard trees and due to the poor state of repair of the boardwalk. Existing amenities, such as the lookout platform on the east side of the marsh which is located on the GM Canada property, and the lookout structure located on the north side of Colonel Sam Drive, are also in a state of disrepair and require upgrading and/or refurbishment to address past vandalism damage and potential public safety concerns.

The Friends of Second Marsh conducts organized outings with school groups and others to further environmental education and fostering stewardship, primarily utilizing the McLaughlin Bay area.

In general, over-use of Second Marsh has not been observed in the past. Overuse is not occurring at present time, owing in part to the closure of trails/limitations of access. The impacts of existing uses on the Marsh environment are localized and seasonal.

2. Site Setting

Urban development, as well as a major highway, surrounds the Marsh to the north and west (**Figure 4**). Schedule 'A', Land Use from the City of Oshawa Official Plan (March 2021) designates Oshawa Second Marsh as 'Open Space and Recreation', and the adjacent lands as 'Industrial', 'Utilities', and 'Special Waterfront Area'. The land immediately east of Second Marsh is surrounded by successional and manicured areas associated with the General Motors headquarters, which provide a partial linkage to Darlington Provincial Park further east. There have been many complementary functions noted because of the connectedness of Oshawa Second Marsh and the provincial park.

Second Marsh is situated in the Black/Harmony/Farwell Creek watershed; however, the marsh was separated from the watershed in the early 2000s by a dyke that channeled Farewell Creek directly into Lake Ontario.

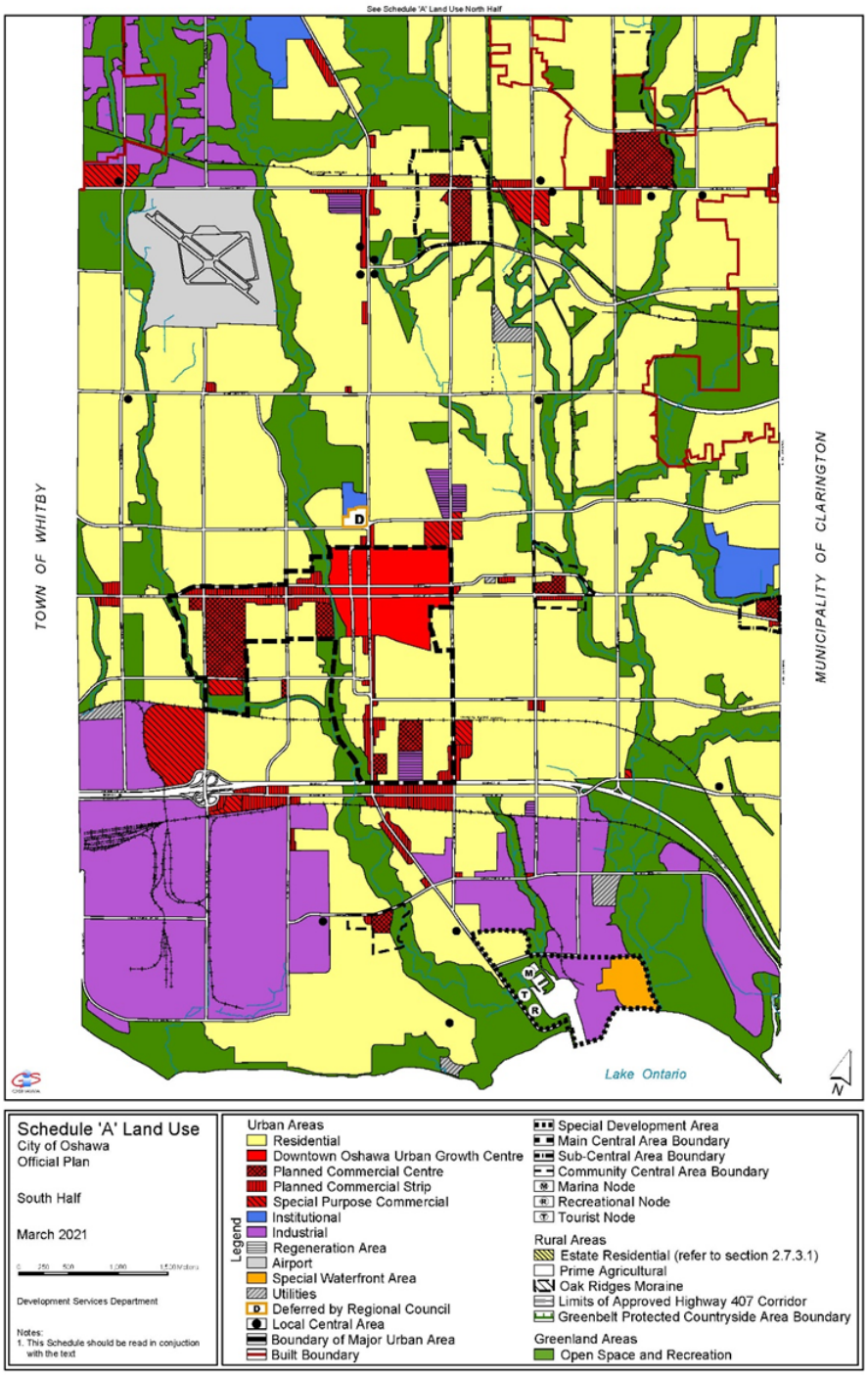


Figure 4. Land Use Context
City of Oshawa, Official Plan, March 2021; please refer to Figure 6 for the current study area boundary.

Industrial development is predominant on the lands to the west. Highway 401 cuts through the watershed just north of Second Marsh, and all western upstream portions of the watershed north of the highway are surrounded by urban residential development. This urban setting has been in place since prior to the development of the 1999 Management Strategy. The eastern part of the watershed supports a larger proportion of agricultural land, with many wetlands. The marsh community is the largest and most diverse coastal marsh within the Region, one of a series of 12 marshes along the coast of Lake Ontario.

The land immediately to the east of the Marsh consists primarily of successional areas, part of the large General Motors plant property. Further to the east is Darlington Provincial Park, an area of planted pines and successional vegetation that surrounds a substantial open water aquatic system, with a fringe of marsh vegetation. Linkage between the two areas of marsh is important, as there are many functions that undoubtedly overlap these areas such as breeding bird territories. This area contributes to the natural setting of Oshawa Second Marsh, potentially contributing functions such as a critical function zone for species that require upland and wetland habitats in order to complete their life cycle.

2.1. Ecoregion Setting

Oshawa Second Marsh has considerable importance from the perspective of representation of its vegetation and landform combination within the province of Ontario. It lies in Ecoregion 6, in Ecodistrict 6E-13. Ecoregions and Ecodistricts describe ecosystems at two scales; Ecoregions (originally referred to as Site Regions), characterized by climatic patterns and bedrock, and Ecodistricts (originally referred to as Site Districts), distinguished by physiographic differences and by the successional trends exhibited by the predominant vegetation type on those physiographic features (Crins et al. 2009). Oshawa Second Marsh was formerly considered the eastern part of Hills's site district 7E-4 (Henson and Brodribb 2005), part of the so-called Carolinian zone, likely because of occasional southern vegetation elements.

Ecoregion 6E incorporates the eastern part of the glacial feature known as the Iroquois shoreline: i.e. the remnant of the former shoreline of glacial Lake Iroquois. Ecodistrict 6E-13 extends along the Lake Ontario shoreline, from west of the Rouge River to Presqu'ile Provincial Park, Trenton and the Bay of Quinte. As indicated by its designation as a provincially significant life science A.N.S.I. (assigned to the portion south of Colonel Sam Drive), the Marsh is considered the "best" representation of coastal barrier beach wetland on clay plain within the Ecodistrict in terms of representation, condition, size, diversity, ecological functions and special features (Hanna 1984). The Ontario Nature Reserves Program (Hanna 1984) noted that Second Marsh was the finest example of a cattail marsh located on the north shore of Lake Ontario between Niagara and Presqu'ile. The marsh was also described as supporting the highest

concentration of waterfowl along this section of Lake Ontario. The Marsh was described in 1984 as follows:

> "a cattail-bur-reed marsh and sedge mat with many areas of open water. Willow carr and ash scrub forest encircle the edge. An ash-willow-balsam poplar floodplain forest occurs upstream. The sand, gravel and pebble beach bar is breached by a single outlet to Lake Ontario. Willow and Balsam Poplar are found in the storm beach" (Hanna 1984).

The Marsh has changed somewhat from that described in 1984. However, many of these elements are still found, and Second Marsh should still be considered a provincially significant representation of marsh within the Ecodistrict.

Additional research within the Ecodistrict has continued to refine the landform/vegetation units that contribute most to this designation. Target vegetation communities for protection priority in this Ecodistrict (Henson and Brodribb 2005) are related to sandy, dry habitats such as dunes, sand barrens and sandy open woodlands.

Targeted flora species at a priority for conservation are largely those of sand dune and aquatic marsh environments, several of which have been reported at Oshawa Second Marsh (further discussion of rare plant species can be found in Appendix 1):

- *Cakile edentula* (American Sea-rocket) (a Great Lakes disjunct species)
- *Chamaesyce polygonifolia* (Seaside Spurge)
- *Nymphoides cordata* (Floating-heart)
- *Potentilla paradoxa* (Bushy Cinquefoil)

Targeted fauna species also primarily include those of marsh habitats, including the following species which have been reported at Second Marsh (for further discussion of bird species see Appendix 1):

- *Chlidonias niger* (Black Tern)
- *Ixobrychus exilis* (Least Bittern)
- *Rallus elegans* (King Rail)

2.2. Watershed Setting

The watershed boundary of the Black/Harmony/Farewell Creek watershed, which originally discharged through Second Marsh, is shown in **Figure 5** (derived from Figure 1, C.L.O.C.A. 2012). Generally, the proportion of natural cover is low within the watershed at 24% (C.L.O.C.A., 2012). The majority is concentrated along the Lake Iroquois Beach, where natural cover,

particularly in the upper reach of the watershed, is considered critical to supporting a healthy watershed.

The western portion of the watershed is occupied by the Harmony Creek subwatershed (the most urbanized within the Second Marsh catchment), which is further divided into 5 subwatersheds. Within these subwatersheds, wetland cover ranges from 0.13% to 11% and forest cover ranges from 4.6% to 17% (C.L.O.C.A. 2011). The overall percentage of wetland cover within the entire Harmony Creek watershed is 5% (C.L.O.C.A. 2011).

The eastern portion of the watershed is less developed. Forest cover is 16% and 22% of the Farewell and Black Creek Subwatersheds, respectively. Wetlands occupy 23% and 22% of the Farewell Creek and Black Creek subwatersheds respectively.

The guidelines for wetland cover set out by Environment Canada for maintaining healthy watersheds state that there should be a minimum of 10% wetland cover in each watershed and at least 6% in each subwatershed (Environment Canada, 2014). Four of the seven subwatersheds of Harmony Creek meet if not surpass those guidelines; however, the other subwatersheds are highly urbanized and the watershed as a whole is deficient in natural cover.

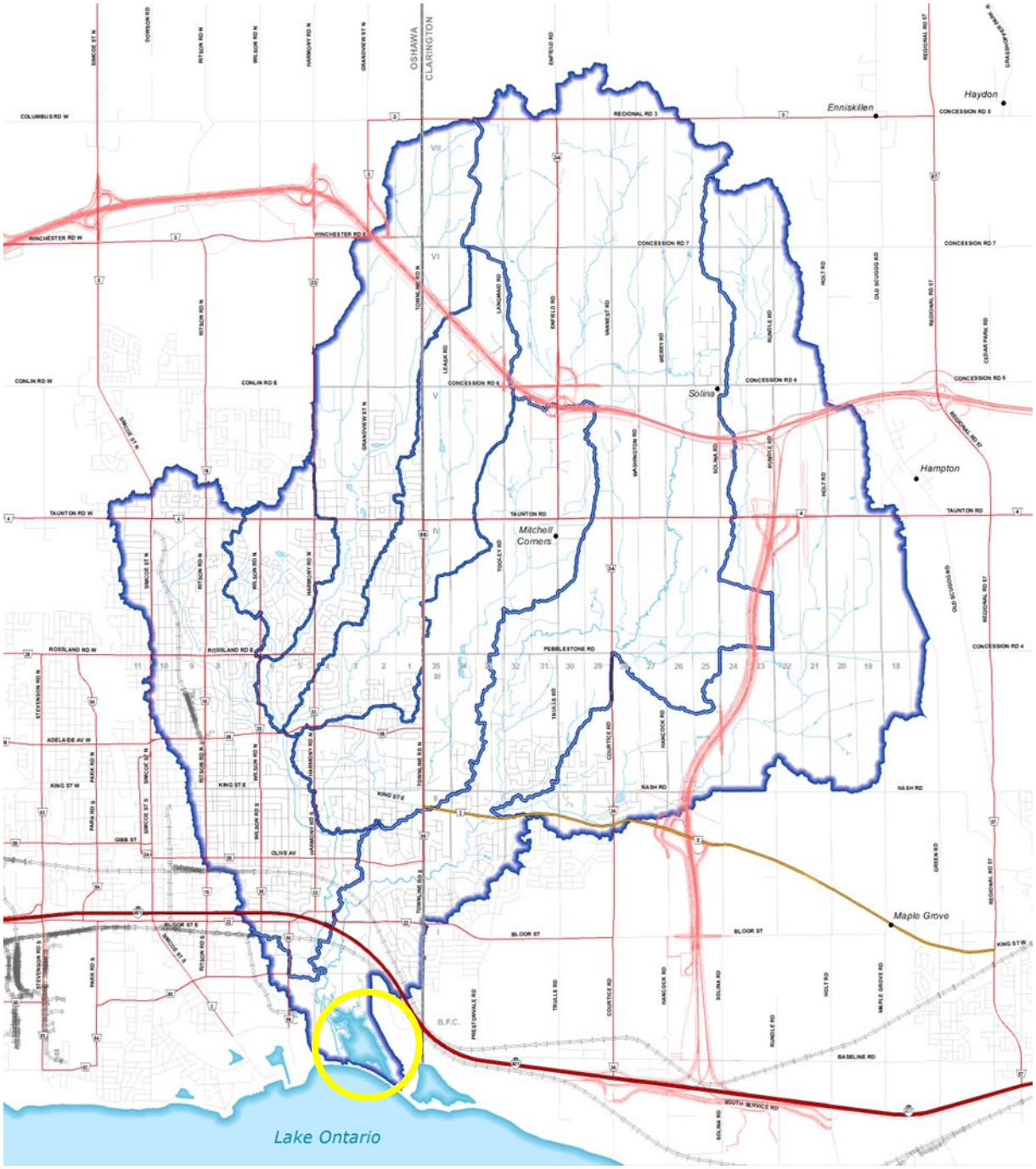


Figure 5. Watershed setting of Oshawa Second Marsh (from C.L.O.C.A 2012). The general location of Oshawa Second Marsh is indicated by the yellow circle

3. Development of the 2023 Management Plan

3.1. Vision

The proposed Vision was presented through stakeholder and public consultation in the Spring of 2019. Based on the consultation (Appendix 2 and Appendix 3), the Vision Statement that guides the updated Management Plan is as follows:

> "**That the Oshawa Second Marsh Area is a healthy, diverse ecological system whose significant features and functions are valued and protected to provide ecosystem services for present and future generations**."

3.2. Management Threats, Challenges and Opportunities

There are threats, challenges and opportunities that must all be considered when developing a management plan with recommendations for actions intended to achieve objectives. By understanding the threats and challenges to achieving goals and objectives the management actions can be designed to increase the success of achieving objectives. It is important to also recognize opportunities that exist through past and current initiatives and the resources and expertise available through stakeholders and partnerships. The following sections review the threats, challenges and opportunities that inform the goals, objectives and management strategies identified in this plan.

3.2.1. Management Threats and Challenges

Threats are species, processes and or events that may cause negative impact to the environment, public use or user safety. Challenges are obstacles to achieving the vision, goals and objectives for Second Marsh that are the result of impacts of threats and limited resources available to address the threats.

Development in Surrounding Areas

Increasing development adjacent to Second Marsh has the potential to affect ecosystem integrity. It was noted in the 1992 management plan that the lands adjacent to the Second Marsh acted as a buffer and contributed critical functions to the Marsh, such as providing foraging and breeding areas for wetland wildlife. The management plan noted that "adjacent upland habitat should be as wide as possible". The General Motors property was developed with the protection of the Second Marsh ecosystem as a guiding principle, and that any future development of this area must consider the long-term future of Second Marsh. Increased development can bring a greater number of users to the park; however, this increases the challenge of balancing public use and environmental protection.

New and Emerging Threats

There may be potential new pests that threaten populations of flora and fauna at Second Marsh. The devastating impacts of Emerald Ash Borer can be seen throughout the Ghost Road Bush, and future pests could have impacts on tree species that may regenerate (or may be planted) within that area such as Asian Long-horned Beetle (*Anoplophora glabripennis*), which has the potential to affect all maple species in the future, Dutch Elm Disease, which will continue to affect American Elm (*Ulmus americana*) and Emerald Ash Borer, which will continue to affect future ash regeneration. Potential diseases are not restricted to plants. An amphibian fungal disease, *Batrachochytrium dendrobatidis* (or B.d.), is being tracked because of its impacts on amphibian populations throughout the world (Whittaker and Vredenburg 2011).

Regional Impacts

In addition, wildlife populations are being affected by factors outside Second Marsh. For example, Canada has lost 40-60% of shorebird, grassland bird, and aerial insectivore populations (N.A.B.C.I. 2019), with suggested reasons for the decline likely including destruction of habitat for breeding, migration stopover and wintering. Insect populations are also declining (Sánchez-Bayo and Wyckhuys, 2019). This research found that in terrestrial ecosystems, Lepidoptera, Hymenoptera and dung beetles (Coleoptera) appear to be the taxa most affected, whereas four major aquatic taxa (Odonata, Plecoptera, Trichoptera and Ephemeroptera) have already lost a considerable proportion of species (Sánchez-Bayo and Wyckhuys, 2019). Since insects are keystone species within all ecosystems, declines in insects have the potential to affect all trophic levels within Second Marsh. Declines in aerial insectivores such as swallows have particularly been suggested to be a result of declines in insect populations (Nebel et al. 2010). This emphasizes the importance of maintaining ecosystem function in Second Marsh, but also notes the importance of understanding the context of regional population trends when analyzing monitoring results.

Hydrology and Water Quality

Flows of Farewell and Harmony Creeks to the south of Colonel Sam Drive have been largely diverted from the aquatic portion of Second Marsh by a constructed dyke, and flow directly into Lake Ontario. Flows from Farewell and Harmony Creek still influence vegetation communities north of Colonel Sam Drive. Some surface water from these creeks can still enter the wetland through the constructed dyke via the fish gate. A two-way pump was installed in the barrier beach to control the amount of water entering the wetland from Lake Ontario but the beach is sometimes overtopped by storms, allowing water from Lake Ontario to enter the marsh.

Groundwater potentially enters Second Marsh through the high groundwater table in the Ghost Road Bush and discharges along Farwell and Harmony Creeks. However, the contribution of groundwater is thought to be relatively low according to the Central Lake Ontario Source Protection Association (C.L.O.S.P.A. 2015).

Water quality has been categorized as “very degraded” for many of the years it has been measured (N.S.E. 2019a). A decrease in some parameters directly related to higher water quality has been noted. For example, nitrate and turbidity levels decreased strikingly between 2003 and 2006. However, other indicators of water quality such as Invertebrate I.B.I.s show that quality has remained consistently moderately degraded to very degraded since 2011 (N.S.E. 2019a).

Shoreline Erosion

The 1992 Management Plan notes that the direction of alongshore drift at the Second Marsh changes daily as winds (and currents) change, causing constant alterations to the barrier beach outlet configuration (City of Oshawa 1992). The net direction of littoral drift along the north shore of Lake Ontario in the Second Marsh area is from west to east. There is a concern that record high water levels in Lake Ontario combined with severe spring storms may result in increased erosion in shoreline communities. For example in the spring of 2017 (and in 2019), the highest water level was recorded on Lake Ontario since reliable records began in 1918 (Environment and Climate Change Canada 2019). This could have implications for management of significant species and communities of sand dunes and beaches on the barrier beach of the marsh. Shoreline erosion and deposition patterns along Lake Ontario’s shoreline are very interconnected. Shoreline erosion patterns have changed along other portions of the Lake Ontario shoreline in the past because of structures built along the shoreline: for example, construction of the Leslie St. Spit has resulted in less deposition of sand on the Toronto Islands, so they are threatened by erosion (Nairn et al. 1994). Similar structures may have the potential to affect the Barrier Beach at Second Marsh, which is already very narrow.

Interactive Effects

Threats and challenges discussed above interact with each other and can be exacerbated by one another. For example, water flow alteration and climate change may have compounding impacts of the barrier beach in the future. Human-caused climate change is expected to particularly affect the hydrology of the Great Lakes; warming temperatures, increasing evaporation, and changing precipitation and snow cover patterns are likely to result in long-term reductions in water levels. Projected decreases in water levels could alter the current distribution and abundance of coastal wetland communities (Mortsch et al. 2006). In 2009, the International

Panel for Climate Change in Ontario suggested that, in Ontario, climate change would lead to a mean temperature increase of 2.5 °C to 3°C. Climate change appears to be giving rise to more extreme storm events than in the past (McDermid et al. 2015, Environmental Law and Policy Centre 2019). Conversely, there have also been predictions that high water levels from extreme rain events could mean that flood pulses within wetlands will be dampened, with wetlands being more consistently inundated and a loss of wetland plant species that depend on periodically exposed soils (Meyer et al. 2006). The synergistic effects of habitat fragmentation, habitat loss, and climate change will also contribute significantly to the decline of biological diversity, and the potential combined effects of these processes will almost certainly be greater than those estimated individually (Nituch and Bowman 2013). Storms and recent high water levels have led to erosion in some areas of the Lake Ontario shoreline, and this may continue to threaten the provincially significant vegetation community along the barrier beach, and ultimately the marsh itself. Increasingly high water levels and severe storms in Lake Ontario that are a potential result of climate change may also be accompanied by breaches in the barrier beach or constructed dyke, with inundation and invasion of carp into the marsh. Increase in shoreline erosion due to hardening of parts of the Lake Ontario shoreline has resulted in consequent change in patterns of erosion and deposition of sand in other areas of the shoreline of Lake Ontario, though it is not known whether these processes may be affecting the shoreline of Second Marsh.

Table 1 provides a summary of the current threats and challenges related to biology, public use and user safety at Oshawa Second Marsh indicating the taxa (or group) potentially impacted by the threat.

Table 1. Current threats and challenges related to biology, public use and user safety at Oshawa Second Marsh.

Threat(s)	Challenge(s)	Potentially Impacted Taxa
Poor water quality, sediment disturbance by carp and goldfish, high nutrient loading, high sediment loading, increased water temperatures, pollution, turbidity or reduced oxygen	• Restoring or maintaining biodiversity and abundance of invertebrate, amphibian and fish populations • Preventing damage to wetland vegetation • Minimizing pollution of the Marsh from upstream impacts throughout the watershed • Limited funding and resources for maintaining berm and fish gate, and	• Invertebrates, insectivorous birds, amphibians, fish • Species that eat Anurans (e.g., herons, snakes) • Species that eat fish • Wetland vegetation

Threat(s)	Challenge(s)	Potentially Impacted Taxa
	particularly drawing down water levels, which requires considerable funding	
Lack of breeding and overwintering habitat and high mortality rates (predation and road mortality)	• Restoring biodiversity and abundance of reptiles and amphibians • Ensuring suitable habitat is available for necessary life stages of reptile and amphibians • Limited funding for creating wildlife passages under road, restoring overwintering sites	• Reptile and amphibians • Species that eat reptiles and amphibians
Exotic fauna species (invertebrates, carp, Mute Swans, European Starling, etc.)	• Maintaining abundance and diversity of native breeding birds • Preventing public injury from European Fire Ants • Removing hazard trees created by Emerald Ash Borer from utilized areas • Limited funding and resources to complete habitat rehabilitation after ash die-off	• Native bird species • Humans
Subsidized predators (e.g., racoons and skunks)	• Limited funding and resources for protecting wildlife (e.g. turtles) from subsidized predators	• Reptiles and amphibians
Exotic flora species	• Limited funding and resources required for invasive species management and habitat restoration • Limited funding and resources for preventing reintroduction and/or re-establishment	• Native flora and fauna

Threat(s)	Challenge(s)	Potentially Impacted Taxa
New pests and/or diseases	• Lack of plan for early detection-rapid response to newly detected threats • Limited funding and resources to monitor and manage.	• Unknown
Noxious weeds	• Limited funding for educating the public to prevent incidents • Removing noxious weeds, such as Cow Parsnip, from publicly accessible areas	• Humans
High populations of Beaver and Muskrat	• Maintaining abundance and diversity of native breeding birds • Managing tree loss and vegetation composition • Managing water levels • Limited funding and resourcesfor managing impacts	• Wetland vegetation • Wetland birds • Human (property)
Recreational activities causing trampling, ad-hoc trails or disturbance to wildlife	• Balancing public use and appreciation with ecosystem protection • Preventing ad-hoc trails, trail braiding or trail widening impacts • Limited funding and resources for managing increased public use considering expanding development and population growth • Difficulty of enforcing minimizing disturbance to wildlife	• Native flora and fauna
Off-leash dog walking	• Balancing public use and enjoyment with minimizing disturbance to wildlife	• Native fauna and flora • Humans

Threat(s)	Challenge(s)	Potentially Impacted Taxa
	• Preventing pet disturbance and waste from negatively impacting vegetation or public experience • Limited ability to enforce.	
Light and noise	• Minimizing disturbance to wildlife • Maintaining buffers despite current development pressures	• Native fauna
Littering and illegal dumping	• Limited ability to provide sufficient litter receptacles in places where there is access for pick-up • Limited ability to enforce • Preventing negative impact to native wildlife through ongoing cleanup of litter	• Humans • Native fauna and flora
Vandalism and arson	• Limited funding and resources for maintaining boardwalks, lookout structures and the fishway	• Humans
Hunting, poaching and harvesting	• Limited funding and resources for preventing illegal hunting and poaching •	• Humans • Native fauna (specifically turtles) • Native flora
Roads and trails	• Balancing need to reduce impacts of trails on natural habitat while minimizing risk to pedestrians from bikers • Limited funding and resources for maintaining boardwalks, trails and infrastructure in good condition • Limited ability to minimize road mortality of wildlife • Limited ability to manage overland runoff of salt, sediment and other	• Humans • Native fauna

Threat(s)	Challenge(s)	Potentially Impacted Taxa
	contaminants from adjacent properties as there is a high proportion of adjacent development with impervious surfaces • Limited funding and resources available to maintain or improve water quality in Second Marsh despite increase in salt, sediment and other contaminants from overland runoff as there is a high proportion of adjacent development with impervious surfaces	
Anthropogenic lake water level regulation	• Consistently high water levels prevent the germination and establishment of emergent vegetation • Limited funding and resources for the high cost of regulating the marsh water level for desired management • Difficulty of enforcing respect for provincially rare vegetation community of the barrier beach	• Wetland plant species • Wetland obligate fauna • Shorebirds • Barrier beach vegetation community
Water flow alteration and increase in shoreline erosion due to hardening of parts of the Lake Ontario shoreline, resulting in consequent change in patterns of erosion and deposition of sand in areas of the shoreline of Lake Ontario	• Maintaining the extent of habitat and function of the barrier beach as a barrier to carp considering changing erosion and sedimentation patterns in Lake Ontario • Limited ability to influence planning decisions outside Oshawa's jurisdiction	• Marsh species that experience negative impact from carp • Barrier beach vegetation community • Shorebirds • Reptiles

Threat(s)	Challenge(s)	Potentially Impacted Taxa
Climate change -more extreme weather events (longer droughts, warmer temperatures or extreme rainfall events) leading to periods of lower water levels in the marsh and/or flooding of the marsh from overflow from Farewell Creek or Lake Ontario	• Limited funding and resources for the high cost of regulating the marsh water level for desired management activities • Limited funding and resources for maintaining boardwalks, lookout structures and the fishway • Limited ability to enforce respect for provincially rare vegetation community of the barrier beach • Limited ability to enforce prevention of ad-hoc trails, trail braiding or trail widening impacts caused by avoidance of flooded areas	• Wetland flora and fauna • Barrier beach vegetation community • Flora adjacent to trail systems near flooded or wet areas

3.2.2. Opportunities

The management of Oshawa Second Marsh has been overseen by a group of dedicated individuals from various stakeholder groups, namely the members of the Marsh Management Committee. Through stakeholder meetings that are recommended to occur at a minimum of once per year, or as needed based on implementation of management actions, there is a higher change of achieving the goals and objectives of the Management Plan.

In the Black/Harmony/Farewell Creek Watershed, C.L.O.C.A. has identified the implementation of best management practices to direct municipal and community action. Implementing and promoting the best management practices identified by C.L.O.C.A. in the Wildlife Corridor Protection and Enhancement Plan (2015), Riparian Corridors Restoration Plan (2017), Instream Barriers Action Plan (2017), and Invasive Species Management Strategy (2017) throughout the watershed will benefit Second Marsh through protecting wildlife corridors, removing instream barriers, improving natural cover and preventing the introduction or spread of invasive species.

3.3. Management Zones

To achieve the management plan vision, it is necessary to identify the components of the study area (referred to as 'Management Zones') that represent the ecological and human focus of the plan. Within Oshawa Second Marsh six Management Zones have been identified within which management goals, objectives and strategies can be developed (**Figure 6**). The Management Zones have been modified to reflect current vegetation mapping as well as the understanding of the functions of each ecosystem.

A second set of targets has been established based on the "Public Use" attributes in Second Marsh. Public Use categories reflect the direct value of the Marsh to humans. For each Management Zone, attributes have been identified that best represent whether the Management Zone is in good condition or functioning. Attributes are then measured with indicators – specific measurable characteristics or collections of characteristics combined into indices. Targets, attributes and indicators are the basis for setting goals, carrying out actions and measuring the success of the management plan.

Table 2 and **Table 3** provide a summary of the Management Zones, ecosystem attributes, and indicators as well as indicate those that are currently measured.

Management Zones

Oshawa Second Marsh Management Plan

Legend

- Ecological Land Classification
- Study Area
- Management Zones

1 - Marsh
2 - Swamp and Swamp/Marsh Ecotone
3 - Riparian Swamp, Forest and Meadow
4 - Barrier Beach
5 - Berm
6 - Adjacent Lands

For ELC definitions, please refer to Figure 1

0 250 500 Meters

Project Number	Date:	N
23-1354	2023-07-12	

Data Provided by: North South Environmental Inc.
Imagery: ESRI
Drone Orthoimagery provided by:
University of Waterloo, August 2018

north-south ENVIRONMENTAL

Table 2. Management Zones, Attributes and Indicators

Management Zone	Ecosystem Attributes	Indicators	Currently Monitored?
1. Marsh	Water Quality	Water Quality Index	Yes
		Turbidity, conductivity, Total Phosphorus, Dissolved Oxygen.	Yes
	Wetland Hydrology	Water levels	Yes
	Breeding Bird Community	Bird I.B.I.	Yes
		Community composition	Yes
	Amphibian Community	Amphibian I.B.I.	Yes
		Species richness	Yes
	Fish Community	Fish I.B.I.	Yes
		Community composition	Yes
	Macroinvertebrate Community	Macroinvertebrate I.B.I.	Yes
		Community Composition	Yes
	Submerged Aquatic Vegetation Community	S.A.V. I.B.I.	Yes
		Community Composition	Yes
2. Swamp (Ghost Road Bush) Marsh-Swamp Ecotone	Vegetation Community	Native species relative abundance	No
		Floristic Quality Index	No
	Breeding Bird Community	Bird I.B.I.	No
		Community composition	No
	Tree community health	Native tree and shrub	No
		regeneration	No
3. Riparian / Riparian Forest and Meadow	Breeding Bird Community	Bird I.B.I.	No
		Community composition	No
4. Barrier Beach	Vegetation Community Natural Cover	Floristic Quality Index	No
		% natural cover in vegetated portions	Yes
5. Constructed Dyke (Berm)	Structural Integrity	Dyke structural integrity (slopes and core) Invasive Species abundance	Yes No
6. Adjacent Lands	Width of Buffer	Geographic Information Systems analysis of buffer width	No
	Buffer Integrity (Vegetation within Buffer)	Proportion of buffer occupied by natural or naturalized vegetation	No
			No

Table 3. Public Use, Attributes and Indicators

Public Use	Attributes	Indicators	Currently Monitored?
Education and Stewardship	Programming	# of programs	Yes
	Public engagement	# of public participants	Yes
	Volunteer engagement	# of volunteers	Yes
	Student engagement/Research Opportunity	# of students	Yes
	Fundraising / donations to support programs and restoration	$ raised	Yes
Passive & Active Recreation	Trail use	# of trail users	No

3.3.1. Context for Management Zones

Each of the Management Zones shown on **Figure 6** are listed in **Table 4**, with a description of their associated functions and values. These are largely interconnected but have been separated for detailed analysis. The desired indicators of ecosystem attributes were used to develop the goals for each Management Zone.

Table 4. Context for identification of goals and objectives: Management Zones within Second Marsh, their functions, and desired ecosystem attributes

Management Zones	Functions and Values Documented in Recent Surveys	Desired Ecosystem Attributes
1. Marsh (including meadow marsh, shallow marsh and aquatic)	• Supports provincial representation of vegetation/landform units • Supports a high diversity of native plant species • Supports regionally and locally rare plant species • Supports warm water fishery with a diversity of trophic levels • Supports provincially rare marsh-nesting bird species and waterfowl species • Provides habitat for marsh-obligate nesting birds • Provides breeding habitat for generalist bird species • Provides habitat for migrating waterfowl and shorebirds • Provides habitat for marsh-obligate mammal species • Provides breeding habitat for amphibians that require “fishless” vernal pools as well as those that require more permanent standing water	• Diverse marsh ecosystem functions that replicate the range of functions noted in the past • High diversity of habitat types maintained by the size and complexity of the marsh (e.g. presence of marsh obligate species, shorebird feeding areas and rare plants present in exposed mats; waterfowl and muskrat nesting habitat present in marshy islands with abundant standing water; migrating waterfowl in broader areas of standing water • High proportion of native vegetation communities; • Adjacent habitat that provides critical function zones for wetland wildlife species • Connections between marsh habitat and adjacent upland habitat enhanced by connectivity of adjacent lands to the east and north

Management Zones	Functions and Values Documented in Recent Surveys	Desired Ecosystem Attributes
2. Swamp / Marsh-Swamp Ecotone	• Supports provincial representation of vegetation/landform unit (basis for A.N.S.I. designation) • Habitat for regionally and locally rare plant species • Habitat for migrating landbirds • Habitat for forest-dependent birds • Potential habitat for breeding amphibians, though breeding pools are used less than in the past • Transitional community between marsh and swamp that has remained relatively undisturbed and supports diversity of wetland species; lower non-native invasive abundance	• High proportion of native vegetation communities; • Gradient between swamp community and marsh community that promotes diversity because of proliferation of transitional habitats • Variable topography with upland hummocks and low depressions that provide habitat for amphibians that breed in the marsh • Functioning woodland amphibian breeding pools • Functional connections between habitat north and south of Colonel Sam Drive • Maintain lack of disturbance and transitional nature in marsh-swamp ecotone that is supported by variations in water levels in marsh
3. Riparian / Riparian Forest and Meadow	• Diversity of habitat areas adjacent to creeks provide additional habitat for amphibian and bird breeding and foraging • Riparian forest provides nutrients and shading to creeks • Many areas are relatively inaccessible and less disturbed by humans • Meadow habitat between the two creeks provided habitat for grassland bird species in the past but remaining	• High proportion of native riparian vegetation communities • Habitat that provides stabilization, shading and protection for creek • Habitat that fosters nesting successional birds north of Colonel Sam Drive • Closely interspersed upland and lowland habitats that provide transitional habitat for wetland wildlife • High habitat value from interspersion of communities and lack of disturbance

Management Zones	Functions and Values Documented in Recent Surveys	Desired Ecosystem Attributes
	meadow is not large enough to attract this guild of birds • Interspersed communities north of Colonel Sam Drive provide a mosaic of habitat that fosters species dependent on mid-successional habitat; this habitat is largely isolated from human disturbance	
4. Barrier Beach	• Supports two rare plant communities, one based on the sandy barrier beach and one based on shallow water on the protected side of the beach • Supports turtle nesting habitat • Provides foraging and nursery habitat for Piping Plover	• High proportion of native vegetation communities • Provincially significant rare plant communities on natural sand dunes • Natural disturbance regime that allows erosion and accretion of sand that fosters native communities
5. Constructed Dyke (Berm)	• Provides a barrier between contaminated, sediment-laden creek input and marsh	• Constructed dyke that separates contaminants and sediment from marsh communities while promoting natural processes
6. Adjacent Lands	• Mitigate impacts from surrounding development	• Buffer strip with largely natural vegetation that functions to protect the Marsh from impacts of adjacent development as encroachment, heat island effect, sediment-laden runoff, etc.

3.3.2. Context for Public Use Categories

Ecosystem services include those that have tangible benefits for humans: education, recreation, public use infrastructure and nature interpretation. Other ecosystem services, such as water

quality improvement and flood control, have been altered because of the diversion of Farewell Creek into Lake Ontario. **Table 5** summarizes a discussion of ecosystem services that would be most desirable in providing human-related functions.

Table 5. Ecosystem Service conservation characteristics desired at Second Marsh

Ecosystem Services	Functions	Desired Ecosystem Services
Education	• Provides an accessible, high-quality and diverse natural system in close proximity to an urban centre	• Maintain ecological integrity within Second Marsh that showcases many aspects of a healthy ecosystem and demonstrates natural processes and interconnections between habitats within and outside the site
Recreation	• Provides passive recreation opportunity in a natural setting	• Promote enjoyment of the natural landscape • Facilitate access without negative impacts to natural features and functions and without substantially increasing evidence of human disturbance that decreases the experience
Public Use Infrastructure	• Provided (prior to degradation of infrastructure) access through Ghost Road Bush to trails and lookouts for enjoyment of the marsh; • The Waterfront trail still exists and provides viewing area along the western portion of Second Marsh	• Maintain access to Ghost Road Bush, the marsh and Farewell Creek that will allow enjoyment of features and promote monitoring and stewardship while protecting natural heritage functions
Nature Interpretation	• Provides an area where the diversity and interconnectedness of the communities within Second Marsh can be experienced	• Provide viewing opportunities for wildlife and vegetation that ensure impacts on ecological integrity are minimized/avoided

Ecosystem Services	Functions	Desired Ecosystem Services
Carbon Sequestration	• Provides an area where carbon is stored	• Increases the amount and time frame of carbon storage through planting of longer-lived trees where appropriate

3.4. Goals and Objectives

Goals and objectives were identified for each Management Zone (**Table 6**). Goals represent the desired long-term future condition. The short-term objectives provide specific, concrete results that are desired, with a timeline for achieving the objective. Goals and objectives are designed to be S.M.A.R.T.: Specific, Measurable, Attainable, Realistic and Time Bound (Government of British Columbia 2001). Strategies that will be used to achieve the goals and objectives can also be found in **Table 5**.

It is important to note that the ability to accomplish the objectives relies on funding and resources. This is particularly important for the water level drawdowns, which require considerable funding to run the pumps and manage other infrastructure during the drawdown.

Table 6. Goals and Objectives for Management Zones at Oshawa Second Marsh

Management Zone	Goals	Strategies	Objectives
1. Marsh	1. By 2035, the Water Quality Index is above the reference wetland average 2. By 2035, the O.S.M. fish community composition is within the 95% confidence ellipse of the reference community average. 3. By 2035, the O.S.M. aquatic macroinvertebrate I.B.I. is above the reference community average. 4. By 2035, the O.S.M. bird community I.B.I. is above the reference community average. 5. By 2035, the O.S.M. amphibian community I.B.I. is above the reference community average. 6. By 2035, achieve and maintain European Reed abundance to less than 15% of its current extent.	1. Water level management. 2. Invasive species management. 3. Restore wetland bathymetry. 4. Promote watershed best management practices and the recommendations of the C.L.O.C.A. Black Harmony Farewell Watershed Plan.	1. By 2035, achieve and maintain an average conductivity at O.S.M. less than 300 us. 2. By 2035, achieve and maintain an average turbidity at O.S.M. less than 6 NTU. 3. By 2035, achieve and maintain an O.S.M. S.A.V. community I.B.I. above the reference community average minus standard deviation. 4. By 2035, achieve and maintain Total Phosphorous less than 0.1 mg/L 5. By 2035, create deepwater refuge for wildlife through excavation 6. By 2035, manage water levels to achieve > 60% vegetated area for one or two years in the ten-year time frame. 7. By 2035, develop monitoring strategy for amphibians. 8. By 2035, implement annual turtle population monitoring program. 9. By 2030, reduce the relative abundance of European Reed by 50%. 10. By 2035, reduce the relative abundance of European Reed by 85%.
2. Swamp / Marsh-Swamp Ecotone	1. By 2035, achieve and maintain native species relative abundance of greater than 73%. 2. By 2035, achieve and maintain a Floristic Quality Index greater than 40. 3. By 2035, achieve and maintain Common Buckthorn abundance to less than 15% of its current extent.	1. Invasive species management 2. Plant native species	1. By 2035, implement Phase 1 of the forest management plan. 2. By 2035, develop and implement a vegetation monitoring protocol to track changes in native species relative abundance and floristic quality. 3. By 2035, develop and implement a monitoring program for amphibians and birds for this conservation target. 4. By 2030, reduce the relative abundance of Common Buckthorn by 50%. 5. By 2035, reduce the relative abundance of Common Buckthorn by 85%.
3. Riparian / Riparian Forest and Meadow	1. By 2035, the riparian and meadow communities at O.S.M. are protected from human disturbance.	1. Invasive species management 2. Manage public access	1. By 2030, create designated public access areas including trails, viewing areas and fishing nodes that best manage impacts of access.

Management Zone	Goals	Strategies	Objectives
	2. By 2035, achieve and maintain European Reed abundance to less than 15% of its current extent.		2. By 2035, develop and implement a vegetation monitoring protocol to track changes in native species relative abundance and floristic quality. 3. By 2030, reduce the relative abundance of European Reed by 50%. 4. By 2035, reduce the relative abundance of European Reed by 85%.
5. Barrier Beach	1. By 2035, the barrier beach habitat at O.S.M. is protected from human disturbance. 2. By 2040, achieve and maintain European Reed abundance to less than 15% of its current extent.	1. Invasive species management 2. Manage public access	1. By 2035, install fencing to limit public access to the barrier beach. 2. By 2035, develop and implement a vegetation monitoring protocol to track changes in native species relative abundance and floristic quality. 3. By 2030, reduce the relative abundance of European Reed by 50%. 4. By 2035, reduce the relative abundance of European Reed by 85%.
5. Constructed Dyke (Berm)	1. By 2035, the constructed dyke continues to be maintained in a manner that provides vehicle access for monitoring and maintenance staff and maintains integrity separating creek from the wetland. 2. By 2040, achieve and maintain European Reed abundance to less than 15% of its current extent.	1. Invasive species management 2. Manage public access 3. Maintain constructed dyke	1. By 2035, develop and implement a monitoring protocol to evaluate the structural integrity of the constructed dyke. 2. By 2035, install fencing to limit public access to the constructed dyke. 3. By 2035, develop and implement a vegetation monitoring protocol to track changes in native species relative abundance and floristic quality 4. By 2030, reduce the relative abundance of European Reed by 50% 5. By 2035, reduce the relative abundance of European Reed by 85%.
6. Adjacent Lands	1. By 2035, the natural vegetation communities in the wetland buffer are protected from land use change	Protect wetland buffer	1. By 2035, maintain 100% of existing (2019) natural cover in the wetland buffer.

3.5. Key Management Priorities

Key management priorities are overarching management themes with related objectives, actions and strategies. There are four key management priorities for Second Marsh:

- Ecological restoration;
- Hydrology and water quality;
- Community education, awareness and stewardship; and
- Public access, while reducing impacts of public use, and continuing operational maintenance;

The Key Management Priorities, with rationales for each priority, are described in the following sub-sections 3.5.1 (Ecological Restoration), 3.5.2 (Management of Hydrology and Water Quality), 3.5.3 (Community Education, Awareness and Stewardship) and 3.4 (Public Access, reducing impacts of public use and operational maintenance). A table is provided for each Key Management Priority that identifies general objectives with recommended strategies and actions, stakeholder responsible for the actions, the priority level related to the actions, and a recommended timeline of short-term (0-5 years) and long-term (6-10 years), from the time of commencement of management activities.

The roles and responsibilities of stakeholders for implementing the recommended actions are based on the roles and responsibilities outlined in section 1.3. These should be reviewed by the Management Committee in order to determine the appropriate “lead” stakeholder. The ability to implement the actions will be based on resources and funding available and ultimately determined through discussion by the Management Committee as whole.

3.5.1. Ecological Restoration

Ecological restoration will be a key management approach to improve the ecological integrity in Second Marsh. Active ecological restoration will include the management of invasive species and select planting of native vegetation. As part of the Forest Management Plan (North-South 2019), restoration recommendations for Ghost Road Bush include the planting of native trees and shrubs to enhance native species composition, increase resilience to invasive species and enhance forest succession. In addition, non-native invasive species have become widespread throughout Second Marsh. For example, Hybrid Cattail is now the dominant species in areas of shallow marsh, and it would be almost impossible to eradicate without considerable impact to other plant species. However, the Invasive Species Management Plan (North-South Environmental 2019b) provides guidance on management of invasive species for which control is possible and would provide considerable benefit, including the management of Common Buckthorn and European Reed.

Ecological restoration will require coordination of public access to ensure that sensitive areas are protected, for example as shown in Appendix 1, newly-planted areas, vernal pools, areas dominated by native species and/or with concentrations of regionally significant plant species, nesting habitat for sensitive bird species, etc.

Ecological restoration should also include restoring wetland bathymetry in the marsh. It is known that sediment was deposited in Second Marsh as a result of land clearing in the 1800s. Subsequently, in 1933, 1938 and 1948, dredgeate excavated from Oshawa Harbor was deposited in the marsh, to an estimated depth of 35cm to 70cm (North-South Environmental 2019a). C.L.O.C.A. has detailed bathymetry mapping for Second Marsh completed by Canada Wildlife Service. Areas of unfrozen water are important for overwintering turtles, which need unfrozen water or substrates in which to overwinter. Fish also need refuges where the water does not freeze. Fish and some turtle species may be intolerant of oxygen-poor conditions in winter (some turtle species are more tolerant of low oxygen than others). Oxygen content may also be limited in shallow water during the summer. The lack of amphibian species that require permanent water such as Bullfrogs may indicate that permanent water is lacking in Second Marsh. Modifying the substrate of the marsh may provide deep areas for fish and turtles to overwinter.

Studies have been conducted to determine the current bathymetry. Further research is necessary to determine what modification of the bathymetry is required, and whether it is feasible. Deeper refuges are limited, therefore further research is required to determine whether water and sediment quality are sufficient to support overwintering fish and turtles in the existing substrate, and if not, what the optimal configuration would be.

If modification to the bathymetry is recommended, research should determine what this should entail. The location, depth and area of excavation would need to be determined, as it is known that some areas of substrate within Second Marsh contain heavy metals and hydrocarbons (DRCWMP 2014). Further investigation would need to be conducted to determine the extent of the contamination (DRCWMP 2014). The logistics of construction in this wetland environment are likely to be challenging. In addition, the trade-offs of excavation must be analyzed as soil disturbance may encourage the spread of non-native invasive species, including European Reed.

Table 7 provides an overview of objectives, strategies, actions, responsibilities, priorities and timelines related to ecological restoration.

Table 7. Key Management Priority: Ecological Restoration

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Optimize the productivity of habitats in the marsh communities for resident and /or reproducing species of native flora and fauna and limit non-native species populations	Invasive species management in Marsh. Maintenance of the fish gate. Ensure pump and pipe system that control water level remain in good working order. Protect the wetland buffer.	Determine conditions that will trigger a marsh drawdown and determine funding sources and staff resources necessary for drawdowns. If feasible, given funding and occurrence of water levels optimum for marsh management, reduce water levels in Second Marsh in spring at the first available opportunity (when permitted by water levels in Lake Ontario) to achieve ratio of 60% emergent vegetation, 40% open water; maintain for a period sufficient to achieve goals of increasing plant species diversity and water quality improvement. Continue to proactively manage water levels within Second Marsh as permitted by the water levels in Lake Ontario and according to a schedule that mimics “natural” water level fluctuation in Lake Ontario as much as is feasible, when funding and water levels in Lake Ontario permit. See rationale in Section 3.5.1.	Ducks Unlimited with help where needed from C.L.O.C.A. and other stakeholders	High	Short-term and long-term
Optimize the productivity of habitats in the Ghost Road Bush for resident and /or reproducing species of native flora and fauna and limit non-native species populations	Restoration and management of Ghost Road Bush	Determine phasing and priorities of invasive species management in Ghost Road Bush; determine methods for invasive species management based on habitat type and target species; implement Invasive Species Management Plan (NSE 2019a). Establish phasing and priorities of restoration planting and develop restoration plans; implement Forest Management Plan (NSE 2019b). Obtain funding and resources needed for invasive species removal and restoration planting.	City of Oshawa with help from all stakeholders		

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
		Identify restoration opportunities/areas. Develop stewardship program to monitor success of restoration program.			
Obtain public support for restoration of Oshawa Second Marsh		Educate the public on the sensitivity of habitats in the Marsh and the importance of the buffer. Organize stewardship activities adjacent to Second Marsh such as planting or maintenance where permitted by landowners.	Friends of Second Marsh with help from C.L.O.C.A.	High	Short-term
Reduce and avoid impacts from trail users on species and communities of concern as recommended in section 3.5.3	Enhancement of formalized trail system. Environmental monitoring.	Secure capital funding (this could be through approved capital budget process, grants, donations) for the design and construction of a formalized trail network that limits public access to species and communities of concern and ensures that existing habitat function and ecological integrity are maintained or improved through restoration where feasible. Decommission informal trails. Monitor for impacts of trail users on vegetation and implement measures to limit this by installing educational signage or barriers to limit access to sensitive areas.	City of Oshawa C.L.O.C.A.	High	Short-term and long-term
Improve overwintering habitat for turtles and fish habitat in the marsh by providing deeper pools and variable depths.	Increase depth and variability of bathymetry in the marsh.	Determine location, depth, and area to be excavated for deepwater refuge. Sediment sampling to determine if contamination present in areas to be excavated. Tender and contract for excavation. Obtain permits and approvals to complete work.	C.L.O.C.A. City of Oshawa	High	Long-term

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Enhance landscape connections, especially between the stream riparian area, Lake Ontario, and McLaughlin Bay / Darlington Park	Enhancement of formalized trail system.	Prepare a redevelopment plan of Second Marsh which incorporates public access and include connections to McLaughlin Bay area into future Capital Project funding. Formalize a trail network that limits public access to sensitive areas identified in Section 3.5.1 and limits impact on ecology/habitat/connectivity, trail development should incorporate restoration measures, and requirements to limit spread of invasive species during construction and maintenance activities (such as clean equipment protocols etc.)	City of Oshawa	Low	Long-term
Maintain presence of other complementary habitat at close to existing levels	Enhancement of continuous habitat and a formalized trail system that is ecologically sensitive.	Continue consultation with landowners to the east to develop a formal connected corridor between the Second Marsh and McLaughlin Bay Wildlife Area. Prepare a redevelopment plan of Second Marsh which allows existing habitats to thrive through the development of formalized trails and decommissioning informal trails.	C.L.O.C.A. City of Oshawa	Low	Long-term

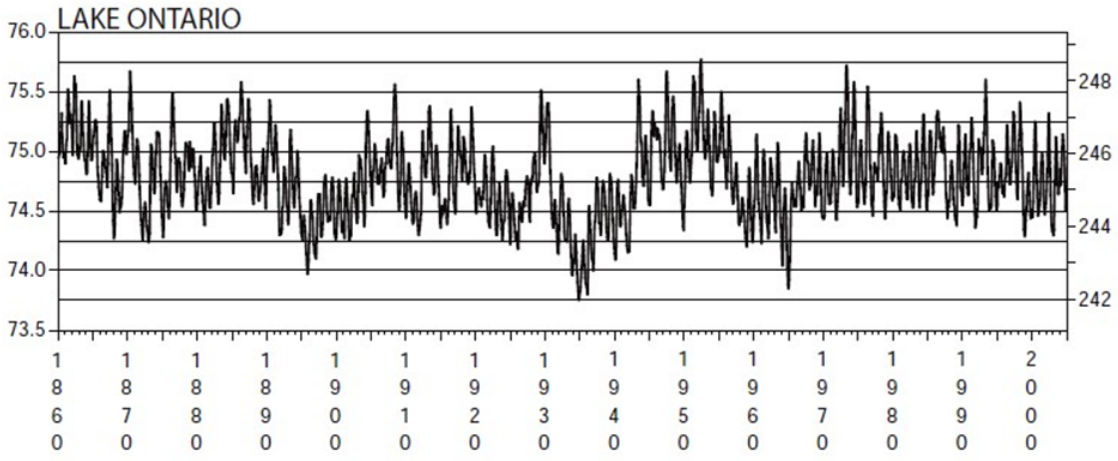
3.5.2. Management of Hydrology and Water Quality

Ecosystems and ecosystem services that are most valued at Oshawa Second Marsh are reliant on maintaining and improving water quality in order to support a representative coastal marsh ecosystem with a high diversity of interconnected habitats. The higher biodiversity at Second Marsh is highly influenced by a gradient of soil moisture and water level - thus the water and Marsh ecosystems are inextricably linked.

Hydrology

Water level management has remained key to managing the habitat of Second Marsh. Friis (2007) concluded that water level management appears to be beneficial for habitat and most wildlife (e.g., marsh-nesting birds, Muskrats) at Oshawa Second Marsh. Water level fluctuations are a natural disturbance in the Great Lakes. Water level fluctuation has been observed in Lake Ontario since recording began, as shown in **Figure 7** (from Wilcox et al. 2007, adapted from their Figure 6). Water levels have been controlled in Lake Ontario since approximately 1960, and as a result, it is thought that flooding pulses have been dampened (Wilcox et al. 2007). The dampening of flood pulses has contributed to colonization of non-native species in coastal wetlands, such as Hybrid Cattail (*Typha x glauca*) and European Reed (*Phragmites australis ssp. australis*) (Meyer et al. 2006). It has reduced habitat for native plant species, especially for small, annual plant species that germinate on exposed shorelines in the fall, both because there is less exposed shoreline area and because these species are poorly adapted to competition from robust emergent such as cattails. The controlled water levels have also affected habitat for marsh birds. Consistently high water levels reduce interspersion, reducing habitat for marsh obligate species, and reducing habitat for migrating shorebirds that also depend on exposed shorelines.

Figure 7. Water level fluctuations in Lake Ontario (adapted from Wilcox et al. 2007, Figure 6)



An approximate measure of the pre-regulated water level fluctuations can be obtained from **Figure 7** by counting the number of pulses that fall into roughly-estimated high, moderate and low categories. Of the 173 pulses that can be counted in this figure, approximately half are in the moderate range, identified as the range between 75.25 m and 74.5 m. Approximately 20% fall into the high category (above 75.25 m), and approximately 30% fall into the low category (below 74.5 m). Therefore, drawdowns are recommended, when feasible within the ten-year time frame for this management plan (to 2035). Prior to regulation of Lake Ontario, moderate water levels would have prevailed for most of a ten-year period, low water levels would have occurred once or twice, and high water levels would have been present in one or two years of a ten-year period. The caveat to this is that it is not known exactly how fluctuations in Lake Ontario would have related to fluctuations in Second Marsh: however, it is assumed they would have been similar, as the barrier beach did not form a complete barrier. In addition, prior to sedimentation in the 1800s as a result of land clearing, and deposition of dredgeate in Second Marsh in the 1930s, the bay encompassed a large area of open water which may have historically had little vegetation (N.S.E. 2019a). The reference condition for marsh drawdowns must therefore be drawn from other wetlands in Lake Ontario with similar hydrological characteristics.

There are additional reasons for longer-term drawdowns. It takes approximately three to five years of sustained water levels for vegetation structure to develop or respond to a particular water depth (International Joint Commission 1981). Drawdowns have increased the diversity and cover of conservative plant and animal species within Second Marsh in the past (North-South Environmental 2019a). Drawdowns favour the interspersion of vegetation that is optimum for marsh-obligate species: approximately 60% vegetation and 40% open water. Drawdowns also improve water quality.

High water levels were the least common phenomenon in lake fluctuations prior to 1960: they would have naturally occurred in one or two of the ten years within the time frame of the management plan. It is likely that water levels will continue to be higher than is desired in many years, especially as extreme rain events are predicted to become more common because of climate change (Environmental Law and Policy Centre 2019). However, high water levels, in conjunction with other control methods, may also benefit control of non-native invasive species, especially European Reed.

The logistics and difficulty of funding water level management will likely dictate when drawdowns and flooding occur to a large extent. Water levels can be very difficult to manage, as the marsh floods extensively during extreme rain events and pumps cannot handle the excess water. There is also a high cost to drawdowns, which requires significant planning to obtain funds and resources.

Water Quality

Land use practices associated with both the rural and the rapidly expanding urban portions of the upstream watershed have exacerbated soil erosion and resulted in excessive sediments suspended in the watershed inflow to the marsh. The resulting poor water quality has limited the recovery of the submergent vegetation communities that were once lush and quite productive. In addition, large numbers of Common Carp have had a significant negative impact on the already fragile wetland ecosystem in the marsh. In addition to the rooting and feeding activities on any established plant material, the carp assist with the re-suspension of silt and clay sediments. Both of these impacts combine to further reduce the potential of the wetland habitat to recover.

Table 8 provides an overview of objectives, strategies, actions, responsibilities, priorities and timelines related to hydrology and water quality.

Table 8. Key Management Priority: Hydrology and Water Quality

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Re-introduce fluctuations in water level to mimic a natural disturbance regime	Manage water levels through periodic drawdowns.	Determine conditions (e.g. low water levels in Lake Ontario) that will trigger a marsh drawdown and determine funding sources and staff resources necessary for drawdowns. Manage water levels within Second Marsh as permitted by the water levels in Lake Ontario and according to a schedule that mimics "natural" water level fluctuation in Lake Ontario as much as is feasible.	Ducks Unlimited	High	Short-term and long-term
Improve water quality in the Marsh	Maintain fish barrier to prevent carp from entering the marsh and disturbing the sediment.	Maintain proper functioning of the fish barrier.	Ducks Unlimited	High	Short-term and long-term
Improve water quality in the Marsh.	Promote watershed best management practices and the recommendations of the C.L.O.C.A. Black Harmony Farewell Watershed Plan.	Ensure upstream changes in land use do not exacerbate impacts to water quality in Farewell Creek. Ensure road maintenance, including use of road salt in winter, follows best management practices to reduce impacts to water quality. Improve upstream storm water management systems and increase riparian vegetation along upstream reaches of Farewell Creek. Encourage best management practices on farmland to reduce runoff of sediment into watercourses within the Farewell Creek watershed. Educate adjacent landowners about land management practices that could impact water quality (e.g., use of fertilizers).	City of Oshawa, C.L.O.C.A. Friends of Second Marsh contribute to stewardship of the watershed.	High	Short-term and long-term

3.5.3. Community Education, Awareness and Stewardship

Education and outreach have been an important part of public use of Second Marsh since 1972: Since the formation of the Friends of Second Marsh (formerly the Second Marsh Defense Fund). Outreach and education programs have been staged at McLaughlin Bay and Second Marsh. These have included the public, schools, other agencies (especially Central Lake Ontario Conservation Authority and Environment Canada) and surrounding landowners and have promoted an understanding of and an appreciation for Second Marsh.

Education and outreach will continue to be an important part of the management of the Marsh to provide information on the functions and values of the Marsh and the considerable ecosystem services it provides in terms of recreation and education.

Although sediment and contaminants from upstream sources have been prevented from entering the marsh because of the creek diversion, it is recommended that in addition liaison continue with residents and businesses within the watershed to attempt to limit contaminants from entering the creek. One of the most important ecosystem services provided by Great Lakes coastal marshes is to improve the quality of water entering the Great Lakes. This service has been effectively eliminated because of the creek diversion, making community stewardship of watershed health ever more important.

Communications strategy

Table 10 summarizes the roles and timeline for various responsibilities in regard to communication. It provides a timeline for communication updates to all stakeholders on progress of implementation and results and sets out communication roles for each partner agency. How the management process and results should be documented and how the results and lessons learned should be shared with the public shall be determined on a case-by-case basis. Communication methods may include public open houses, community events, educational programs and/or interpretive signage.

3.5.3.1. Protect wetland buffer

Surrounding land use has a high potential to affect Oshawa Second Marsh. The following are examples of potential impacts that accompany development:

- Construction impacts such as sedimentation, removal of adjacent vegetation.
- Encroachment (generally associated more with residential development than with industrial development), including land appropriation, dumping, creation of ad hoc paths and invasion by pets such as cats and dogs.

- Increase in physical edge effects such as increased artificial light, increased sunlight from removal of adjacent vegetation, drying winds and noise.
- Increase in nutrients and contaminants (especially salt) in runoff from impervious surfaces, lawns and roads.

A principal form of mitigation for impacts of surrounding land use is the implementation of buffers with natural vegetation cover that protect the natural area from impacts, as well as providing habitat that complements the natural area's functions. Under the Provincial Policy Statement (2020), the Adjacent Lands for Provincially Significant wetlands, within which development would potentially have impacts, includes a width of 120m. Management of surrounding land use may also include some form of physical barrier such as fencing. Maintaining natural buffers around Second Marsh will require community education, stewardship and cooperation from adjacent landowners and partners.

Table 9 provides an overview of objectives, strategies, actions, responsibilities, priorities and timelines related to community education, awareness and stewardship.

Table 9. Key Management Priority: Community Education, Awareness and Stewardship

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Increase stewardship and active participation in management of the Marsh	Develop partnerships with government agencies, community groups, school boards and institutions and businesses to support Marsh restoration programs, research, funding and engagement. Provide opportunities for meaningful participation by volunteers. Enlist broad community support for and participation in programs and restoration activities at the Marsh. Promote stewardship within the watershed and restore riparian habitats within urban valleylands and reduce sediment inputs from eroding stream banks and stormwater management. Promote understanding of watershed connections to the Marsh among watershed and regional residents and municipal officials.	Attract financial support from local and regional communities to promote stewardship strategies. Reach out to adjacent landowners regarding the maintenance and protection of natural buffers on adjacent lands. Formalize stewardship activities and citizen scientist programs including projects within the watershed.	Friends of Second Marsh C.L.O.C.A.	High	Short-term and long-term
Educate the broader community on the sensitivities of Second Marsh and the role everyone can play in protecting and enhancing the ecological integrity of Second Marsh.	Promote coordination of land use planning and management with adjacent landowners to encourage compatibility with Marsh restoration activities. Coordinate the development, programming and promotion of recreation/tourism activities with other facilities from Oshawa Lakeview Park to Darlington Provincial Park. Promote understanding of watershed connections to the Marsh among watershed and regional residents and municipal officials. Promote implementation of best management practices throughout the watershed.	Implement a formal “outdoor classroom” to support education programs and accommodate school groups and other gatherings; as part of the public access redevelopment capital planning.	City of Oshawa	High	Short-term
		Develop and implement a Comprehensive Education, Outreach and Stewardship Plan and provide the City with regular updates. Monitor and report on the plan. Create education and awareness campaigns. Review existing interpretive signage and update as necessary to reflect the changes including ecosystem services, invasive species management.	Friends of Second Marsh	High	Short-term and long-term

Objective	Strategies	Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
		Educate the public on best management practices implemented in the watershed and on how they can implement these practices on their properties.			
Manage Second Marsh as part of the broader watershed	Integrate management plan into Watershed planning	Implement recommendations from Watershed Management Plan; Organize stewardship activities on adjacent lands	C.L.O.C.A.	High	Long-term
Ensure adjacent lands remain naturally vegetated to continue to provide an ecological buffer to impacts from adjacent land uses.	Communicate with adjacent landowners regarding the ecological sensitivity in Second Marsh and the value of naturally vegetated adjacent lands. Ensure future development of adjacent lands adequately considers impacts to the ecology of Second Marsh. Promote good stewardship and management of adjacent lands.	Liaise with adjacent landowners to discuss the ecological sensitivity of Second Marsh. Review specific development applications to determine if potential impacts have been appropriately and correctly identified and effective mitigation proposed. Educate the public regarding the sensitivity of Second Marsh and the need to protect and enhance adjacent lands. Organize stewardship activities on adjacent lands with landowners such as planting of native vegetation or enhancement of natural vegetated areas where permitted by adjacent landowners.	Friends of Second Marsh City of Oshawa	High	Short-term and long-term

3.5.4. Public Access and Operational Maintenance

Oshawa Second Marsh provides the public with valuable opportunities to enjoy nature-based activities and recreation. However, negative impacts to this environmentally sensitive area can occur when the public accesses areas outside of the designated trail system. Examples of such impacts include:

- Off-leash dog walking resulting in disturbance to wildlife and habitats;
- Vandalism of the carp control grate at the fishway;
- Trampling of vegetation in the forest, on the beach and in the riparian area adjacent to the creek through creation of unsanctioned trails;
- Littering.

There are also conditions within and around Second Marsh that pose a concern related to user safety or comfort, including the following:

- European Fire Ants;
- Flooding and high water table;
- Dead/dying hazard trees;
- The presence of Cow Parsnip, a noxious weed; and
- Speeding vehicles on Colonel Sam Drive.

There are a number of opportunities to enhance public use while mitigating adverse effects on the Marsh environment, including the following:

- Implementation of a cohesive and coordinated interpretive signage program that serves to educate while encouraging stewardship and responsible behaviour;
- Implementation of a wayfinding signage program that orients users and promotes use of formalized trails;
- Establishment of formalized entry points/gateways into Second Marsh at appropriate locations;
- Enhancement of the formalized trail system with a focus on strengthening connections to the Waterfront Trail, discouraging public access along the top of the constructed dyke and establishing connections to key viewpoints into Second Marsh;
- Implementation of boot brushes at trailheads to minimize introduction or movement of invasive plant species;
- Implementation of a formal ‘outdoor classroom’ to support education programs and accommodate school groups and other gatherings;
- Encourage public participation in events and monitoring within the Marsh;

- Repair or replacement of existing damaged lookout structures and other constructed amenities; and,
- Enhancement of enforcement and increase of police presence to reduce the prevalence of unlawful activities.

Overall, opportunities exist to support existing uses and encourage education and stewardship while at the same time mitigating the impacts of undesirable activities and patterns of public use within Second Marsh. **Table 10** provides a summary of objectives, strategies, actions, responsibilities, priorities and timelines related to public access and operational maintenance.

3.5.4.1. Rationale for Closure of the Barrier Beach

The Barrier Beach is a highly sensitive and significant habitat. Not only is it a provincially significant vegetation community, the only area within Second Marsh providing habitat for conservative plant species of dunes and beaches, it also is used as habitat by an endangered species, Piping Plover, that nests on the beach at McLaughlin Bay. The beach and accompanying dunes are paradoxical in that they require natural disturbance to persist, such as wind, water and wave erosion and deposition, but are also sensitive to human disturbance such as trampling, which breaks down plant roots and facilitates the spread of non-native species. The beach has become narrower in some years as water levels have risen on Lake Ontario, so that impacts are concentrated on a few metres of beach. There have been visible impacts on vegetation on the beach, which has been denuded in some areas. Natural vegetation on the beach is important not only because it represents a rare vegetation community, but because it contributes to anchoring the sand on the barrier beach and maintaining a structural separation between the marsh and Lake Ontario. A break in the beach could equilibrate water levels with Lake Ontario so they could not be managed and would re-introduce Common Carp. However, stabilizing the beach with artificial methods tends to over-stabilize the sand and promote conditions that would allow non-native invasive species to dominate.

The viewing structure at the east end of the beach has been planned to limit impacts as much as possible, but at the same time allow some access to view the lake. A viewing area is a practical measure to reduce the potential for people to breach the barrier, as the desire to see the lake is likely to overcome respect for the natural heritage of the beach.

3.5.4.2. Maintain Constructed Dyke

The constructed dyke separates the creek from the marsh. It was installed to prevent contaminants and sediment from entering the marsh and to allow for drawdowns of marsh water levels to expose the seed bank, encourage wetland vegetation growth and improve diversity of wetland-dependent plant species and marsh-obligate bird species. A spillway is provided in case of very high water in Farewell Creek.

The constructed dyke also provides access to official vehicles for maintenance and monitoring.D.U.C. staff and trained project partners undertake annual inspections of the water control, management and containment infrastructure, (fish gate, pump structure and constructed dyke) to ensure structural integrity.

Table 10. Key Management Priority: Public Access and Operational Maintenance

Objective	Strategies	Action	Lead Stakeholder(s) Responsible	Priority Level (High/Low)	Timeline
Public access provided in designated areas to provide safe nature appreciation opportunities while minimizing adverse effects on the Marsh environment.	Ensure that recreational users are educated about the natural values and sensitivity of the Marsh. Provide access with appropriate controls for popular Marsh-dependent uses such as birdwatching and restrict fishing impacts by providing suitable access to appropriate fishing opportunities. Develop and implement a cohesive and coordinated interpretive signage program that serves to educate while encouraging stewardship and responsible behaviour. This could include trail specific signage regarding the sensitive nature of Second Marsh and user info (e.g., prohibit all dogs and cycling on trails). A trail barrier is proposed to be constructed at the point where the trail along Farewell Creek crosses over the constructed dyke. This barrier will direct users northward to Colonel Sam Drive. Ensure that recreational users are exposed to educational messages about the safety hazards in the Marsh (e.g., European Fire Ants, Cow Parsnip).	Secure funding for capital work including grants, donations etc. Prepare a redevelopment plan of Second Marsh which incorporates public access improvements into future Capital Project funding. Implement a cohesive and coordinated interpretive signage program that serves to educate while encouraging stewardship and responsible behaviour. .	City of Oshawa Friends of Second Marsh C.L.O.C.A.	High	Short-term
	Protect significant areas through directing users	Install fencing at key points to prevent access to sensitive areas and install signage to educate users as to why access is prohibited Implement a wayfinding signage program that orients users and promotes use of formalized trails.	City of Oshawa	High	Short-term

Objective	Strategies	Action	Lead Stakeholder(s) Responsible	Priority Level (High/Low)	Timeline
Strengthen points of entry and connections to the Waterfront Trail	Enhance formalized trail system, entry points/gateways into Second Marsh at appropriate location(s). Develop and implement wayfinding signage program that orients the user and promotes use of formalized trails. Identify suitable parking areas as on-street parking close to Waterfront Trail and formalize the parking lot by McLaughlin Bay Nature Reserve.	Prepare a redevelopment plan of Second Marsh that incorporates public access into future Capital Project funding. Enhance the formalized trail system with a focus on strengthening connections to the Waterfront Trail.	City of Oshawa	High	Short-term
Manage existing and future primary and secondary trail systems around the Marsh to provide safe and enjoyable visitor experiences while protecting adjacent natural values	Review and inspect existing trail system and assess safety risks.	Inspect built trails and structures by City of Oshawa in accordance with operating and asset management practices to determine if there is vandalism or improper use of these elements. Frequency of inspection should be in accordance with the City's park and trail standards for inspections. Incorporate trails into the City's asset inventory to be maintained and inspected in accordance with the City's operating practices and standards. Engage M.L.E.L.S. and Durham Regional Police as necessary or as part of regular inspection program. Consider additional trails in the future once hazardous conditions are no longer an issue and restoration work has been implemented. Determine the potential route for a trail north of Colonel Sam Drive. Report any issues including ad-hoc trails, signs of use, vandalism, illegal dumping, litter, etc. to the City through Service Oshawa to be addressed as appropriate.	City of Oshawa	High	Short-term

Objective	Strategies	Action	Lead Stakeholder(s) Responsible	Priority Level (High/Low)	Timeline
		Conduct user surveys to document numbers of users, type of use and general satisfaction every five years. Remove the former boardwalk through the Ghost Road Bush in winter, to avoid impacts, as it may continue to attract pedestrian traffic in spite of its derelict condition. Eliminate public access to the constructed dyke and barrier beach through construction of barriers shown in the Schematic Concept Plan for Public Access; as Barrier Beach is a provincially significant plan community and habitat for endangered species, and constructed dyke is adjacent to essential infrastructure.			
Enhance understanding of Marsh functions	Provide interpretive signage and ensure it remains legible and relevant	Establish a review and inspection program for interpretive signage to ensure they remain relevant and update or refresh accordingly.	Friends of Second Marsh	High	Short-term and long-term
Enhance the aesthetic quality of heavily used areas around the Marsh and ensure trails and infrastructure are maintained.	Repair or decommission existing damaged lookouts and seek opportunities to replace either in-situ or in alternate preferred locations. Design and construction should consider where feasible and possible: - A new on-grade trail south of Colonel Samuel Drive within a 25 m corridor with enhanced native planting and creation of pocket wetlands and other micro habitats; - Hydrologic studies to verify the flood elevation during storm events; - Fluvial geomorphological studies to characterize erosion patters and define the meander belt;	Prepare a redevelopment plan of Second Marsh which incorporates public access into future Capital Project funding. Install new trails and viewing platforms south of Colonel Sam Drive.	City of Oshawa	Low	Short-term and long-term

Objective	Strategies	Action	Lead Stakeholder(s) Responsible	Priority Level (High/Low)	Timeline
	- Monitoring of ice formations, movement and damming patterns; and, - Geotechnical investigations to determine appropriate sub-base composition to support the trail.				
Maintain the function of the constructed dyke.	Prevent access to constructed dyke. Prevent growth of trees and associated deeper root systems on the dyke. Prevent burrowing of muskrats in the dyke.	Continue to monitor the constructed dyke to ensure structural integrity through visual inspections of the dyke annually in the spring before full vegetation leaf out: • Slope Stability: inspection of upstream and downstream slopes which are subject to burrowing animals, lack of vegetation providing protection, woody vegetation (trees) whose roots may impact the dyke core, slumping, wave erosion, water level against slope and dyke and any observed seepage. • Core Structural Integrity: ensuring no major roots through core, top slumping, ruts (made by motorized vehicles) allowing water to penetrate the core. Address any deficiencies found as a result of an inspection where risk of failure is identified. Mow vegetation and complete maintenance of the constructed dyke outside of the breeding bird window and turtle nesting season to the greatest extent possible.	Ducks Unlimited	High	Short-term and long-term

4. Public Use Concept Plan

In response to public input (discussed in Section 1.4), the Schematic Concept Plan for Public Use was generated (**Figure 8**). This Concept Plan illustrates the various initiatives that are proposed to facilitate public access, and enhance appreciation of, Second Marsh. The concept ensures the continued protection of sensitive areas, like the barrier beach.

It is important to note that, subsequent to the completion of Phase 1 Community Engagement process, GM Canada announced that the McLaughlin Bay Nature Reserve lands that are located east of Second Marsh would be donated to the City of Oshawa. Subsequently the land was transferred to the City in 2023 through an agreement between the City and GM Canada which provides details on the use of the land. In response, the Concept Plan addresses both the Second Marsh study area and the McLaughlin Bay Nature Reserve lands in regard to recreation and public use.

In moving forward, it is recommended that F.S.M. undertake regular trail user study and report to the City annually on activities undertaken by F.S.M. including a list of activities and a summary of the number of participants.

Oshawa Second Marsh Management Plan

Schematic Concept Plan for Public Access

July 2019

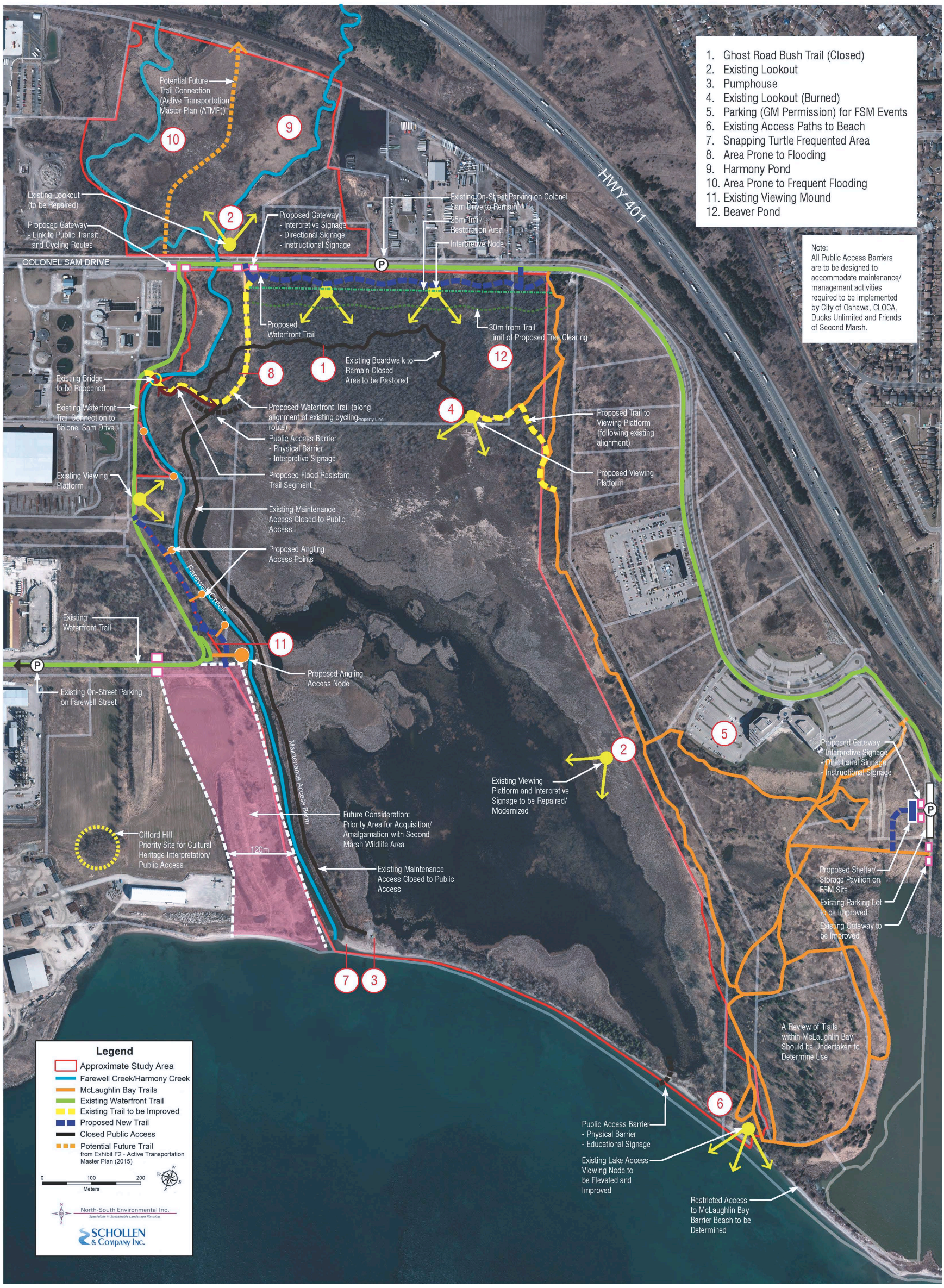


Figure 8. Public use concept plan

Key Initiatives proposed as illustrated on the Concept Plan include the following:

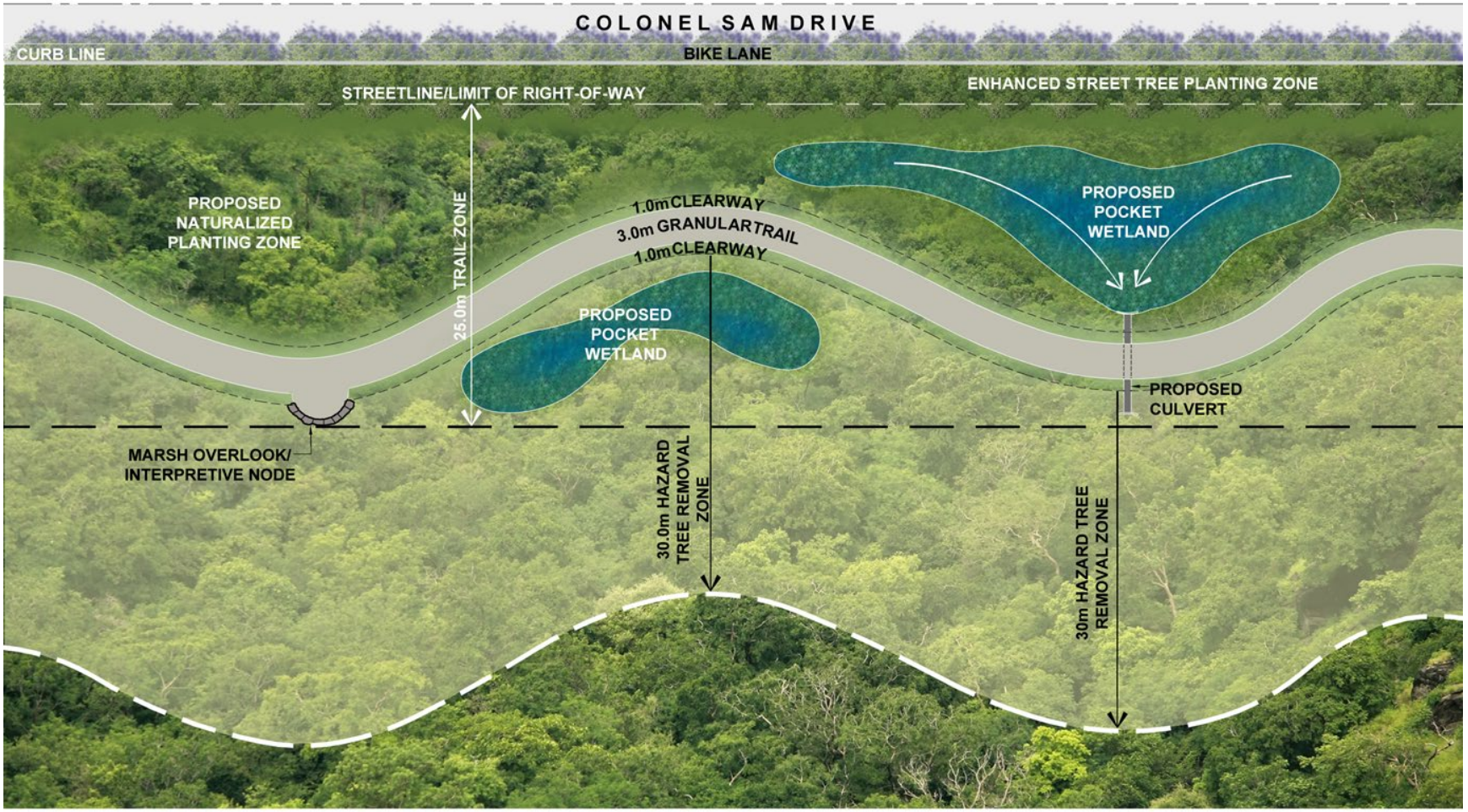
4.1. Trail System

The Ghost Road Bush boardwalk is currently routed through a swamp community dominated by dying Green Ash. To reconstruct and maintain the boardwalk, dying ash would need to be felled within approximately 30 m of the either side of the trail. The resulting impacts would include opening of the central part of the canopy, which would exacerbate the growth of Common Buckthorn in the understory. While the dying ash are likely to fall spontaneously anyway, the process would be speeded by the requirement to remove hazard trees. Dead trees will provide habitat and allow for management work to be undertaken as time and budget permit. Additional trails may be considered in the future once the hazards have been eliminated and restoration work has been well implemented. In addition, it would be preferable not to have a trail within the more sensitive areas within the Provincially Significant Wetland, as there are inevitable impacts that tend to accompany trails, such as construction impacts, off-trail impacts (such as unsanctioned trails created by some users) and indirect impacts such as off-leash dogs and littering. Trails within Second Marsh would be considered separate from the Waterfront Trail. Trail specific signage would be posted that stresses the increased sensitivity of the Second Marsh environment and, because of this sensitivity, prohibiting all dogs and cycling on trails within the Second Marsh Wildlife Area.

In response, the existing Ghost Road Bush Trail/Boardwalk is proposed to be permanently closed. Management of public access is an important strategy that is used to ensure the significant functions and values of Second Marsh are not negatively affected by human impacts. Human disturbance is an important factor in reducing the initiation of nesting and breeding success of some bird species, particularly marsh birds. Human trampling has a high potential to disturb and compact soils, leading to the death of sensitive plant species and exacerbating the invasion of non-native invasive species.

The east/west linkage access to Second Marsh will be accommodated through the creation of a new trail that is proposed to be located south of Colonel Sam Drive (**Figure 9**). This trail will be located within an area that is less prone to flooding, and where most dead trees have already been removed. The trail will be constructed on-grade to minimize the use of the boardwalk segments in order to reduce capital cost and requirements for long-term maintenance. The proposed east-west trail will be located within a 25m wide corridor that will be enhanced by native plantings and the creation of pocket wetlands and other micro-habitats.

On the west side of Second Marsh, the trail system will generally correspond with the existing Second Marsh alignment. However, the existing bridge that crosses Farewell Creek is proposed



Proposed East/West Trail Schematic Concept Plan

Figure 9. Schematic Concept Plan of Proposed Trail

to be re-opened and a new segment of trail is proposed to extend from the bridge to Colonel Sam Drive, linking to the existing maintenance access area on the south side of Colonel Sam Drive (**Figure 10** provides a conceptual illustration of this type of trail). The segment of the trail located east of the existing bridge will be subject to periodic flooding and ice impacts and therefore it will need to be constructed to withstand these conditions. A number of studies will be required to be completed to support the design of the segment of the trail including:

- Hydrologic studies to verify the flood elevation during storm events;
- Fluvial geomorphological studies to characterize erosion patters and define the meander belt;
- Monitoring of ice formations, movement and damming patterns; and,
- Geotechnical investigations to determine appropriate sub-base composition to support the trail.

Figure 10. Example of an improved trail

The trail system that presently exists on the east side of Second Marsh is proposed to be retained. An existing segment of trail is proposed to be improved to provide access to a new viewing platform in the current location of the wooden bridge. The viewing platform will provide views of the existing 'Beaver Pond' and the marsh. Trails will be constructed to be accessible to users of all abilities.

A potential future trail connection that extends northward from Colonel Sam Drive is illustrated on the Concept Plan, consistent with the City's Active Transportation Master Plan.

In order to protect existing natural features, sensitive areas such as the barrier beach and habitats of vulnerable species the following initiatives are proposed:

- The existing maintenance to the constructed dyke is proposed to be closed to public access. A trail barrier is proposed to be constructed at the point at which the trail along Farewell Creek crosses over the constructed dyke. This barrier will direct uses northward to Colonel Sam Drive. South of the barrier, the maintenance access to the constructed dyke should be allowed to naturalize. This will impede public access while still accommodating access for maintenance purposes, including access to the pump house and fish gate by authorized parties.

- The Barrier Beach will be closed to public access through the installation of barriers on the eastern and western ends of the Barrier Beach. These barriers will deter users from accessing the barrier beach from McLaughlin Bay Trails on the east side of Second Marsh.

In both cases, trail barriers will be designed to be physical deterrents while accommodating access for maintenance and monitoring by authorized persons.

These physical deterrents will be supplemented with educational signage that informs the public about the sensitivity of the environment and the need for protection from human disturbance. The barriers will need to be designed and constructed to withstand high water levels, wave uprush and ice migration inland from Lake Ontario. Their design will also need to respond to the dynamic nature of the Barrier Beach. Permits and/or approvals may be required from C.L.O.C.A., Fisheries and Oceans Canada (under the Fisheries Act) and the Ministry of Natural Recourses and Forestry (M.N.R.F.) under the Lakes and Rivers Improvement Act (and potentially the Public Lands Act) to facilitate the implementation of these proposed barriers contingent on their location and design. The placement of the viewing structure near the beach will require consultation with the Ministry of the Environment, Conservation and Parks (M.E.C.P.) to ensure compliance with the Endangered Species Act with respect to habitat for Piping Plover.

4.2. Parking

The demand for parking will be addressed through the continued provision of on-street parking on Colonel Sam Drive (illustrated conceptually on **Figure 11**), the existing on-street parking located on Farewell Street in the vicinity of the Waterfront Trail, and the formalization of an existing parking lot that is located south of the terminus of Colonel Sam Drive, in the McLaughlin Bay Nature Reserve. This improved parking area will accommodate 34 vehicles. The parking area will also accommodate bus turning areas, as buses are important to support Friends of Second Marsh education programs, should the provision of these programs increase in the future. The parking area improvements are proposed to incorporate Low Impact Development (L.I.D.) initiatives to address storm water runoff and

Figure 11. Example of improved parking area

maximize solar reflectivity to reduce the heat and drying effect of pavement, which can have impacts on adjacent natural features.

4.3. Education and Visitor Experience

A number of initiatives are proposed to capitalize upon opportunities for public education and appreciation of Second Marsh including the following:

- The installation of two new viewing platforms (illustrated conceptually in **Figure 12**), one at the shore of Lake Ontario at the eastern end of the Barrier Beach, and one in the vicinity of the 'Beaver Pond' at the location of the existing bridge structure over the pond in the northeast section of Second Marsh. The implementation of this new structure will entail the removal of the existing structure. The proposed new structure will provide views of the open water habitat within the marsh and will afford the experience of being immersed in the marsh environment.
- Repair or improvements to existing viewing platforms.
- The creation of new angling access points along the west side of Farewell Creek (illustrated conceptually in **Figure 13**) that will direct anglers

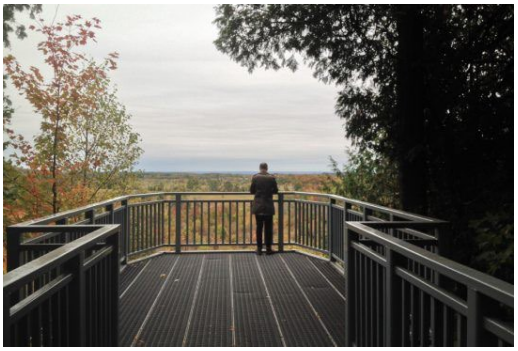


Figure 12. Example of viewing platform

Figure 13. Example of a designated angler access point

away from the constructed dyke and deter trampling of vegetation on the east side of Farewell Creek.

- Installation of interpretive signage at key strategic locations along trails and at viewpoints (illustrated conceptually in **Figure 14**).
- The exploration of technologies that will allow visitors to source information remotely using smart phone technology and cameras installed to permit wildlife observation remotely.
- The implementation of a combination shelter/storage facility within the Friends of the Second Marsh land parcel within the McLaughlin Bay Natural Reserve. This facility will accommodate the staging of educational programs and the storage of equipment to support education and stewardship initiatives and programs.
- The establishment of new "gateways" at the key points of entry into the Wildlife Area including the entrance from Farewell Street, the entrance from Colonel Sam Drive and the entrances on the east side of the Marsh at the parking lot and proposed Friends of Second Marsh education facility. Gateways should be consistent in terms of design, character and signage.

Figure 14. Examples of educational and interpretive signage at key locations.

In addition to the interpretive signage, a program of signage is proposed that will direct appropriate use and promote protection of the environment. These signs will clearly emphasize that certain activities are permitted, as well as those that are not permitted, to enable education and enforcement.

All the amenities that are proposed to be implemented as described above should be designed and constructed to resist vandalism and require a minimum of maintenance to remain sustainable and resilient over-time in recognition of the potential impacts of environmental conditions. Designs should incorporate habitat enhancement and L.I.D. initiatives where feasible to enhance the Second Marsh environment.

5. Recommended Implementation Priorities

A detailed implementation plan is beyond the scope of this report and should be determined based on available resources and funding; however, this section summarizes at a high level

some of the recommended priorities for implementation of the actions described in Section 3.5. The table of goals, strategies and objectives (**Table 5)** provides a time frame for the accomplishment of each goal and objective within each Management Zone. **Table 11** provides an overview and recommended timelines for implementation for each of the strategies / management actions.

Table 11. Timeframe of Recommended Management Actions

Management Actions	Description	Timeframe	
		Immediate (2-5 Years)	Future (5-10 Years)
Draw down water levels proactively, to increase biodiversity and water quality prior to observing declines	Depending on funding and feasibility, periodically reducing water levels in Second Marsh (when permitted by water levels in Lake Ontario) to achieve ratio of 60% emergent vegetation, 40% open water approximately every 15-20 years	X	X
Remove existing boardwalk	Removal of the former boardwalk through the Ghost Road Bush in winter to avoid impacts to vegetation and soils, or at least remove the visible portions connecting to main trails, as it may continue to attract pedestrian traffic and pose a hazard in spite of its derelict condition;	X	
Install barrier to block access to the beach and install signage to inform the public of rationale	Eliminate public access to the constructed dyke and barrier beach through construction of barriers shown in the Schematic Concept Plan for Public Access;	X	
Remove hazard trees in the Ghost Road Bush according to Forest Management Plan (in areas of planned infrastructure only)	Implementation of the initial phase of the Forest Management Plan;	X	
Implement restoration planting in Ghost Road	Implementation of the initial phase of the Invasive Species Management Plan and Forest Management Plan;	X	

Management Actions	Description	Timeframe	
		Immediate (2-5 Years)	Future (5-10 Years)
Bush according to Forest Management Plan			
Implement remaining Schematic Concept Plan: waterfront trail link, additional trails and viewing platforms	Installation of new trails (immediate) and viewing platforms (future).	X	X
Implement Invasive Species Management Plan for management units 1, 2, and 5	Implementation of the initial phase of the Invasive Species Management Plan	X	
Implement Management Plans for management units 3, 4, and 6	Implementation of the other phases of the Invasive Species Management Plan and Forest Management Plan.		X
Investigate need and feasibility of modifying bathymetry of areas of the marsh to provide refuges for fish and overwintering sites for turtles			X
Determine potential route/linkage for a trail north of Colonel Sam Dr.	In accordance with the recommendations of the Active Transportation Master Plan.		X
Monitor Ecological Parameters		X	X

5.1. Opportunities and Needs for Partnerships

Maintaining previous partnerships is critical for management of Oshawa Second Marsh. Partners such as Friends of Second Marsh, C.L.O.C.A., Ducks Unlimited Canada, and neighbouring landowners such as GM have been critical in managing Second Marsh, especially in conveying knowledge of Marsh functions and values, understanding of the value of ecosystem services to the public, managing adjacent lands and providing funding and maintenance for the construction of trails, constructed dyke and fish gate.

Identifying potential new partnerships will be important to ensure a continued ability to implement management recommendations. These could include the following:

- Commemorative tree and bench program for sponsorship;
- Collaboration with colleges, universities and other educational institutions to undertake research and seek funding for continued management of the Marsh;
- Contact with new landowners in the vicinity of Second Marsh to assist with management of adjacent lands.

5.2. Management Strategy Analysis and Adaptation

The current management plan proposes management for the next decade; until 2035. There are many uncertainties regarding future management of Second Marsh, including magnitude and character of changes in vegetation and wildlife due to climate change, the decline in insects and bird populations, Great Lakes water levels, and new invasive pests and diseases. Continued analysis of the monitoring data, as well as review of broader trends reported in the literature, will help document and compare the local trends within Second Marsh to further an understanding of regional trends in the Great Lakes Basin.

Review of the current management strategies is recommended to commence in the two years prior to the expiration of the current management plan in 2035, with preparation of a formal revised management plan in the two years following 2035, when some of these uncertainties may have begun to be resolved.

Continuing analysis of the trends seen in annual monitoring data should also be conducted yearly, in order to detect issues early and initiate a response to problems as soon as they arise.

Other analyses and reporting of trends, conducted at time intervals described in **Table 12**, should be conducted in each year the monitoring is conducted.

5.3. Review and Amendment Process

The time frame suggested for the life span of the current management plan is 12 years. During this period, monitoring should be assessed and if the objectives are not met, the Management Committee should discuss potential reasons not meeting objectives, and determine if management objectives should be reviewed and revised.

6. Monitoring Plan

The need to continue monitoring in Oshawa Second Marsh is reiterated throughout the 1999 monitoring strategy and continues to be a priority in the present. Ongoing monitoring and monitoring needs are summarized in the background report and in **Table 12** of this report.

It is recommended that the current monitoring of biological attributes be continued by C.L.O.C.A., and that monitoring should be expanded where noted in the following sections by C.L.O.C.A. pending funding and resources.. Monitoring results should be analyzed by C.L.O.C.A., and an action plan developed in response to monitoring results. Monitoring will also be used to determine success of restoration where appropriate.

Table 12 includes recommendations for monitoring actions within each Management Zone, with recommended monitoring actions, identification of stakeholder responsible for monitoring, the priority level, and timeline of short-term (0-5 years) and long-term (6-10 years) from the commencement of the management plan.

Table 12. Environmental Monitoring

Management Zone	Monitoring Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Marsh	Continue to monitor the following parameters: • Water quality - Turbidity, pH, Conductivity, Total Phosphorus, Dissolved Oxygen • Wetland Hydrology – water levels • Breeding bird community - Bird I.B.I., Community Composition, breeding bird status • Amphibian Community – Amphibian I.B.I., species richness • Fish Community – Fish I.B.I., Community Composition • Macroinvertebrate Community – Macroinvertebrate I.B.I., Community Composition • Submerged Aquatic Community – S.A.V. I.B.I., Community Composition, interspersion Recommended Future Monitoring: • Percent emergent Vegetation • Migratory Waterfowl Community – abundance and diversity • Migrating shorebirds – abundance and diversity • Waterfowl nesting – number and diversity of nests • Muskrat population – number of mounds • Overwintering and nesting turtles – abundance and diversity • Migratory landbird community – abundance and diversity • Invasive *Phragmites* – percent cover	C.L.O.C.A.	High	Short-term and long-term
Swamp / Marsh-Swamp Ecotone	Add new monitoring stations to the monitoring program within the Ghost Road Bush. Continue to monitor the following parameters: • Vegetation (species richness, invasive species) • Breeding birds (I.B.I.) • Amphibian – marsh monitoring protocol (I.B.I.) • Ecological restoration efforts	C.L.O.C.A.	High	Short-term and long-term
Riparian / Riparian Forest and Meadow	Continue to monitor the following parameters: • Vegetation (species richness, invasive species) • Breeding birds (I.B.I.) • Amphibian – marsh monitoring protocol (I.B.I.) • Bank and stream erosion • Public access and use (e.g., ad hoc trails, camp spots, other disturbance)	C.L.O.C.A.	High	Short-term and long-term

Management Zone	Monitoring Action	Lead Stakeholder Responsible	Priority Level (High/Low)	Timeline
Barrier Beach	Monitor the following parameters: • Vegetation (species richness, invasive species) • Breeding birds (I.B.I.) • Public access and use	C.L.O.C.A.	High	Short-term and long-term
Constructed Dyke (Berm)	Continue to monitor the following parameters: • Integrity and condition of constructed dyke. • Condition and effectiveness of barrier (fence) to access dyke.	Ducks Unlimited	High	Short-term and long-term
Adjacent Lands	Periodic review of aerial photos to determine if there are adjacent land uses that are resulting in reduced natural cover adjacent to Second Marsh.	C.L.O.C.A.	High	Long-term

6.1. Effectiveness Monitoring

Monitoring should include monitoring for effectiveness of actions at achieving the goals and objectives of the management plan. Effectiveness monitoring currently conducted is described in **Table 13**. All aspects of monitoring of Second Marsh's ecological integrity that are currently undertaken should continue to be monitored. Additional monitoring recommendations (which will depend on logistics and funding) are also summarized in **Table 13**.

Table 13. Effectiveness monitoring at Second Marsh, with recommended additional monitoring

Attribute	Recommended Monitoring Methods	Frequency	Stakeholder(s) Responsible
Water quality (physical parameters)	• Continue current methods (D.R.C.W.M.P. 2014)	Once per year	C.L.O.C.A.
Water Level	• Continue current methods (D.R.C.W.M.P. 2014) • Map bathymetry of marsh according to accepted research protocols • Continue to monitor areas of potential sedimentation to determine whether removal of sediment would be effective.	To be determined by bathymetry study	C.L.O.C.A.
Submerged Aquatic Vegetation	• Continue current methods (D.R.C.W.M.P. 2014) • Continue to monitor I.B.I.	Following current schedule	C.L.O.C.A.
Amphibians	• Continue M.M.P. at sites established by C.L.O.C.A. • Reinstate monitoring stations (from 2010 monitoring report) north of Colonel Sam Drive and, when and where hazards can be managed. In the Ghost Road Bush	Three times per year per M.M.P. protocols	C.L.O.C.A.

Attribute	Recommended Monitoring Methods	Frequency	Stakeholder(s) Responsible
Breeding Birds	• Continue current methods (D.R.C.W.M.P. 2014) • Continue M.M.P. at the stations established by C.L.O.C.A. • Reinstate monitoring stations north of Colonel Sam Drive and, when and where hazards can be managed in the Ghost Road Bush	Twice per year per M.M.P. and Forest Bird Monitoring Program protocols	C.L.O.C.A. Ducks Unlimited
Emergent Vegetation	• Establish monitoring of interspersion through drone/U.A.V. photography	Once per year (summer)	C.L.O.C.A.
Breeding Waterfowl and/or Muskrat	• Establish monitoring of suspected nest sites through drone/U.A.V. photography • Report number of nests using “nest site” algorithm used in current report	Once per five years (summer)	Ducks Unlimited

Attribute	Recommended Monitoring Methods	Frequency	Stakeholder(s) Responsible
Migrating Waterfowl	• Commence waterfowl monitoring in spring and fall during high water events to determine waterfowl abundance and use of Second Marsh • Determine areas of concentration • Investigate whether monitoring could be conducted effectively by volunteers	Twice per year (spring and fall) Investigate feasibility of more frequent monitoring through volunteers, if protocols and expertise can be standardized	Ducks Unlimited
Migrating Shorebirds	• Conduct shorebird surveys in spring and fall during low water events to determine shorebird abundance and use of Second Marsh, • Determine areas of concentrations • Investigate whether monitoring could be conducted by volunteers	Twice per year (spring and fall) Investigate feasibility of more frequent monitoring through volunteers, if protocols and expertise can be standardized	C.L.O.C.A. Ducks Unlimited
Phragmites	• Instate monitoring through drone/U.A.V. photography • Map areas of Phragmites • Report to City	Once per three years UAV results should be used to determine direction with future UAV work	C.L.O.C.A.

6.2. Citizen Science (Informal Monitoring)

Informal monitoring using citizen science platforms can contribute to monitoring data and reduce monitoring costs. Informal monitoring differs from public events and outreach as it is community/volunteer led. However, once informal monitoring programs are established, public events and outreach may be used to increase public knowledge of and encourage participation in informal monitoring programs.

The involvement of the public in documenting and observing wildlife should be explored, but limitations of this type of monitoring should be taken into account and protocols (e.g., Birds Canada Marsh Monitoring, Forest Bird Monitoring, Ontario Breeding Bird Atlas) established early. Friends of Second Marsh and other agencies involved with the Marsh should continue to participate in and encourage discussions leading to a coordinated approach to wetland monitoring. Utilizing social media and apps to document observations is a tool that could contribute to knowledge and understanding. eBird data is accessed by many naturalists in the area to observe shorebirds, waterfowl and landbirds: Oshawa Second Marsh is considered an eBird “hotspot”. Naturalists also submit records of species within Second Marsh through iNaturalist.

However, monitoring as currently conducted through eBird would not meet the standards established by previous monitoring. Generally, monitoring through eBird does not have standardized protocols, and the difference in effort, timing, and seasonal visits between observers gives rise to differences in results that would likely not be able to be definitively ascribed to trends in populations as a result of habitat changes. Expertise varies among individuals. In addition, observers appear to record observations within a study radius that incorporates areas beyond Second Marsh. However, many highly qualified naturalists provide observations to eBird and iNaturalist, and these sites may help to foster a sense of community and stewardship among naturalists. There are bird monitoring programs that use eBird for submitting and sharing results, such as the Important Bird and Biodiversity Area counts (Bird Studies Canada 2019). Opportunities should be explored for using this technology, with the intent that effort, season, time, spatial extent and expertise could be standardized for monitoring purposes, and that protocols would be established for protecting Species at Risk records. Special access could be granted for birders who were willing to apply protocols for access and information gathering. For example, the City could consider giving out permits to professional birders or photographers who meet established criteria to allow them to access wider areas of the Marsh for monitoring; similar to permits issued to birders by the Region of Durham for access to the Scugog Sewage Lagoons in Port Perry.

6.3. Roles and Responsibilities to Coordinate Monitoring

Effective implementation of the monitoring plan requires clear and coordinate communication with participating stakeholders. **Table 14**. proposes roles and responsibilities for communication and coordination of monitoring in Oshawa Second Marsh with guidance for timing of communication between various stakeholders.

Table 14. Roles and responsibilities for Oshawa Second Marsh monitoring process

Stakeholder	Role	Timeline
City of Oshawa	• Seeks funding as needed. • Allows access onto City property for the purposes of managing the marsh • Conducts regular park and trail inspections in accordance with the City's quality standards. • Communicates with public where required	• Annual discussion of monitoring with C.L.O.C.A. and Friends of Second Marsh; prior to monitoring season • Communication with public when required
C.L.O.C.A.	• Seeks funding and grants if required. • Conducts effectiveness monitoring and updates Stakeholders as needed. • Provides permanent repository for all monitoring data • Communicates results of effectiveness monitoring to City and OSM Management Committee when necessary. • Provides analysis of trends noted through effectiveness monitoring and communicates them to City • Provides expertise to support management initiatives • Provides incidental reports on compliance issues to City if observed during visits	• Results of monitoring to be submitted to City and members of the Management Committee as necessary to ensure proper management of the marsh • Compliance issues to be reported as soon as noted

Stakeholder	Role	Timeline
Ducks Unlimited	• Conducts monitoring of the infrastructure used to draw down water levels (constructed dykes, pumps)	• Results of monitoring to be submitted to the City and F.S.M. in the event of infrastructure problems
Friends of Second Marsh	• reports issues to the City	• ongoing
Public	• Provides additional informal monitoring through eBird and iNaturalist, following development of protocols for monitoring • provides input on compliance monitoring to the City	• ongoing

7. References

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APPENDIX 1 | 2018 Surveys and Analysis

1. Current Attributes and Functional Relationships of the Marsh

Current conditions were investigated through field visits in the study area in 2018, including vegetation inventories to document invasive species, identify the location of rare or uncommon species and update Ecological Land Classification. In addition, a review of monitoring and inventory work undertaken since 1999 was undertaken to evaluate the ecological function of the Marsh. The following sections describe the methods and results of studies that were completed in 2018. Some additional background information is reviewed to provide an ecological context for the past and present management plan, and to enable the management plan to be read largely as a stand-alone report. However, detailed background information is provided in the Background Report (N.S.E. 2019a) and that report should be consulted for detail.

Scientific names are provided after common names for the first mention of plant species within the text, as common names have not been standardized for these taxa (and some species do not have common names). Scientific names are not provided within the text for vertebrate animals as common names are standardized and well-known for these groups. However, scientific names for all species mentioned are provided in the Background Report.

2. Methods for Ecological Studies and Monitoring in 2018

Five visits were conducted to document vegetation at Second Marsh over the course of 2018 (**Table A1)**. One of the objectives of the field work was to refine the Ecological Land Classification (E.L.C.) mapping previously delineated by C.L.O.C.A. in 2004 on the most recent aerial photography (2015) and informed by Unmanned Aerial Vehicle (U.A.V.) imagery obtained within the study area (as described in the Invasive Species Management Plan for Second Marsh: N.S.E. 2019b). Invasive species locations and populations were also document in addition to significant species, focusing on the habitats where significant species were noted in the past.

A list of species was obtained in each vegetation community, as well as information on each layer (canopy, sub-canopy shrub layer and ground layer) gathered in accordance with modified protocols for Ecological Land Classification (E.L.C.) provided in 1998 (Lee et al. 1998). The E.L.C. surveys were scoped to focus on obtaining an overview of dominant vegetation within each community, as vegetation communities had previously been delineated in detail within the study area in 2004 and the focus of the surveys was to update the E.L.C. previously undertaken. In addition, two locations were assessed with a Dutch auger within the swamp south of Colonel Sam Drive in order to confirm soil type and water level depths that would inform potential management options (e.g., active restoration through underplanting in Ghost Road Bush).

Table A1. Field visits conducted in 2018 to document vegetation within the study area

Date	Primary Focus	Incidental Information
20 May	S.W.D. community south of Colonel Sam Drive	Evidence of breeding birds
12 July	S.W.D. communities north of Colonel Sam Drive and main S.W.D. south of road	Evidence of breeding birds
20 July	Communities south of Colonel Sam Drive	Evidence of breeding birds
24 August	Aquatic communities	
2 September	Coastal Meadow Marsh community (M.A.M.4)	

During vegetation surveys, evidence of breeding for birds was obtained where possible, as the visits were within the timing window when birds were nesting. However, it should be emphasized that these surveys were not focused on breeding birds so were not within the timing windows most appropriate for breeding bird surveys, and absence of observations does not represent absence of species. While the weather conditions were appropriate for bird surveys, surveys were conducted relatively early and late in the breeding season (20th May and 12th July) and were not conducted exclusively in the early morning (though the vegetation surveys began at 0700).

2.1. Unmanned Aerial Vehicle Methods

Methods for surveys using a U.A.V. are described in Appendix B of the Invasive Species Management Plan. In brief, the U.A.V. was flown over Second Marsh on July 11th and August 3rd, 2018. Multiple images were acquired (over 700 on the first visit and over 1700 on the second visit) at a resolution of between 3.94 cm and 2.68 cm for the two visits, respectively. The images were stitched together to create the composite aerial photos provided in Section 3.1 (**Figure A1**).

An algorithm was used to identify areas that were potentially nesting sites for ducks or mounds for Muskrat. Each location identified by the algorithm was visually inspected to see if objects could be discerned based on the resolution of the imagery, and put into one of three classifications: possible duck nest, open space and possible Muskrat mounds. Possible duck nest sites had silhouettes of ‘football’ shaped objects which were identified as possible ducks. The Open Spaces were areas were the vegetation was compacted and disturbed, which appeared to be bare soil/ground. The Unknown areas were areas that could not be classified.

3. Summary of Results

The following sections summarizes the findings of ecological studies conducted since the Background Report (N.S.E. 2019a).

3.1. Vegetation Communities

Vegetation community mapping (i.e., Ecological Land Classification or E.L.C.) was refined based on 2018 field investigations as shown in **Figure A1**. Areal coverage for each community is listed in **Table A2**. Shallow marsh comprises just over half of the area of Second Marsh, with deciduous swamp as another important component (approximately 23%). **Table A3** provides a list of vegetation communities within the marsh, with a summary of the species in each of the layers: canopy, sub-canopy, shrub and ground. Emergent vegetation comprised 84% of the open wetland component of Second Marsh by mid-summer (July). Open water was more prevalent earlier in the year.

The vegetation in the Ghost Road Bush (deciduous swamp community) has changed because of the impacts of Emerald Ash Borer on the formerly dominant Green Ash (Fraxinus pennsylvanica). Very large, almost dead Green Ash provide little shade. As a result, invasive species (primarily Manitoba Maple and Common Buckthorn) are dominant in the canopy and high sub-canopy and shrub layer. However, shade from these layers create a relatively shaded ground layer, dominated in most places by native species. In addition, extensive suckering around the base of moribund ash also creates shade. Small and large depressions (shown in **Figure A2 in Section 3.2.1**) foster diversity: they create habitat for both native and non-native wetland and transitional species, such as Forget-me-not (*Myosotis* spp.). Larger depressions are dominated by sedges such as Lakebank Sedge (*Carex lacustris*).

Additional flora diversity was noted at the south end of the swamp community, where higher water levels maintained a more open community with fewer trees and shrubs. This community is likely transitional in nature and the extent of shrubs likely fluctuates with changes in water levels. Shallow Marsh and Meadow Marsh diversity was also concentrated in transitional areas. The highest diversity was often noted where the edge of these communities met areas of deeper water.

Table A2. Areal coverage of vegetation ecosites at Oshawa Second Marsh in 2018

Ecosite	Area (Ha)	Percent Total Area
Beach	3.39	2.50
Cultural	6.59	4.87
Forest	0.09	0.07
Meadow Marsh	8.92	6.58

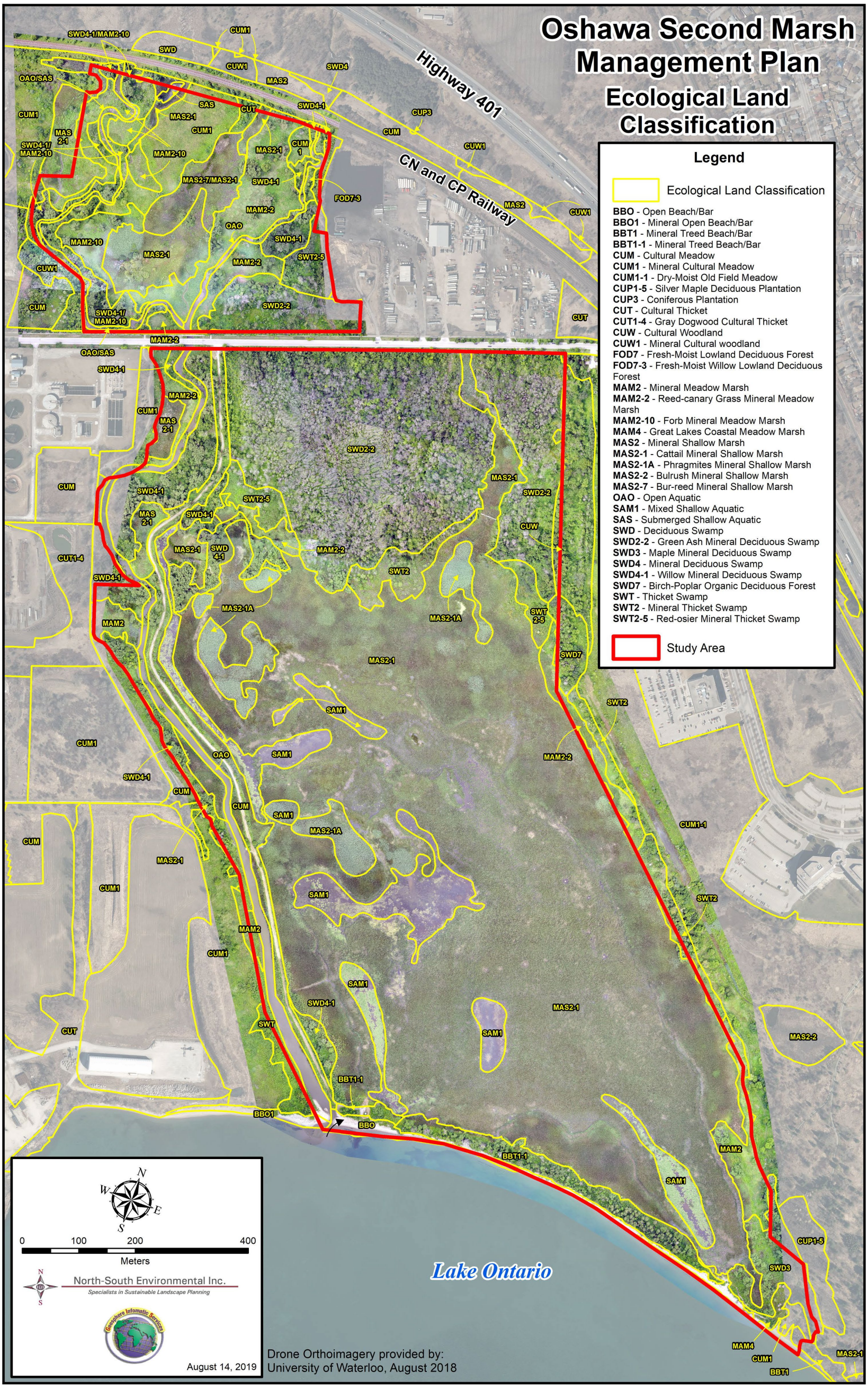
Ecosite	Area (Ha)	Percent Total Area
Cattail Shallow Marsh	69.01	50.94
Phragmites Shallow Marsh	2.75	2.03
Open Water	2.72	2.00
Aquatic	7.64	5.64
Deciduous Swamp	30.82	22.75
Thicket Swamp	3.55	2.62

Table A3. Vegetation community descriptions of ecosites within Oshawa Second Marsh

Code	Vegetation Ecosite	Vegetation Description	Additional remarks
B.B.O.	Open beach/bar	Open sand with occasional scattered Sea-rocket (*Cakile edentula*) and Seaside Spurge (*Euphorbia polygonifolia*)	Evidence of trampling in this community
B.B.S.	Shrubby beach/bar	Dominated by Cottony Willow (*Salix eriocephala*), Sandbar Willow (*S. exigua*), with seedlings of Cottonwood (*Populus deltoides*); ground layer mainly consists of Silverweed (*Potentilla argentea*)	
B.B.T.	Treed Beach/Bar	Dominated by Manitoba Maple, Common Buckthorn, Starry False-Solomon's Seal (Maianthemum stellatum)	Occurs along the upland edge of the beach
C.U.M.1	Cultural Meadow	Dominated by Canada Goldenrod (*Solidago canadensis*) and Smooth Brome (*Bromus inermis*, with Smooth Bedstraw (*Galium album*) and abundant Field Bindweed (*Convolvulus sepium*), with a dense ground mat of Kentucky Bluegrass (*Poa pratensis*)	Many non-native species in this community as is usual for cultural meadows in Ontario
C.U.T.1	Cultural Thicket	Dominated by Domestic Apple (*Malus pumila*) and hawthorns (*Crataegus* spp.) with a ground layer similar to Cultural Meadow	
C.U.T.1-4	Gray Dogwood Cultural Thicket	Dominated by dense Gray Dogwood; very sparse understory and ground layer	
F.O.D.7-3	Fresh-Moist Willow Lowland Forest	Dominated by Hybrid Willow (*Salix* x *fragilis*) and Manitoba Maple (*Acer negundo*), with sub-canopy dominated by Manitoba Maple and sparse shrub layer; ground layer dominated by Dame's Rocket (*Hesperis matronalis*) and Smooth Brome	Abundant large downed woody debris in this community
M.A.M.2	Graminoid Mineral Marsh	Dominated by Flowering Rush (*Butomus umbellatus*) and Barnyard Grass (*Echinocloa muricata*), with other scattered graminoids	This community occurs locally where the barrier beach meets areas of open aquatic marsh. Areas of bare sand within this community
M.A.M. 2-2	Reed Canary-grass Mineral Meadow Marsh	Dominated by Reed Canary-grass with occasional Lance-leaved Aster (*Symphyotrichum lanceolatum*), Canada and Tall goldenrods (*Solidago canadense* and *S. altissima*) and Grass-leaved Goldenrod (*Euthamia graminifolia*)	Little diversity in this community; large areas north of Colonel Sam Drive, with small patches among cattails to the south
M.A.M.2-10	Forb Mineral Meadow Marsh	Dominated by Lance-leaved Aster (*Symphyotrichum lanceolatum*) and Jewelweed (*Impatiens capensis*), with a large variety of other species such as Himalayan Balsam (*Impatiens glandulifera*), Wild Parsnip (*Pastinaca sativa*), Spotted Water-hemlock (*Cicuta maculata*) and Bittersweet Nightshade	Almost no areas of standing water in this community
M.A.M.4	Coastal Meadow-Marsh	Dominated by Canada Bluejoint (*Calamagrostis canadensis*) and Baltic Rush (*Juncus balticus*), with abundant Tall Anemone (*Anemone virginiana*), scattered Sandbar Willow and Red-osier Dogwood; regionally rare species included Slender-leaved False-foxglove (*Agalinis tenuifolia*) and Andrews' Closed Gentian (*Gentianopsis andrewsii*).	Community considered provincially rare; threatened by Red-osier Dogwood at the edge
M.A.S.2-1	Mineral Cattail Shallow Marsh	Dominated by a mixture of cattails: Wide-leaved Cattail (*Typha latifolia*), Narrow-leaved Cattail (*T. angustifolia*) and the hybrid between them (*T*. x. *glauca*), in places with Reed Canary-grass (*Phalaris arundinacea*) and European Reed (*Phragmites australis*), with scattered species under the cattail such as Purple Loosestrife (*Lythrum salicaria*), Canada Bluejoint (Calamagrostis canadensis), Soft Rush (*Schoenoplectus tabernaemontani*) and Lakebank Sedge (*Carex lacustris*), and Bittersweet Nightshade (*Solanum dulcamara*)	Some areas of bare soils under the cattail; soils soft with deep silt north of Colonel Sam Drive
M.A.S.2-1A	Mineral Phragmites Shallow Marsh	Dominated by European Reed with a very sparse understory consisting mainly of Bittersweet Nightshade	Some portions of this community with patches of standing water
M.A.S.2-2	Bulrush Mineral Shallow Marsh	Community reportedly dominated by Common Three-square Bulrush (*Schoenoplectus pungens*)	Previously mapped
M.A.S.2-7	Bur-reed Mineral Shallow Marsh	Community reportedly dominated by Broad-fruited Bur-reed (*Sparganium eurycarpum*)	Previously mapped; not seen during surveys, possibly because it occurs in areas that were inaccessible at the time of the survey

Code	Vegetation Ecosite	Vegetation Description	Additional remarks
S.A.M.1	Mixed Aquatic	Mainly dominated by White water lily (*Nymphaea odorata*) with only a few areas of Variegated Pond-Lily (*Nuphar variegata*) on the surface, with Coontail (*Ceratophyllum demersum*) and Sago Pondweed (*Stuckenia pectinata*) below the surface; some areas with abundant native and non-native Water-milfoil (*Myriophyllum sibiricum, M. spicatum*, and the hybrid between them), waterweeds (*Elodea* spp.) and Common Bladderwort (*Utricularia vulgaris*)	
S.A.S.	Submerged Shallow Aquatic	Dominated by Sago Pondweed and water-milfoils, similar to SAM1 above	
S.W.D.3	Maple Mineral Deciduous Swamp	Small community similar to SWD 4 but dominated by Swamp Maple (*Acer freemannii*)	Previously mapped
S.W..D4	Green Ash Swamp	Dominated by a tall canopy of dead and dying Green Ash (*Fraxinus pennsylvanica*), with a lesser abundance of Hybrid Willow and colonies of Trembling Aspen (*Populus tremuloides*); sub-canopy is mainly dominated by Manitoba Maple, mature Common Buckthorn; shrub layer dominated by Red-osier Dogwood, Common Buckthorn and re-sprouting Green Ash; ground layer dominated by Fringed Loosestrife (*Lysimachia ciliata*), native Stinging Nettle (*Urtica dioica* ssp. *gracilis*) and Wood Nettle (*Laportea canadensis*), with Forget-me-not (*Myosotis scorpioides*) dominating in vernal pools. Hummocks and low ridges are inhabited by forest upland species such as May-apple (*Podophyllum peltatum*), Peduncled Sedge (*Carex pedunculata*) and trilliums (*Trillium* spp.).	Very abundant woody debris of a variety of sizes on the ground from cut ash (especially adjacent to roads and constructed dykes) as well as naturally fallen ash; many shallow vernal pools Ground layer is relatively diverse and dominated largely by native species despite the predominance of buckthorn
S.W.D.4-1	Willow Mineral Deciduous Swamp	Community dominated by Hybrid Willow and Manitoba Maple; with an open canopy and sub-canopy composed of Red-osier Dogwood, ground layer dominated by Jewelweed and Bittersweet Nightshade	
S.W.T.2	Thicket Swamp	An open canopy of Green Ash and Manitoba Maple, community dominated by a sub-canopy of dense Red-osier Dogwood and Cottony Willow and a ground layer of Jewelweed and Fringed Loosestrife	

Figure A1. Vegetation Communities at Oshawa Second Marsh



3.1.1. Provincially Rare Vegetation Communities

Two provincially significant vegetation communities occur within Second Marsh. Open Beach/Bar communities dominated by Sea-rocket (B.B.O1.-1) are considered provincially rare (NHIC 2019), with a status of S2S3. This community has been reduced to a small area at the west end of the beach, close to the shrubby upland edge, as high water levels have flooded the beach adjacent to the water and trampling has denuded the remaining beach of vegetation.

Graminoid Great Lakes Coastal Meadow Marsh (M.A.M.4-1) is also considered a provincially significant community. This community is considered globally and provincially rare, with a global status of G2? and provincial status of S2. The edges of this community are threatened by invasion of shrubs such as Red-osier Dogwood.

3.1.2. Changes in Vegetation Communities Since 1997 Vegetation Inventories

There are three broad changes in vegetation communities that are most evident within Oshawa Second Marsh since the previous vegetation monitoring report in 1997: the death of ash trees in the mineral deciduous swamp (the Ghost Road Bush) due to Emerald Ash Borer (E.A.B.) and the vigorous growth of robust emergent plant species in response to the drawdown of water levels in 2016, particularly narrow-leaved Cattail, hybrid cattail and European Reed. These two changes are discussed in the following sections. Emerald Ash Borer is discussed extensively in the Forest Management Plan (N.S.E. 2019c).

3.1.2.1. Death of Ash

All mature ash showed signs of morbidity due to E.A.B. Most common signs were death of the canopy branches, adventitious sprouting of branches near the base or from the trunk, and death of the entire tree. However, the ground layer was still relatively shaded because of the surviving leaves on upper branches, vigorous suckering, and presence of other non-native species such as Manitoba Maple and mature Common Buckthorn. However, the ground layer was notably largely dominated by native species, though with non-native invasives such as Common Buckthorn and Garlic-mustard abundant in some areas.

3.1.2.2. Installation of Constructed dyke

The constructed dyke that separated the watercourse from the marsh communities was installed in 2001. The constructed dyke likely affected areas of shallow marsh and Manitoba Maple deciduous swamp along the west side of the marsh. The effects of separating this major water source from the marsh are likely still being determined.

The constructed dyke is a focus of many non-native species, possibly some of which were brought in with the fill used to construct the constructed dyke. Some of these are common in

cultural habitats (north of Colonel Sam Drive), such as Smooth Brome. However, some are invasive such as Himalayan Balsam, Long-bristled Smartweed (*Persicaria longiseta*, a relatively newly reported non-native species) and European Reed.

3.1.2.3. Growth of Robust Emergents

In 1997, a large proportion of the marsh was mapped as open water (Gartner-Lee 1997). In 2018, the marsh was dominated largely by cattails, with patches dominated by the invasive European Reed; as noted in Section 3.3, the percentage of emergent in the open wetland portion of Second Marsh was 84%. Much of the marsh was inaccessible because the cattail formed solid colonies that could neither be traversed on foot nor by canoe. The growth of other species under the cattail and Phragmites was relatively sparse. However, a higher diversity of species occurred in small patches at the edges of the cattail mats. The change in vegetation cover is considered attributable to the installation of the constructed dyke, efforts to control water levels and the reduction of carp in the marsh.

3.1.2.4. Information Gaps

Approximately 28% of the locally and regionally significant species previously recorded were found in 2018, and it is expected that other significant species still occur within the study area. Additional significant species may be found through future surveys, whether they occur in areas not surveyed in 2018, or during times of the year when observations and identification is more probable. Future surveys should be conducted during different seasons (a minimum of spring, summer and fall) to ensure different flowering times are covered, as species are most identifiable and visible when they are flowering.

Additional marsh species will likely be found in times when increased or decreased water levels reveal areas that were inaccessible in 2018. The pools of open water at the centre of the marsh (which were inaccessible at the time of the marsh survey) should be searched in late August or September during times of higher water levels for additional submergent species such as native pondweeds (*Potamogeton spp.*).

3.2. Flora and Floristics

Five Hundred and eighty-four flora species have been noted within Oshawa Second Marsh since 1971 when flora inventories were first undertaken. Twenty-eight percent of the species are non-native. The abundance of non-native species is high relative to the flora of Ontario which is approximately 23% non-native species (Kaiser 1983) with non-natives occupying a high percentage of most communities.

A Floristic Quality Analysis (F.Q.A.) is provided in **Table A4**.The F.Q.A. is a measure used to compare natural areas (Oldham et al. 1995). A Floristic Quality Index (F.Q.I.) is derived from the

assignment of a number between 1 and 10 to each native plant according to its habitat requirements (the Coefficient of Conservatism: abbreviated as C). Plants found in a diversity of habitats have low Cs, and plants found only in a few, highly specific habitats have high Cs. The scores (for native plants only) are averaged to obtain the Native Mean C and summed and divided by the square root of the number of species to obtain the F.Q.I. Therefore, habitats where conservative species predominate have high Native Mean Cs; habitats where there is a higher diversity of conservative species have higher F.Q.I.s.

The analysis for each community at Second Marsh uses only the species for which the community was known (some of the early plant lists did not record the vegetation community within which the species was found). The analysis noted the highest floristic quality within the deciduous swamp, followed by shallow marsh.

The quality of some communities is extraordinarily high, particularly within the deciduous swamp (S.W.D.) and shallow marsh (M.A.S.), because of the high diversity of conservative plant species under the upper vegetation layers (which are largely dominated by non-native species). Many of the plants observed are conservative in their habitat needs. Cultural communities (i.e., vegetation communities more heavily influenced by historical anthropogenic changes) on the site have lower quality. Forest and marsh communities are likely more sensitive to disturbances to their hydrologic regime and structural characteristics (e.g. canopy of trees in forest providing shade to understory, shrub and ground cover species). In contrast, cultural communities are resilient to changes in light levels, moisture and soil disturbance. Of the 193 native species noted in deciduous swamp communities, 164 (85%) had Cs of 5 or over. Of the 95 native species noted in the shallow marsh community, 72 (76%) had Cs of 5 or over.

The F.Q.I. indicates that the vegetation quality within the swamp and shallow marsh is much higher than is usually seen in urban environments. As a comparison, communities in urban areas of Ontario, for example Mississauga, typically have F.Q.I.s in the 15-30 range. F.Q.I.s of 40 to 45 are fairly high for rural landscapes in the Greater Toronto Area.

A mean Coefficient of Conservatism over 4 indicates a community composed largely of conservative species with requirements for specific habitats. A mean C under 4 indicates that the site is primarily vegetated with adaptable species that can withstand a variety of habitat changes. Areas with higher coefficients may be more sensitive to disturbance for example a change in water regime, influx of non-native species or canopy disturbance. Cultural communities (i.e., vegetation communities more heavily influenced by historical anthropogenic changes) on the site are resilient to changes in light levels, moisture and soil disturbance. In contrast, forest and marsh communities are likely more sensitive to disturbances to their

hydrologic regime and structural characteristics (e.g. canopy of trees in forest providing shade to understory, shrub and ground cover species).

Table A4. Floristic Quality Analysis for Oshawa Second Marsh

Ecosite (ELC Community Series)	Number of Introduced Plants	Number of Native Plants	Total Number of Plants	Native FQI	Native Mean C
Beach (B.B.O.)	16	53	71	26.90	3.70
Cultural (C.U.)	59	88	154	33.17	3.54
Lowland Forest (F.O.D.)	7	10	19	11.46	3.63
Meadow Marsh (M.A.M.)	27	65	98	33.14	4.11
M.A.M.4	5	23	29	18.90	3.94
Shallow Marsh (M.A.S.)	26	95	126	39.97	4.10
Submerged Aquatic (S.A.S.)	7	35	44	23.47	3.97
Deciduous Swamp (S.W.D.)	56	193	257	59.19	4.26
Thicket Swamp (S.W.T.)	4	33	38	19.21	3.34
Total for Oshawa Second Marsh	162	397	584	93.84	4.71

Note: The total number of plants does not necessarily equal the sum of native and non-native plants because for some species, status is uncertain.

3.2.1.1. Significant Flora Species

One hundred and thirty-one significant species have been reported from Oshawa Second Marsh since 1971. Significant species are defined as those that are provincially rare within the province of Ontario, as defined by the Natural Heritage Information Centre (N.H.I.C.), Regionally rare within the Greater Toronto Area (according to Varga et al. 2000), locally rare and locally uncommon within Durham Region, as defined by Varga et al. (2000). One provincially significant species, Nuttall's Pondweed, was observed in the 2018 surveys.

Some of the provincially rare species reported in the past were likely mis-identified (**Table A5**); however, the Marsh remains a highly significant habitat for regionally and locally rare species, as well as the provincially rare species Nuttall's Pondweed. Some parts of the marsh were inaccessible at the time of the 2018 surveys so further surveys would likely reveal additional rarities.

3.2.1.2. Provincially Rare Species

Table A5 provides a list of the seven provincially rare plants that have been recorded in surveys since 1971. One of these species was noted in 2018 surveys: Nuttall's Waterweed (*Elodea*

nuttallii). The location of this species is shown on **Figure A2**. Four of these species are likely reported in error: Short-stemmed Iris, Canada Lily, Yellow-fruited Sedge and Canada Cinquefoil. Short-stemmed Iris is noted only from Essex County (Oldham 2009), and in that county, only from Pelee Island, so this species was likely mis-identified. A photograph captioned "Canada Lily" is shown in the 1984 Preliminary Rehabilitation Strategy for Second Marsh (Davies et al. 1984) but the photo is clearly Michigan Lily (*Lilium michiganense*), as indicated by the curved-back petals. Canada Lily was also listed as the common name for *Lilium michiganense* in the report on Biological Sensitivities of the Secondary Trail (Gartner-Lee 1994), but *Lilium michiganense* is the scientific name for Michigan Lily, a more common species that has been documented many times in Second Marsh, so the reference was likely to this species. Searches were conducted in suitable habitat for other reported provincially significant species, but they were not found, and there were also likely other misidentifications. Two species are endangered because of a disease (American Chestnut and Butternut) (chestnut was planted, according to Gartner-Lee 1994), and they may have died.

Table A5. Provincially significant species noted in Oshawa Second Marsh from 1971 to present

Scientific Name	Common Name	S Rank	Comments
Elodea nuttallii	Nuttall's Waterweed	S3	Noted in 2018 in aquatic habitat
Lilium canadense.	Canada Lily	S1?[1]	Likely a misnomer or misidentification
Iris brevicaulis	Short-stemmed Iris	S1	Likely misidentification; occurs only on Pelee Island
Carex annectens	Yellow-fruited Sedge	S2	Reported only from Lambton, Essex, Niagara and Hastings (Oldham 2009); considered a Carolinian species associated with prairie habitats; so probably in error.
Potentilla canadensis	Canada Cinquefoil	S2?	Inhabits savannah habitat not present at O.S.M.; Oldham (2009) notes that this is "similar to the common and widespread P. simplex and probably overlooked and frequently misidentified (some county records doubtful)." This species may have been misidentified.

Scientific Name	Common Name	S Rank	Comments
Castanea dentata	American Chestnut	S1S2	Species introduced through planting (Gartner-Lee 1997); Endangered species because of a disease; individuals may have died
Juglans cinerea	Butternut	S2?	Species endangered because of a disease; individuals may have died

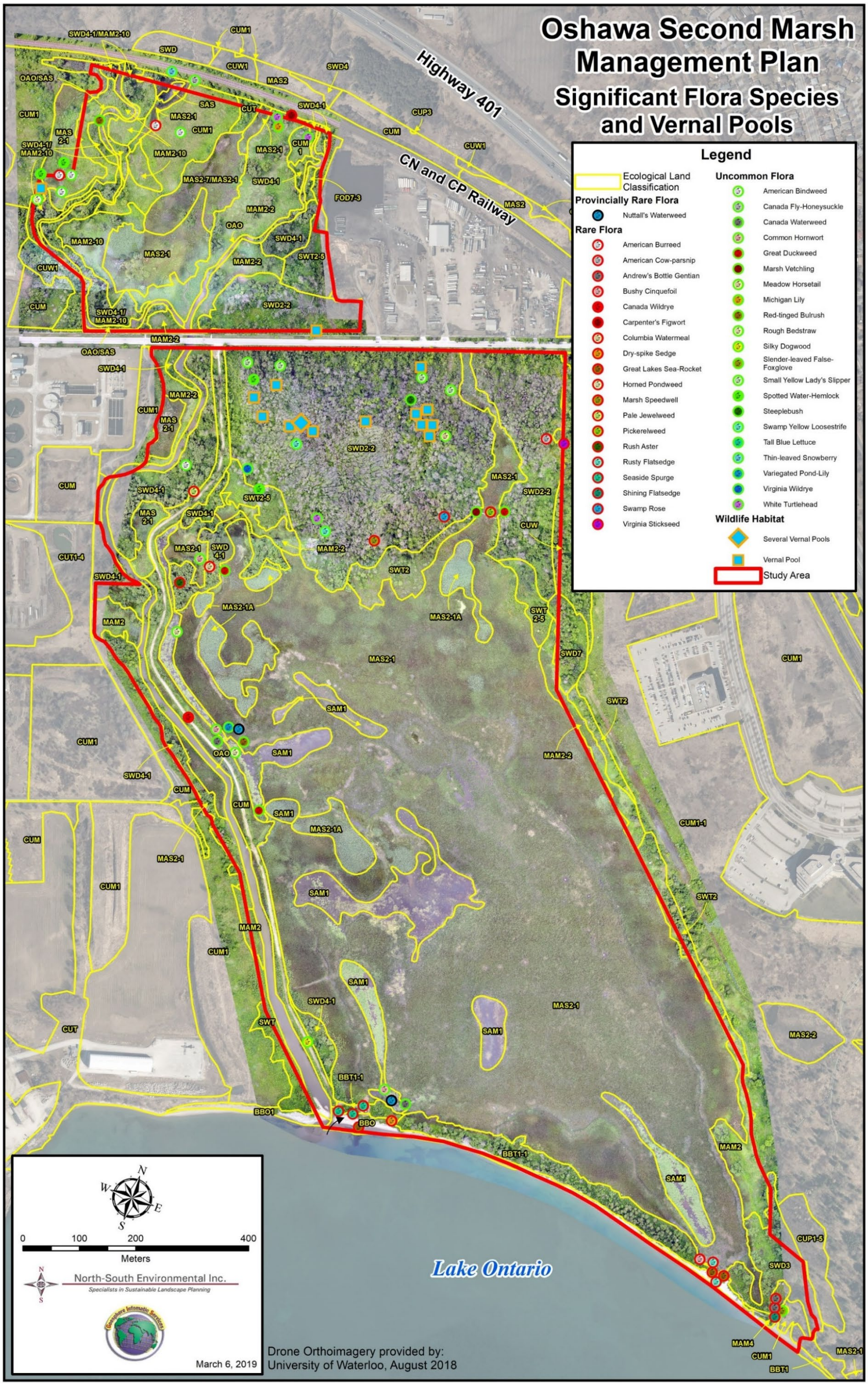


Figure A2. Significant Flora Species and Habitat Elements at Oshawa Second Marsh

3.2.1.3. Locally and Regionally Significant Species

A total of 124 locally and regionally significant species have been noted at Oshawa Second Marsh since 1971 (Appendix A1). **Figure A2** shows the locations of regionally and locally significant flora species recorded during 2018 vegetation surveys. Appendix A1 lists all regionally and locally significant species noted in flora surveys since 1971. Appendix A1 also notes the habitat where each species was found, or, if the habitat was not reported, notes the most likely habitat (determined from the description of the species' habitat from Reznicek et al. (2013)).

The approximate breakdown of vegetation communities for significant species is as follows:

- Species of open wetlands (shallow marsh and meadow marsh): 64
- Species of deciduous swamp: 38
- Species of aquatic habitat: 8
- Species of cultural habitat: 8
- Species of beach habitat: 5

Most significant species are related to open marsh communities: shallow marsh and meadow marsh. However, the boundary between shallow marsh and meadow marsh habitat is not clear-cut, as it includes the transitional area between the two habitats that varies according to changes in water level and soil moisture. There are many species that inhabit the transitional habitat between these communities. For example, many species of marsh habitats occur in small wet openings in deciduous swamp, or at swamp edges. Species of meadow marsh habitats can thrive on water-soaked woody debris or small hummocks in shallow marsh and at the edges of aquatic communities. Species of shallow marsh can also occur at the edges of aquatic communities and species of cultural habitats may occur at the edges of beaches.

3.2.1.4. Target species of Conservation Priority in Ecodistrict 6E-13

Notably, there are several plant species documented in 2018 at Second Marsh that were identified as being of conservation priority in the Ecodistrict, as discussed in Section 2.1. (Henson and Brodribb 2005). These are all associated with sand beach and marsh habitats:

- American Sea-rocket (a Great Lakes disjunct species)
- Seaside Spurge
- Bushy Cinquefoil

3.2.2. Information Gaps

Surveys of the fish community should continue, as they are indicators of aquatic health and habitat change. However, the species present are highly adaptable, and changes in numbers and species may occur with rapid changes in aquatic habitat in different years.

3.1. Amphibians

Calling amphibians surveys have been conducted in Oshawa Second Marsh for 25 years: 1983, and 1994 to 2019 (results were included until 2016 for this report). Surveys from 1994 to 2010 included both call counts and sweeps for amphibian larvae; the call counts were conducted at 10 stations south of Colonel Sam Drive and two stations north of Colonel Sam Drive. Call counts between 2011 and 2016 (C.L.O.C.A. 2016) included call counts from six of the 10 stations surveyed between 1994 and 2010

3.1.1. Amphibian Breeding South of Colonel Sam Drive

Eight amphibian species have been noted within the Marsh south of Colonel Sam Drive, as listed in **Table A6**. All species have been heard calling in breeding habitat. The earliest baseline study by Cecile (1983) concluded that Second Marsh had a low diversity and density of amphibians. However, moderate numbers of breeding amphibians are consistently heard every year. It is likely that Second Marsh has increased in importance for regional amphibian populations as the surrounding areas have become built-out.

As noted in the background report, and as can be seen in the total number of amphibians reported in any year, the numbers of amphibians heard calling are highly variable. There were no consistent trends indicating that numbers of amphibians were declining recently; though an unusually low diversity and abundance of amphibians, especially Green Frog, was noted in 2016 surveys. Results of larval sweeps conducted until 2010 indicated that numbers of calling amphibians do not reflect the numbers of larvae produced in a given year (Kamstra 2010). Amphibian populations rely on occasional years where unusually large numbers of young are produced, and there can be a long time lag between “good” years (e.g. Semlisch et al. 1996). It should be noted that Spring Peepers have not been noted in larval sweeps at any station within Second Marsh.

Table A6. List of amphibian species, their abundance, number of years reported, last year reported and breeding habitat within Oshawa Second Marsh south of Colonel Sam Drive (from Kamstra 2010, C.L.O.C.A. 1995-2016)

Common Name*	Number of Years Reported	Last Year Reported	Range of Numbers in each year (total for all Stations)	Breeding Habitat
Spring Peeper	6	2010	1 to 3	Primarily main body of marsh
Gray Treefrog	2	2006	1 to 5	One noted in main body of marsh, possibly transient; also noted in 1992 management plan
Wood Frog	21	2016	4 to full choruses	Main marsh, adjacent wetlands
Northern Leopard Frog	18		1 to 23	Main marsh, adjacent pond at southeast corner
Green Frog	18	2016	1 to 85	Main marsh, adjacent wetlands
American Bullfrog	4	2010	1	One noted only; main marsh
American Toad	18	2016	3 to 54	Ponds east and west of main marsh
Blue Spotted /Jefferson Salamander	1	1982	1	possible egg mass in Ghost Road Bush; not reported after 1983; would likely have been detected during larval sweeps if they were present
Mudpuppy	n/a	unknown	n/a	Noted in 1992 Management Plan as present between 1941 and 1981
Pickerel Frog	n/a	1988	n/a	Noted in Ontario Reptile and Amphibian Atlas
Red-spotted Newt	n/a	1987	n/a	Noted in Ontario Reptile and Amphibian Atlas

Note: Please see Background Report for scientific names. Number of years reported is for within the 19 years surveyed since 1983.

3.1.2. Amphibian Breeding North of Colonel Sam Drive

Five species of amphibian have been found to breed north of Colonel Sam Drive, as listed in **Table A7**. Amphibian breeding habitat is relatively scarce north of Colonel Sam Drive, as it is confined to two small ponds (as shown in the Background Report, N.S.E. 2019a). Nonetheless, amphibian calling surveys until 2010 consistently showed that amphibians bred in these ponds.

Larval amphibians of all species shown in **Table A7** (except Spring Peeper) are also reported in the two locations where sweeps were conducted north of Colonel Sam Drive. However, larval sweeps indicated very low numbers of larvae within the ponds north of Colonel Sam Drive. There is a particular indication of decline in American Toad, as larvae were absent from these ponds in all sweeps after 2006.

Table A7. List of amphibian species, their abundance, number of years reported, last year reported and breeding habitat within Oshawa Second Marsh north of Colonel Sam Drive (from Kamstra 2010)

Common Name*	Number of Years Reported	Last Year Reported	Range of Total Numbers for all Stations	Breeding Habitat
Spring Peeper	2	2007	1	Northwest Pond
Wood Frog	6	2010	1 to 11	Northwest Pond and South Pond
Northern Leopard Frog	2	2001	1	Northwest and South Pond
Green Frog	12	2009	1 to 7	Primarily Northwest Pond with one observation at South Pond
American Toad	14	2008	1 to 10	Northwest Pond and South Pond

Note: Please see Background Report for scientific names. Number of years reported is for within the 17 years surveyed since 1994; surveys not conducted north of Colonel Sam Drive in 1983 or after 2010

3.1.3. Amphibian Breeding within Ghost Road Bush

Amphibian call surveys are not conducted within the vernal pools within the Ghost Road Bush. However, sweeps for amphibian larvae were conducted from 1994 until 2010 within three vernal pools, stations E, F and J, within this swamp. Surveys were also conducted within a constructed pond (station T) from 2004 (when it was constructed) to 2010. Low numbers of Wood Frog larvae were noted within the two natural vernal pools, with moderate numbers noted at Station F, a vernal pool in the centre of the Ghost Road Bush. Low numbers of American Toad, Wood Frog, Leopard Frog and Green Frog larvae were noted in the constructed pond.

3.1.4. Discussion of Habitat

Amphibians recorded at Second Marsh consist of those that breed in so-called “fishless” ponds and develop into adults within a growing season, including Wood Frog, Spring Peeper, Gray Treefrog and American Toad, as well as species that breed in more permanent ponds: Northern

Leopard Frog and Green Frog. The presence of breeding Wood Frogs within the main body of the Marsh in recent years likely indicates that there are microhabitat areas within the Marsh that are isolated from fish predators.

The frog species present also may indicate the impermanence of aquatic habitat available within the Marsh. Green Frog, which are noted in amphibian surveys every year, may take more than one year to develop, but can develop within a year. Bullfrog larvae take more than one year to develop, and so need water that remains unfrozen. The absence of breeding Bullfrogs may thus indicate that the water within the marsh generally freezes to the bottom in winter.

The vernal pools within Ghost Road Bush (shown in **Figure A2**) may be becoming less functional as amphibian habitat that they were in the past. This was noted as early as 2002. Henshaw and Kamstra (2002) reported in 2002 that:

“Ghost Road Bush contains several linear sloughs that appear to be fed entirely by runoff. The hydrology appears to have changed in recent years. Only some sloughs still hold water. Most if not all of the sloughs, dry up between early and late summer in most years. Only the deeper pools that maintain water the longest, have the potential of providing larval habitat for Wood Frogs. On April 14, 1994, during a deliberate search for Wood Frogs, it was noted that frog choruses were only present in sloughs that were at least 50 cm deep. These sloughs appear to be fed by spring runoff. The western sloughs may receive much of their water from Farewell Creek when it floods over its banks.”

3.1.5. Information Gaps

Amphibian monitoring is an important source of information about this group of vertebrates at Second Marsh. Amphibians are indicators of the type of aquatic habitat within the Marsh and as an indicator of ecological integrity. Amphibian monitoring north of Colonel Sam Drive should be reinstated to inform about habitat changes including water quantity and quality, and to determine whether this part of Second Marsh supports breeding habitat that is likely becoming limited in the Region.

3.2. Birds

Birds are the most intensively studied fauna at Second Marsh. The focus of formal bird surveys at Oshawa Second Marsh has been on breeding birds, as breeding birds have highly specific habitat needs. However, there have been many informal observations of migrating birds as well, particularly waterfowl and shorebirds within the marsh habitat. Breeding bird monitoring has occurred from 1995 to the present south of Colonel Sam Drive, with additional monitoring stations monitored north of Colonel Sam Drive and within the marsh community from 1995 to 2010.

3.2.1. Breeding Birds

Ninety-two bird species have been recorded within Oshawa Second Marsh for which there is evidence of breeding (Appendix 2). Some observations of birds that were consistent with possible breeding were noted incidentally in 2018 vegetation surveys.

3.2.2. Provincially Significant Bird Species

Table A8. Provincially Significant Marsh Breeding Bird Species noted in Monitoring at Oshawa Second Marsh (from D.R.C.W.M.P. 2014)**Table A8** provides a list of bird species considered provincially significant at Second Marsh. Most of these species are dependent on open marsh habitat: there were few provincially significant species associated with the Ghost Road Bush or the mosaic of marsh habitats north of Colonel Sam Drive. None of these species were noted during surveys in 2018.

The list of provincially significant species recorded in recent years includes all marsh-nesting species targeted as species of conservation priority in Ecodistrict 6E-13 (Henson and Brodribb 2005), as follows:

- Black Tern
- Least Bittern
- King Rail

The only targeted species not found was Loggerhead Shrike, a species of successional habitats.

Table A8. Provincially Significant Marsh Breeding Bird Species noted in Monitoring at Oshawa Second Marsh (from D.R.C.W.M.P. 2014)

Species	Year last observed	Federal Status (C.O.S.E.W.I.C. /Schedule 1)	Provincial Status (C.O.S.S.A.R.O.)	Habitat Requirements
Least Bittern	2018	Threatened / Threatened	Threatened; Ontario status S4B	Preferentially breed in large marshes (>5-10ha) with tall emergent vegetation, relatively stable water levels (< 1 m, 10-50 cm), and about 50% open water interspersed in small pockets throughout the vegetated areas ("hemi-marsh") (C.O.S.E.W.I.C. 2009a). Hoar (2019, pers. comm.) noted this species in the southeast corner of the marsh during the breeding season in 2018; 2 individuals also noted on eBird
Yellow Rail	1972	Special Concern / Special Concern	Special Concern; Ontario status S3B because of extensive breeding range on James Bay coast	Nest in wet marshy areas of short, grass-like vegetation that have an overlying dry mat of dead vegetation that they use to roof their nests. The habitat must remain wet throughout the breeding season, but have < 15 cm standing water (C.O.S.E.W.I.C. 2009b).
King Rail	2011	Endangered / Endangered	Endangered; Ontario status S1B	Occupy a variety of freshwater marshes and successional marsh-shrub swamp habitats. Preferred habitat is large marshes with more open shallow water areas merging with shrubby areas. They require large expanses of marsh, not overgrown with cattails, to return in successive years, and persist over time in Ontario (C.O.S.E.W.I.C. 2011). Hoar (2019, pers. comm.) noted this species in 2011 but considered the habitat as borderline for breeding

Species	Year last observed	Federal Status (C.O.S.E.W.I.C. /Schedule 1)	Provincial Status (C.O.S.S.A.R.O.)	Habitat Requirements
Black Tern	2009	Not At Risk / Not at Risk	Special Concern; Ontario status S3B, S4M	Nest in shallow, highly productive freshwater wetlands with emergent vegetation. The hemi-marsh stage provides optimal nesting opportunities. Habitat use is positively related to wetland area and negatively to isolation of wetland habitat (Burke 2012). Hoar (2019, pers. comm.) reports small numbers are seen annually during migration

3.2.3. Additional Occasional Breeding Species at Risk at Second Marsh

Piping Plover (Endangered in Canada and Ontario)

Hoar (2019, pers. comm.) noted that 1-2 pairs now breed annually on the adjacent barrier beach at Darlington Provincial Park. Individuals occasionally forage during breeding season on the lakeshore side of the Second Marsh barrier beach. Before the intensive cattail/phragmites growth with this last drawdown these next-door breeders would regularly visit the marsh to forage on the mudflats and gravel bar island.

Eastern Wood-pewee (Special Concern in Canada and Ontario)

One individual of Eastern Wood-pewee, which is considered a Species at Risk with a status of Special Concern, was noted singing during vegetation surveys in Ghost Road Bush in 2018, and was a possible breeder. This species was noted by Henshaw and Kamstra (2002) as generally represented by four to 10 pairs each year, usually in the swamp (Ghost Road Bush) or riparian zones. This species was noted during the Marsh Monitoring Program (M.M.P.) in 2002, 2006, 2007 and 2015. Hoar (2019 pers. comm.) notes that it is a common migrant and uncommon breeder in the Ghost Road bush.

Wood Thrush (Threatened in Canada and Special Concern in Ontario)

Wood Thrush, a forest-nesting Species at Risk, was noted in some years between 1995-2001 by Henshaw and Kamstra (2002) but the habitat is considered marginal as it is too small and wet for this species (Henshaw and Kamstra 2002). It was noted as a flythrough in the 2016 M.M.P. It was not listed between 2002 and 2010 by the Environment Canada monitoring and was not noted during vegetation surveys in 2018.

Barn Swallow (Threatened in Canada and Ontario)

Barn Swallow has also been noted foraging over the marsh. It is also considered a Species at Risk (with a status of Threatened in Canada and Ontario). This species nests on human structures, generally buildings and bridges. It has not been noted recently nesting within the marsh, though Henshaw and Kamstra (2002) noted that it nested underneath the bridge over Farewell Creek on Colonel Sam Drive in 1999 and 2001. It likely nests in the vicinity of the marsh: Barn Swallows regularly forage up to 200 m from their nest sites. Foraging areas are an important aspect of Barn Swallow habitat, especially for brood-rearing. Marshes are particularly favoured as they are sources of abundant flying insects, so Second Marsh provides important feeding and brood-rearing habitat for this and other swallow species.

Red-headed Woodpecker (Recently evaluated as Endangered in Canada; Threatened under Schedule 1 of the Species at Risk Act; Special Concern in Ontario)

Hoar (2019, pers. comm.) notes that this species is an uncommon annual migrant at Second Marsh. It has bred at least twice since 1992 in Ghost Road Bush and the southeast corner of the marsh/ adjacent Cool Hollow area of Mclaughlin Bay Nature Reserve.

Bobolink (Threatened in Canada and Ontario)

Hoar (2019 pers. comm.) notes that this species has nested in meadow area within Second Marsh north of Colonel Sam Drive in the past decade. Pernanen (2002-2010) noted this species only twice during annual point counts that included the meadow, in 2010 and 1999 (Pernanen 2006), but felt it was a non-breeding visitor. Henshaw and Kamstra (2002) noted that one was noted occasionally during breeding bird surveys, and that it was commoner adjacent. It is an annual common migrant.

Eastern Meadowlark (Threatened in Canada and Ontario)

Hoar (2019 pers. comm.) notes that this species has nested in the meadow area within Second Marsh north of Colonel Sam Drive in the past decade. Pernanen (2002-2010) noted this species only once, in 1999, during point counts that included the meadow. Henshaw and Kamstra (2002) noted that one or two pairs nested in the study area, and that it was also adjacent. Many are seen in migration over and adjacent to the marsh.

3.2.4. Marsh-Nesting Obligate Species

Twelve bird species have been classified by Environment Canada and Bird Studies Canada as marsh-nesting obligates (M.N.O.) in southern Ontario (Environment Canada and Central Lake Ontario Conservation Authority 2004), as shown in **Table A9**. These are notable as, with a few exceptions, they are rare in the Greater Toronto Area, with specific habitat requirements. Except for Swamp Sparrow, they are generally species of large marshes that do not inhabit small patches of marsh in the vicinity of urban creeks and storm ponds. They are considered to be indicators of marsh quality. Nine of these species were noted in recent years of monitoring, and there have been sporadic records of them since that time. The Marsh provides breeding habitat for non-obligate marsh species as well, for example Red-winged Blackbird (which was monitored by the Environment Canada monitoring program) and Common Yellowthroat.

Observations of Sedge Wren are included here as they have been highlighted as an unusual marsh-nesting species that may have nested sporadically at Second Marsh. They generally prefer large wet meadows with short, largely graminoid meadow marsh vegetation, which may be absent from the marsh.

Table A9. Marsh-nesting species noted in Oshawa Second Marsh from 1996 to 2018

Species	Maximum Numbers Noted 1995-2000[2]	Maximum Numbers Noted 2001-2005[3]	Maximum Numbers Noted 2006-2010[2]	Recent Sightings[4]
Obligate Marsh Nesters (as defined by Pernanen 2010)				
American Bittern	None since 1 in 1997 and 1998	Not noted in breeding season	One noted 2006; 1 also noted by M.M.P.	1 noted 13 May, 2018 on eBird
Least Bittern	Not noted	1 noted in 2002 and 2005	1 in 2006, 5 in 2007, 3 in 2008, 0 in 2009-2010	1 noted by M.M.P. in 2012 and 2013; 2 noted 19 June, 2018 on eBird
American Coot	1 individual noted in 2000	0 in 2001-2004, 4 in 2005; one noted by M.M.P. in 2004 and 2005	1-4 in 2006-2008, 0 in 2009-2010; 1 noted by M.M.P. in 2008	Fledged young noted in August 2018
Common Gallinule	12-14 pairs noted each year in 1995-1998, 1 in 2000	0 in 2001, 4 in 2003, 4 in 2005, 0 in 2002 and 2004	2-20 noted each year	1 noted in 2012 and 2017 M.M.P., fledged young noted in August 2018
Wilson's Snipe	Historical breeder only	Not noted	Not noted	1 noted on 3 May 2018 on eBird
Black Tern	2-4 in 1995, maximum 23 pairs in 1998, 0 in 1999 and 2000	0 in 2001, 1 in 2002, 0 in 2003-2004, 24 in 2005	4 in 2006, 14 in 2007, 5 in 2008, 1 in 2009, 0 in 2010; last one noted by M.M.P. in 2008	1 noted in May 2016 on eBird

[2] Henshaw and Kanstra (2002) except where otherwise noted.
[3] Pernanen (2001-2010) except where otherwise noted.
[4] Source for this column is noted for each observation.

Species	Maximum Numbers Noted 1995-2000[2]	Maximum Numbers Noted 2001-2005[3]	Maximum Numbers Noted 2006-2010[2]	Recent Sightings[4]
Forster's Tern	Not noted	Not noted	Not Noted	1 noted 8 May, 2016 on eBird (likely a migrant)
Marsh Wren	7 to 54	11 to 50	32 to 62	15 noted in 2012, 10 noted in 2013, 11 noted in 2015, 3 noted in 2016, 3 noted in 2017 (all M.M.P.), singing male heard at mouth of Farewell Creek in July, 2018 (N.S.E.)
Pied-billed Grebe	Noted as "historical breeder only"	0 in 2001-2004, 5 in 2005	1-8 noted each year; 1 or 2 noted each year by M.M.P.	No recent records (none noted in M.M.P.)
Sora	3 pairs in 2000 after an absence of 7 years	1 noted in 2002 and 2004, 12 in 2005	2-10 noted each year until 2009, 1 noted in 2010	2 noted 14 May, 2018 on eBird
Virginia Rail	16 to 20 noted from 1995-1998, fewer than 5 in 1999 and 2000	5 to 18	11 to 18 to 2009, 2 in 2010	1 noted in 2012, 3 noted in 2013 M.M.P., 1 noted in 2017 (all M.M.P.); 1 noted 14 July 2018 on eBird
Swamp Sparrow	20-54 pairs, increasing	55 to 77	53-74	11 to 14 noted in 2012 to 2016, 15 noted in 2017 M.M.P., 2 heard singing in July, 2018 (N.S.E.)
Non-Obligate Marsh Nesters				
Red-winged Blackbird	170 to 250 females	129 to 149	120 to 171	13 to 31 noted each year in 2012 to 2016 M.M.P., 14 noted in 2017 M.M.P.

Species	Maximum Numbers Noted 1995-2000[2]	Maximum Numbers Noted 2001-2005[3]	Maximum Numbers Noted 2006-2010[2]	Recent Sightings[4]
Common Yellowthroat	25 to 40 pairs in marsh each year; 4 to 7 noted each year by M.M.P.	6 to 9 noted each year by M.M.P.	3 to 8 noted each year by M.M.P.	5 to 8 noted each year by M.M.P.
Sedge Wren	One probably bred along the west side of the Marsh in 1996 and breeding was confirmed at nearby M.B.W.R. in 1997; 1 noted in 1996 and 1997 M.M.P.	1 noted in 2002 on eBird; 1 noted in 2005 M.M.P.	none	none

3.2.5. Nesting Waterfowl Species

Second Marsh has been notable for providing habitat for waterfowl species in some years. **Table A10** notes the waterfowl species have been noted occasionally as possible or probable breeding species within the Marsh (Mallard and Canada Goose have been noted more frequently than others). Henshaw and Kamstra (2002) noted that despite the loss or decline of some nesting and brood habitat, breeding waterfowl continued to be an important attribute of the Marsh.

U.A.V. photography within the marsh was analysed with the aid of an algorithm that searched for roughly circular areas of flattened vegetation in the marsh: these were characterized as “duck or muskrat nests”. These 133 “duck nests” were screened visually at as high a resolution as possible to determine if they could be identified more precisely. Seventeen of these sites appeared on visual screening to be muskrat mounds, that were also potential nest sites for marsh-nesting ducks. Forty-seven of these sites appeared to be possible flattened vegetation mats for nesting ducks. A pair of swans (species not determined) was visible on one of the latter sites: this could have been a Mute Swan or a Trumpeter Swan. The visual signatures of sixty-eight sites were ambiguous and could have simply been sites where cattail had died.

Table A10. Waterfowl species noted potentially breeding at Oshawa Second Marsh

Species	Comments on Abundance
Trumpeter Swan	Not reported by Henshaw and Kamstra (2002); breeding attempts noted in 2003, 2006 and 2007 (young noted in two years); pairs seen occasionally in other years; 1 noted in 2012, 10 noted in 2016 M.M.P.; one nest with two young noted in 2018 U.A.V. surveys may have been Trumpeter Swan or Mute Swan
Mute Swan	Henshaw and Kamstra (2002) reported 2 to 3 pairs each year, and that this species is increasing; one nest with two young noted in 2018 U.A.V. surveys may have been Trumpeter Swan or Mute Swan
Canada Goose	Henshaw and Kamstra (2002) report 15 to 20 pairs each year, and that this species was increasing; no data from 2002-2010; several noted each year in M.M.P. surveys
Wood Duck	Henshaw and Kamstra (2002) report 3 to 5 pairs each year; not reported from 2002-2010; 3 noted in 2012, 10 noted in 2013, 1 noted in 2016 (all M.M.P.), several females noted in Ghost Road Bush and marsh in July, 2018; this species nests in tree cavities so Ghost Road Bush may continue to provide nesting habitat until trees fall

Species	Comments on Abundance
Green-winged Teal	Henshaw and Kamstra (2002) reported 2 to 4 pairs; reported by M.M.P. in 2006, 2009 and 2012
American Black Duck	Henshaw and Kamstra (2002) report that this is a historical breeder only; noted by M.M.P. in 2013
Mallard	Henshaw and Kamstra (2002) report that population is usually between 20 and 35 nesting pairs; several noted by M.M.P. every year from 1995-2016.
Blue-winged Teal	Henshaw and Kamstra (2002) reported that 3 to 6 pairs nest annually but that decline in pond habitat had reduced brood habitat for this species; reported occasionally from 2002-2010 during the breeding season but no confirmed nesting; reported by M.M.P. in 2010 and 2016 but no evidence of breeding; may nest in the vicinity (in fields)
Northern Shoveler	Henshaw and Kamstra (2002) reported that 2 to 5 pairs attempted nesting each year; M.M.P. noted one in 2003 and 2008
Gadwall	Henshaw and Kamstra (2002) reported that 1 brood was noted in 2001, though this is a late-nesting species and additional surveys would have likely detected more; 1997 survey detected 8 to 11 pairs; noted every year in M.M.P. from 1995 to 2015.
Ruddy Duck	Not reported by Henshaw and Kamstra (2002); reported occasionally during the breeding season from 2002-2010 but no confirmed nesting; 1 reported by M.M.P. in 2003
American Wigeon	Henshaw and Kamstra (2002) report that one nest found in 1996 and 1997; not reported from 2002-2010
Hooded Merganser	Henshaw and Kamstra (2002) report that breeding reported on two occasions since 1989; this species nests in tree cavities

3.2.6. Colonial Nesting Species

One colonial nesting species has been noted within Second Marsh that likely breeds: Green Heron. Other tree-nesting colonial species (herons) are reported frequently as foragers but have not been known to nest in recent years (**Table A11**). One ground-nesting colonial species (Common Tern) is noted in some years.

Table A11. Colonial nesting species noted potentially breeding at Oshawa Second Marsh

Species	Comments on Abundance
Tree Nesting	

Species	Comments on Abundance
Black-crowned Night-heron	Adults and immature seen foraging but no evidence of nesting
Great Blue Heron	Noted nesting prior to 1995 but no evidence of nesting after that
Great Egret	Not known to breed at the Marsh though occasionally observed foraging in the marsh; not reported by Henshaw and Kamstra (2002)
Green Heron	Henshaw and Kamstra (2002) reported 3 to 5 pairs each year; a few pairs noted in most years from 2002-2010; noted by M.M.P. in 2012 and 2015; noted exhibiting behaviour consistent with breeding in the marsh in 2018 (landed in swamp west of dike)
Ground-nesting	
Common Tern	Nesting platforms provide habitat islands for Common Terns in the Marsh. While this species is not considered a marsh obligate, it is a colonial nester for which habitat has become restricted in the Great Lakes (Cuthbert et al. 2003). This species does not use tern habitat islands during drawdowns (Pernanen 2007), probably because the platforms are vulnerable to predators when not surrounded by water. 40-80 noted from 1995 to 2000, 2 to 12 in 2005 to 2010, 2 noted on artificial nesting islands on June 19, 2018 on ebird
Caspian Tern	Forage in Second Marsh every year; a few noted every year by M.M.P. until 2015; not known to nest

3.2.7. Forest Species

The Ghost Road Bush provides breeding habitat primarily for forest-generalist species (Appendix 2), mainly adaptable species that are common in small patches in urbanized areas of southern Ontario. A few forest area-sensitive species have also been noted, mostly those that are marginally area-sensitive and not considered to be true indicators of habitat for area-sensitive birds (e.g. White-breasted Nuthatch, Blue-gray Gnatcatcher, American Redstart) or can incorporate disparate patches of forest into a larger home range (e.g. Pileated Woodpecker, Hairy Woodpecker). Two Species at Risk have been noted possibly breeding in the forested area: Eastern Wood-pewee and Wood Thrush, as discussed above. Other species unusual in urbanized southern Ontario (personal observation) that were heard singing in early to mid-July of 2018, and should be considered at least possible breeders, included two Least Flycatcher and one Northern Rough-winged Swallow, which were noted north of Colonel Sam Drive. Fledged young of Great Horned Owl were noted in the Ghost Road Bush.

3.2.8. Marsh Bird Breeding Habitat and Changes in the Marsh

It has been assumed in the past that the most likely reason for changes in marsh obligate bird species, and likely amphibians as well, is the water level in the marsh, especially levels that favour approximately equal proportions of open water to vegetation (City of Oshawa 1992). Pernanen (2010) describes the relationship of the extent of vegetation to the water level as follows:

"Following construction of the constructed dyke to separate Harmony Creek from the marsh in 2001, the marsh was partially dewatered during 2003 and a full drawdown occurred in 2004, resulting in extensive new growth of emergent vegetation. In 2007, the water control structure remained closed for most of the breeding season to maintain a high-water level in the marsh, in an attempt to kill off invasive European Reed stands and some of the extensive growth of cattail that had dominated the northern part of the marsh since the 2004 drawdown. Some of the dense cattail stands did die off, but in the southern part of the marsh softstem bulrush was prevalent in areas and patchy, hemi-marsh conditions were observed at various locations within the emergent vegetation communities. The current extent of emergent vegetation [Pernanent was speaking of the year 2010] in Oshawa Second Marsh is greater than prior to the initial drawdown in 2004, but is much less than in the years following that drawdown."

Obligate marsh species abundance was relatively high in the years 2000-2005, after the water levels were drawn down. Pernanen (2007) states that there was a particularly dramatic increase in Virginia Rails and Marsh Wrens in 2002, after the dike was constructed in 2001. However, there have been some years with higher water levels that have fostered higher obligate marsh species abundance: for example, obligate marsh species abundance was also high in 2006-2010, when water levels were maintained at a higher level.

Henshaw and Kamstra (2002) noted in their 2002 summary of the previous ten years' monitoring that while total species richness for the study area had remained relatively unchanged, numbers of obligate marsh-nesting species had undergone a steep decline, both historically and since 1995, excluding waterfowl and Swamp Sparrow. Species richness of marsh obligates had also declined markedly since the 1920s and somewhat since 1995. They listed the following factors which likely affected marsh-breeding birds:

- an impaired food supply,
- variable summer water levels and
- physical loss or impairment of habitat.

Several interacting factors also likely influence marsh-nesting birds: the ratio of vegetation to water, water depth around the nest site, presence of mud flats or mats of marsh vegetation used

for foraging, food abundance etc. It is thought that many species have exacting requirements for depth of water and vegetation patterns, which may not occur every year (and may be difficult to replicate in managed marshes). For example, site fidelity of Black Terns is variable but typically low (Burke 2012). Terns may return to previous nesting areas for many years but may suddenly abandon marshes with no visible changes in site characteristics. They have also been found to return to a site after an absence of years, presumably having moved to other wetlands in the area or different regions in the interim (Burke 2012). The type of dominant vegetation is also thought to be important. Many marsh birds require clear, shallow water in which they can see and catch their prey (Ontario Ministry of Natural Resources and Forestry 2016) and so are affected by increase in turbidity. Turbidity also affects lower levels of the food chain that support prey (Burke 2012). Marsh birds may be highly vulnerable to water level changes if nests are low enough to be flooded or exposed soils leave the nest accessible to predators. Recent research has indicated that marsh obligate species nest less frequently in dense European Reed than in marshes dominated by native species (Robichaud and Rooney 2016), while other studies show that invasion of European Reed has little effect on most marsh species, with the exception of Marsh Wren, which is a habitat-specialist species (Lupien Gagnon et al. 2014). Tozer (2016) suggests that invasive Purple Loosestrife and European Reed are a threat to most of southern Ontario's declining marsh-dependent breeding bird species.

European Reed provides some ecosystem benefits: for example it sequesters nutrients, heavy metals and carbon, builds and stabilizes soils, and creates self-maintaining vegetation in urban and industrial areas where many plants do not thrive (Kiviat 2013). The tradeoffs of management must be carefully considered, as outcomes of European Reed management have not been monitored in long-term studies and the success of management may be unpredictable (Hazelton et al. 2014). Additional threats include Hybrid Cattail if it results in a loss of open patches of deep water and interspersion, which are preferred by many marsh obligate species, especially Least Bittern (Tozer et al. 2010).

A decline in marsh-nesting birds at Second Marsh may also be due to broader declines in populations. For example, Least Bittern populations have declined in Canada by between 16% and 63% (M.N.R.F. 2016). Similarly, Black Terns have been declining since the 1950s, with a 61% decline in the past 30 years (Burke 2012). Confounding this is the fact that some marsh-nesting species, such as Black Tern and Marsh Wren, are semi-colonial, and may not nest without the added stimulus of individuals of their own species in the vicinity (Ahlering et al. 2010). Some marsh birds also prefer marshes with certain other species that may indicate habitat quality, such as Pied-billed Grebe (Ward et al. 2010). A decline in individuals of one species may therefore affect other individuals of the same species, or of other species.

3.2.9. Migrating Waterfowl

The Marsh has been noted since the 1950s as a significant stopover area for migrating waterfowl: for example, 30,000 ducks were banded at Second Marsh from 1956 to 1973, making it one of the top 5 banding locations on the Atlantic flyway (Environment Canada 1981). It is listed as a Hotspot on eBird, with thousands of observations comprising 276 species, many of them waterfowl. High counts (over 200) of waterfowl in spring and fall since 2000 have included the following species (though it should be noted that high counts may include birds on the lakeshore side of the barrier beach as well):

- 8600 Red-breasted Merganser (November 2011)
- 7210 Canada Geese (Marsh 2013)
- 2086 Brant (October 2012)
- 1696 Greater Scaup (January 2013)
- 993 Mallard (November 2014)
- 730 Long-tailed Duck (April 2011)
- 457 Common Goldeneye (January 2013)
- 296 Gadwall (April 2013)
- 260 Ring-necked Duck (April 2017)
- 259 Blue-winged Teal (August 2002)

It is likely that Oshawa Second marsh would meet the criteria for Significant Wildlife Habitat for migrating waterfowl based on these numbers, in some years. Migrating waterfowl generally use large areas of open water for spring stopover sites, probably as protection from predators. They often avoid vegetated edges but may conceal themselves in vegetative cover at stopover sites if the vegetation is inaccessible to predators. The presence of food sources at aquatic sites in spring may be less important than resting habitat for some species. Strafford et al. (2014) note that though it has been assumed that plant foods are critical during spring staging because of the birds' energy requirements, there is little evidence on the extent to which the availability of carbohydrate-based food is limiting for many migratory waterfowl populations. They note that such limitation is relatively unlikely among populations that exploit agricultural grain during migration (e.g. arctic-nesting geese and ducks). However, other species, such as Lesser Scaup, are highly dependent on amphipods during spring migration (Strafford et al. 2014). Amphipods are vulnerable to fish predators, and turbidity, which can indicate colonization by fish, may be associated with less food for species that depend on amphipods (Strafford et al. 2014).

3.2.10. Migrating Shorebirds

Notable occurrences of shorebirds have been recorded in the spring in Second Marsh as well (eBird 2019), including:

- 2000 “peep” (small shorebird) species (May 2016)
- 1000 Dunlin (May 2004)
- 810 Semipalmated Sandpiper (May 2015)
- 800 Shorebirds (several species) (May 2015)
- 200 Shorebirds (several species) (May 2016)
- 600 Whimbrel (May 2015)
- 500 Least Sandpiper (May 2004)
- 190 Semipalmated Plover (May 2016)

It is likely that Oshawa Second Marsh would meet the criteria for Significant Wildlife Habitat for migrating shorebirds based on these numbers, in some years. Migrating shorebirds are dependent on exposed mud flats and mats of vegetation for foraging during migration, so lower water levels may be favouring migrating shorebirds, while higher water levels foster Significant Wildlife Habitat for migrating waterfowl, so the two functions likely cannot be achieved in the same year but would occur in different years. The high counts of shorebirds appear to be more recent than high counts of ducks and geese, possibly indicating that the marsh has become more suitable for migrating shorebirds than for waterfowl because of recent drawdowns. However, this could be an artefact of eBird, which is highly dependent on the number of birders that are willing to submit records of numbers of birds seen.

3.2.11. Migrating Landbirds

The Background Report notes that many species of landbirds have been noted migrating through Oshawa Second Marsh. Wooded areas within 2 km of the shore of Lake Ontario are considered particularly important for landbird stopovers (M.N.R. 2000), and use of the habitat by >200 birds/day and with >35 species with at least 10 bird species recorded on at least 5 different survey dates is considered an indication of Significant Wildlife Habitat (M.N.R.F. 2015). Surveys would have to be conducted in spring and fall to document the function of the wooded areas as landbird stopover habitat.

Oshawa Second Marsh has been noted as a stopover area for many rare species. For example, Sharp-tailed Sparrow, a species that nests in marshes on the shore of James Bay and Hudson’s Bay and is seen very rarely on migration, was particularly noted here in the 1990s. eBird records include a wide diversity of rare migrants such as Golden Eagle, Olive-sided Flycatcher and Prothonotary Warbler.

3.2.12. Migrating Gulls

As noted in the Background Report, Second Marsh is a spring staging area for the largest known concentrations of Little Gulls in North America. Numbers up to 200 have been noted, which is remarkable as the total population of Little Gulls in North America is thought to be approximately 100-200 birds (Cornell Laboratory of Ornithology 2017).

Bonaparte's Gulls also gather in the Marsh in large numbers during migration (from Hoar 2019, pers. comm.).

3.2.13. Species at Risk Noted as Migrants or Foragers, for which Breeding Evidence is Absent

Table A12 provides a list of Species at Risk and provincially significant species that are not thought to nest in the marsh, but use the marsh as a stopover location in most years.

Table A12. Colonial nesting species noted potentially breeding at Oshawa Second Marsh

Species	Federal Status/ Status on Schedule 1	Provincial Status and Rank*	Notes (from Hoar 2019, pers. Comm.)
Golden Eagle	Not At Risk	Endangered / S2B	Annual migrant over the marsh mid October to December. Falls with stronger suitable winds result in more individuals over the marsh being forced to the lakeshore from their preferred route a few kms north of the marsh.
Prothonotary Warbler	Endangered / Endangered	Endangered / S1B	Very rare vagrant in the study area Last one seen here May 15 2014. Naturalists have put up and maintained nest boxes for this species in sloughs within ghost road woods. No nesting seen.
Canada Warbler	Threatened / Threatened	Special Concern / S4B	Uncommon annual migrant during migration. Can be found daily in small numbers in May and August to September
American White Pelican	Not At Risk	Threatened / S2B	Individuals have loitered in the summer within the marsh in 2010 and 2011. Expect more migrants now that this species breeds in Lake Erie and in the sault Ste Marie area.

Species	Federal Status/ Status on Schedule 1	Provincial Status and Rank*	Notes (from Hoar 2019, pers. Comm.)
Chimney Swift	Threatened / Threatened	Threatened / S4B	Common migrant and breeder in the area. Forages over the marsh daily once it arrives. Suitable nesting areas are near the marsh.
Common Nighthawk	Special Concern / Special Concern	Special Concern / S4B	Uncommon spring migrant, common early fall migrant. Possibly extirpated as a breeding species on suitable habitat adjacent to the marsh
Eastern Whip-poor-will	Threatened / Threatened	T.H.R./S4B	Uncommonly seen migrant yearly has bred in Darlington Provincial Park till early 2000s.
Evening Grosbeak	Special Concern / Special Concern	Special Concern/S4B	Irruptive irregular migrant from the north. When it does come south it forages on the abundant Manitoba maple seed crops around the marsh.
Golden-winged Warbler	Threatened / Threatened	Threatened / S3B	Uncommon and decreasing annual migrant. Has bred in the adjacent area in 1991.
Grasshopper Sparrow	Special Concern / Special Concern	Special Concern / S4B	Uncommon annual migrant.
Horned Grebe	Special Concern / Special Concern	Special Concern / S1B, S3N, S4M	Common annual migrant and occasionally wintering species in Lake Ontario adjacent to the marsh. In previous years before the marsh was highly vegetated in the south half this species foraged regularly and was observed doing courtship displays occasionally (probability it would breed in the marsh is quite low).
Loggerhead Shrike	Endangered / Endangered	Endangered / S1B	rare migrant not seen annually
Louisiana Waterthrush	Threatened / Threatened	Threatened / S2B	rare migrant not seen annually

Species	Federal Status/ Status on Schedule 1	Provincial Status and Rank*	Notes (from Hoar 2019, pers. Comm.)
Cerulean Warbler	Endangered / Endangered	Threatened / S2B	rare migrant not seen annually
Olive-sided Flycatcher	Special Concern / Special Concern	Special Concern / S4B	annual regular migrant that favours the edge of Ghost road woods.
Bank Swallow	Threatened / Threatened	Threatened / S4B	Common/abundant migrant and forager over the Marsh. There are several colonies in lakeshore bluffs adjacent to the marsh and within foraging distance. It can be the most abundant swallow seen at the Marsh any time after it arrives
Rusty Blackbird	Special Concern / Special Concern	Special Concern / S4B / S3N	Annual migrant here occasionally; some small numbers overwinter.
Short-eared Owl	Threatened / Special Concern	Threatened / S4?B,S2S3N	Uncommon annual migrant and wintering species. Observed roosting in the cattails within the marsh several times
Bald Eagle	Not At Risk	Special Concern / S4	Common fall migrant, uncommon year-round resident. Can be seen occasionally any day of the year at the marsh. Only Durham region nest is on Lake Scugog.
Peregrine Falcon	Not At Risk / Not on Schedule 1	Special Concern /S4	Seen almost daily at the marsh from April to December. Common fall migrant. Nests on Lakeridge Health (Oshawa Hospital) and in the St Mary's cement quarry. Individuals from either nest will hunt the marsh sometime multiple times daily.
Yellow-breasted Chat	Endangered / Endangered	Endangered / S1B	Historic records from the immediate adjacent area latest found was spring 1991 at Darlington Provincial Park.

Species	Federal Status/ Status on Schedule 1	Provincial Status and Rank*	Notes (from Hoar 2019, pers. Comm.)
Barn Owl	Endangered / Endangered	Endangered / S1	Some historic records for Barn Owls. There are some recent observations and a specimen found in the west Whitby area. This species may still exist here but very rarely.

3.2.14. Information Gaps

- Monitoring in the past 8 years has of necessity (because of financial and logistical constraints) focused on the stations along the marsh periphery. The interior of the marsh is likely an area important for marsh-obligate species, and this has received less study than in the past (prior to 2011). Monitoring of the marsh interior will be more important to determine if water level management is effective in providing additional habitat for target species.
- The use of the marsh by nesting waterfowl has not been characterized recently; UAV surveys indicate that this may be an important function of the marsh.
- The extent of use of Oshawa Second Marsh by migrating landbirds has not been empirically characterized.
- Monitoring has not included the lands to the north of Colonel Sam Drive, which have been documented as habitat for regionally uncommon species in the past.
- The presence and abundance of amphipods and other important resources for migrating waterfowl has not been analyzed, though the data may be available in monitoring results for the water column.

3.3. Fish Communities and Ecological Relationships

Eighteen fish species have been noted in Oshawa Second Marsh in monitoring completed by C.L.O.C.A. from 2002 to 2015. Ten other species have been noted in other monitoring. **Table A13** provides a list of species, notes the number of years the species has been reported in the Marsh and the last year it was reported. As noted in the background report (N.S.E. 2019a), fish surveys consistently demonstrate that Oshawa Second Marsh hosts a warm-water fish community dominated by Common Carp, Brown Bullhead (Ameiurus nebulosus) and Gizzard Shad (Dorosoma cepedianum) from spring through early fall. A resident community using the marsh year-round consists of Fathead Minnows (Pimephales promelas), Pumpkinseed (Lepomis gibbosus), young-of-the-year Northern Pike, Rock Bass (Ambloplites rupestris) and a

small population of Common Carp and Brown Bullhead (discussed in Canadian Wildlife Service 2005).

Table A13. Fish species noted during monitoring by C.L.O.C.A. at Oshawa Second Marsh, from 2002 to 2015

Common Name	Scientific Name	Number of Years noted in the Marsh	Last Year Recorded (from C.L.O.C.A. Monitoring Plan unless otherwise noted)
Brown Bullhead	*Ameiurus nebulosus*	12	2015
Goldfish	*Carassius auratus*	11	2014
White Sucker	*Catostomus commersoni*	3	2013
Brook Stickleback	*Culaea inconstans*	1	2005
Minnow sp.	*Cyprinidae*	1	2014
Common Carp	*Cyprinus carpio*	7	2015
Gizzard Shad	*Dorosoma cepedianum*	3	2014
Northern Pike	*Esox lucius*	2	2008
Banded Killifish	*Fundulus diaphanus*	1	2010
Green Sunfish	*Lepomis cyanellus*	1	2011
Pumpkinseed	*Lepomis gibbosus*	7	2013
Bluegill	*Lepomis macrochirus*	2	2009
Largemouth Bass	*Micropterus salmoides*	1	2015
Golden Shiner	*Notemigonus crysoleucas*	1	2008
Yellow Perch	*Perca flavescens*	7	2013
Bluntnose Minnow	*Pimephales notatus*	2	2013
Fathead Minnow	*Pimephales promelas*	11	2015
Black Crappie	*Pomoxis nigromaculatus*	1	2007
White Bass	*Morone chrysops*	n/a	MNRF Historic data
Spottail Shiner	*Notropis hudsonius*	n/a	MNRF Historic data
Alewife	*Alosa pseudoharengus*	n/a	MNRF Historic data
Blacknose Dace	*Rhinichthys atratulus*	n/a	1979/1980 (reported in 1991 Management Plan)

Common Name	Scientific Name	Number of Years noted in the Marsh	Last Year Recorded (from C.L.O.C.A. Monitoring Plan unless otherwise noted)
Creek Chub	*Semotilus atromaculatus*	n/a	1979/1980 (reported in 1991 Management Plan)
Logperch	*Percina caprodes*	n/a	1979/1980 (reported in 1991 Management Plan)
White Perch	*Morone americana*	n/a	1979/1980 (reported in 1991 Management Plan)
Johnny Darter	*Etheostoma nigrum*	n/a	1979/1980 (reported in 1991 Management Plan)
Common Shiner	*Luxilus cornutus*	n/a	1979/1980 (reported in 1991 Management Plan)
American Eel	*Anguilla rostrata*	n/a	Noted by Hoar (2019, pers. comm.) to have been fished regularly from the Marsh outlet but not seen in over 20 years

Note: The above table include 12 years of monitoring data from between 2002 to 2015.

The list of fish noted in more recent years is typical for nearshore marsh habitat in Lake Ontario. It is difficult to predict the fish species community that will remain in the Marsh in the long term, as conditions may change unpredictably, for example as a result of unusual storm events and vandalism of the fish gate. Exceptionally low water levels and warm temperatures may lead to oxygen-poor conditions in some areas, and though many species are tolerant of low oxygen and warm water, a few species are not as tolerant. Three coolwater species are present: Yellow Perch, White Sucker and Northern Pike, and these may be less likely to survive if warm temperatures dominate for several years. A few species are intolerant of high turbidity (for example, Brook Stickleback), so if large carp were able to return to the Marsh and the turbidity increased these species could be affected. Extensive freezing in the winter could eliminate fish from all but the deepest pools, (with the possible exception of species such as brown bullhead, which can burrow into sediment in winter).

However, fish are likely to recolonize the marsh frequently. The fish gate is designed to allow small fish (up to 7.7 cm in width) to enter the marsh from Farewell Creek, which is open to Lake Ontario. Breaches of the barrier beach (or failure of the fish gate) could also introduce larger fish from time to time, though it is unlikely that they would survive the conditions in the marsh as long as lower water levels were maintained.

3.3.1. Information Gaps

Surveys of the fish community should continue, as they are indicators of aquatic health and habitat change. However, the species present are highly adaptable, and changes in numbers and species may occur with rapid changes in aquatic habitat in different years.

3.4. Invertebrate Communities and Relationships

- Insects have primarily been studied at Second Marsh in the context of water quality measures. The Background Report discusses the benthic communities within the site. As noted in that report, the invertebrate community has been generally characterized by "poor" water quality indicators: chironomids and oligochaetes, since 2011.

3.4.1. Information Gaps

Biodiversity of flying insects has not been sampled at Second Marsh. The species richness and diversity of flying insects is important for its support of aerial insectivores, including bats and birds.

3.5. Mammals

As noted in the Background Report, 29 species of mammals have been noted at Second Marsh. Most of these are widespread species of urban habitats, such as White-tailed Deer, Raccoon, Striped Skunk, Red Fox, Coyote, etc. These mammals are regularly seen at the Marsh. Small mammals are infrequently recorded because of their cryptic habits but methods used to trap small mammals frequently result in high mortality, so they are not recommended.

Wetland species include Muskrat and Beaver, both noted in 2018 surveys. UAV photography was analyzed with the use of an algorithm that searched for characteristic roughly circular openings of flattened vegetation that were interpreted as "duck nests". Many of these appeared on closer examination to be muskrat mounds (which were also possibly being used by nesting ducks). Of 133 "duck nests" noted, 18 appeared to be muskrat mounds, and one appeared to be a beaver lodge. Signs of Beaver were also noted on the southeast corner of the marsh.

As discussed in the Background Report, there is potential maternity roosting habitat within the Ghost Road Bush for four species of bats that are considered Endangered in Canada and Ontario: Little Brown Myotis, Northern Myotis, Eastern Small-footed Bat and Tricoloured Bat. Little Brown Myotis and Northern Myotis form maternity roosts in tree cavities and under loose bark, which are amply available in the Ghost Road Bush.

Tricoloured Bat forms maternity colonies in clusters of dead and live leaves (particularly oak leaves), as well as tree cavities. This species may also be present. All species prefer to roost adjacent to standing water where flying insects are readily available for foraging, so the Ghost

Road Bush provides many aspects of the habitat that for important for bat roosting. Eastern Small-footed Bat forms roosts in rock crevices (and only occasionally tree cavities) and so is less likely to be present than the other species.

3.5.1. Information Gaps

While there is potential habitat for these bat species in the Ghost Road Bush, the actual use by roosting bats has not been documented. Bat monitoring using automated acoustic detection techniques according to protocols developed by the Ontario Ministry of Natural Resources and Forestry (M.N.R.F. 2015) is recommended to determine what function the Marsh serves for these species, if any.

However, the Ministry of Environment, Conservation and Parks (M.E.C.P.) has indicated that the function of the Ghost Road Bush for tree-nesting Species at Risk bats is likely low, and that further surveys would not need to be done to support tree removal assuming certain recommendations for timing and location of removals were followed (email from Margaret Berube to Michelle Whitbread and Heather Brooks, July 10, 2016).

3.6. Reptiles

Four reptile species have been noted specifically within Oshawa Second Marsh: Eastern Gartersnake, Northern Red-bellied Snake, Snapping Turtle and Blanding's Turtle. Reptiles tend to be elusive and can be overlooked, and there have been no comprehensive surveys of reptiles within the marsh that have included, for example, intensive searches for snakes, intensive binocular surveys for basking turtles at the beginning of spring which would indicate whether the marsh is used by turtles for overwintering, etc. Other species that occur within the 10 x 10 km Ontario Reptile and Amphibian Atlas "square", for which habitat is present at Second Marsh, include the following:

- Midland Painted Turtle (last noted 2018)
- Dekay's Brownsnake (last noted 2017)
- Red-eared Slider (a non-native species last noted 2009)
- Milksnake (last noted 1987)
- Eastern Musk Turtle (last noted 1952)

Two provincially significant turtle species have been noted within the marsh, as shown in **Table A14**. One additional turtle species, Midland Painted Turtle, was recently evaluated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (C.O.S.E.W.I.C. 2018), and has been listed on Schedule 1 of the Species at Risk Act. It has not been evaluated

in Ontario by the Committee on the Status of Species at Risk in Ontario (C.O.S.S.A.R.O.) and has not been added to the list of Ontario Species at Risk.

Table A14. Provincially Significant Reptile Species noted in Monitoring at Oshawa Second Marsh (from D.R.C.W.M.P. 2014)

Species	Year last observed	Federal Status/ Status on Schedule 1	Provincial Status / Provincial Rank	Habitat Requirements
Blanding's Turtle	2006	Threatened / Threatened	Threatened / S3	The preferred wetlands occupied are eutrophic and are characterized by shallow water with an organic substrate and high density of aquatic vegetation (C.O.S.E.W.I.C. 2005). Hoar (2019, pers. comm.) notes that he has not seen a young Blanding's Turtle in 40 years.
Snapping Turtle	2018 to 2023 (tracks observed on the beach, nest excavation)	Special Concern / Special Concern	Special Concern / S4	The preferred habitat for the species is characterized by slow-moving water with a soft mud bottom and dense aquatic vegetation (C.O.S.E.W.I.C. 2008).
Midland Painted Turtle	Observed basking in most years	Special Concern / Special Concern	No Status / S4	Inhabits a variety of lakes, ponds and marshes

Hoar (2019, pers. comm.) reports that a Spotted Turtle (a species considered Endangered in Canada and Ontario) was released into the Marsh in 1990. Spotted Turtle were also reported from Farewell Creek upstream of the marsh in the 1991 annual bird report (Henshaw and Kamstra 1991).

3.7. Significant Wildlife Habitat

While analysis of Significant Wildlife Habitat (S.W.H.) is often used to indicate whether an area should be protected under the Provincial Policy Statement (P.P.S.) it is also useful for indicating the ecological functions that would be considered significant in a provincial context. In this case, S.W.H. can be used to highlight which habitat functions could be prioritized for maintaining and enhancing in the long term.

All types of Significant Wildlife Habitat (S.W.H.) are shown in **Table A15**, with an analysis of whether this type of habitat occurs on site (for further detail on criteria for S.W.H., please see Ecoregion Schedules for Ecoregion 6E: M.N.R.F. 2015). The site meets the criteria for nine S.W.H. types, all associated with the wetland and woodland habitats on the site (the large marsh and deciduous swamp south of Colonel Sam Drive). Oshawa Second Marsh also meets the criteria for nine additional categories of S.W.H., which need to be confirmed with species observations.

Table A15. Analysis of S.W.H. at Oshawa Second Marsh according to M.N.R.F. Ecoregion Schedules for Ecoregion 6E (M.N.R.F. 2015)

Type of S.W.H.	Meets Criteria for S.W.H. according to Ecoregion Schedule
Seasonal Concentration Areas of Animals	
Waterfowl Stopover and Staging Areas (Terrestrial)	**No** – no flooded grain fields noted in areas within study area
Waterfowl Stopover and Staging Areas (Aquatic)	**Yes** – significant areas of standing water with number and diversity of species present that meet criteria
Shorebird Migratory Stopover Area	**Yes** –shorebird staging noted; numbers and diversity have been reported that meet criteria
Raptor Wintering Area	**No** – meadow habitat does not meet criteria provided in Ecoregion schedule
Bat Hibernacula	**No** – no caves present where bats could avoid freezing temperatures
Bat Maternity Colonies	**Candidate** (within Ghost Road Bush) – habitat within woodlands is suitable to support maternity roosts for Big Brown Bats and Silver-haired Bats.
Turtle Wintering Areas	**Candidate** –areas of permanent standing water present, turtles observed in these areas
Reptile Hibernaculum	**Not known** - none known; no unusual concentrations of snakes noted
Colonially -Nesting Bird Breeding Habitat (Bank and Cliff)	**No** – no banks or cliffs present
Colonially -Nesting Bird Breeding Habitat Breeding Habitat (Tree/Shrubs)	**No** - no colonial tree/shrub nesting species noted nesting regularly
Colonially -Nesting Bird Breeding Habitat (Ground)	**No** –colonial ground-nesting species noted (Common Tern) on nesting platforms only

Type of S.W.H.	Meets Criteria for S.W.H. according to Ecoregion Schedule
Migratory Butterfly Stopover Areas	**No** - Site is within 5 km of Lake Ontario but butterflies have not been reported in sufficient numbers to meet this qualification
Landbird Migratory Stopover Areas	**Candidate** - Site is within 5 km of Lake Ontario and large numbers of landbirds have been noted in migration; numbers and diversity have not been formally evaluated
Deer Yarding Areas	**No** - Not mapped by M.N.R.F.
Deer Winter Congregation Areas	**No** - Not mapped by M.N.R.F., no unusual concentrations of deer sign noted
Rare Vegetation Communities or Specialized Habitat for Wildlife	
Rare Vegetation Communities	**Yes** – rare vegetation community noted on barrier beach, and in coastal meadow marsh at the southeastern corner of the marsh
Waterfowl Nesting Area	**Candidate** – number and diversity of nesting waterfowl may meet criteria in Ecoregion schedules
Bald Eagle and Osprey Nesting, Foraging and Perching Habitat	**Candidate** –Osprey and Bald Eagle present
Woodland Raptor Nesting Habitat	**No** – woodland does not provide candidate SWH in terms of size and interior area
Turtle Nesting Areas	**Yes** – turtles have been noted nesting on the Barrier Beach; they likely also nest on the constructed dyke but human-made habitat is specifically excluded from Significant Wildlife Habitat by M.N.R.F.
Seeps and Springs	**No** - Seeps and springs not noted
Amphibian Breeding Habitat (Woodlands)	**Yes** –numbers of amphibians in vernal pools in Ghost Road Bush and pools adjacent to the Marsh met criteria in the past that indicate S.W.H., though current numbers may not meet criteria in some areas
Amphibian Breeding Habitat (Wetlands)	**Yes** – Number and diversity of amphibians that breed in wetlands meet criteria
Woodland Area-Sensitive Bird Breeding Habitat	**No** – no areas of forest interior > 200 m from edge and indicator species not present
Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species)	

Type of S.W.H.	Meets Criteria for S.W.H. according to Ecoregion Schedule
Marsh Bird Breeding Habitat	**Yes** - habitat present; indicator species noted in numbers and diversity that meet criteria
Open Country Bird Breeding Habitat	**No** - habitat not present, indicator species not noted
Shrub/Early Successional Bird Breeding Habitat	**No** – some habitat present (though not of a size sufficient to meet criteria), but indicator species not noted in sufficient numbers or diversity to meet criteria
Terrestrial Crayfish	**No** – no evidence of terrestrial crayfish observed
Special Concern and Rare Wildlife Species	**Yes** – Eastern Wood-pewee in Ghost Road Bush; Snapping Turtle noted in vicinity of wetland
Animal Movement Corridors	**Candidate** – Movement corridors for amphibians moving from their terrestrial habitat to breeding habitat can be extremely important for local populations; movement not documented on the site but likely occurs between ponds and between habitat on- and off-site; movement between habitat north and south of Colonel Sam Drive has not been studied

APPENDIX A1 | List of Flora Species Noted at Oshawa Second Marsh

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Acorus americanus (Raf.) Raf.	American Sweetflag	G5	S4			R3	R		8									
Agalinis tenuifolia (Vahl) Raf.	Slender-leaved False Foxglove	G5	S4S5			U	R		7		x		x	x			x	
Alopecurus aequalis Sobol. var. aequalis	Short-awned Foxtail	G5T5	S4			R10	U		7									
Amelanchier laevis Wiegand	Smooth Serviceberry	G5	S5			U	U		5									
Amelanchier sanguinea (Pursh) DC.	Round-leaved Serviceberry	G5	S5			X	U	Rr	7								x	
Anemone quinquefolia L. var. quinquefolia	Wood Anemone	G5T5	S5			R4	U		7								x	
Bidens discoidea (Torr. & A.Gray) Britton	Small Beggarticks	G5	S4			R3	R	NP	6									
Bolboschoenus fluviatilis (Torr.) Soják	River Bulrush	G5	S4S5			R3	R		7				x		x			
Cakile edentula subsp. edentula var. lactustris Fernald	Great Lakes Sea Rocket	G5T3T5	S4			R6	R	Rr	9	x								
Calla palustris L.	Wild Calla	G5	S5			U	U		8									
Campanula aparinoides Pursh	Marsh Bellflower	G5	S5			R4	R		7									
Cardamine bulbosa (Schreb. ex Muhlenb.) Britton, Sterns & Poggenb.	Bulbous Bitter-cress	G5	S4			R1	R		8									
Cardamine pensylvanica Muhlenb. ex Willd.	Pennsylvania Bittercress	G5	S5			U	U		6									
Carex annectens (E.P.Bicknell) E.P.Bicknell	Yellow-fruited Sedge	G5	S2						9									
Carex aquatilis Wahlenb.	Water Sedge	G5	S5			U	R		7									
Carex atherodes Spreng.	Wheat Sedge	G5	S4			R3	R	R	6									
Carex lasiocarpa Ehrh.	Woolly-fruit Sedge	G5	S5			R7	R		8									
Carex lurida Wahlenb.	Sallow Sedge	G5	S4S5			R4	R1		6									
Carex normalis Mack.	Larger Straw Sedge	G5	S4			E	R	R	6									
Carex pallescens L.	Pale Sedge	G5	S4			R5	R	R	5									
Carex pellita Willd.	Woolly Sedge	G5	S5			U	R		4									

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Carex scoparia Schkuhr ex Willd.	Pointed Broom Sedge	G5	S5			R1	R		5					x				
Carex siccata Dewey	Dry-spike Sedge	G5	S4			R5	R		8	x								
Carex umbellata Schkuhr ex Willd.	Umbellate Sedge	G5	S5			R2	R	R	7									
Carex vesicaria L.	Inflated Sedge	G5	S5			R1	R		7									
Carex viridula Michx. subsp. viridula	Greenish Sedge	G5T5	S5			R5	R		5									
Castanea dentata (Marsh.) Borkh.	American Chestnut	G4	S1S2	END	END		R	NPRr	8									
Celtis occidentalis L.	Common Hackberry	G5	S4			E	R		8									
Ceratophyllum demersum L.	Common Hornwort	G5	S5			U	U		4							x	x	
Chelone glabra L.	White Turtlehead	G5	S5			U	U		7			x			x		x	
Comandra umbellata (L.) Nutt. subsp. umbellata	Eastern Bastard Toad-flax	G5T5	S5				R		6									
Comarum palustre L.	Marsh Cinquefoil	G5	S5			U	U		7				x					
Cornus obliqua Raf.	Silky Dogwood	G5	S5			U	U		5		x						x	x
Cornus racemosa Lam.	Grey Dogwood	G5	S5			R6	X		2									
Cyperus bipartitus Torr.	Shining Flatsedge	G5	S5			R5	R		4						x			
Cyperus odoratus L.	Rusty Flatsedge	G5	S4			R6	R	R	5				x		x	x		
Cypripedium parviflorum var. makasin (Farw.) Sheviak	Small Yellow Lady's-slipper	G5T4T5	S4S5			U	U		7									
Cypripedium reginae Walter	Showy Lady's-slipper	G4G5	S4			R11	R		7									
Cystopteris fragilis (L.) Bernh.	Fragile Fern	G5	S4				E	Rr	7									
Dasiphora fruticosa (L.) Rydb.	Shrubby Cinquefoil	G5	S5			R1	R		9		x							
Decodon verticillatus (L.) Elliott	Swamp Loosestrife	G5	S5			R5	R		7									
Deparia acrostichoides (Swartz) M. Kato	Silvery Spleenwort	G5	S4			U	U		8									
Eleocharis acicularis (L.) Roem. & Schult.	Needle Spikerush	G5	S5			U	R		5						x			
Eleocharis palustris (L.) Roemer & Schultes	Creeping Spikerush	G5?	S5			R8	U		6									
Elodea canadensis Michx.	Canada Waterweed	G5	S5			U	U		4						x	x		

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Elodea nuttallii (Planch.) H.St.John	Nuttall's Waterweed	G5	S3				R	R	8									
Elymus canadensis L. var. canadensis	Canada Wildrye	G5T5	S5			R2	R		8	x	x				x			
Elymus riparius Wiegand	Eastern Riverbank Wildrye	G5	S4			R4	R		7									
Elymus virginicus L.	Virginia Wildrye	G5	S5			U	X		5								x	
Epilobium coloratum Biehler	Purple-veined Willowherb	G5	S5			R5	R		3									
Equisetum pratense Ehrh.	Meadow Horsetail	G5	S5			U	R		8								x	
Equisetum sylvaticum L.	Woodland Horsetail	G5	S5			R7	R		7								x	
Euphorbia polygonifolia L.	Seaside Spurge	G5?	S4			R3	R	Rr	10	x								
Eutrochium purpureum (L.) E.E.Lamont var. purpureum	Purple Joe Pye Weed	G5T5?	S4			E	R	NPRr	8									
Galium aparine L.	Common Bedstraw	G5	S5			U	U		4									
Galium asprellum Michx.	Rough Bedstraw	G5	S5			U	U		6				x		x	x		
Gentiana andrewsii Griseb. var. andrewsii	Andrews' Bottle Gentian	G5?T5?	S4			R10	R		6		x		x	x	x			
Geranium maculatum L.	Spotted Geranium	G5	S5			R7	U		6								x	
Hackelia virginiana (L.) I.M.Johnst.	Virginia Stickseed	G5	S5			R4	U		5								x	
Hamamelis virginiana L.	American Witch-hazel	G5	S4S5			R4	X		6									
Heracleum maximum W.Bartram	American Cow Parsnip	G5	S5			R4	R		3								x	
Hypericum punctatum Lam.	Spotted St. John's-wort	G5	S5			R2	R		5									
Hypopitys monotropa Crantz	Pinesap	G5	S4			R5	R		6									
Impatiens pallida Nutt.	Pale Jewelweed	G5	S4			R6	U		7								x	
Iris brevicaulis Raf.	Short-stemmed Iris	G4	S1						9								x	
Juglans cinerea L.	Butternut	G4	S2?	END	END	X	X		6									
Juglans nigra L.	Black Walnut	G5	S4?			U	X	r	5								x	
Juncus balticus subsp. littoralis (Engelm.) Snogerup	Shoreline Rush	G5T5	S5			R8	R		5	x			x	x				
Juncus canadensis J.Gay ex Laharpe	Canada Rush	G5	S5			R2	R		6				x			x		

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Juncus nodosus L.	Knotted Rush	G5	S5			U	U		5									
Juniperus virginiana L. var. virginiana	Eastern Red Cedar	G5T5	S5			X	U		4		x							
Lactuca biennis (Moench) Fernald	Tall Blue Lettuce	G5	S5			U	U		6								x	
Lathyrus palustris L.	Marsh Vetchling	G5	S5			U	R		6	x							x	
Lemna trisulca L.	Star Duckweed	G5	S5			X	U		4							x	x	
Lilium canadense L.	Canada Lily	G5	S1?															
Lilium michiganense Farw.	Michigan Lily	G5	S4			U	U		7						x		x	
Lindera benzoin (L.) Blume	Northern Spicebush	G5	S4				R		6									
Liparis loeselii (L.) Rich.	Loesel's Twayblade	G5	S4S5			U	U		5									
Liriodendron tulipifera L.	Tulip Tree	G5	S4					NPRr	8		x							
Lonicera canadensis Bartram ex Marshall	Canada Fly-honeysuckle	G5	S5			U	X		6		x							
Ludwigia palustris (L.) Elliott	Marsh Seedbox	G5	S5			R4	R		5						x			
Lycopus asper Greene	Rough Water-horehound	G5	S4			R1	R											
Lysimachia terrestris (L.) Britton, Sterns & Poggenb.	Swamp Yellow Loosestrife	G5	S5			U	R		6				x				x	
Lysimachia thyrsiflora L.	Tufted Yellow Loosestrife	G5	S5			U	U		7									
Menyanthes trifoliata L.	Bog Buckbean	G5	S5			R3	R		9									
Mimulus ringens L. var. ringens	Square-stemmed Monkeyflower	G5T5	S5			X	U		6	x			x	x			x	
Muhlenbergia frondosa (Poir.) Fernald	Leafy Muhly	G5	S4			R4	R	R	5									
Myriophyllum sibiricum Kom.	Siberian Water-milfoil	G5	S5			R1	R		6							x		
Nuphar variegata Engelm. ex Durand	Variegated Pond-lily	G5	S5			U	U		4				x		x	x		x
Nymphaea odorata subsp. tuberosa (Paine) Wiersma & Hellquist	Tuberous White Water-lily	G5T5	SU			X	U									x		
Oenothera biennis L.	Common Evening Primrose	G5	S5			X	U		0	x								
Oenothera parviflora L.	Small-flowered Evening Primrose	G5	S5			U	X		1	x					x			

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Oenothera perennis L.	Perennial Evening Primrose	G5	S5			R4	R		6		x							
Panicum virgatum L.	Old Switch Panicgrass	G5	S4				R		6		x							
Persicaria punctata (Elliott) Small	Dotted Smartweed	G5	S5			R4	R		4				x		x			
Platanthera hyperborea (L.) Lindl.	Leafy Northern Green Orchid	G5	S4S5			U	U		5									
Platanthera psycodes (L.) Lindl.	Small Purple Fringed Orchid	G5	S4?			R5	R		8									
Platanus occidentalis L.	Sycamore	G5	S4			R2	R	r	8									
Pontederia cordata L.	Pickerelweed	G5	S5			R2	R		7	x					x			
Potamogeton berchtoldii Fieber	Narrow-leaved Small Pondweed	G5	S5			R2	R		4									
Potamogeton foliosus Raf. subsp. foliosus	Leafy Pondweed	G5T5	S5			R4	R		4									
Potamogeton natans L.	Floating-leaved Pondweed	G5	S5			U	U		5									
Potamogeton pusillus L.	Small Pondweed	G5	S4?			U	R		5	x						x	x	
Potamogeton richardsonii (A. Bennett) Rydb.	Richardson's Pondweed	G5	S5			U	R		5						x			
Potentilla canadensis L.	Canada Cinquefoil	G5	S2?			R2	R		5									
Potentilla simplex Michx.	Old Field Cinquefoil	G5	S5			U	U		3		x							
Potentilla supina subsp. paradoxa (Nutt.) Sojak	Bushy Cinquefoil	G5T5	S4			R3	R	PRr	8	x								
Prunus nigra Aiton	Canada Plum	G4G5	S4			U	U		4									
Quercus alba L.	White Oak	G5	S5			R4	X		6									
Quercus bicolor Willd.	Swamp White Oak	G5	S4				R		8									
Quercus macrocarpa Michx.	Bur Oak	G5	S5			U	X		5									x
Ranunculus pensylvanicus L.f.	Pennsylvania Buttercup	G5	S5			R10	R		3								x	
Rhynchospora alba (L.) M. Vahl	White Beakrush	G5	S5			R1	R		10									
Rosa acicularis subsp. sayi (Schwein.) W.H.Lewis	Prickly Rose	G5T5	S5			R1	R		7								x	
Rosa palustris Marshall	Swamp Rose	G5	S5			R4	R		7								x	
Rubus pensilvanicus Poir.	Pennsylvania Blackberry	G5	SU					R	6									

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Rumex britannica L.	Greater Water Dock	G5	S5			U	U		6									
Sagittaria rigida Pursh	Sessile-fruited Arrowhead	G5	S4			R2	R		6				x					
Salix lucida Muhlenb.	Shining Willow	G5	S5			X	U		5						x		x	
Salix myricoides Muhlenb.	Bayberry Willow	G4	S4			R2	R	Rr	10									
Salix nigra Marshall	Black Willow	G5	S4			R5	R		6									
Salix serissima (L.H.Bailey) Fernald	Autumn Willow	G5	S5			R2	R		6									
Sanicula marilandica L.	Maryland Sanicle	G5	S5			U	X		5								x	
Schoenoplectus pungens (Vahl) Palla	Common Three-square Bulrush	G5	S5			R2	R		6									
Scirpus cyperinus (L.) Kunth	Common Wooly Bulrush	G5	S5			X	X	R	4				x					
Scirpus microcarpus J.Presl & C.Presl	Red-tinged Bulrush	G5	S5			U	U		4								x	
Scirpus pendulus Muhlenb. ex Willd.	Hanging Bulrush	G5	S5			U	U		3									
Scrophularia marilandica L.	Carpenter's Figwort	G5	S4			R2	R		7						x			
Shepherdia canadensis (L.) Nutt.	Soapberry	G5	S5			R8	R		7									
Solidago juncea Aiton	Early Goldenrod	G5	S5			U	U		3									
Sparganium americanum Nutt.	American Burreed	G5	S5			R3	R		6									
Sparganium eurycarpum Engelm.	Broad-fruited Burreed	G5	S5			U	U		3				x		x	x	x	x
Sphenopholis intermedia (Rydb.) Rydb.	Slender Wedgegrass	G5	S4S5			R5	U		6									
Spiraea tomentosa L.	Steeplebush	G5	S5			R4	R		5								x	
Spiranthes cernua (L.) Rich.	Nodding Ladies'-tresses	G5	S5			U	R		5		x		x					
Spirodela polyrhiza (L.) Schleid.	Great Duckweed	G5	S5			U	U		4	x					x	x	x	
Sporobolus cryptandrus (Torr.) A.Gray	Sand Dropseed	G5	S4			U	R		2									
Stachys palustris L.	Marsh Hedge-nettle	G5	SE5			R1	R						x		x		x	
Stuckenia pectinata (L.) Börner	Sago Pondweed	G5	S5			X	U		4			x	x		x	x		

Scientific Name	Common Name	G Rank	S Rank	SARA	ESA	Durham	GTA	Central Region	CC	BBS,BBO, BBT	CU	FOD 7	MAM	MAM 4	MAS	SA	SWD	SWT
Symphoricarpos albus (L.) S.F. Blake	Thin-leaved Snowberry	G5	S5			U	U		7		x							
Symphyotrichum boreale (Torr. & A.Gray) Á.Löve & D.Löve	Rush Aster	G5	S5			R6	R		10								x	
Symphyotrichum ciliatum (Ledob.) G.L.Nesom	Rayless Alkali Aster	G5	S3?			X	X				x							
Symphyotrichum pilosum var. pringlei (A.Gray) G.L.Nesom	Pringle's Aster	G5T5	S4				R		9								x	
Toxicodendron radicans (L.) Kuntze var. radicans	Eastern Poison Ivy	G5T5	S5			U	X		5	x	x						x	
Utricularia vulgaris subsp. macrohiza (Leconte ex Torr.) R.T. Clausen	Greater Bladderwort	G5T5	S5			X	U		4				x			x	x	
Vaccinium macrocarpon Aiton	Large Cranberry	G4	S4			R3	R		10									
Vallisneria americana Michx.	American Eelgrass	G5	S5			R3	R		6									
Veronica americana (Raf.) Schwein. ex Benth.	American Speedwell	G5	S5			R6	U		6							x		
Veronica catenata Pennell	Sessile Water-speedwell	GNR	SU				R	R	7									
Veronica scutellata L.	Marsh Speedwell	G5	S5			R5	R		7								x	
Viburnum nudum var. cassinoides (L.) Torr. & A.Gray	Wild Raisin	G5	S5			R5	R		7									
Viburnum opulus subsp. trilobum var. americanum Aiton	Highbush Cranberry	G5T5	S5			U	X		5		x						x	x
Viola nephrophylla Greene	Northern Bog Violet	G5	S5			R2	R		7									
Wolffia borealis (Engelm.) Landolt & Wildi ex Gandhi, Wiersema & Brouillet	Northern Watermeal	G5	S4S5			R6	R		4						x			
Wolffia columbiana H.Karst.	Columbia Watermeal	G5	S4S5			R8	R		4								x	
Zannichellia palustris L.	Horned Pondweed	G5	S4			R3	R	R	4							x		

APPENDIX 2 | List of Questions Used for Stakeholder Engagement

Second Marsh Management Plan

Public Survey, Preliminary Management Plan

SCHOLLEN & Company Inc. / North-South Environmental Inc.

Interest in Second Marsh

1. How important is Second Marsh to you?
   Please select one.

   ☐ Very important

   ☐ Important

   ☐ Somewhat important

   ☐ Not important

   ☐ Other, please specify: _____

2. Have you visited Second Marsh in the past?

   ☐ Yes

   ☐ No, skip to **Question 5**

3. Which of the following best captures how often you have visited Second Marsh in the past? Please select one.

- ☐ 4 or more times per week
- ☐ 1 to 3 times per week
- ☐ 1 to 3 times per month
- ☐ 2 to 6 times per year
- ☐ Once a year
- ☐ Once every few years

4. If you <u>have</u> visited Second Marsh, what was the purpose of your visit(s)?
   Please select all that apply and then skip to **Question 11**.

   ☐ Nature-based activity (e.g. bird watch, photography, nature walks)

   ☐ Family outing (e.g. picnics, family gatherings)

   ☐ Relaxation (e.g. sit, read, visit natural setting)

   ☐ Educational activity (e.g. school groups, educational tours)

   ☐ Transportation (e.g. walk or cycle to or from a location)

   ☐ Water-based activity (e.g. canoe, kayak, swim)

   ☐ Physical activity (e.g. run, bike, walk)

   ☐ Stewardship / Restoration event

   ☐ Other, please specify: _____

5. If you have not visited Second Marsh, why not?

- ☐ Lack of time
- ☐ Lack of awareness of Second Marsh
- ☐ Lack of programs
- ☐ Safety concerns
- ☐ Accessibility / transportation
- ☐ Lack of facilities
- ☐ Lack of trails
- ☐ Not interested
- ☐ Other, please specify: _____

6. Prior to the closure of Second Marsh to the public as a result of the hazards imposed by the decline of the ash trees, how would you rate the current level of maintenance of Second Marsh?

- ☐ Excellent
- ☐ Good
- ☐ Average
- ☐ Poor
- ☐ Very poor
- ☐ Other, please specify: _____

Management Plan Vision

The draft vision for Second Marsh is stated as follows:

“That the Oshawa Second Marsh Area is a healthy, diverse ecological system whose significant features and functions are valued and protected to provide ecosystem services for present and future generations.”

7. Do you agree with this vision statement?

   ☐ Yes (skip to **Question 9**)

   ☐ No

8. If your response was “No”, what changes or additions would you like to see?

   _____

   _____

   _____

Management Plan Goals

The following are the goals that formed the foundation of the Second Marsh Management Strategy (May 1999).

- **Watershed Goal:**

  Reduce the sediments, nutrients and other pollutants entering Second Marsh from upstream watershed sources and reduce extremes in stream flow.

- **Ecological Restoration Goal:**

  Restore an ecologically diverse wetland with healthy, self-sustaining population of flora and fauna.

- **Community Support and Participation Goal:**

  Enlist broad community support for and participation in programs and restoration activities at the Marsh.

- **Education/Learning Goal:**

  Establish Second Marsh a centre of continuous learning about wetland ecosystems.

- **Recreational/Tourism Goal:**

  Promote recreational and tourism uses that are compatible with the Marsh environment as part of a broader regional destination node.

9. Do you agree with the goals as stated?

   ☐ Yes (skip to **Question 11**)

   ☐ No

10. If your response was “No”, what additions or changes do you suggest for incorporation in the updated Management Plan?

_____

_____

_____

_____

_____

_____

11. What is most important for Second Marsh?
Please select one option per row.

	1 (Most Important)	2	3	4	5	6 (Least Important)
Protection of the ecosystem	☐	☐	☐	☐	☐	☐
Opportunities for recreation	☐	☐	☐	☐	☐	☐
Opportunities for nature experience	☐	☐	☐	☐	☐	☐
Educational opportunities	☐	☐	☐	☐	☐	☐
Opportunities for exercise	☐	☐	☐	☐	☐	☐
Opportunities for access to the Lake / waterfront	☐	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐	☐

12. Please indicate the level of importance you give to the following Second Marsh community elements:

	1 (Most Important)	2	3	4	5	6 (Least Important)
Encourage environmental education, nature appreciation and stewardship	☐	☐	☐	☐	☐	☐
Promote a range of recreational activities while being sensitive to the environment	☐	☐	☐	☐	☐	☐
Provide opportunities to experience culture (e.g. performing arts, public art, social events, or cultural celebrations)	☐	☐	☐	☐	☐	☐
Promote tourism and allow revenue generation opportunities to offset costs to the community	☐	☐	☐	☐	☐	☐
Provide opportunities for social interaction and gathering	☐	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐	☐

13. Please indicate the level of importance you give to the following access and connection elements of Second Marsh:

	1 (Most Important)	2	3	4	5	6 (Least Important)
Link trails to local and regional roads	☐	☐	☐	☐	☐	☐
Improve linkages between Second Marsh and the Waterfront trail	☐	☐	☐	☐	☐	☐
Provide better opportunities to access the lake (i.e. boardwalks and shoreline improvements)	☐	☐	☐	☐	☐	☐
Increase the number of places where the public can access the marsh	☐	☐	☐	☐	☐	☐
Ensure that people of all physical abilities can access the Second Marsh	☐	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐	☐

Services and Infrastructure

14. Please indicate the level of importance you give to the following Second Marsh transportation elements:

	1 (Most Important)	2	3	4	5	6 (Least Important)
Trails for biking	☐	☐	☐	☐	☐	☐
Vehicle parking	☐	☐	☐	☐	☐	☐
Secure bicycle parking	☐	☐	☐	☐	☐	☐
Transit stops in close proximity	☐	☐	☐	☐	☐	☐
Safe bridges / boardwalks	☐	☐	☐	☐	☐	☐
Connection to existing trails	☐	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐	☐

15. How long are you willing to travel to visit Second Marsh?
Please select one.

- ☐ Less than 5 minutes
- ☐ 6 to 10 minutes
- ☐ 11 to 30 minutes
- ☐ 31 minutes or more
- ☐ Does not matter

16. What types of activities would you like to pursue at Second Marsh?
Please select one option per row.

	Very desirable	Desirable	Somewhat desirable	Not desirable	Do not know
(A) Picnicking	☐	☐	☐	☐	☐
(B) Fishing / Water activities	☐	☐	☐	☐	☐
(C) Biking	☐	☐	☐	☐	☐
(D) Walking / Hiking	☐	☐	☐	☐	☐
(E) Education Programs	☐	☐	☐	☐	☐
(F) Relaxation (e.g. visit natural setting, bird watch) / Quiet time	☐	☐	☐	☐	☐
(G) Organized activities (e.g. events, festivals, naturalization programs)	☐	☐	☐	☐	☐
(H) Winter Activities (e.g. cross-country skiing / snowshoeing, skating)	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐

17. What types of park facilities and services would you like to see at Second Marsh?
Please select one option per row.

	Very desirable	Desirable	Somewhat desirable	Not desirable	Do not know
(A) Picnic shelters	☐	☐	☐	☐	☐
(B) Seating	☐	☐	☐	☐	☐
(C) More trails	☐	☐	☐	☐	☐
(D) Educational / Learning centres	☐	☐	☐	☐	☐
(E) Parking Areas	☐	☐	☐	☐	☐
(F) Observation decks / lookouts	☐	☐	☐	☐	☐
(G) Equipment rentals (e.g. skis, binoculars, etc.)	☐	☐	☐	☐	☐
(H) Serviced washrooms	☐	☐	☐	☐	☐
(I) Information signage	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐

18. What types of interpretive and educational elements would you prefer for Second Marsh?
Please select one option per row.

	Very desirable	Desirable	Somewhat desirable	Not desirable	Do not know
(A) Commemorative sculpture	☐	☐	☐	☐	☐
(B) Signage	☐	☐	☐	☐	☐
(C) Educational centre	☐	☐	☐	☐	☐
(D) Interactive opportunities	☐	☐	☐	☐	☐
(E) Historical interpretation elements	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐

19. What types of trails would you prefer in at Second Marsh?
Please select one option per row.

	Very desirable	Desirable	Somewhat desirable	Not desirable	Do not know
(A) Paved	☐	☐	☐	☐	☐
(B) Gravel	☐	☐	☐	☐	☐
(C) All natural	☐	☐	☐	☐	☐
(D) A combination	☐	☐	☐	☐	☐
(E) Accessible for strollers and wheelchairs	☐	☐	☐	☐	☐
Other, please specify: _____	☐	☐	☐	☐	☐

20. Imagine Second Marsh 20 - 25 years from now; please list the elements you would like it to have:

_____

_____

_____

_____

_____

21. How likely would you be to join a Second Marsh stewardship group to support its continued restoration and enhancement?

- ☐ Very likely
- ☐ Likely
- ☐ Somewhat likely
- ☐ Not likely
- ☐ No interest

22. How would you prefer to be informed about initiatives at Second Marsh?
Please select all that apply.

- ☐ Community newsletters
- ☐ Newspaper
- ☐ Letters
- ☐ Email (mailing lists)
- ☐ Website
- ☐ Other, please specify: _____

Personal information on this form is collected pursuant to Section 11 of the Municipal Act, 2001 and will be used to provide input to the development of the Second Marsh Management Plan. Questions about this collection should be directed to the City's Freedom of Information Coordinator at 50 Centre Street South, Oshawa, Ontario, L1H 3Z7 or by phone at 905-436-3311.

23. Do you have any further comments regarding the Second Marsh Management Plan?

_____

_____

_____

_____

_____

_____

_____

_____

Demographics & Community Engagement Evaluation

24. How old are you?

☐	12 and under	☐	13 – 17
☐	18 – 24	☐	25 – 34
☐	35 – 44	☐	45 – 54
☐	55 – 64	☐	65+

25. Are you an Oshawa resident, and/or Oshawa business/property owner?

☐	Yes	☐	No (skip to **Question 28**)

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26. If you answered "Yes" to **Question 25**, what does your postal code begin with:

☐	L1G	☐	L1H – North of King St.
☐	L1H – South of King St.	☐	L1J
☐	L1K	☐	L1L

27. If you answered "Yes" to **Question 25**, what ward do you live in / is your business in:

☐	Ward 1	☐	Ward 2
☐	Ward 3	☐	Ward 4
☐	Ward 5	☐	Don't know

28. If you answered "No" to **Question 25**, please provide the first three digits of your postal code.

☐☐☐

Personal information on this form is collected pursuant to Section 11 of the Municipal Act, 2001 and will be used to provide input to the development of the Second Marsh Management Plan. Questions about this collection should be directed to the City's Freedom of Information Coordinator at 50 Centre Street South, Oshawa, Ontario, L1H 3Z7 or by phone at 905-436-3311.

29. Please rate the following statements.

	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree
I understand how my Second Marsh Management Plan feedback will be used.	☐	☐	☐	☐	☐
I have a good understanding of the Second Marsh Management Plan based on the information provided in the survey.	☐	☐	☐	☐	☐
I feel the survey was a good opportunity to participate in the Second Marsh Management Plan consultation.	☐	☐	☐	☐	☐
I understand the next steps in the Second Marsh Management Plan consultation and timing going forward.	☐	☐	☐	☐	☐

30. Would you like to be contacted about future community meetings, focus groups, or initiatives for Second Marsh?

☐ Yes ☐ No

31. If you answered “Yes” to **Question 30**, please provide the following contact information:

Name: _____

Phone number: _____

Email address: _____

Personal information on this form is collected pursuant to Section 11 of the Municipal Act, 2001 and will be used to provide input to the development of the Second Marsh Management Plan. Questions about this collection should be directed to the City’s Freedom of Information Coordinator at 50 Centre Street South, Oshawa, Ontario, L1H 3Z7 or by phone at 905-436-3311.

APPENDIX 3 | Public Consultation

Project Report

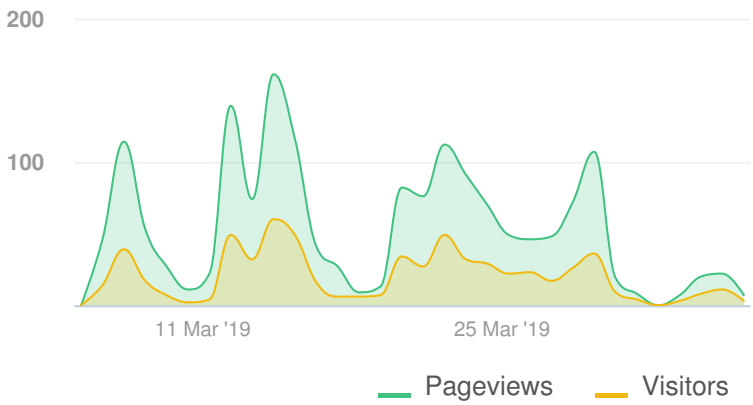
04 March 2019 - 04 April 2019

Connect Oshawa

Second Marsh Management Plan

engagement hq by Bang the Table

Visitors Summary



Highlights

TOTAL VISITS	MAX VISITORS PER DAY	NEW REGISTRATIONS
705	60	7

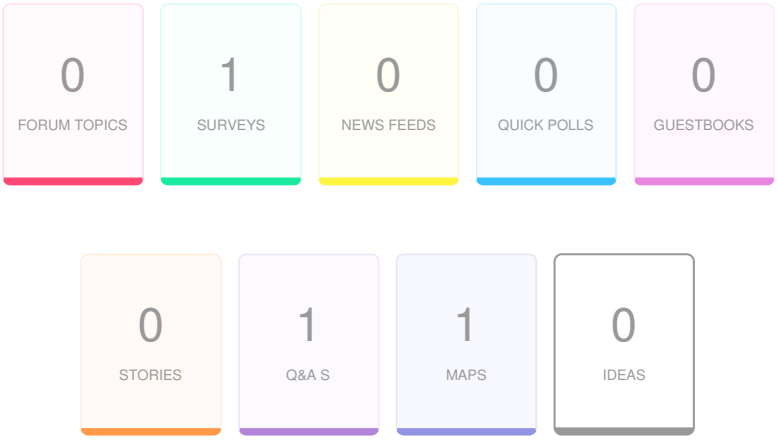
ENGAGED VISITORS	INFORMED VISITORS	AWARE VISITORS
125	364	590

Aware Participants	590
Aware Actions Performed	Participants
Visited a Project or Tool Page	590

Informed Participants	364
Informed Actions Performed	Participants
Viewed a video	0
Viewed a photo	17
Downloaded a document	120
Visited the Key Dates page	4
Visited an FAQ list Page	0
Visited Instagram Page	0
Visited Multiple Project Pages	222
Contributed to a tool (engaged)	125

Engaged Participants	125		
Engaged Actions Performed	Registered	Unverified	Anonymous
Contributed on Forums	0	0	0
Participated in Surveys	19	35	63
Contributed to Newsfeeds	0	0	0
Participated in Quick Polls	0	0	0
Posted on Guestbooks	0	0	0
Contributed to Stories	0	0	0
Asked Questions	2	1	0
Placed Pins on Places	1	7	0
Contributed to Ideas	0	0	0

ENGAGEMENT TOOLS SUMMARY



Tool Type	Engagement Tool Name	Tool Status	Visitors	Contributors		
				Registered	Unverified	Anonymous
Qanda	Question & Answer	Archived	29	2	1	0
Map	Second Marsh Management Plan	Archived	91	1	7	0
Survey Tool	Second Marsh Management Plan Survey	Archived	282	19	35	63

INFORMATION WIDGET SUMMARY

3	7	0	0	0
DOCUMENTS	PHOTOS	VIDEOS	FAQS	KEY DATES

Widget Type	Engagement Tool Name	Visitors	Views/Downloads
Document	Second Marsh Draft Background Report	109	132
Document	Second Marsh Management Plan Public Open House Presentation Boards	22	24
Document	Second Marsh Management Plan Image Loop	3	3
Photo	Second Marsh	11	11
Photo	Second Marsh	9	9
Photo	Second Marsh	9	10
Photo	Second Marsh	8	8
Photo	Second Marsh	5	5
Photo	Second Marsh	5	5
Photo	Second Marsh	5	5
Key Dates	Key Date	4	4

QANDA

Question & Answer

VISITORS 29	CONTRIBUTORS 3	CONTRIBUTIONS 3

Q

14 March 19

Is the City considering puchasing adjacent vacant property lots (such as along the west side of Colonel Sam Dr) t o help preserve and protect the area around the marsh?

A

Publicly Answered

Hi [**username**], thank you for your question. The Management Plan is focused on managing the existing land associate d with Oshawa Second Marsh.

Q

16 March 19

what is the difference between the community engagement table and public open house?

A

Publicly Answered

Hi [**username**], thank you for your question.At both the community engagement table and the Public Open House, atten dees will be able to:complete a survey on paper or online;participate in the place marking exercise on paper or onl ine; and,ask questions to consultation representative.Community engagement tables will pop-up in hallways at thr ee city facilities: South Oshawa Community Centre, City Hall and Delpark Homes Centre (formerly Legends Cent re). Organizations that support Second Marsh will join City staff at these events.Drop-in Public Open Houses will r un out of the C-Wing Committee Room at City Hall. This will be run by City staff and the consulting team. Eight pr esentation boards will be available for viewing at this event (the boards are also available for download online).

QANDA

Question & Answer

Q

28 March 19

When is it anticipated that the Great Lakes Wetland Centre will be built? This was proposed a long time ago.

A

Publicly Answered

Thanks for your question, [**username**]. The Great Lakes Wetland Centre was an initiative led by Friends of Secon d Marsh. Please contact Friends of Second Marsh at 905-723-5047 for more information on this.

ENGAGEMENT TOOL: MAP

Second Marsh Management Plan

VISITORS 91	CONTRIBUTORS 8	CONTRIBUTIONS 13

2019-03-06 15:50:25 -0500

CATEGORY
Favourite Spot

Love sitting here and enjoying the view.
Address: 1123 Farewell Street, Oshawa, Ontario L1H 8W2, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-15513

2019-03-14 11:53:54 -0400

CATEGORY
Favourite Spot

Address: Colonel Sam Drive, Oshawa, Ontario L1H 8W8, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-15821

2019-03-14 11:54:18 -0400

CATEGORY
Area of Concern

Address: 795 Colonel Sam Drive, Oshawa, Ontario L1H 8A8, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-15822

2019-03-20 14:50:09 -0400

CATEGORY
Favourite Spot

nice sitting area
Address: 1123 Farewell Street, Oshawa, Ontario L1H 8W2, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-16419

2019-03-20 14:50:44 -0400

CATEGORY
Area of Concern

sensitive area
Address: Beaton, Oshawa, Ontario, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-16421

2019-03-20 14:50:55 -0400

CATEGORY
Area of Concern

People dumping garbage
Address: Colonel Sam Drive, Oshawa, Ontario L1H 8A8, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-16422

2019-03-22 22:35:40 -0400

Boreal Chickadee spotted this year (late 2018 early 2019)
Address: Highway 401, Oshawa, Ontario L1H 7Z8, Canada

http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17037

ENGAGEMENT TOOL: MAP

Second Marsh Management Plan

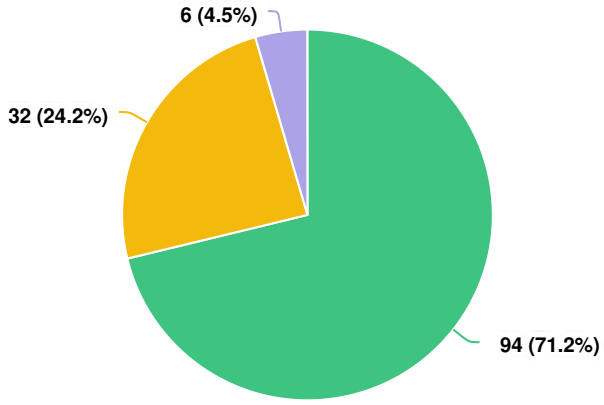
2019-03-25 22:44:31 -0400	CATEGORY Favourite Spot	A great place for wild life and soaking up water by the lake front Address: 1519 Connery Crescent, Oshawa, Ontario L1J 8E4, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17499
2019-03-26 12:52:39 -0400	CATEGORY Area of Concern	Rehabilitation is needed. Trees down, over grown. Tower should be reconstructed. Address: 795 Colonel Sam Drive, Oshawa, Ontario L1H 8P7, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17582
2019-03-27 21:44:32 -0400	CATEGORY Favourite Spot	Address: Beaton, Oshawa, Ontario, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17593
2019-03-27 21:48:14 -0400	CATEGORY Area of Concern	Address: 795 Colonel Sam Drive, Oshawa, Ontario L1H 8A8, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17594
2019-03-27 21:48:32 -0400	CATEGORY Area of Concern	Address: 1189 Colonel Sam Drive, Oshawa, Ontario, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17595
2019-03-27 21:49:13 -0400	CATEGORY Area of Concern	Address: 795 Colonel Sam Drive, Oshawa, Ontario L1H 8A8, Canada http://connectoshawa.ca/secondmarsh/maps/second-marsh-management-plan?reporting=true#marker-17596

ENGAGEMENT TOOL: SURVEY TOOL

Second Marsh Management Plan Survey

VISITORS 282	CONTRIBUTORS 117	CONTRIBUTIONS 133

How important is Second Marsh to you?

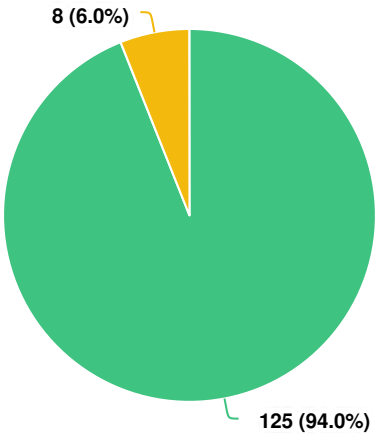


Question options

Very important Important Somewhat important

Optional question (132 responses, 1 skipped)

Have you visited Second Marsh in the past?

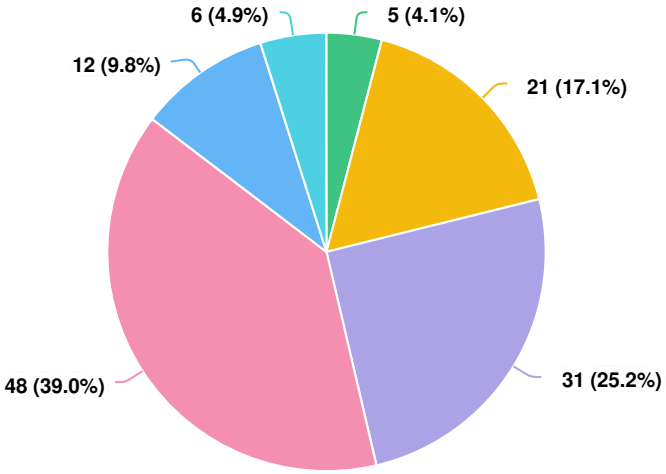


Question options

Yes No

Optional question (133 responses, 0 skipped)

Which of the following best captures how often you have visited Second Marsh in the past?

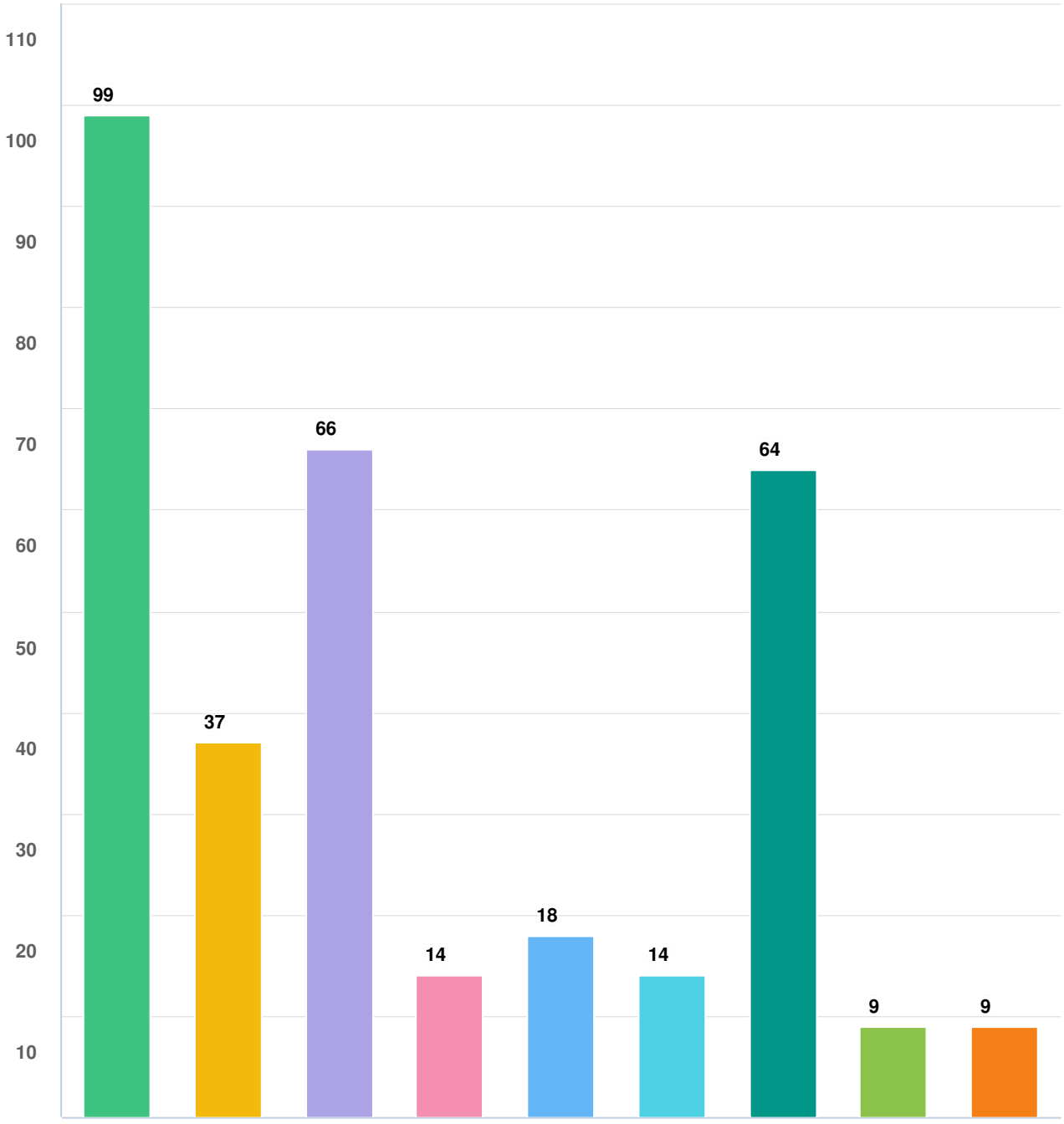


Question options

4 or more times per week | 1 to 3 times per week | 1 to 3 times per month | 2 to 6 times per year | Once a year | Once every few years

Optional question (123 responses, 10 skipped)

If you have visited Second Marsh, what was the purpose of your visit(s)?

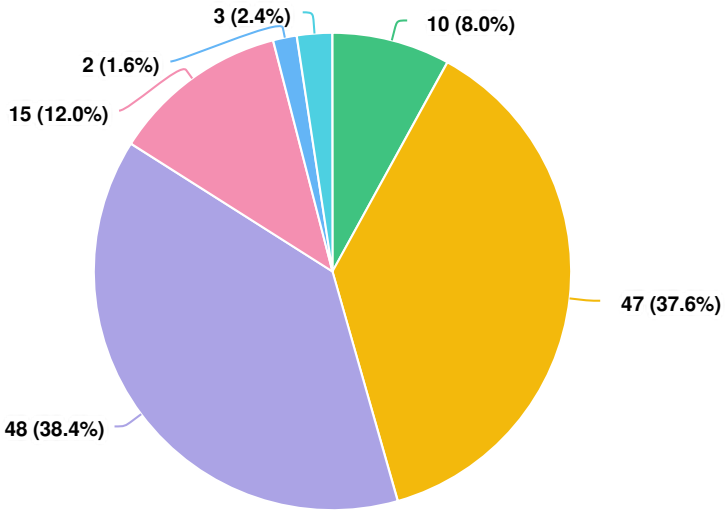


Question options

- Nature-based activity (e.g. bird watch, photography, nature walks)
- Family outing (e.g. picnics, family gatherings)
- Relaxation (e.g. sit, read, visit natural setting)
- Educational activity (e.g. school groups, educational tours)
- Transportation (e.g. walk or cycle to or from a location)
- Water-based activity (e.g. canoe, kayak, swim)
- Physical activity (e.g. run, bike, walk)
- Stewardship / Restoration event
- Other, please specify

Optional question (133 responses, 0 skipped)

Prior to the closure of Second Marsh to the public as a result of the hazards imposed by the decline of the ash trees, how ...

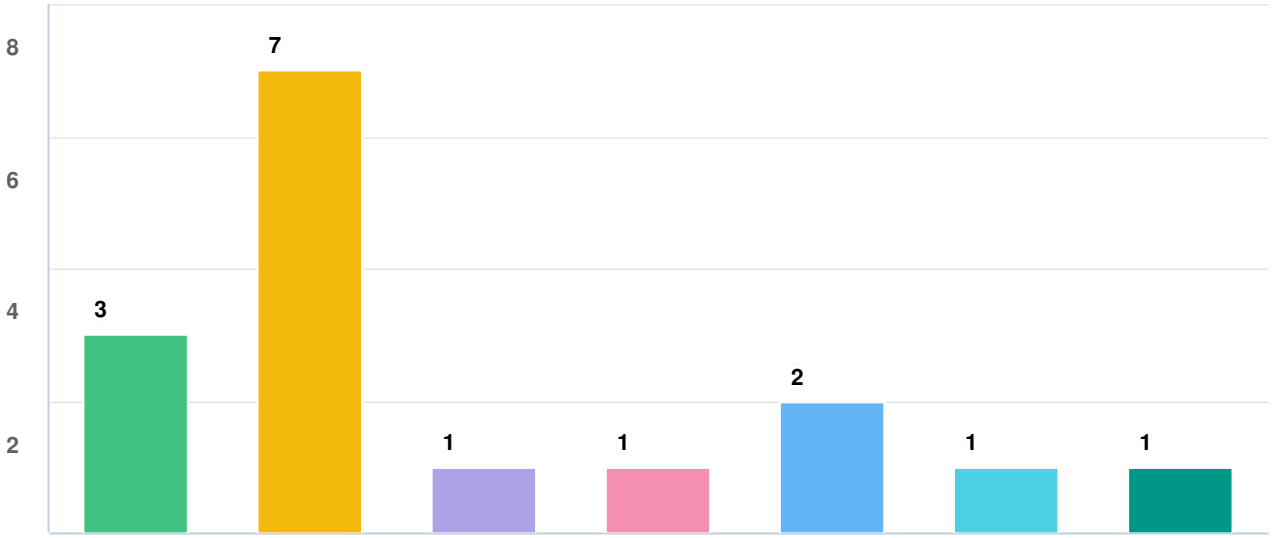


Question options

Excellent Good Average Poor Very poor Other, please specify

Optional question (125 responses, 8 skipped)

If you have not visited Second Marsh, why not?

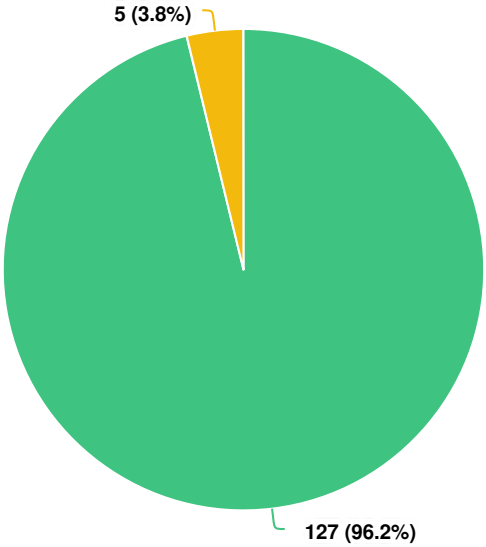


Question options

Lack of time Lack of awareness of Second Marsh Lack of programs Accessibility / transportation Lack of facilities Lack of trails Other, please specify

Optional question (133 responses, 0 skipped)

Do you agree with this vision statement?

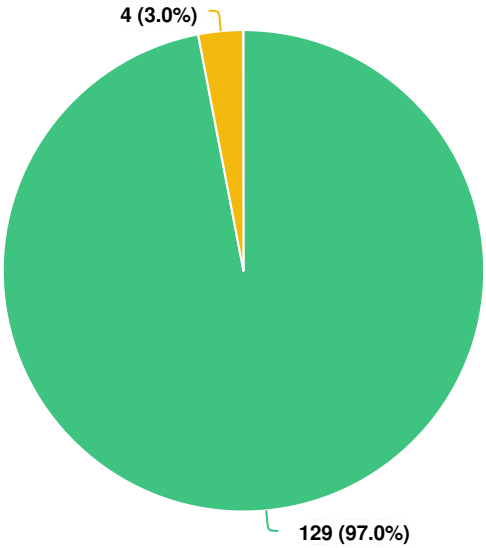


Question options

Yes No

Optional question (132 responses, 1 skipped)

Do you agree with the goals as stated?

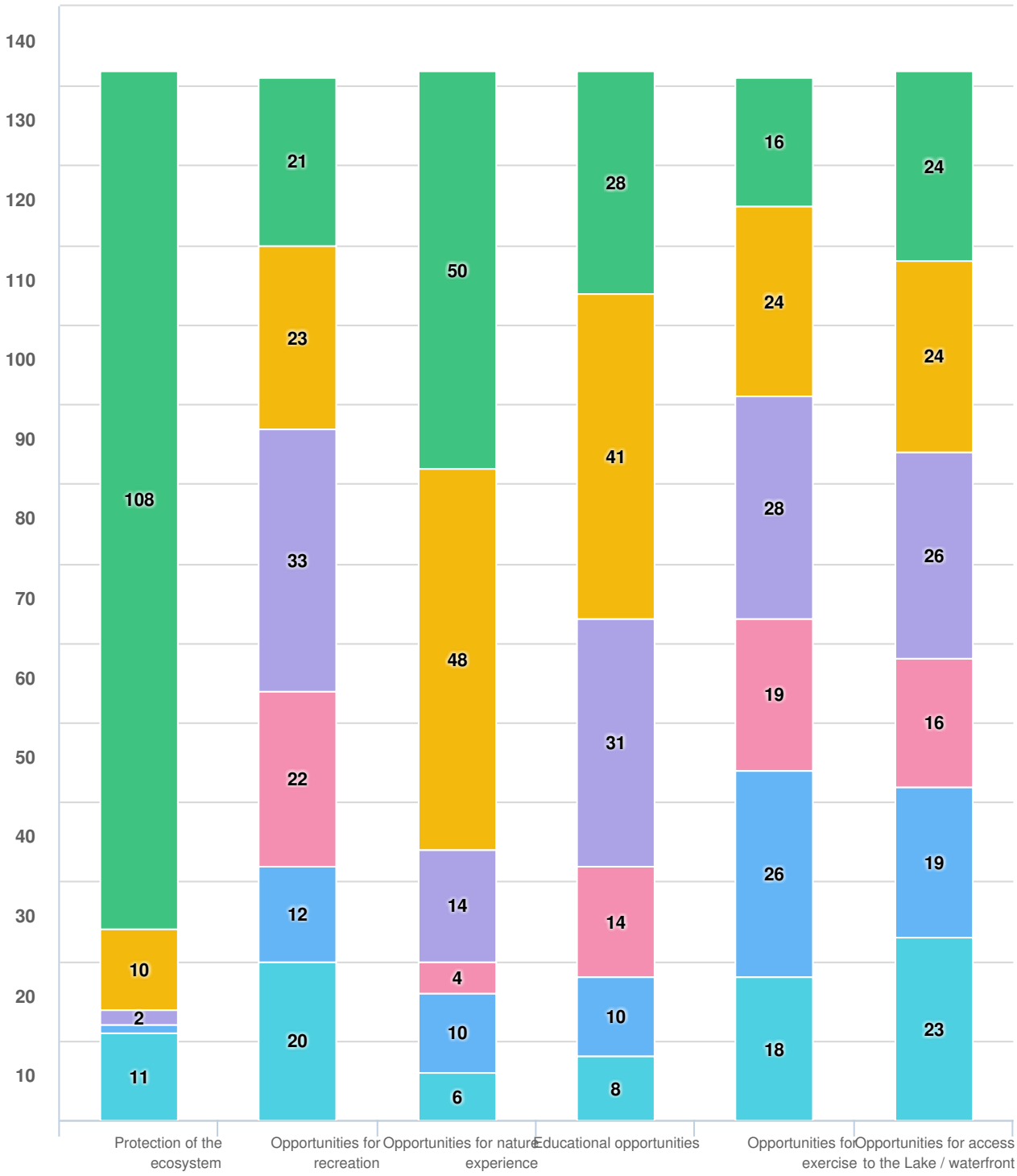


Question options

Yes No

Optional question (133 responses, 0 skipped)

On a scale of 1 to 6, where 1 is the most important and 6 is the least important, what is the most important for Second Mar...

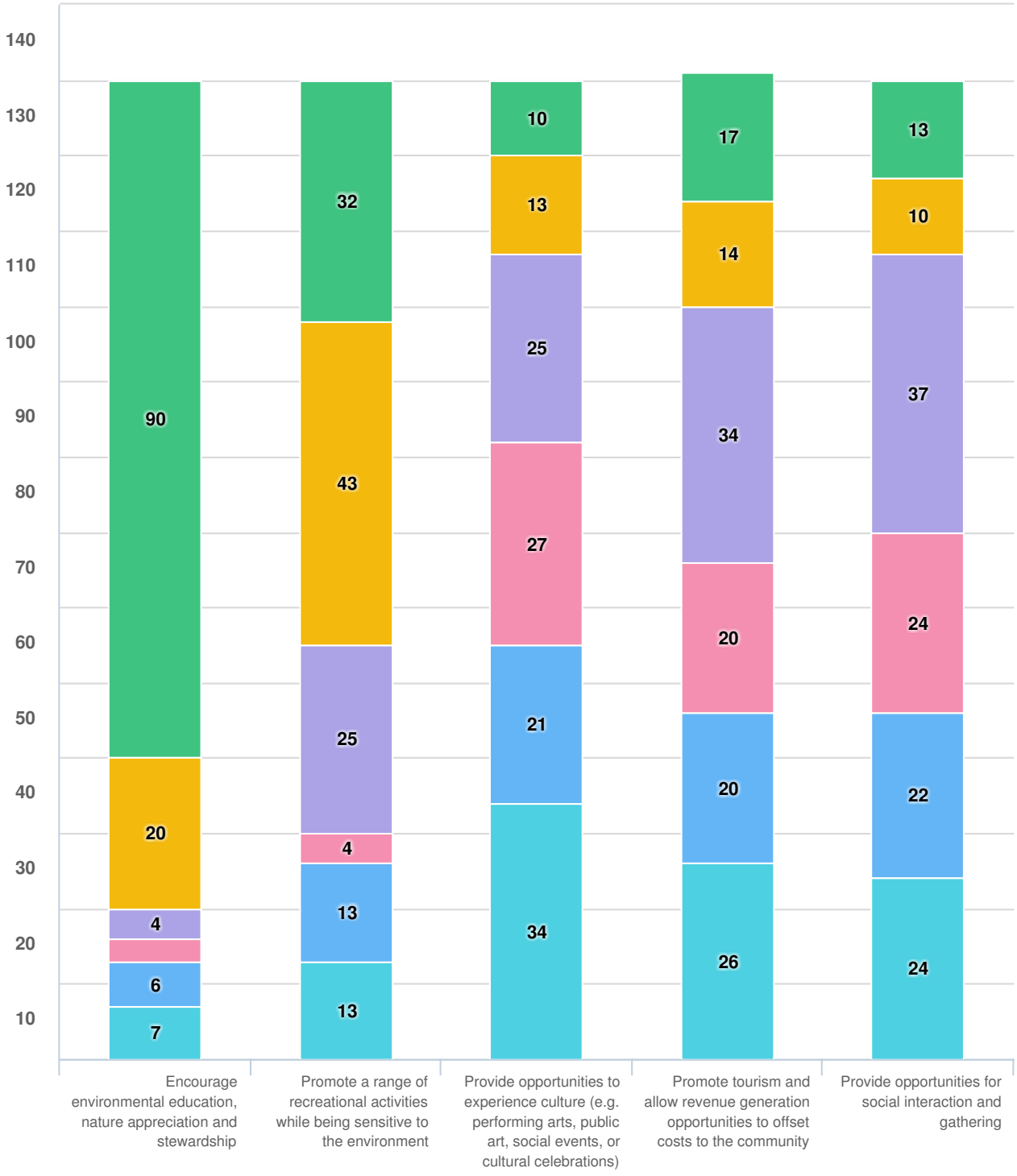


Question options

1 2 3 4 5 6

Optional question (133 responses, 0 skipped)

On a scale of 1 to 6, where 1 is the most important and 6 is the least important, please indicate the level of importance ...

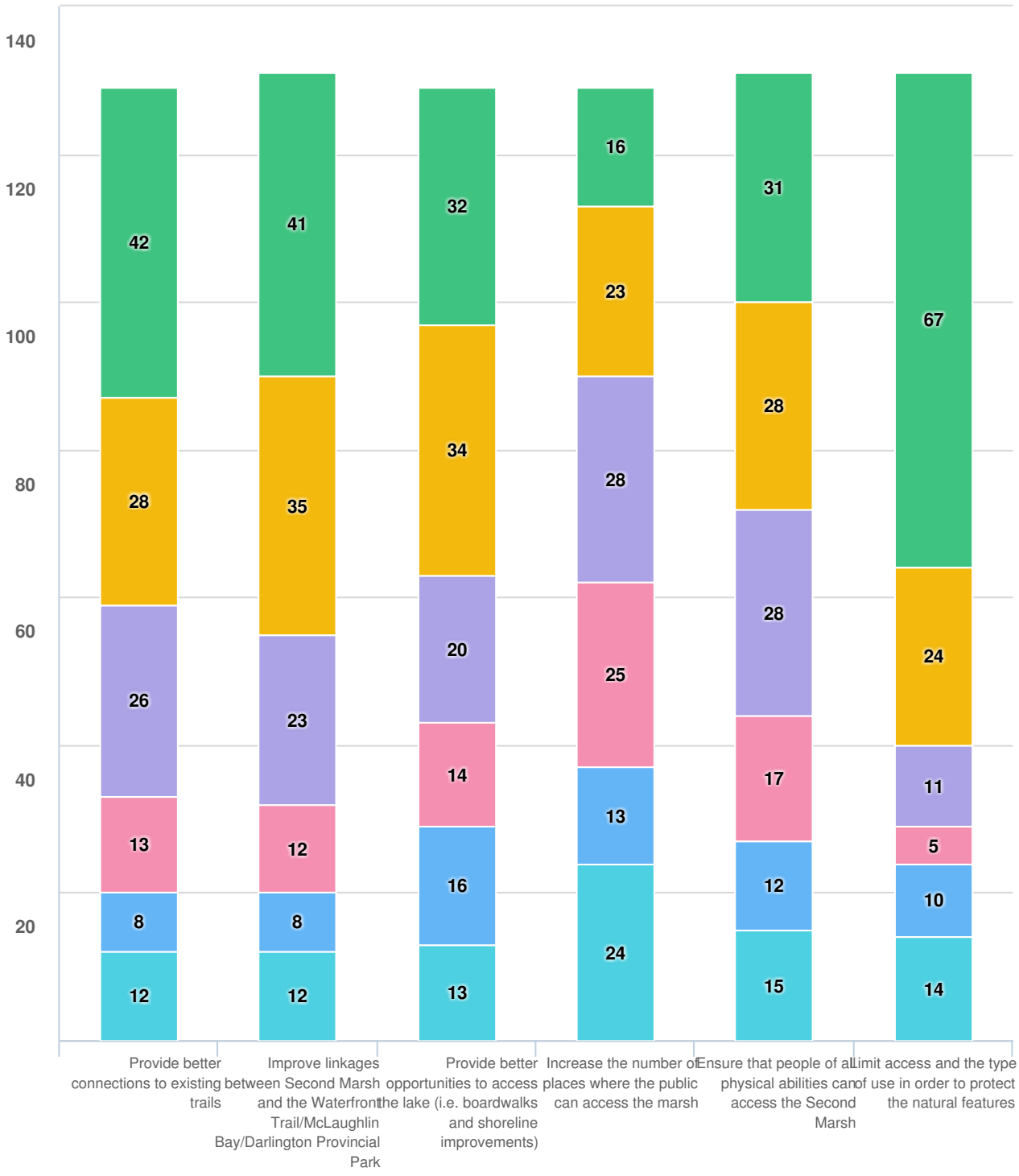


Question options

1 2 3 4 5 6

Optional question (133 responses, 0 skipped)

On a scale of 1 to 6, where 1 is the most important and 6 is the least important, please indicate the level of importance y...

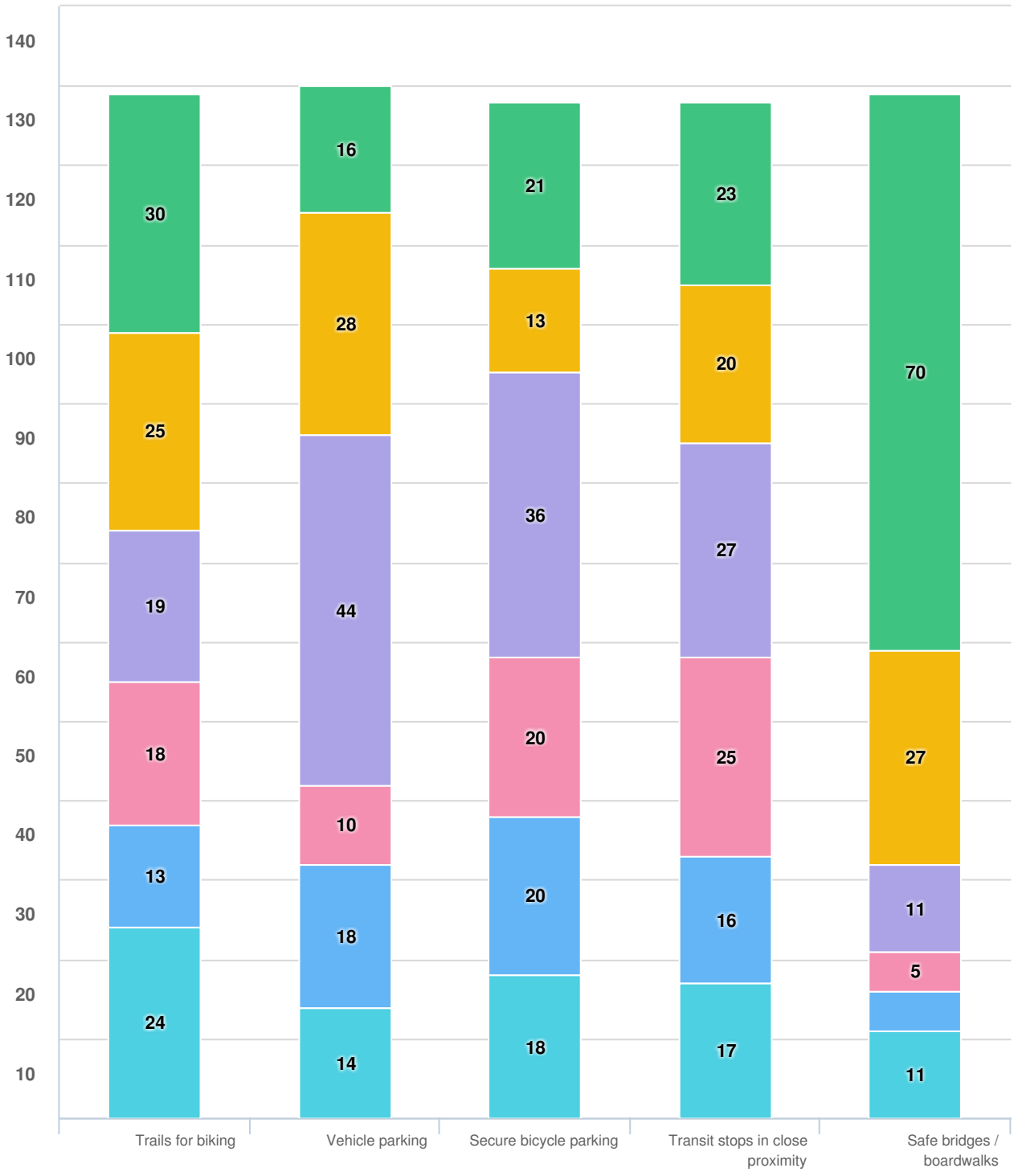


Question options

1 2 3 4 5 6

Optional question (133 responses, 0 skipped)

On a scale of 1 to 6, where 1 is the most important and 6 is the least important, please indicate the level of importance ...



Question options

1 2 3 4 5 6

Optional question (133 responses, 0 skipped)

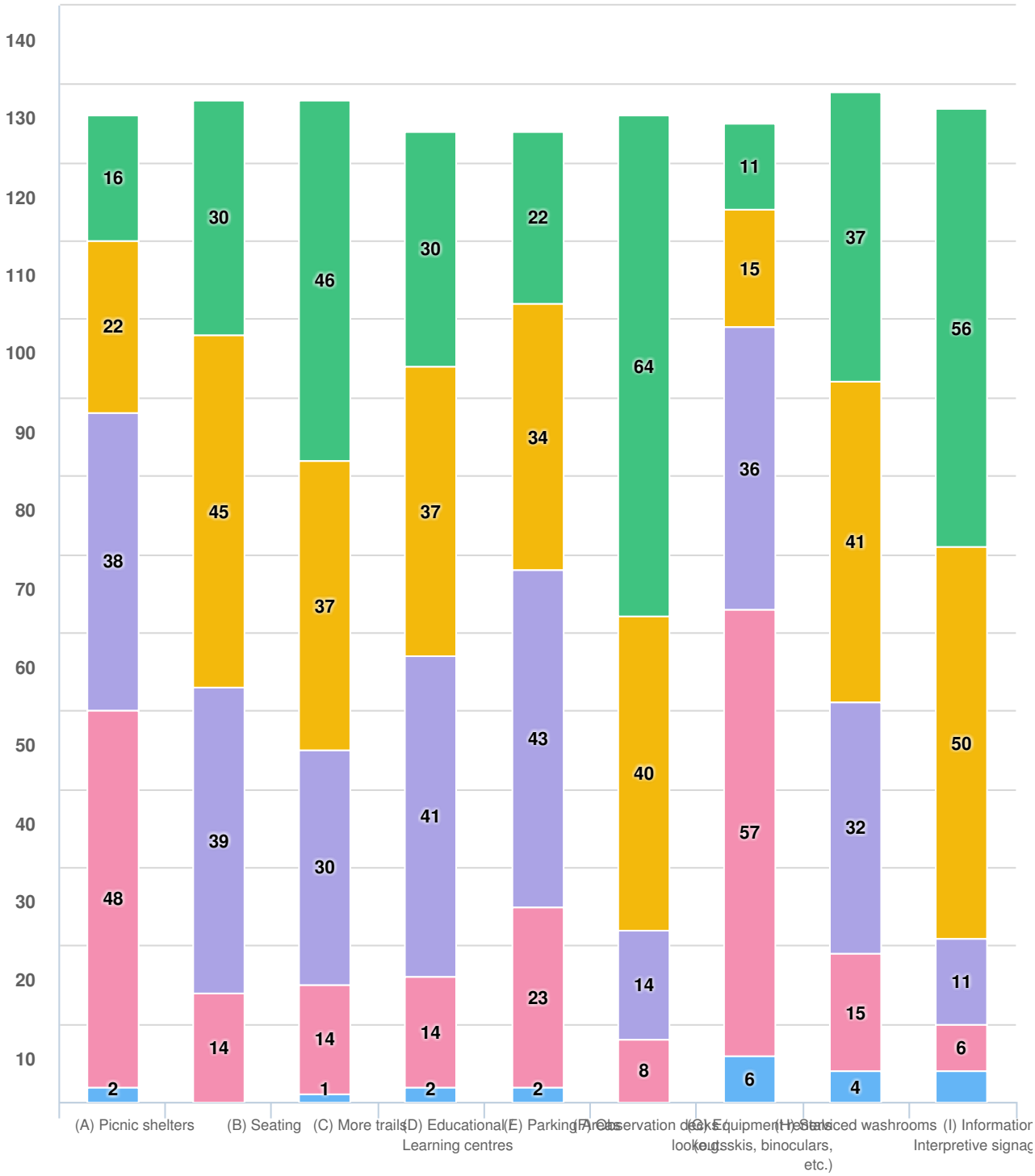
What types of activities would you like to pursue at Second Marsh?

Question options

Very desirable · Desirable · Somewhat desirable · Not desirable · Do not know

Optional question (133 responses, 0 skipped)

What types of park facilities and services would you like to see at Second Marsh?

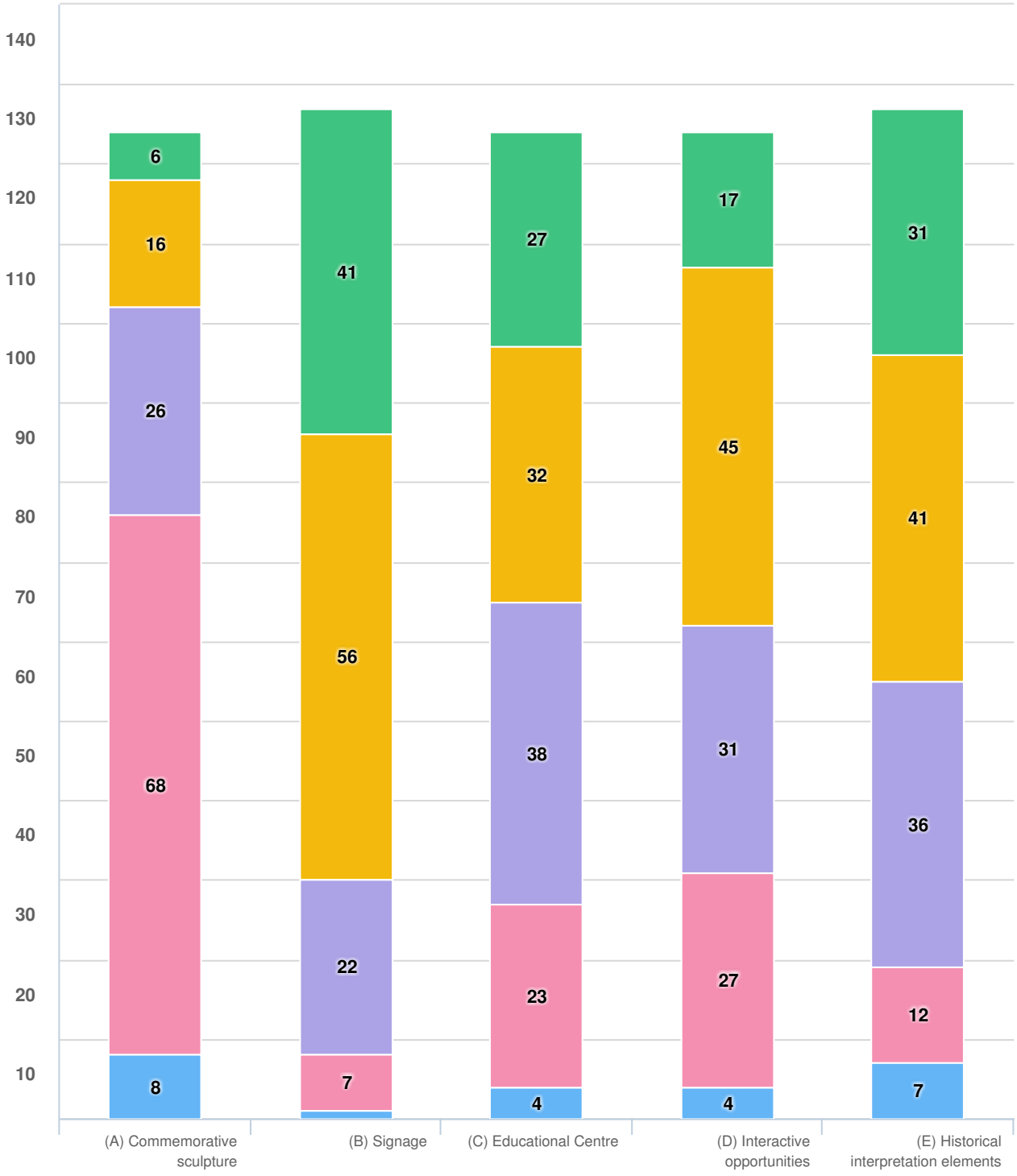


Question options

Very desirable | Desirable | Somewhat desirable | Not desirable | Do not know

Optional question (133 responses, 0 skipped)

What types of interpretive and educational elements would you prefer for Second Marsh?

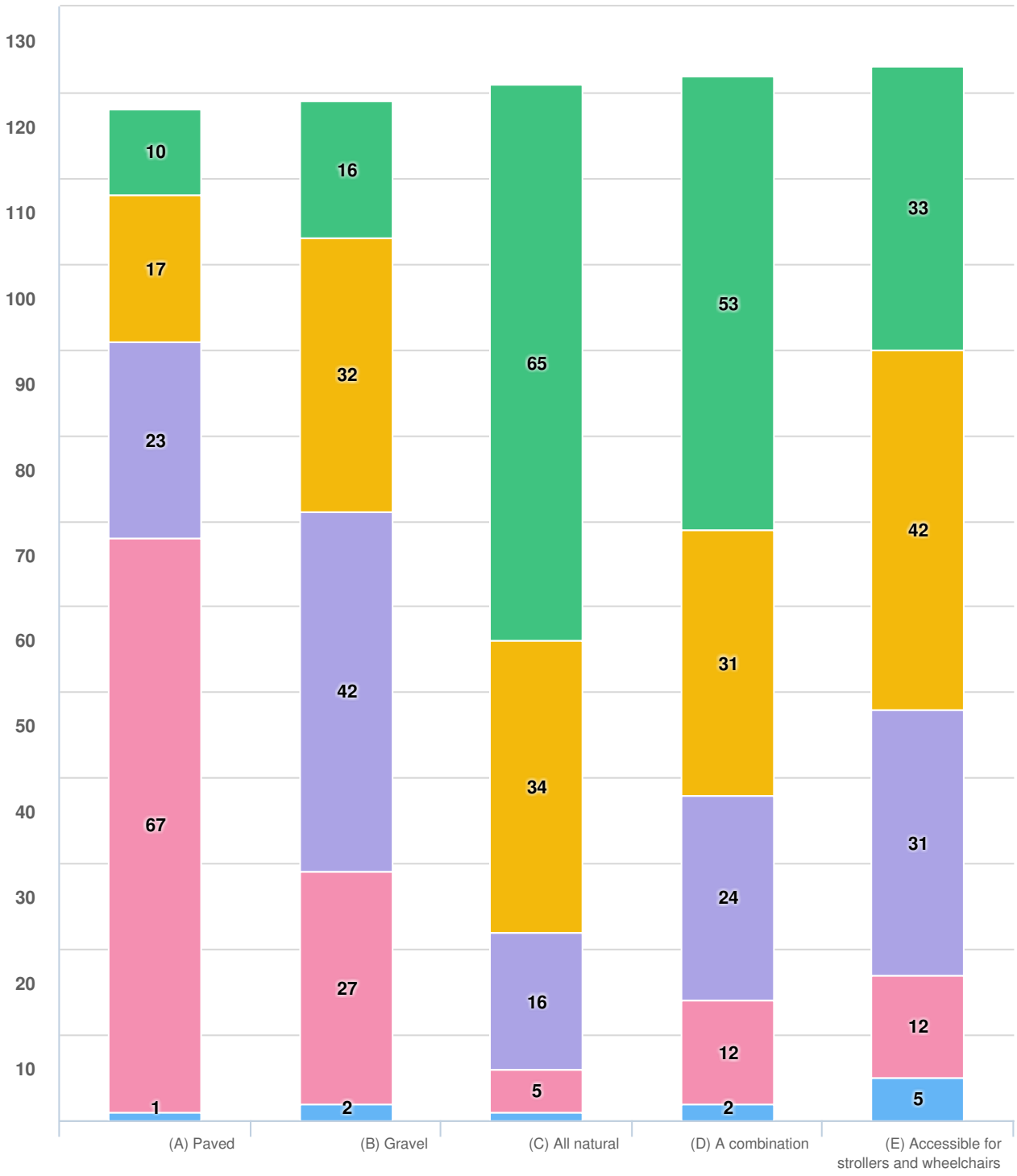


Question options

Very desirable · Desirable · Somewhat desirable · Not desirable · Do not know

Optional question (133 responses, 0 skipped)

What types of trails would you prefer at Second Marsh?

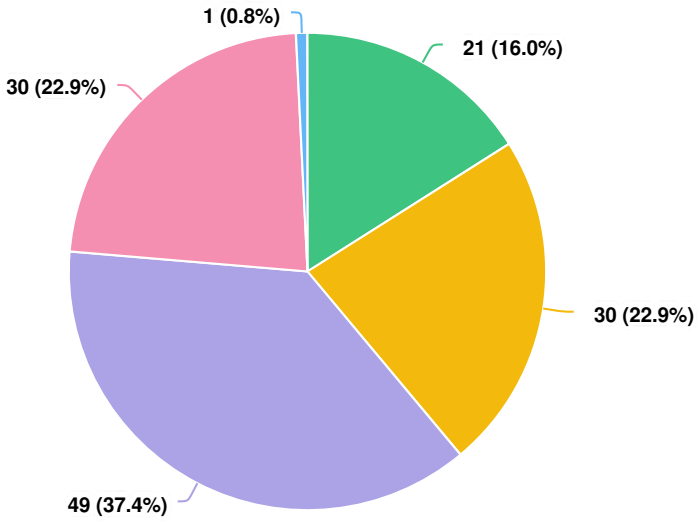


Question options

Very desirable Desirable Somewhat desirable Not desirable Do not know

Optional question (133 responses, 0 skipped)

How likely would you be to join a Second Marsh stewardship group to support the continued restoration and enhancement of th...

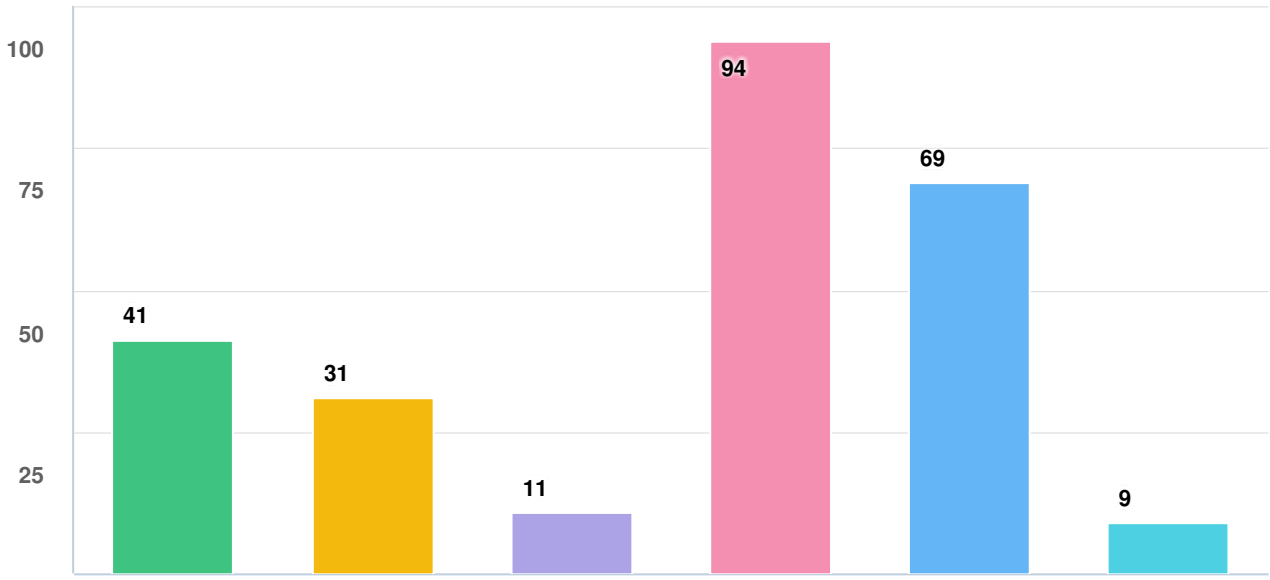


Question options

Very likely | Likely | Somewhat likely | Not likely | No interest

Optional question (131 responses, 2 skipped)

How would you prefer to be informed of initiatives at Second Marsh?

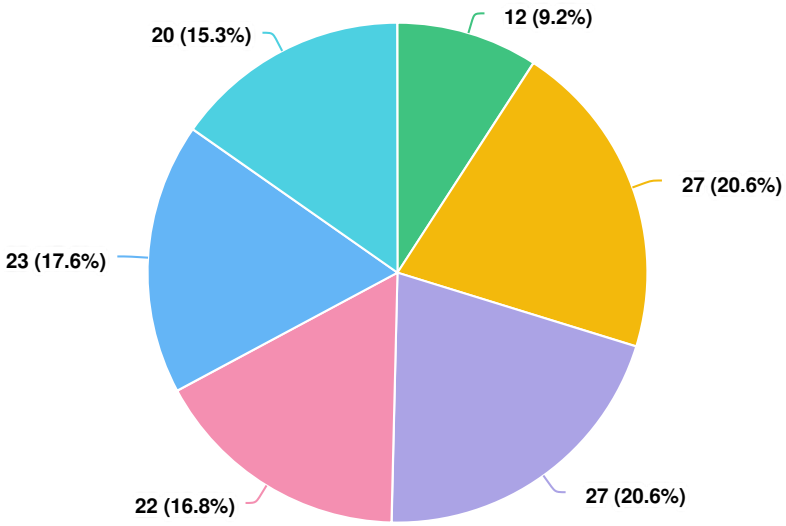


Question options

Community newsletters | Newspaper | Letters | Email (mailing lists) | Website | Other, please specify

Optional question (133 responses, 0 skipped)

How old are you?

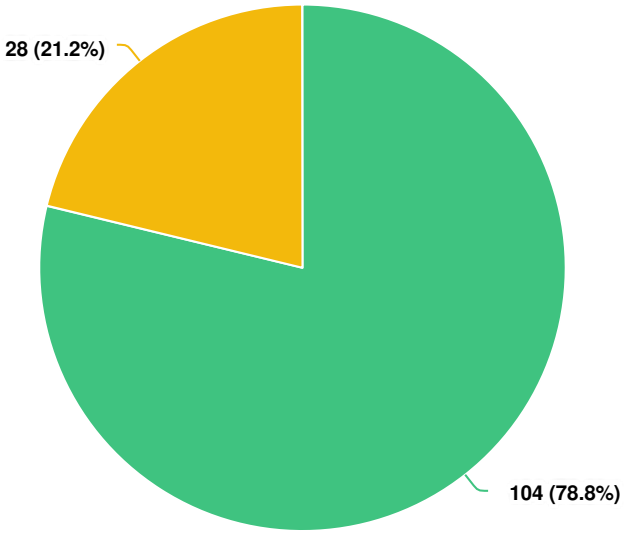


Question options

18 – 24 25 – 34 35 – 44 45 – 54 55 – 64 65+

Optional question (131 responses, 2 skipped)

Are you an Oshawa resident, and/or Oshawa business/property owner?

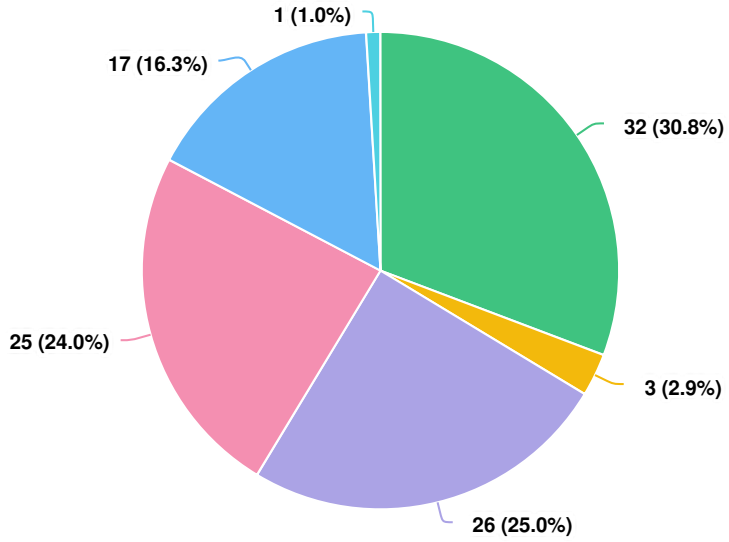


Question options

Yes No

Optional question (132 responses, 1 skipped)

What does your postal code begin with?

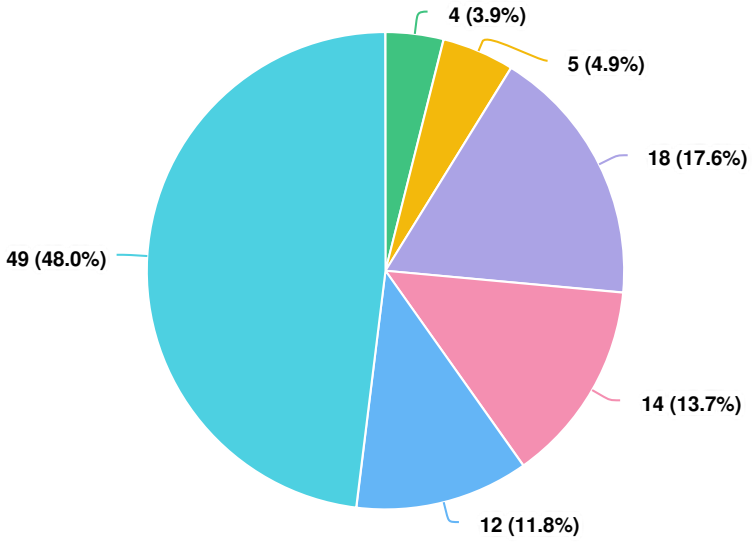


Question options

L1G L1H – North of King St. L1H – South of King St. L1J L1K L1L

Optional question (104 responses, 29 skipped)

What ward do you live in / is your business in?

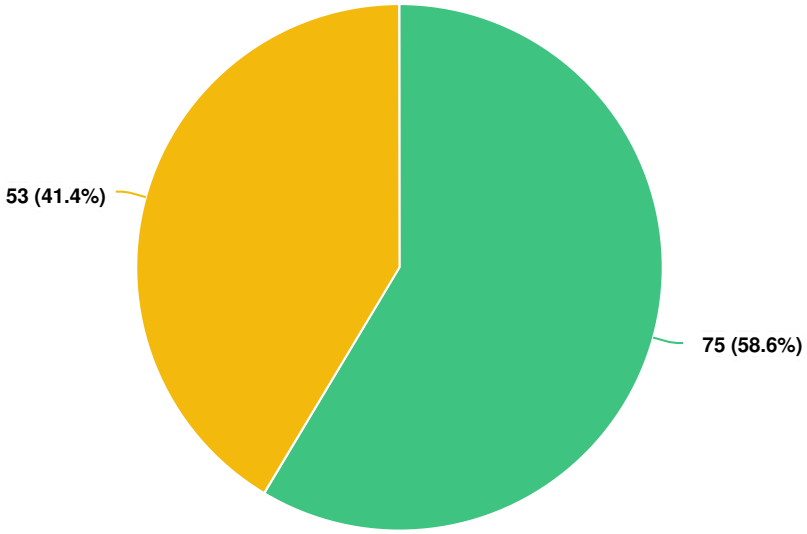


Question options

Ward 1 Ward 2 Ward 3 Ward 4 Ward 5 Don't know

Optional question (102 responses, 31 skipped)

Would you like to be contacted about future community meetings, focus groups, or initiatives for Second Marsh?

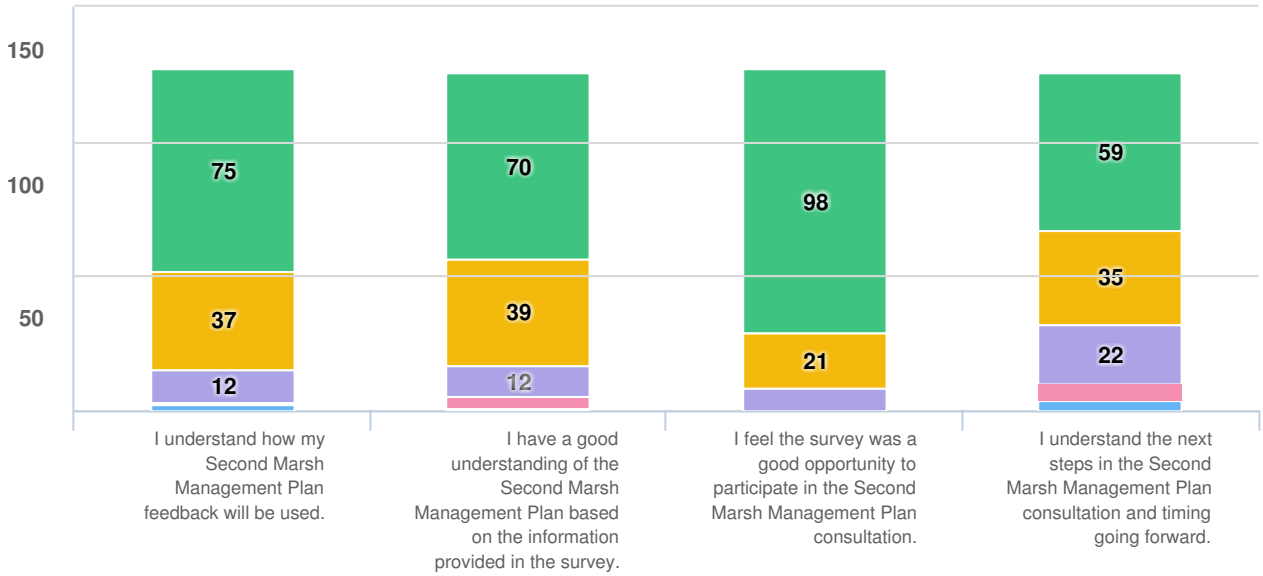


Question options

Yes No

Optional question (128 responses, 5 skipped)

Please rate the following statements:



Question options

Agree Somewhat agree Neutral Somewhat disagree Disagree

Optional question (133 responses, 0 skipped)

APPENDIX 4 | Ecosystem Services Valuation

4. Ecosystem Services Valuation

A recent report on the ecosystem services provided by Second Marsh (Green Analytics 2019) concluded that the ecosystem services provided by Oshawa Second Marsh have a considerable financial benefit to Oshawa, Clarington and Whitby. Green Analytics (2019) used the population of Oshawa census area 379,848, which includes the southern portion of Oshawa, Clarington and Whitby rather than the municipality, as users of Oshawa Second Marsh are drawn from a wider area. The conclusions of the report were:

1. The recreation value generated from the Second Marsh is estimated to range from $0.34 million to $34 million per year.
2. Second Marsh is estimated to provide $62,139 worth of carbon sequestration per year. This does not account for the death of ash trees in the Ghost Road Bush but assumes the tree cover typical of swamp habitats would be maintained within the marsh.
3. Second Marsh is estimated to provide $1.6 M to $3.5 M in biodiversity value for the residents of Oshawa. It is not possible to estimate the additional value for residents outside Oshawa (biodiversity value tends to decrease outside the jurisdiction in which an area is found) but there would likely be an additional biodiversity and recreational value to residents outside Oshawa.

Based on the services quantified, the Oshawa second marsh is estimated to provide $3.44 M to $5.70 million per year in ecosystem service values. **Table A16** provides a summary of ecosystem service characteristics desired at Second Marsh.

Table A16. Ecosystem service conservation characteristics desired at Second Marsh

Ecosystem Services	Functions	Desired Ecosystem Services
Education	• Provides an accessible, high-quality and diverse natural system in close proximity to an urban centre	• Maintain ecological integrity within Second Marsh that showcases many aspects of a healthy ecosystem and demonstrates natural processes and interconnections between habitats within and outside the site
Recreation	• Provides passive recreation opportunity in a natural setting	• Promote enjoyment of the natural landscape • Facilitate access without negative impacts to natural features and functions and

Ecosystem Services	Functions	Desired Ecosystem Services
		without substantially increasing evidence of human disturbance that decreases the experience
Public Use Infrastructure	• Provided (prior to degradation of infrastructure) access to trails and lookouts for enjoyment of the marsh	• Maintain access to the marsh and Farewell Creek that will allow enjoyment of features and promote monitoring and stewardship while protecting natural heritage functions
Nature Interpretation	• Provides an area where the diversity and interconnectedness of the communities within Second Marsh can be experienced	• Provide viewing opportunities for wildlife and vegetation that ensure impacts on ecological integrity are minimized/avoided
Carbon Sequestration	• Provides an area where carbon is stored	• Increases the amount and time frame of carbon storage through planting of longer-lived trees where appropriate

CO-25-22
Attachment 2

August 2024

Oshawa Second Marsh

Invasive Species Management Plan

Prepared for

City of Oshawa

north-south ENVIRONMENTAL

North-South Environmental Inc. • 101B King Street West • Cambridge, Ontario • N3H 1B5

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Nikki Lobsinger- Report editing

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Oshawa Second Marsh Invasive Species Management Plan

1. Introduction

1.1. Purpose of the Invasive Species Management Plan

Oshawa Second Marsh ("Second Marsh" or "the Marsh") is considered to be one of the best examples of a Great Lakes coastal wetland remaining in the Greater Toronto Area and it has been designated as both a Provincially Significant Wetland (P.S.W.) and a Life Science Area of Natural and Scientific Interest (A.N.S.I.). In addition to providing habitat for a diversity of plants and wildlife, the Marsh provides valuable ecosystem services to humans and is a valued recreational area for the local community. However, the Marsh's ecology reflects a long history of human disturbance including land conversion for agriculture, urbanization, water pollution and the introduction of exotic invasive species (The Scientific and Technical Committee, 2000).

Invasive species are recognized as one of the largest threats to global biodiversity and are also one of the largest threats to the biodiversity and ecological integrity of Oshawa Second Marsh. The Oshawa Second Marsh Management Plan (City of Oshawa, 1992) and the Second Marsh Management Strategy (Ron Reid Bobolink Enterprises, 1999) were produced to address threats to the ecological integrity of the marsh; invasive species were identified as one of the main threats to the features and ecological functions of Second Marsh. Management activities including invasive species management were implemented following the 1992 and 1999 Plan and Strategy to help maintain and restore the health of the Marsh by the City of Oshawa, Central Lake Ontario Conservation Authority (C.L.O.C.A.), Friends of Second Marsh (F.S.M.) and Ducks Unlimited Canada (D.U.C.). In 2018, the Oshawa Second Marsh Management Committee retained a consultant team, led by North-South Environmental Inc. (N.S.E.), to prepare an update to the Management Plan based on environmental changes and management activities undertaken since the 1992 Plan and 1999 Strategy. A major goal of the Management Plan update was to revisit management objectives and actions in light of changes to the Marsh as a result of past management efforts and current threats to the ecological integrity of the Marsh.

This Invasive Species Management Plan (I.S.M.P.) is a component of the update to the Oshawa Second Marsh Management Plan (N.S.E. and Schollen, 2023) and is intended to provide a coordinated approach to invasive species management in the Marsh. Using information from past reports and studies, as well as field investigations conducted in 2018 by N.S.E., a list of priority invasive species for management in Oshawa Second Marsh has been developed and specific management considerations and approaches for each species are provided. The I.S.M.P. is intended to be used in conjunction with the updated Oshawa Second Marsh Management Plan (N.S.E. and Schollen, 2023) and the Oshawa Second Marsh Forest Management Plan (F.M.P.) (N.S.E., 2024) as part of a comprehensive management approach.

1.2. Background

Oshawa Second Marsh contains a variety of invasive plant and wildlife species that threaten the site's ecological integrity. A number of previous studies and reports have documented invasive species in the Marsh and the surrounding area. Some are relatively recent introductions to the Marsh, such as Emerald Ash Borer (*Agrilus planipennis*), while others are well established and have been present in the Marsh for many decades.

2. Methodology

2.1. Field Investigations

N.S.E. conducted field surveys in Oshawa Second Marsh in the spring and summer of 2018. Table 1, below, lists the dates of field visits to the Marsh and the activities conducted on each date. The objectives of field investigations were to identify rare or uncommon species, refine vegetation communities previously delineated according to Ecological Land Classification (E.L.C.), and document and map invasive species present in the Marsh including their extents of occurrence. Invasive species surveys included general area searches on foot and by canoe. Standardized Baseline Monitoring for Invasive Species field sheets were used to collect invasive species information (see Appendix A).

In order to more precisely map the extent of Common Reed (*Phragmites australis* subspecies *australis*) in areas that could not be easily mapped due to access issues, Dr. Derek Robinson at the University of Waterloo was retained to collect high-resolution (up to 2.68 centimetres (cm) per pixel) aerial imagery of the Marsh using an unmanned aerial vehicle (U.A.V.). U.A.V. flights were conducted on July 11th and August 3rd, 2018, and over 168 hectares of the Marsh

was mapped. Specific procedures and methodology for U.A.V. mapping can be found in Appendix B.

Table 1: Dates of field investigations conducted at Oshawa Second Marsh

Date	Activities
June 20, 2018	Vegetation inventory, invasive species mapping
July 11, 2018	U.A.V. mapping (University of Waterloo)
July 12, 2018	Vegetation inventory, invasive species mapping
July 19, 2018	Vegetation inventory, invasive species mapping
August 3, 2018	U.A.V. mapping (University of Waterloo)
August 24, 2018	Vegetation inventory, invasive species mapping
September 4, 2018	Vegetation inventory, invasive species mapping

2.2. Identification of Priority Species and Sites

2.2.1. Priority Species

The purpose of identifying priority invasive species in Oshawa Second Marsh is to focus management efforts and limited resources on a selection of species that are having the greatest impact on the ecological integrity of the Marsh. Note that only plants were included in the analysis of priority species. Emerald Ash Borer, Common Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*) are discussed in this report but require much different management techniques and targets than invasive plants. Additionally, submergent and floating aquatic invasive plant species, such as European Frogbit and Eurasian Watermilfoil, were not included in the assessment of priority species as they also require much different management techniques.

Priority invasive species lists for Ontario have been developed by the Ontario Invasive Plant Council (O.I.P.C.) and other organizations. Information sources referenced when developing the priority invasive species list for plants included:

- A Landowner's Guide to Managing and Controlling Invasive Plants in Ontario (Anderson et al., 2016);
- A Quick Reference Guide to Invasive Plant Species (O.I.P.C., 2016);
- C.L.O.C.A. Invasive Species Management Strategy (C.L.O.C.A., 2010); and

- Invasive Exotic Species Ranking for Southern Ontario (Urban Forest Associates Inc., 2002).

Following the review of background reports and the completion of field investigations, a summary of invasive species occurrences was prepared. A list of ten priority species was determined by identifying the most widespread and abundant invasive species in the Marsh.

An "Importance Value" (I.V.) was calculated for each invasive species as a metric combining frequency of occurrence and abundance. The Importance Value was calculated by adding the number of observations (N) of each species to the highest abundance code (Amax) reported for that species (see the Baseline Monitoring Form in Appendix A for abundance codes), such that:

$$IV = N_{species} + A_{max}$$

The species with the nine highest I.V.s were selected to be priority invasive species for management. Common Reed was selected as the top invasive species for management based on its abundance and knowledge of its aggressive tendencies and high potential for ecological disruption. An I.V. was not calculated for Common Reed since its distribution in the Marsh was mapped in more detail using a different methodology (i.e., U.A.V. mapping). Four different species of invasive honeysuckles (*Lonicera* spp.) were lumped for the purposes of the priority invasive species analysis since they share similar life histories and invasive tendencies.

Table 2 in Section 3.2.1 lists the priority invasive species for management in Oshawa Second Marsh.

Management techniques for the priority invasive species listed in Table 2 are provided in Section 4. Table 4 in Section 4.3 lists specific management techniques and discusses their benefits and risks. Management techniques are based on provincial Best Management Practices (B.M.P.s) recommended by the O.I.P.C. and Ministry of Natural Resources and Forestry (M.N.R.F.), where available.

2.2.2. Prioritization of Management Units

Priority areas were identified in order to focus resources on sensitive habitats and locations where the greatest conservation outcomes could be achieved with the least resource commitment. In order to identify priority areas for invasive species management, Oshawa Second Marsh was divided into nine management units which aggregated areas with similar

vegetation composition and invasive species concerns. Figure 1 shows a map of invasive species management units referred to in this plan.

Priorities for invasive species management were assigned to each management unit based on the presence of Species at Risk (S.A.R.), S.A.R. habitat, provincially rare and locally rare species, rare vegetation communities (e.g., mineral open beach bar), Significant Wildlife Habitat (S.W.H.), floristic quality and the overall density of priority invasive species. S.A.R. habitat, S.W.H. and high-quality vegetation communities were weighted higher due to their sensitivity to environmental changes caused by invasive species. These features were identified through field investigations and are discussed in more detail in the updated Oshawa Second Marsh Management Plan (2023). Sites with low densities of priority invasive species are generally higher priority since they require fewer resources to eradicate or control invasive species.

The ranking system included the following attributes:

- Presence of S.A.R. and S.A.R. habitat (1 point for each species);
- Presence of S.W.H. (1 point for each habitat type);
- Presence of locally rare species (1 point for presence regardless of number of species);
- Floristic Quality Index (F.Q.I.) (2 points for high F.Q.I., 1 point for medium F.Q.I.[1]); and
- Invasive species cover (2 points for less than 25% cover, 1 point for less than 75% cover).

Using this ranking system, management units were assigned a management priority based on total score (High Priority=6+ points; Medium Priority=4 to 5 points; Low Priority=2 to 3 points). Management priorities across Oshawa Second Marsh are discussed in Section 4.1.

[1] A high, medium and low Floristic Quality Index (F.Q.I.) value is considered >40, 30 to 39.99 and <30, respectively.

Figure 1 | Management Units
Oshawa Second Marsh Management Plan

Legend

- Study Area
- Management Units
- Extent of UAV Imagery (2018)

0 250 500 Meters

Project Number	Date:	N
23-1354	2024-07-25	

north-south ENVIRONMENTAL

3. Background and Existing Conditions

3.1. Previous Studies and Management Activities

3.1.1. Previous Studies Documenting Invasive Species

Through a combination of background review and field investigations, a total of 30 invasive species were identified at Oshawa Second Marsh, consisting of 26 plants, two fish and two insects.

Invasive Plants

Previous vegetation surveys dating back as far as 1971 have documented invasive plant species in Oshawa Second Marsh. Invasive plant species documented in the Marsh include aquatic plants such as European Frogbit (*Hydrocharis morsus-ranae*) and Eurasian Watermilfoil (*Myriophyllum spicatum*), wetland plants such as Purple Loosestrife (*Lythrum salicaria*) and upland plants such as Garlic Mustard (*Alliaria petiolata*), European Buckthorn (*Rhamnus cathartica*) and Dog-strangling Vine (*Vincetoxicum rossicum*). Invasive Common Reed (*Phragmites australis* subspecies *australis*) was observed in the Marsh as early as 2002 (W. Walancik, pers. comm., 20 September 2018) and covered over 5.35 hectares (ha) of the Marsh (see Section 3.1.1) as of the 2018 plant inventory. Common Reed has had major ecosystem effects on coastal wetlands throughout the Great Lakes. Activities have been undertaken to manage populations of invasive plant species in the Marsh by a variety of groups and are discussed in Section 3.1.2.

Invasive Insects

Emerald Ash Borer is an invasive insect species that has had a devastating impact on ash (*Fraxinus* spp.) trees in Ontario. Emerald Ash Borer was first detected in Ontario in Essex County in 2003 and has since spread throughout most of the province south of the Canadian Shield. It is unclear when Emerald Ash Borer first arrived at Oshawa Second Marsh, but this species has had a major impact on the Marsh's ash population. In 2016, it was documented that much of the deciduous swamp north and south of Colonel Sam Drive, referred to as Ghost Road Bush, which at the time consisted of approximately 97% ash trees, was infested with Emerald Ash Borer.

European Fire Ant (*Myrmica rubra*) colonies are present on the berm at the western edge of Oshawa Second Marsh and also in the area of the east wooden bridge (F.S.M., pers. comm.,

16 April, 2019). European Fire Ants are an invasive species that are increasing in distribution and abundance in North America (Wetterer & Radchenko, 2011). They can be hazardous to humans because of their sting and swarming behaviour.

Invasive Fish

Environment and Climate Change Canada (E.C.C.C.) and C.L.O.C.A. have documented increasing numbers of invasive Common Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*) in Second Marsh since 2002 (C.L.O.C.A., 2013; E.C.C.C. & C.L.O.C.A., 2014). In addition to outcompeting native fish species and reducing native fish populations, these invasive fish species cause changes to aquatic plant communities and water quality because of their feeding habits (Lorenzini et al., 2007; E.C.C.C. & C.L.O.C.A., 2014). Management of Common Carp in the Marsh was initiated in 2001 (see Section 3.2.4).

3.1.2. Past and Ongoing Management Activities

Various invasive species management activities have been conducted at Oshawa Second Marsh since at least 2001. Much work has been done by F.S.M. and their partners, including D.U.C., C.L.O.C.A. and the City of Oshawa.

Invasive Plants

Specific invasive species management activities organized by F.S.M. have included:

- Purple Loosestrife removal by F.S.M. and community volunteers until 2004 when it was determined that all accessible populations of Purple Loosestrife had been pulled; and
- Garlic Mustard removal by volunteers along the Waterfront Trail and along the boardwalk trail.

In 1994 and 1997, Black-margined Loosestrife Beetles (*Neogalerucella calmariensis*) were released as a biological control method for Purple Loosestrife. Although no formal surveys were conducted to quantify the beetles' effect on Purple Loosestrife in the Marsh, Purple Loosestrife is no longer present at high densities and the effectiveness of Loosestrife Beetles in Ontario and elsewhere in North America has been well documented (Albright et al., 2004; Hinz et al., 2019). Purple Loosestrife plants observed in the Marsh have had evidence of Black-margined Loosestrife Beetles. Insect biological controls form self-perpetuating populations that can spread throughout and beyond the invaded region (Warne 2018). Black-margined Loosestrife Beetles need Purple Loosestrife to support their populations. When

plants grow from the seed bank the insect biological controls are expected to naturally spread and feed on newly established Purple Loosestrife plants.

Invasive Insects

In 2017, the abundance of dead ash trees in Ghost Road Bush prompted the closure of the trail due to safety concerns. Also in 2017, infested ash trees were removed within 30 m of Colonel Sam Drive, along the Marshland Trail and along the maintenance access road/berm.

Invasive Fish

Management of Common Carp began in 2001 with the installation of a fish exclusion fish grate by D.U.C. on the water level control structure at the western edge of the Marsh. The grate functioned as an exclusion barrier to Common Carp but was damaged in 2009, allowing Common Carp to regain access to the marsh. The original fish grate design included adjustable bars which could be moved by Common Carp, allowing the fish to access the Marsh. The fish gate was modified by D.U.C. in 2015 with bars welded in place to prevent Common Carp from moving the bars and accessing the Marsh. Drawdown of water levels in the Marsh in April 2015 also helped reduce the population of Common Carp.

3.2. Existing Conditions

3.2.1. Priority Invasive Plant Species

A list of ten priority invasive species for management was determined using the methodology described in Section 2.2.1. The final list of priority species can be found in Table 2, below. Figure 2 illustrates the locations of invasive species recorded during field investigations at Oshawa Second Marsh.

Table 21: Priority invasive plant species for management in Oshawa Second Marsh

Priority	Common Name	Scientific Name	Distribution and Abundance in OSM	B.M.P.s Available from O.I.P.C./M.N.R.F.
1	Common Reed	*Phragmites australis* subspecies *australis*	Invasive Common Reed was mapped in Oshawa Second Marsh using high-resolution U.A.V. imagery. Using this method, over 5.35 ha of Common Reed stands were mapped in the marsh, mostly in Management Unit #2. Figure 3, below, shows the extent of Common Reed in the Marsh as of 2018. It should be noted that because Common Reed is an aggressive species capable of rapid growth, the extent of the species in Oshawa Second Marsh can be expected to grow in 2019 and beyond if not properly managed.	Yes
2	Common Buckthorn	*Rhamnus cathartica*	Common Buckthorn is present at varying densities in 7 of the 9 Management Units in Oshawa Second Marsh. It is especially prevalent in Management Unit #3 where it comprises over 80% of the subcanopy and understory (i.e., shrub layer). Management techniques for Common Buckthorn in Management Unit #3 are discussed in detail in the Oshawa Second Marsh Forest Management Plan (F.M.P.).	Yes
3	Wild Parsnip	*Pastinaca sativa*	Wild Parsnip is present in high densities between Colonel Sam Drive and the C.N. and C.P. railways (in Management Unit #s 6, 7 8 and 9) and in Management Unit #3 (see Figure 3). There are three patches in the ditch on the south side of Colonel Sam Drive.	Yes

Priority	Common Name	Scientific Name	Distribution and Abundance in OSM	B.M.P.s Available from O.I.P.C./M.N.R.F.
4	Invasive Honeysuckles	*Lonicera* x *bella*, *L. maackii*, *L. tatarica*, *L. xylosteum*	Four invasive honeysuckle species were documented in Oshawa Second Marsh: Bell's Honeysuckle, Amur Honeysuckle, Tartarian Honeysuckle and Fly Honeysuckle. Invasive honeysuckles are present in terrestrial vegetation communities throughout the Marsh but are at their highest densities in Management Unit #s 3 and 5.	Yes
5	Creeping Thistle/ Canada Thistle	*Cirsium arvense*	Creeping Thistle is also commonly called Canada Thistle despite being introduced from Europe. Several dense patches of Creeping Thistle were identified in Management Unit #s 6 and 8.	No
6	Purple Loosestrife	*Lythrum salicaria*	Purple Loosestrife is present at varying densities throughout Oshawa Second Marsh but is most prevalent in Management Unit #s 3, 5, 6, 7 and 8. Some particularly dense patches were documented at the edge of the swamp to the south of Colonel Sam Drive and along Farewell Creek.	Yes
7	Dog-strangling Vine	*Vincetoxicum rossicum*	Dog-strangling Vine is present at various locations in Oshawa Second Marsh, but it is most abundant in Management Unit #5 and the eastern portion of Management Unit #3. There are also isolated occurrences in Management Unit #s 8, 9 and the western portion of Unit #3.	Yes
8	Himalayan Balsam	*Impatiens glandulifera*	Himalayan Balsam is very prevalent in Management Unit #8 and is also present in Management Unit #5.	No

Priority	Common Name	Scientific Name	Distribution and Abundance in OSM	B.M.P.s Available from O.I.P.C./M.N.R.F.
9	Narrow-leaved Cattail	*Typha angustifolia*	Narrow-leaved Cattail is abundant in marsh communities throughout Oshawa Second Marsh. Narrow-leaved Cattail hybridizes with the native Broad-leaved Cattail to form a hybrid (*Typha* x *glauca*), which is abundant throughout Oshawa Second Marsh. However, only Narrow-leaved Cattail is recommended for management.	No
10	Garlic Mustard	*Alliaria petiolata*	Garlic Mustard is most abundant in Management Unit #5 and is also present in Management Unit #9 and the eastern portion of Unit #3.	Yes

Species	Management Unit
Amur Maple	3, 5
Common Buckthorn	3, 5, 7, 8, 9
Common Reed	3, 8
Creeping Jenny	6
Creeping Thistle	6, 8
Dame's Rocket	5
Dog-strangling Vine	3, 5, 7, 9
European Cranberry Viburnum	3, 7, 9
Garlic Mustard	3, 5, 9
Hairy Willowherb	6, 8
Himalayan Balsam	5, 8
Invasive Cattails	6, 7, 8
Invasive Honeysuckles	3, 5, 8
Multiflora Rose	3, 5
Purple Loosestrife	3, 5, 6, 7, 8
Sorbaria	3
Wayfaring Tree	3
White Poplar	5, 6
Wild Parsnip	3, 6, 7, 8, 9

Figure 2 | Species and Management Units
Oshawa Second Marsh Management Plan

Legend

- Study Area
- Management Units
- Extent of UAV Imagery (2018)

Species

- Amur Maple
- Common Buckthorn
- Creeping Jenny
- Creeping Thistle
- Dame's Rocket
- Dog-strangling Vine
- European Cranberry Viburnum
- Garlic Mustard
- Hairy Willowherb
- Himalayan Balsam
- Invasive Cattails
- Invasive Honeysuckles
- Manitoba Maple
- Multiflora Rose
- Phragmites
- Purple Loosestrife
- Sorbaria
- Wayfaring Tree
- White Poplar
- Wild Parsnip

0 250 500 Meters

Project Number	Date:	N
23-1354	2024-08-09	

north-south ENVIRONMENTAL

Figure 3 | Common Reed and Management Units

Oshawa Second Marsh Management Plan

Management Unit	Common Reed (Area: m2)
2	48,136
6	3,812
8	1,570

Legend

- Study Area
- Management Units
- Extent of UAV Imagery (2018)
- Common Reed

0 250 500 Meters

Project Number	Date:	N
23-1354	2024-07-25	

north-south ENVIRONMENTAL

3.2.2. Non-priority Invasive Plant Species

Other terrestrial invasive plant species are present in Oshawa Second Marsh but are not widespread or abundant enough to be considered priority species for management. Many are in the early stages of establishment but do not currently pose a significant threat to the native biodiversity and ecological functions in the Marsh at this time. Although they are not considered priority species, management of these species could be implemented depending on funding and resources available and in conjunction with management of priority species. Non-priority invasive plant species documented in the Marsh are listed in Table 3.

Table 3: Non-priority invasive plant species documented in Oshawa Second Marsh

Common Name	Scientific Name	Management Unit(s) where Found
Amur Maple	*Acer ginnala*	3, 5
Creeping Jenny	*Lysimachia nummularia*	6
Creeping Thistle	*Cirsium arvense*	6,8
Dame's-rocket	*Hesperis matronalis*	5
European Cranberry Viburnum	*Viburnum opulus* variety *opulus*	3, 7, 9
European Frogbit	*Hydrocharis morsus-ranae*	Widespread in 2
Gypsywort	*Lycopus europaeus*	
Hairy Willowherb	*Epilobium hirsutum*	6, 8
Himalayan Balsam	*Impatiens glandulifera*	5, 8
Multiflora Rose	*Rosa multiflora*	3, 5
Norway Maple	*Acer platanoides*	Present in swamp communities
Prince's-feather	*Persicaria orientalis*	
Reed Canary Grass	*Phalaris arundinacea*	Widespread in 6
Sorbaria	*Sorbaria sorbifolia*	3
White Poplar	*Populus alba*	5,6
Invasive Willows	*Salix alba, S. euxina, S. matsudana*	4, 9
Yellow Iris	*Iris pseudacorus*	

Common Name	Scientific Name	Management Unit(s) where Found
Wild Parsnip	*Pastinaca sativa*	3, 6, 7, 8, 9

These species may pose a risk to Oshawa Second Marsh in the future. The extent and severity of the risk is unknown. The abundance of these invasive species may increase to levels that impact the natural environment. Changing conditions associated with management actions, development, maintenance, and/or climate change may also influence the abundance of these species.

Submergent and floating aquatic invasive plant species, such as European Frogbit and Eurasian Watermilfoil, are also considered non-priority invasive species.

3.2.3. Invasive Insects

Emerald Ash Borer

Emerald Ash Borer is well-established at Oshawa Second Marsh and has had a devastating impact on ash trees. Emerald Ash Borer was first detected in North America in the Detroit area in 2002 and was first detected in the Windsor area of Ontario in 2003. Over the past two decades, Emerald Ash Borer has become established from Windsor to Northumberland County, the Ottawa region, Montreal and other cities in eastern Canada (M.N.R.F., 2018). Emerald Ash Borer larvae kill ash trees by eating the cambium (the tree's vascular tissue) and leaving exit holes that allow other pathogens to infect the tree (M.N.R.F., 2018). Control and/or eradication of Emerald Ash Borer will not be effective at Oshawa Second Marsh because the pest has already affected nearly 100% of ash trees there. Therefore, rather than preventing further infestation, management for Emerald Ash Borer will focus on mitigating harm to infrastructure and human safety by removing dead or dying trees deemed to be high risk (see Section 4.5)

3.2.4. Invasive Fish

Common Carp and Goldfish have been documented in the wetland for decades. Common Carp prompted the fish way and exclusion grate to be installed. The exclusion grate size prevents large mature Common Carp from accessing the Marsh to spawn. Goldfish and native fish species due to their smaller size are not excluded by it. It is reasonable to assume that there remains a population of these both Common Carp and Goldfish in the Marsh; however, abundance is typically extracted from general fish community surveys and the

assumption is made that this data is reflective of true population. Abundance of these species has been noted to fluctuate. These species require ongoing management to prevent long-term impacts to aquatic vegetation community structure. Management of invasive fish species primarily involves two components – exclusion and removal – and is discussed in more detail in Section 4.5.2.

4. Invasive Species Management

4.1. Management Priorities – Species and Sites

The priority invasive plant species for management in Oshawa Second Marsh listed in Table 2 were determined using the methodology described in Section 2.2.1. Management activities should primarily target priority invasive plant species in order to optimize resources and keep management targets achievable. Likewise, identifying priority areas for invasive species management will ensure the most efficient use of resources and provide the greatest benefit to the ecology of the Marsh. Therefore, management units have been assigned a management priority in order to achieve the best outcomes for ecological integrity with the fewest resource requirements.

Priority areas were determined using the methodology described in Section 2.2.2. Invasive species management units were delineated and are illustrated on Figure 1. Within each management unit, the abundance and cover of invasive species has been estimated (see Figure 4, below). Habitat for S.A.R., S.W.H. and locally rare species has also been mapped and is discussed in the Oshawa Second Marsh Management Plan (N.S.E. and Schollen, 2023). Management priorities are illustrated in Figure 5, below.

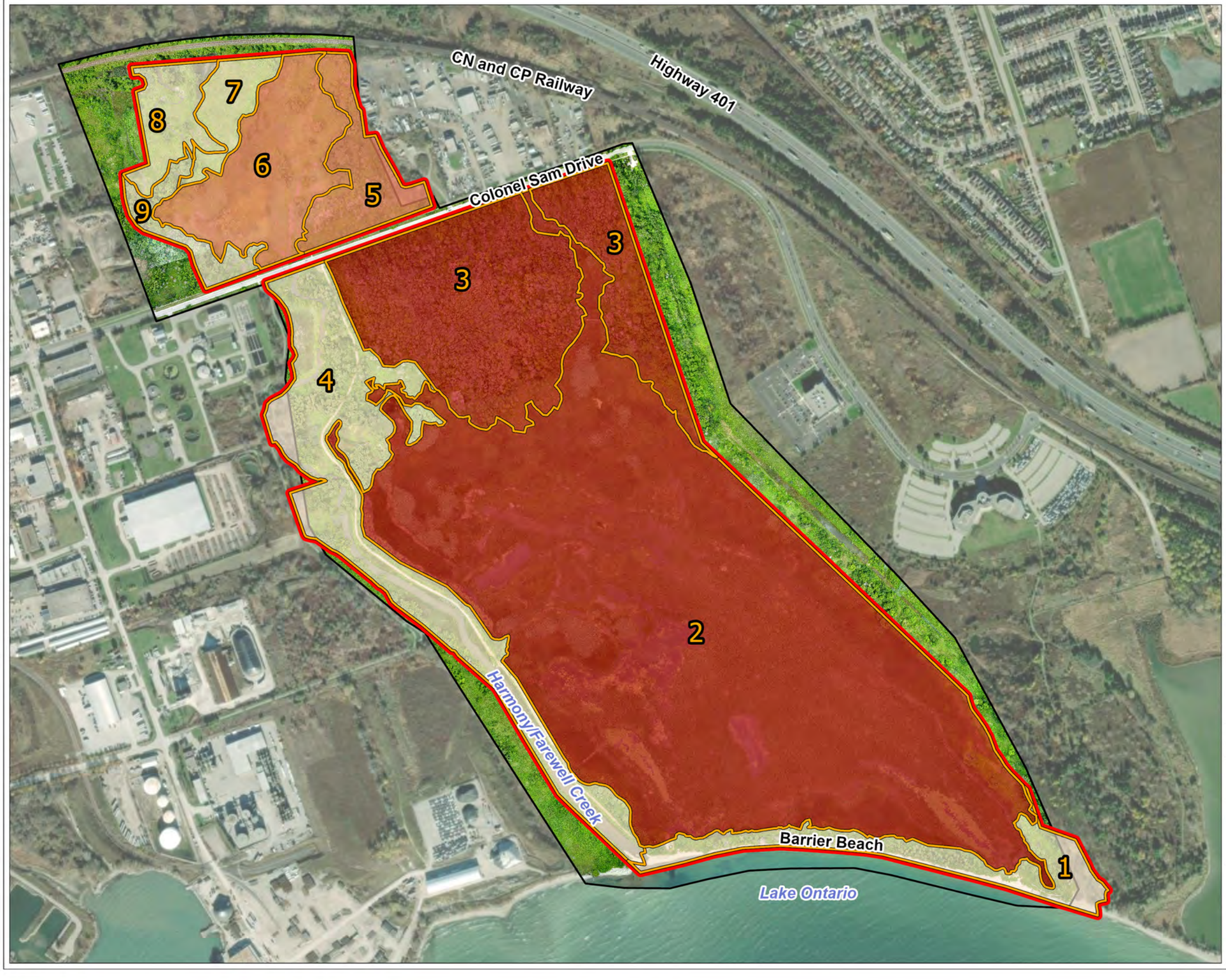

Figure 4 | Invasive Species and Management Units

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Management Units
- Extent of UAV Imagery (2018)

Invasive Species Cover

- < 25%
- 25 - 75%
- > 75%

0 250 500 Meters

Project Number	Date:	N
23-1354	2024-07-25	

north-south ENVIRONMENTAL

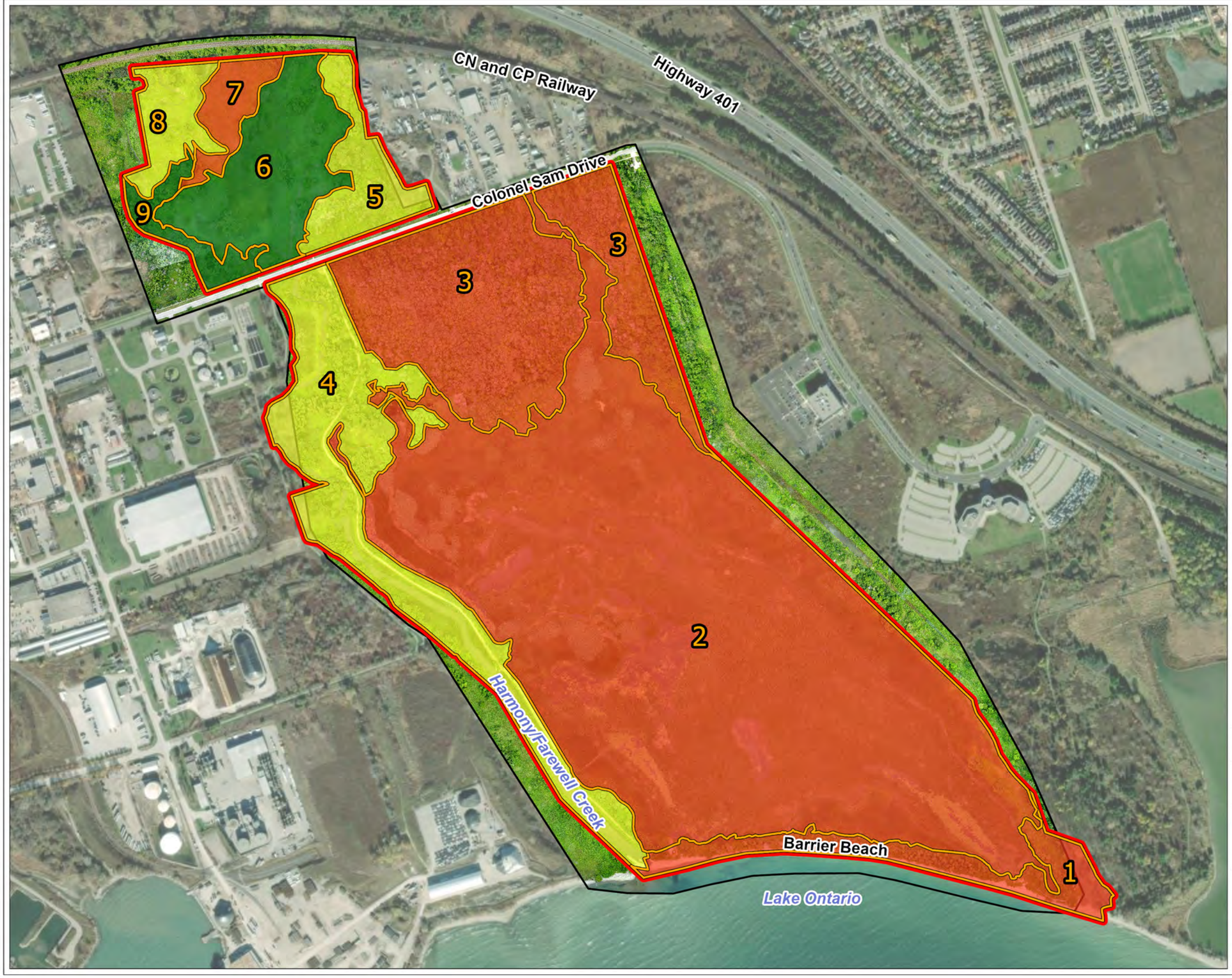

Figure 5 | Priority Areas and Management Units

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Management Units
- Extent of UAV Imagery (2018)

Priority Areas

- Low
- Medium
- High

0 250 500 Meters

Project Number	Date:	N
23-1354	2024-07-25	

north-south ENVIRONMENTAL

4.2. Work Plan

Table 4 breaks down ecological characteristics and invasive species management needs for each of the management units described previously (see Figure 5). This high-level work plan should be used to guide invasive species management activities over the lifetime of the I.S.M.P. Detailed work plans should be developed periodically, ideally on an annual basis, to determine specific tasks which can be accomplished with the funding and resources available.

The work plan summarized in Table 4 is an ideal scenario that is not constrained by funding and resource availability. A variety of options for implementing the I.S.M.P. could be explored and several options are discussed in Section 4.3. Ultimately, the decision to implement certain components of the work plan before others should be the decision of the administrators of the I.S.M.P. and should reflect available funding and resources.

A more detailed discussion of the goals, objectives, actions, and targets of the I.S.M.P. can be found in the following sections. A detailed discussion of invasive species management techniques, as well as background and justification for the estimated costs and recommended timelines in Table 4 are also provided.

Table 42: Specific recommendations for invasive species management units in Oshawa Second Marsh

Management Unit[1]	Priority[2]	Invasive Species Present[3]	Invasive Species Cover[4]	S.A.R. Habitat, S.W.H. Present[5]	F.Q.I.[6]	Management Activities[7]	Targets[8]	Estimated Costs[9]	Recommended Timelines[10]	Opportunities for Volunteer Engangement[11]
1	High	• Common Buckthorn*	<15%	• Rare vegetation communities (beach bar; coastal meadow marsh) • Regionally rare plant species	Low	• Mechanical removal of low-density buckthorn • Monitor buckthorn cover to ensure it remains below 15%	Maintain less than 15% cover of invasive species	$139,000	5-15 years	
2	High	• Common Reed* • Narrow-leaved Cattail* • European Frogbit*	>75%	• Habitat for S.A.R. birds • Marsh bird breeding habitat (candidate) • Habitat for provincially rare plant species • Regionally rare plant species	Medium	• Herbicide application to Common Reed patches • Herbicide application to invasive cattails • Monitor invasive species cover to determine effectiveness of management activities	Reduce cover of priority invasive species to less than 15%	$61,630	5-15 years	
3	High	• Common Buckthorn* • Garlic Mustard* • Purple Loosestrife* • Common Reed * • Dog-strangling Vine* • Multiflora Rose • Wild Parsnip* • Invasive Honeysuckles* • European Cranberry Viburnum • Amur Maple • Sorbaria • Gypsywort	>75%	• Amphibian breeding habitat (woodland) (candidate) • Habitat for Eastern Wood-pewee (Special Concern) • Presence of area-sensitive bird species	High	• Buckthorn control using herbicides and mechanical removal • Mechanical removal of Garlic Mustard • Mechanical removal of Purple Loosestrife • Common Reed control using herbicides • Dog-strangling Vine control using herbicides • Wild Parsnip chemical control using herbicides • Mechanical removal of invasive woody species • Mechanical removal of herbaceous species • Monitor invasive species cover to determine effectiveness of management activities • Monitor restoration plantings for survival, establishment and spread	Reduce cover of priority invasive species to less than 15%	$884,000	5-15 years	Manual removal of Garlic Mustard, Purple Loosestrife, invasive honeysuckles, European Cranberry Viburnum, Amur Maple, Sorbaria, Gypsywort and Norway Maple

Management Unit[1]	Priority[2]	Invasive Species Present[3]	Invasive Species Cover[4]	S.A.R. Habitat, S.W.H. Present[5]	F.Q.I.[6]	Management Activities[7]	Targets[8]	Estimated Costs[9]	Recommended Timelines[10]	Opportunities for Volunteer Engangement[11]
		• Norway Maple								
4	Medium	• Garlic Mustard* • Wild Parsnip* • Common Reed* • Invasive Willows	<15%	n/a	High	• Mechanical removal of Garlic Mustard • Wild Parsnip chemical control using herbicides • Common Reed control using herbicides • Mechanical removal of invasive willows • Monitor invasive species cover to ensure it remains below 15%	Maintain less than 15% cover of invasive species	$205,800	15-20 years	Manual removal of Garlic Mustard and invasive willows
5	Medium	• Common Buckthorn* • Garlic Mustard* • Dog-strangling Vine* • Invasive Honeysuckles* • Purple Loosestrife* • Himalayan Balsam* • Dame's-rocket • White Poplar • Multiflora Rose • Amur Maple	15-75%	n/a	High	• Buckthorn control using herbicides and mechanical removal • Mechanical removal of Garlic Mustard • Dog-strangling Vine control using herbicides • Mechanical removal of invasive woody species • Mechanical removal of herbaceous species • Monitor invasive species cover to determine effectiveness of management activities	Reduce cover of priority invasive species to less than 15%	$134,000	15-20 years	Manual removal of Garlic Mustard, invasive honeysuckles, Purple Loosestrife, Himalayan Balsam, Dame's-rocket, White Poplar and Amur Maple
6	Low	• Purple Loosestrife* • Narrow-leaved Cattail* • Creeping Thistle* • Wild Parsnip* • Reed Canary Grass • White Poplar • Creeping Jenny	<15%	n/a	Medium	• Buckthorn control using herbicides and mechanical removal • Mechanical removal of Garlic Mustard • Creeping Thistle chemical control using herbicides • Wild Parsnip control using herbicides • Reed Canary Grass control using herbicides • Mechanical removal of invasive woody species • Mechanical removal of herbaceous species • Monitor invasive species cover to ensure it remains below 15%	Maintain less than 15% cover of invasive species	$186,900	15-20 years	Manual removal of Purple Loosestrife, White Poplar, Creeping Jenny and Hairy Willowherb

Management Unit[1]	Priority[2]	Invasive Species Present[3]	Invasive Species Cover[4]	S.A.R. Habitat, S.W.H. Present[5]	F.Q.I.[6]	Management Activities[7]	Targets[8]	Estimated Costs[9]	Recommended Timelines[10]	Opportunities for Volunteer Engangement[11]
		• Hairy Willowherb								
7	High	• Common Buckthorn* • Dog-strangling Vine* • Wild Parsnip* • Purple Loosestrife* • Narrow-leaved Cattail* • European Cranberry Viburnum	<15%	• Migratory butterfly stopover habitat (candidate) • Habitat for Monarch (Special Concern)	Medium	• Buckthorn control using herbicides and mechanical removal • Dog-strangling Vine control using herbicides • Wild Parsnip chemical control using herbicides • Narrow-leaved Cattail control using herbicides • Mechanical removal of invasive woody species • Monitor invasive species cover to ensure it remains below 15%	Maintain less than 15% cover of invasive species	$64,600	5-15 years	Manual removal of Purple Loosestrife and European Cranberry Viburnum
8	Medium	• Common Buckthorn* • Creeping Thistle* • Purple Loosestrife* • Narrow-leaved Cattail* • Wild Parsnip* • Invasive Honeysuckles* • Himalayan Balsam* • Hairy Willowherb	<15%	• Amphibian breeding habitat (wetland) (candidate)	Medium	• Buckthorn control using herbicides and mechanical removal • Creeping Thistle control using herbicides • Narrow-leaved Cattail control using herbicides • Wild Parsnip chemical control using herbicides • Mechanical removal of invasive woody species • Mechanical removal of herbaceous species • Monitor invasive species cover to ensure it remains below 15%	Maintain less than 15% cover of invasive species	$95,600	15-20 years	Manual removal of Purple Loosestrife, invasive honeysuckles, Himalayan Balsam and Hairy Willowherb
9	Low	• Wild Parsnip* • Common Buckthorn* • Garlic Mustard* • Dog-strangling Vine*	<15%	n/a	Low	• Wild Parsnip chemical control using herbicides • Buckthorn control using herbicides and mechanical removal • Mechanical removal of Garlic Mustard • Dog-strangling Vine control using herbicides • Mechanical removal of invasive willows	Maintain less than 15% cover of invasive species	$63,600	15-20 years	Manual removal of Garlic Mustard and invasive willows

Management Unit[1]	Priority[2]	Invasive Species Present[3]	Invasive Species Cover[4]	S.A.R. Habitat, S.W.H. Present[5]	F.Q.I.[6]	Management Activities[7]	Targets[8]	Estimated Costs[9]	Recommended Timelines[10]	Opportunities for Volunteer Engangement[11]
		• Invasive Willows				• Monitor invasive species cover to ensure it remains below 15%				

[1]Refer to Figure 1; [2]Refer to Section 4.1; [3]Priority invasive species for management are marked with a (*); [4]Cover estimated based on visual assessment or UAV mapping (Common Reed); [5]SAR, SWH and rare species are discussed in more detail in the updated Oshawa Second Marsh Management Plan (N.S.E. and Schollen, 2023); [6]Floristic Quality Index (FQI): Low=<30, Medium=30-39.99, High=>40; [7]Based on management techniques described in Section 4.5 and following provincial B.M.Ps; [8]Refer to Table 6 in Section 4.4; [9]Refer to Table 8 in Section 4.9; [10]Refer to Table in Section 4.4; [11]Assumes that volunteers will manually remove low-density or sporadic occurrences of invasive species.

4.3. Management Strategies and Risk Assessment

The management actions, targets, timelines, and costs discussed in this I.S.M.P. (see Section 4.4, 4.5, 4.8 and 4.9) have been used to identify specific management recommendations for each invasive species management unit in Oshawa Second Marsh. Table 4 details the specific management recommendations for each management unit.

The work plan provided in Table 4 reflects a comprehensive invasive species management strategy and is an idealistic approach not constrained by funding or other resources. However, alternative management strategies could take a more targeted or selective approach to invasive species management in the Marsh. The following management strategies have been assessed for their ability to mitigate ecological risks, cost of implementation, and ability to achieve the goals of the I.S.M.P.:

- Strategy 1: Doing no invasive species management ("Do Nothing");
- Strategy 2: Manage only Common Reed and Common Buckthorn (the two highest priority invasive species);
- Strategy 3: Manage only priority invasive species in high priority management units;
- Strategy 4: Manage selected invasive species in selected management units (selected species and locations will depend on funding and resources available); and
- Strategy 5: Comprehensive management of all species in all management units.

An evaluation of the above management strategies is provided in Table 5 to break down the risk management ability, engagement opportunities and costs associated with each strategy and determine how each strategy satisfies the objectives outlined in Section 4.4.

In general, a lower upfront cost of a strategy correlates with a higher risk of negative impacts persisting in the marsh. The upfront costs increase between Strategy 1 and Strategy 5. Conversely, the continued impact of invasive species and potential for habitat degradation is reduced between Strategy 1 and Strategy 5. Not addressing the invasive species problem now (Strategy 1) also results in exponentially higher costs to implement Strategy 2 to Strategy 5 in the future as the abundance and extent of invasive species will increase over time without management. Strategy 5 has the highest upfront cost; however, if implemented along with an ongoing E.D.R.R. it would increase the ecological integrity and resilience of the Marsh more rapidly and provide a higher value (including economically) of ecosystem services.

Table 5: Evaluation of management strategies as they relate to risk mitigation, opportunities, costs and objectives of the I.S.M.P.

Management Strategy	Ability to Mitigate Risks		Opportunities	Cost to Implement	Achieves Objectives of I.S.M.P.		
	Hazards	Loss of Ecological Function	Community Engagement		Objective 1: Reduce abundance of invasive plants	Objective 2: Optimize professional and volunteer resources	Objective 3: Monitor effectiveness of management techniques of I.S.M.P.
Strategy 1: Do Nothing	Low	Low	None	n/a	No	No	n/a
Strategy 2: Manage only highest priority species (Common Reed and Common Buckthorn)	Medium	Medium	Yes	Moderate	In part	Yes	Yes
Strategy 3: Manage only High Priority management units	Medium	Medium	Yes	Moderate	In part	Yes	Yes
Strategy 4: Manage selected invasive species in selected management units	Medium	Medium	Yes	Low to Moderate	In part	Yes	Yes
Strategy 5: Comprehensive management of all invasive species in all management units	High	High	Yes	High	Yes	Yes	Yes

4.4. Management Objectives, Actions and Targets

Objectives, actions, targets, and timelines should be established in order to maximize the effectiveness of the I.S.M.P. and measure the success of management initiatives. As stated in Section 1.1, the purpose of the I.S.M.P. is to provide a coordinated approach to invasive species management in the Oshawa Second Marsh. To this end, specific management objectives are:

1) Reduce the relative abundance of invasive plant species in the Marsh and improve ecological integrity;
2) Optimize resources by collaborating with agencies, professionals, and volunteers; and
3) Monitor the effectiveness of specific management techniques and of the I.S.M.P. overall.

In order to achieve the objectives outlined above, actions must be prescribed along with measurable targets and realistic timelines for implementation. Table 6, below, lists objectives, actions, targets, and timelines to track the progress of the I.S.M.P.

Table 6: Summary of objectives, actions, targets, and timelines

Objective	Action	Target	Timeline
1) Reduce abundance of invasive plants	Implement invasive species management in high priority management units	Reduce invasive species cover to less than 15% in high priority management units	5-15 years
	Implement invasive species management throughout Oshawa Second Marsh	Reduce invasive species cover to less than 15% across Oshawa Second Marsh	15-20 years
2) Optimize professional and volunteer resources	Engage with the community through education and volunteer opportunities	Keep local residents informed about management activities	Ongoing
		Provide workshops or other opportunities for volunteers to get involved with invasive species management	Ongoing

Objective	Action	Target	Timeline
	Review and update resource allocation based on priorities and funding	Target resources to meet timelines associated with high priority management units and species	Annually
3) Monitor effectiveness of management techniques and I.S.M.P.	Complete baseline inventory of invasive species	Baseline inventory of invasive species in the Marsh	Complete
	Monitor high priority management units following implementation of management activities	Monitoring of high priority management units initiated	Every 5 years following implementation of management activities
	Implement early detection and rapid response (E.D.R.R.) program	E.D.R.R. program implemented	Ongoing

4.5. Management Techniques and Risk Assessment

Specific recommendations for invasive species management units in Oshawa Second Marsh have been provided in Table 4. At a high level, invasive species management involves three key phases:

1. Baseline inventory;
2. Eradication/control action; and
3. Monitoring.

Baseline inventories of invasive plant species in Oshawa Second Marsh were conducted by N.S.E. in 2018 and the results are summarized in this report and in the updated Oshawa Second Marsh Management Plan (N.S.E. and Schollen, 2023). Eradication and/or control techniques for the priority invasive plant species listed in Table 2 are discussed in this section.

4.5.1. Eradication and Control of Invasive Plants

Eradication and control techniques for invasive plant species will depend on the target species, area to be controlled, resources (people and funding) and effectiveness on the target species (based on B.M.P.s and scientific studies) and public acceptance. Management techniques such as controlled burns, heavy use of herbicides or even mechanical removal of extensive areas of invasive Common Buckthorn could face opposition from members of the public. Educational signage and presentations could help alleviate public concerns about invasive species management activities, but public perception may be a factor in deciding what management techniques to implement. Eradication and control methods for invasive plant species include:

- Mechanical control;
- Chemical control;
- Biological control; and
- Controlled burning.

Management techniques for invasive plant species are listed in Table 7. For species which have B.M.P.s available from O.I.P.C. and M.N.R.F., it is generally recommended that management techniques follow these B.M.P.s. Invasive plant species in Oshawa Second Marsh with existing provincial B.M.P.s are:

- Common Reed / Invasive Phragmites (Gabby, 2020);
- Common Buckthorn (Anderson, 2012a);
- Wild Parsnip (Tassie & Sherman, 2014a);
- Invasive Honeysuckles (Tassie & Sherman, 2014b);
- Dog-strangling Vine (Anderson, 2012b);
- Garlic Mustard (Anderson, 2012c);
- Reed Canary Grass (Anderson, 2012d); and
- Multiflora Rose (Warne, 2018).

Invasive plant species in Oshawa Second Marsh that do not currently have provincial B.M.P.s include Creeping Thistle, Himalayan Balsam, Narrow-leaved Cattail and European Frogbit. The Alberta Invasive Species Council (A.I.S.C.) has recommendations for Creeping Thistle management (A.I.S.C., n.d.) and a comprehensive summary of management options for that species is provided by DiTomaso et al. (2013). A recent study found that biological control combined with active restoration using native species is effective at controlling Creeping Thistle (Burns et al., 2013).

B.M.P.s for Himalayan Balsam are available from the King County (Washington) Noxious Weeds Control Program (2010) and Invasive Species Ireland (Kelly et al., 2008). Manual removal (i.e., hand pulling) of Himalayan Balsam has been shown to effectively control small populations and could present opportunities for volunteer engagement (Wichrowski, 2010).

Management techniques for Narrow-leaved Cattail are often lumped with management techniques for native cattails, but treatments should be targeted to Narrow-leaved Cattail patches in order to prevent collateral damage to native Broad-leaved Cattail. Management techniques are summarized by DiTomaso et al. (2013) and described in detail by Miklovic (2000) and Apfelbaum (1985) and are similar to B.M.P.s for invasive Common Reed.

Management options for European Frogbit are currently very limited. Several herbicides have been shown to be effective but their use in aquatic environments is generally not permitted in Canada and it is difficult to target European Frogbit without collateral damage to other vegetation (Nault & Mikulyuk, 2009). Manual removal of European Frogbit is difficult where it occurs in deeper water (Institute of Environmental Sustainability, n.d.). Because there is no easily prescribed management technique for controlling European Frogbit, it is not discussed further in this plan.

Active management of invasive plants, regardless of whether chemical, mechanical, or biological control is used, typically requires repeat treatments over several years. A single treatment is generally not effective and eradicating or controlling infestations of invasive plants can take several years since the seeds of many invasive plant species can remain viable in the soil for several years and there is likely a well-established seedbank of invasive species. If treatments are not repeated for several years, control methods can result in more dense populations of invasive plants, especially if the technique results in disturbance to the soil (e.g., mechanical pulling) or improper girdling or stem cutting (leading to suckering or increased shoot growth)

4.5.1.1. Considerations for Invasive Plant Management

Accurate identification of invasive plant species is a critical part of eradication and control programs. Practitioners and volunteers should be trained in the proper identification of invasive species to avoid collateral damage to native species as a result of management activities. For example, the following native honeysuckle species are present in the Marsh and should not be mistaken for invasive honeysuckle species during management:

- Canada Fly Honeysuckle (*Lonicera canadensis*);

- Limber Honeysuckle (*L. dioica*);
- Hairy Honeysuckle (*L. hirsuta*); and
- Swamp Fly Honeysuckle (*L. oblongifolia*).

Timing of implementation of management activities should consider the life stage of the plant to be controlled: generally, invasive plants should be removed or killed prior to seed production. Furthermore, any removal of vegetation should ensure there are no disturbances to active bird nests in order to comply with the Migratory Birds Convention Act (1994), which prohibits harm to most birds and their nests. It is recommended that removal of any vegetation be conducted between September 10th and March 31st to avoid the typical bird breeding period.

Use of herbicides over water is generally prohibited under the provincial Pesticides Act (1990) and will require special permission for use on Common Reed and other invasive species in Management Unit #2 and other aquatic habitats in the Marsh. Herbicides used for invasive species management should only be used by professionals with a Pesticide Applicator's License. Because of the potential for collateral damage of native vegetation by herbicides, application of herbicides in late fall or winter is recommended to reduce impacting desirable species.

Wild Parsnip is the third most important invasive species in Oshawa Second Marsh and is known to contain photosensitive chemicals in its sap that are hazardous to humans. Only professionals equipped with appropriate personal protective equipment should implement management techniques for Wild Parsnip. While mechanical methods (e.g. mowing, tilling, tarping, pulling) are somewhat effective at controlling Wild Parsnip, these methods are not recommended because they pose a health risk to humans. Chemical methods are preferred for controlling Wild Parsnip (Tassie & Sherman, 2014a).

4.5.1.2. Biomass Disposal Techniques

Removal of invasive plant species and transportation off site can cause invasive species to be introduced to new locations. Proper disposal of invasive plant biomass is necessary in order to prevent dispersal of these species. In addition, species such as Wild Parsnip contain chemicals hazardous to human health and there are safety concerns related to transportation and disposal of these species. Disposal of invasive species biomass should consider the quantity of material, risk of dispersal into new areas, safety concerns and resources available. Appendix D outlines four recommended disposal methods for invasive species biomass.

Note that the Canadian Food Inspection Agency (C.F.I.A.) regulates the transport of wood and other materials that may contain Emerald Ash Borer and that Oshawa Second Marsh is located in one of the Emerald Ash Borer Regulated Areas of Canada (C.F.I.A., 2018). Transport of ash material outside of the Marsh is therefore not permitted. Ash trees that are removed in order to protect infrastructure and human health and safety should be left where they fall.

4.5.1.3. Post-removal Planting

Planting native species after the removal of invasive plants is an important component of invasive species management because removal of invasive species can cause soil disturbance, increase light levels and alter other conditions that promote invasion by other species or resurgence of species being removed. Without deliberate reintroduction of native vegetation, invasive species management may simply lead to a cycle of invasion and further degradation of the ecosystem. This is a particular concern in areas that are dominated by monocultures of invasive species, such as Common Buckthorn, or areas that have experienced major changes to vegetation structure because of species such as Emerald Ash Borer.

Planting following invasive species management in Oshawa Second Marsh may involve planting native trees, shrubs, herbaceous plants and/or seed mixes to replace and compete with invasive species. The purposes of planting native species are to:

- Out-compete exotic invasive species;
- Enhance native species biodiversity and ecological function; and
- Improve ecological integrity.

In general, species planted for ecological restoration should complement existing native species composition in the immediate vicinity of the site. Species planted should be suited to the hydrological and environmental characteristics of the community. For example, following removal of Garlic Mustard from a deciduous forest community, species typical of deciduous forest groundcover should be planted. In many cases it may not be possible to restore an ecosystem to pre-invasion conditions, particularly if the site has undergone significant changes/disturbance. Restoration activities should reflect the existing hydrological, biological, and climatological conditions at a site, even if those do not reflect historical conditions. For example, planting ash trees following removal of Common Buckthorn or dead ash may be a futile endeavour since planted material will likely be killed by Emerald Ash

Borer before reaching maturity. In essence, planting should aim to improve and enhance ecological functions and biodiversity recognizing existing and future conditions.

The Oshawa Second Marsh Forest Management Plan (N.S.E., 2024) provides specific recommendations for restoration activities in Management Units 3 and 5 and should be referred to in order to plan for site restoration following removal of Common Buckthorn and dead ash trees in those areas.

4.5.2. Management Techniques for Common Carp and Goldfish

Common Carp and Goldfish are likely present in Management Unit #2. Management of invasive fish species consists of three components: exclusion, removal and prevention. Common Carp should continue to be excluded from the Marsh by maintaining the water control structure at the western edge of the Marsh and ensuring that it functions as a barrier to Common Carp passage while allowing passage of native species. Maintaining this structure is expected to be effective at preventing most Common Carp from accessing the Marsh and no additional management is considered necessary. However, it is recommended that active removal of invasive fish be considered after flooding events or if the exclusion structure is damaged and Common Carp enter the Marsh. There is additional benefit of actively removing invasive fish already present in the Marsh during drawdown periods when they are most accessible to address Goldfish, which are not excluded from the existing structure. The Royal Botanical Gardens (R.B.G.) in Hamilton, Ontario, have had great success at reducing Common Carp populations in their marshlands by using a fish barrier and actively removing Common Carp already in the marsh (R.B.G., n.d.). Note that it is a condition of fishing licenses and scientific collection permits for fish that any invasive fish species captured must be euthanized (M.N.R.F., 2016).

The final component of invasive fish management is preventing introductions of Common Carp, Goldfish, and other invasive fish species. Fish may be released into the Marsh deliberately or unintentionally as bait, disposal of aquarium pets or deliberate introductions of charismatic fish (M.N.R.F., 2016). Fish may also be introduced elsewhere within the watershed (e.g., stormwater management ponds, watercourses, etc.) and disperse into the Marsh. Introduction pathways could be targeted by installing educational signage at publicly accessible locations around the Marsh.

Table 7: Management techniques for invasive plants

Control Method	Technique	Description	Suitable Vegetation	Suitable Priority Species	Tools/ Materials Required	Advantages	Disadvantages
Mechanical	Hand Pulling or Digging	• hand pulling invasive plants • weed-wrenches can also be used for woody species • can be used as an interim measure while other methods are being planned or waiting for permissions • must dispose of plant material that is removed	• effective for species without rhizomatous root systems	• Buckthorn • Garlic Mustard • European Cranberry Viburnum • Himalayan Balsam • Invasive Honeysuckles • Norway Maple • Creeping Thistle • Dame's-rocket • Hairy Willowherb • Amur Maple • White Poplar • Creeping Jenny • Gypsywort • Sorbaria	• weed-wrenches • Extractigator® • shovel	• low-overhead cost • low danger • sometimes effective • can often be done by volunteers with minimal training	• can be difficult to remove all roots • labour-intensive • desirable native species can be trampled or pulled by mistake • will cause localized soil compaction • sometimes not effective
	Mowing and Cutting	• cutting of invasive shrubs and trees, often in conjunction with herbicide application • mowing of extensive area entirely dominated by invasive species (herbaceous or grass)	• all plant types	• Buckthorn • Common Reed • Dog-strangling Vine • Garlic Mustard • European Cranberry Viburnum • Invasive Honeysuckles • Norway Maple • Creeping Thistle • Dame's-rocket • Hairy Willowherb • Amur Maple • White Poplar	• handsaws • power saws • brush-cutters • mower • weed-whipper	• some activities possible for volunteers (e.g., cutting) • simple, easy	• stressed woody plants are occasionally killed by cutting, but most survive and re-sprout • soil compaction with heavier machinery • larger equipment may damage adjacent native vegetation • cutting of deciduous woody invasive usually requires follow-up treatment with herbicide • species such as Common Buckthorn will need follow up treatment (i.e. chemical) since this will not remove the population but makes it more manageable

Control Method	Technique	Description	Suitable Vegetation	Suitable Priority Species	Tools/ Materials Required	Advantages	Disadvantages
	Physical Covering - Mulching	• covers low-growing species • inhibits photosynthesis to slow or prevent further growth when mulch layer is at least 7.5 cm in depth • can be used in conjunction with a layer of newspaper or cardboard under the mulch to inhibit initial growth of invasive species • can be used for taller vegetation, after cutting/mowing	• herbaceous plants and grasses that are either low growing or have been cut low to the ground	• Garlic mustard • Dame's-rocket • Hairy Willowherb • Creeping Jenny	• mulch • shovels • buckets • wheelbarrow	• adds organic matter to the soil as mulch decomposes	• less effective with time as mulch decomposes
	Physical Covering - Tarping	• used in areas of complete invasive species dominance • inhibits photosynthesis • reduces seedling regeneration • contributes to killing off the seedbank	• herbaceous plants and grasses that are either low growing or have been cut low to the ground	• Common Reed • Dog-strangling Vine • Garlic mustard • European Cranberry Viburnum • Wild Parsnip • Creeping Thistle • Dame's-rocket • Hairy Willowherb • Creeping Jenny	• tarps • landscape staples	• able to control large area of invasives with minimal cost or effort	• difficult to install on uneven ground, rocks, or stumps • often dug up by animals or vandals and some plants survive • results in large un-vegetated area that requires planting with native species to prevent re-growth of invasives • species such as Dog-strangling Vine will need follow up treatment (i.e. chemical) since this will not remove the population but makes it more manageable
Mechanical	Girdling	• a ring of bark is cut around the base of the stem severing the cambium and often the xylem preventing the flow of nutrients to the roots and water to the upper stem. The plant dies slowly as stored reserves in the roots are depleted. The cut must be done completely around the stem to be effective.	• used for large woody species that will not become a hazard (i.e. away from trails, adjacent properties	• Norway Maple • Amur Maple • White Poplar	• hand saw • hatchet • hand girdling tool (e.g., Ringer)	• less costly than cutting down entire tree • provides habitat for wildlife (e.g., birds feeding on insects) • if performed correctly, does not cause re-sprouting	• shrubs and young trees often re-sprout vigorously unless herbicide is also used in the cut • may continue to live or re-sprout if done incorrectly

Control Method	Technique	Description	Suitable Vegetation	Suitable Priority Species	Tools/ Materials Required	Advantages	Disadvantages
Chemical	Spray or spot application	• often performed in conjunction with mechanical treatment • pesticides classified by effect, but most are systemic • can be applied to cut stumps, cuts through the bark (hack-and-squirt), or to outside of bark on young stems (basal bark treatment), or to foliage by wicks or sprayers • herbicides that top-kill only (i.e. vinegar formulations) are not usually effective except for annual species prior to seed set	• terrestrial invasive species with extensive root systems	• Buckthorn • Common Reed • Dog-strangling Vine • Garlic Mustard • European Cranberry Viburnum • Himalayan Balsam • Invasive Honeysuckles • Norway Maple • Wild Parsnip • Creeping Thistle • Narrow-leaved Cattail • Reed Canary Grass • Dame's-rocket • Hairy Willowherb • Amur Maple • White Poplar • Creeping Jenny • Gypsywort • Sorbaria	• Pesticide Applicator's License • Integrated Pest Management certificate • chemical • application equipment • personal protective equipment (gloves, tyvek ® suit, rubber boots, etc.)	• effective tool for new and small populations of invasive plants • will kill target plants • can have residual control of seed-bank • less labour	• specialized training, certifications required • public concern for environmental health • potential for negative effects on non-target plants • restrict/avoid herbicide use near water bodies including wetlands (refer to the *Pesticides Act* for guidance and regulations) • Glyphosate needs to be applied immediately after cutting vs. Triclopyr which can be applied later in the growing season (note: Triclopyr is more expensive than Glyphosate)

Control Method	Technique	Description	Suitable Vegetation	Suitable Priority Species	Tools/ Materials Required	Advantages	Disadvantages
Controlled Burns	Controlled fire in a specific area	• can reduce above-ground biomass that has been suppressing native vegetation • can kill most woody plants if done repeatedly, allowing dominance of herbaceous and graminoid (e.g., grasses) species	• species not adapted to a fire-controlled ecosystem	• Common Reed • Invasive Honeysuckles	• qualified controlled burn experts (contact Fire Management Program with MNRF for more information) • associated burn equipment	• part of integrated management plan for certain species or communities (i.e. tallgrass prairie or savannah)	• requires highly specialized knowledge and entails higher risks • not appropriate in some urban areas or conifer plantations due to risk of fire spread • does not kill plant roots; plants usually grow back but may be weakened and more easily controlled by other methods • high financial cost • need permission from fire department • narrow window of suitable weather conditions or season for it • will require more communication/notices to surrounding community
Biological Control	Insects	• controlled release of invasive plant species predator	• vegetation that cannot be effectively controlled by other means • under development for Dog-strangling Vine	• Purple Loosestrife • Creeping Thistle	• suitable insects	• usually highly specific • often effective • can be self-sustaining (low-effort after initial introduction)	• possibility that biological control agent adopts other (e.g., native) plant hosts • will not eliminate a species but will reduce numbers to low levels • must be approved by federal and provincial authorities before release

4.6. Opportunities for Public Engagement

Engaging community volunteers in invasive species management activities can have desirable outcomes. Volunteers can provide additional personnel for invasive species management at little or no cost and engaging community volunteers can improve public awareness about invasive species and local ecology.

The Friends of Second Marsh have initiated a number of invasive species management activities over the years and will be an excellent resource for invasive species management in the future. For invasive plant species with small, localized occurrences in Oshawa Second Marsh, and for which mechanical removal is an effective management technique supported by provincial B.M.P.s, volunteers could be involved in management activities. Community invasive species pulls could be organized for the following species in Oshawa Second Marsh: Common Buckthorn (isolated patches), invasive Honeysuckles, Creeping Thistle, Himalayan Balsam, Garlic Mustard, Dame's-rocket, Hairy Willowherb, Creeping Jenny, Gypsywort, and Sorbaria. Volunteers should avoid hazardous situations (e.g., within the Ghost Road Bush where dead or dying ash trees pose a hazard, Wild Parsnip removal, or Multiflora Rose) or that require licensed pesticide applicators (e.g., Common Reed, Purple Loosestrife, Dog-strangling Vine, Narrow-leaved Cattail and large patches of Common Buckthorn).

The Friends of Second Marsh could coordinate community invasive species removal activities. Other groups that could be engaged include local field naturalist clubs, universities, colleges, and public schools. Volunteers should only be used where invasive species removal can be targeted and is not likely to cause damage to sensitive native species and habitats.

4.7. Monitoring

O.I.P.C. recommends that management programs for invasive species incorporate an E.D.R.R. program (O.I.P.C., 2019). E.D.R.R. is an adaptive management model that consists of:

1) Early detection – regular documentation and identification of invasive species occurrences;
2) Rapid response – development and implementation of management techniques to eradicate or control the occurrence; and
3) Monitoring and reassessment – evaluation of the response effectiveness and whether the E.D.R.R. objectives were achieved.

It is possible that new invasive species will be detected in Oshawa Second Marsh during the lifetime of the I.S.M.P. This could include new populations of invasive species already present in the Marsh, or new species not currently present in the Marsh. An E.D.R.R. program should therefore be implemented to detect and manage species and sites that are not currently prioritized in the plan and new populations of species identified as priority invasives.

Monitoring should also be implemented to determine whether the targets set out in Table 6 are being met. Monitoring should be conducted by individuals proficient at invasive species identification and using a standard method for estimating abundance, such as the Baseline Monitoring for Invasive Species data sheets provided in Appendix A. Monitoring should be conducted in areas where invasive species are being managed to determine the effectiveness of management techniques. Native plantings, as discussed in Section 4.5.1.3, should be monitored for survival, establishment and spread. Monitoring should be conducted periodically based on the timelines recommended in Section 4.8, below. For example, monitoring should be conducted at high priority management units every five years following invasive species management to determine whether invasive plant cover has been reduced to less than 15%. Monitoring of the entire marsh should be conducted every 10 years to determine whether invasive plant cover has been reduced to less than 15%.

4.8. Recommended Timelines

Planning for invasive species removal should consider priorities, plant phenology (e.g., when can the species be identified, can it be removed before setting fruit), management techniques (e.g., seasonality of certain techniques), relevant legislation (e.g., Migratory Bird Act), safety (e.g., removal of dead ash trees prior to removal of other invasive species), and resource availability (e.g., fiscal year, funding opportunities or external support). Recommended timelines have been provided in the work plan (Table 4). Timelines to achieve the work outlined in Table 4 are intended to be financially and logistically feasible and reflect the need for repeat treatments of invasive species. For example, successful reduction of Common Buckthorn cover to less than 10% in high priority management units may take up to five years of repeated mechanical removals and herbicide treatments. Successful reduction in current invasive species cover by 50% to less than 15% across all of Oshawa Second Marsh may take more than 15 to 20 years.

Invasive species management is likely to be an ongoing need to ensure the ecological integrity in Second Marsh does not degrade. Certain activities and targets should be ongoing, such as keeping local residents informed of management activities, engaging

volunteers and implementing an E.D.R.R. program. In addition, management priorities, funding and resources should be reviewed annually to allocate resources effectively from year to year.

Monitoring should be an ongoing activity with regards to invasive species management in Oshawa Second Marsh. Monitoring of priority management units to determine whether invasive plant cover targets have been achieved and/or whether restoration plantings have been successful should be conducted every five years following implementation of management activities. Community volunteers could be engaged in regular monitoring of management areas for invasive species following implementation of invasive species management activities.

4.9. Estimated Costs

The cost of invasive species management activities recommended in this plan will depend on the area of invasive species to be treated, treatment method, restoration requirements and opportunities for volunteer engagement. For example, use of herbicides for invasive species management can only be conducted by trained professionals and may be more expensive than mechanical control techniques, which could be accomplished by volunteers. However, herbicide treatments tend to be more effective than mechanical methods, overall.

Table 8, below, lists the estimated cost per day and per hectare for different invasive species management activities. These costs have been estimated at a high level based on various assumptions and the actual costs may vary. Costs have also been estimated for planting activities to be conducted following invasive species management and these are listed in Table 9. Costs for management actions are based on the costs for a contractor to undertake the work. Where opportunities are available for volunteers to be engaged, costs would be lower.

Table 83: Estimated costs for invasive species management activities in Oshawa Second Marsh

Work Item	Productivity /day	Staffing Requirements /day	*Cost/day (labour and equipment)	Cost/ha	Notes
Cut and treat Common Buckthorn, chip and remove materials, leave stumps	• Dense growth (10 stems/m^2) = 0.09 ha Light/scattered growth (1 stem/ 2m^2) = 0.4 ha	• 4 people	$3,620	$39,820 dense $9,050 light	Small patches of Common Buckthorn may be cut by volunteers and then treated by a professional after to reduce costs.
Cut and treat Common Buckthorn, pile materials on site, leave stumps	• Dense growth (10 stems/m^2) = 0.09 ha • Light/scattered growth (1 stem/ 2m^2) = 0.4ha	• 4 people	$2,120	$23,320 dense $5,300 light	Small patches of Common Buckthorn may be cut by volunteers and then treated by a professional after to reduce costs.
Cut and treat other tree/shrub species <30cm D.B.H., pile brush materials on site, leave logs and stumps	• 0.25 ha	• 2 people	$1,920	$7,680	Small patches of invasive shrubs may be cut by volunteers and then treated by a professional after to reduce costs.

Work Item	Productivity /day	Staffing Requirements /day	*Cost/day (labour and equipment)	Cost/ha	Notes
Cut and treat other tree/shrub species <30cm D.B.H., remove brush and logs, leave stumps	• 0.25 ha	• 2 people	$1,920	$7,680	Small patches of invasive shrubs may be cut by volunteers and then treated by a professional after to reduce costs.
Spray invasive Common Reed in marsh, leave dead materials on site	• 0.5 ha	• 4 people	$2,800	$5,600	Removal of dead materials would need to be priced if needed, or burn dry material on site.
Wick invasive Common Reed in marsh mixed with native plants, leave dead materials on site	• 0.25 ha (1 stem/m^2 density)	• 4 people	$2,680	$10,720	
Spray (herbicide) herbaceous invasive species (e.g. Dog-strangling Vine)	• 0.4 ha	• 2 people	$1400	$3,500	
Wick (herbicide) herbaceous invasive species mixed with natives	• 0.25 ha	• 2 people	$1400	$5,600	

Work Item	Productivity /day	Staffing Requirements /day	*Cost/day (labour and equipment)	Cost/ha	Notes
Pull herbaceous plants (e.g. Garlic Mustard), remove from site (bag)	• 0.3 ha	• 2 people	$1,060	$3,534	Can be done by volunteers under supervision.
Clear entire dense buckthorn monoculture (machine grubbing and tilling sapling woody plants and root crowns)	• 0.4-1.0 ha	• 5 people	$2,700	$2,700-$6,750	Sites must be relatively flat, stumps must be <20 cm diameter at ground level.
Re-cut and treat stumps of cut trees or shrubs after cutting	• 0.25 ha	• 2 people	$1,920	$7,680	Re-cutting stumps left 15 cm tall by removal crew, 1 day to 1 year after initial cutting
Girdle trees without herbicide treatment	• 60 trees @ 30 cm D.B.H.	• 1 person	$600	$7,500	Trees less than 15 cm diameter at base should be cut and stumps treated
*All costs are estimates using current typical market costs; fuel/mileage and H.S.T. is extra.					
Assumes qualified people working with necessary licences and certifications.					
Leaving materials on site means pile cut brush or stems of herbs to rot over time.					
Stumps are left cut on site and not treated with herbicide unless stated otherwise. For full control stumps would still need to be treated, or re-cut and treated at a later time.					

Table 94:Estimated costs for restoration planting activities at Oshawa Second Marsh

Restoration Planting Type	Size of Stock/method	Cost of plant, mulch and labour /plant	Recommended Density	Cost/area	Notes
Tree (large)	Bare root, container grown, 5-7 gallon pot	$40-50	1 plant/ 10m^2	$2,000-2,500 / 0.5 ha	Volunteers reduce labour costs by $10/tree
Tree (small)	1 gallon/whip	$30-40	1 plant/ 10m^2	$1,500-2,000 / 0.5 ha	Volunteers reduce labour costs by $10/tree
Shrub (large)	Bare root, container grown, 3-5 gallon pot	$20-30	2 plants/ 10m^2	$2,000-3,000 / 0.5 ha	Volunteers reduce labour costs by $10/tree
Shrub (small)	1 gallon/whip	$15-20	4 plants/ 10m^2	$3,000-4,000 / 0.5 ha	Volunteers reduce labour costs by $10/tree
Herbaceous and Graminoids	plugs and pots	$8-10	10 / m^2	$80-100/m2	Volunteers reduce labour by $1.25/plant
	Seeding (hand)	n/a	Variable by community type	$500 / 0.5 ha	Volunteers can be used for this.

5. Conclusions

At least 26 invasive plant species, as well as two invasive fish species and two invasive insects, occur in Oshawa Second Marsh. Several of these have caused major changes to vegetation composition and impacts to the Marsh's ecological integrity or human health. The I.S.M.P. provides a coordinated approach to managing these species and identifies actions, targets, and timelines for management activities. The Marsh has been broken down into invasive species management units within which priorities, actions and targets have been prescribed (see Table 4).

Ten key invasive species for management at Oshawa Second Marsh have been identified: Common Reed, Common Buckthorn, Wild Parsnip, invasive honeysuckles, Creeping Thistle, Purple Loosestrife, Dog-strangling Vine, Himalayan Balsam, Narrow-leaved Cattail, and Garlic Mustard. These species should be managed using techniques recommended in provincial Best Management Practices and other authoritative documents. Specific management actions to control or eradicate these species are outlined in Table 4. Additional non-priority invasive species should be managed where funds and resources allow.

Emerald Ash Borer has run its course in Oshawa Second Marsh and control or eradication of this insect pest is no longer possible. Therefore, management should focus on risk mitigation as outlined in the Forest Management Plan (N.S.E., 2024). The fish gate should be maintained to serve as a barrier to Common Carp. Consideration could be given to active removal of Common Carp and Goldfish from the Marsh during drawdown periods.

Monitoring is a critical component of invasive species management. E.D.R.R. should be implemented in the Marsh and the surrounding community should be engaged to help monitor populations of invasive species and report new populations of invasive species. Monitoring should be conducted periodically to determine whether the management actions prescribe in this plan have achieved their respective targets.

Oshawa Second Marsh remains an ecosystem of regional and global significance despite the prevalence of invasive species. Invasive species management will help improve or prevent further impacts to the Marsh's ecological integrity.

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Appendix 1 | Baseline Monitoring for Invasive Species field sheets

MANDATORY

START	END
Date	
Observers	

- ☐ Invasive Species Identified
- ☐ Polygons/Waypoints Marked
- ☐ Species at Risk Present
- ☐ Population Details Form
- ☐ Health Risk
- ☐ Photos

Provide Invasive Species Population Details on the associated data collection sheet provided.

Instructions for *Invasive Species Population Details* Data Sheet

Polygon ID/Waypoint *Polygons can be marked on a hard-copy air photo with associated notes and waypoints documented on a datasheet, or information can be entered digitally on a tablet with air photo and GPS capabilities. Use this column to record polygon ID/Waypoint number.*

Location Description *Describe location being surveyed when invasive species was encountered: Trail, Property Boundary, Watercourse, Waterbody, Area of Interest (AOI), etc.*

Vegetation Community *Identify ELC unit(s) that polygon overlaps.*

Plant Species *Use acceptable species codes based on scientific nomenclature (e.g. ACESASA).*

Area Disturbance *Check disturbance(s) present within or adjacent to the polygon or waypoint. For 'Other' check column and describe in 'comment' column.*

Management Triggers *Check column if any are applicable within or adjacent to the polygon.*

Population Characteristics

Abundance *Provides context to population characteristics. Use codes to approximate population numbers.*

Population Codes: **1** = 1-2 **2** = 3-5 **3** = 6-20 **4** = 21-50 **5** = 51-100 **6** = 100+

Distribution *Within-site species distribution can be scattered (many plants scattered evenly throughout area), patchy (plants in distinct patches), a combination of scattered and patchy (a dense patch that becomes more scattered further from the dense patch), or contain very few individuals (few individuals in close proximity can be interpreted as one patch)*

Comments *Provide any additional comments that may help guide management decisions and provide additional context to the site-specific invasive species populations. Phenology, current effects on the surrounding ecosystem, adjacent native plants etc..*

Track/ Waypoint	**Location Description** e.g. Trail, Boundary	***ELC Unit***	**Plant Species**	**Population Characteristics** *(within polygon)*		**Comments** *Phenology, effects on ecosystem, adjacent native plants and population, etc.*
				Abundance	**Distribution** *Scattered, patchy, dense*	

Track/ Waypoint	**Location Description** e.g. Trail, Boundary	***ELC Unit***	**Plant Species**	**Population Characteristics** *(within polygon)*		**Comments** *Phenology, effects on ecosystem, adjacent native plants and population, etc.*
				Abundance	**Distribution** *Scattered, patchy, dense*	

Appendix 2 | U.A.V. Surveys Memorandum

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Second Marsh Management Plan

UAV Image Acquisition Deliverable
By: Dr. Derek Robinson, Ben Meinen, and Omar Dzinic

Purpose

Given the size of Second Marsh and the difficulty to access the interior marsh by foot or canoe for manual ecological zone classification measurements, unmanned aerial vehicle (UAV) imagery were acquired.

Regulatory Protocol

The process to legally fly a UAV over Second Marsh required the following steps:

1) Acquisition of a Special Flight Operations Certificate from Transport Canada
2) Approval from NAV Canada, which was granted under the condition that
    a. Call the Oshawa Control Tower prior to and after completion of the flight at 905-576-2398.
    b. Report any flight anomalies to the Oshawa Control Tower as soon as practicable.
3) Michelle Whitbread, Parks and Environmental Services Coordinator for the City of Oshawa as well as project lead Sal Spitale from North-South Environmental were made aware of the date and times of flights.
4) Access to Second Marsh was acquired with key to gated access road from headquarters at 199 Wentworth St. E., Oshawa.
5) Signage was then posted at the four entry points into Second Marsh to inform the public of the operations taking place within the property boundaries.

Operations Protocol

To conduct UAV flights on Second Marsh requires the following steps:

1) Ground control points were spread along the length of the beach, the access road, and along Wentworth street for the south portion of Second Marsh and were similarly placed around the perimeter where possible for the northern portion of Second Marsh. (Approximately 1 hr)
2) A high accuracy (< 2cm) RTK Global Positioning Receiver was used to spatially locate ground control points. The location of ground control points in the imagery in combination with their GPS locations ensure images accurate represent the placement of features in the image to within 2 cm. (Approximately 2 hrs)

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3) Once the ground control points are put in place flight operations can commence. Two personnel were involved with the specific flight operations
    a. Pilot in Command (Dr. Derek Robinson) who is in charge of all flight operations.
    b. Spotter (Collaborator/Student) who maintains visual line of sight with the UAV and acts to prevent distraction to the pilot.
4) After flights were completed, ground control points were collected, signage were removed, keys returned, and notification of end of flight missions to the Oshawa Control Tower was made.

Flight Summary

- Two UAV field campaigns were conducted
    - Campaign 1 - July 11, 2018
    - Campaign 2 - August 3, 2018
- Campaign 1
    - UAV model: DJI Inspire 1
        - System Value: $10,000
    - Images acquired: 728
    - UAV height: 60 m
    - Image resolution: 3.94 cm
    - GCPs: 15
- Campaign 2
    - UAV model: Aeryon Labs SkyRanger
        - System Value: $120,000
    - Images acquired: 1748
    - UAV height: 100 m
    - Image resolution: 2.68 cm
    - GCPs: 20
- Total area mapped: 1.86 km^2 (460.8 acres)

Results

Using Campaign 2 imagery we digitized the location of two plant communities as well as duck or muskrat nests. Phragmites were digitized at a Scale of 1:200 into four categories comprising less than 25%, 25-50%, 51-75%, and 76-100%. The minimum mapping unit used was 2m, which means that no polygon (i.e., area) was digitized that was less than 2m spatially in any direction. From this work we identified 42 patches of dense Phragmites stands. We also found that the majority of the marsh had some amount of Phragmites established, which

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yielded a total area of coverage of 0.17 km². Over half of this area comprised less than 25% Phragmites coverage, but a substantial amount of area was within the 75-100% coverage classification. Our confidence in the accuracy of these data is high.

In addition to Phragmites, poisonous parsnip was digitized, which was identified only along the access road from Wentworth St. to the southwestern edge of Second Marsh. The accuracy of these digitized data was low relative to the Phragmites digitization data, but the same scale, density classification, and minimum mapping unit were used. In total, 1624 m2 (0.0016km2) in area were composed of poisonous parsnip. While the area in poisonous parsnip is relatively small, in both campaigns we encountered at least 6 members of the public that use the access road for recreational purposes who could be affected by this plant species.

Lastly, we identified a number of nests in the marsh that require further classification as either duck or muskrat nests. We have commenced discussion with North-South Environmental on this issue, but primarily observed ducks in these locations when they were close to the access road or beach. In total we identified 133 nests.

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Appendix 3 | Recommended Biomass Disposal Techniques

Appendix 3. Recommended Biomass Disposal Techniques

Biomass Disposal Technique	Target Groups	Description	Disposal method	Leave materials on or off site	Comments
Solarization	Herbaceous plants	Place plants entirely into heavy black bags (contractor grade)	Leave bags in the sun for several weeks (placing on dark pavement has the best effect) Label bags as necessary and/or assign a designated area	Either; there is no concern of spread due to containment in bags Depending on volume, the City can handle storage of smaller quantities.	Consider alternative options when facing larger quantities of material. Disposal of inert materials in municipal waste facility Seeds may remain viable under 50 °C[2]
Chipping	Woody plants that do not reproduce vegetatively	Chip woody material	• Spread chipped woody material (e.g., on trails), • In area where large (>10 m^2) amount of invasive species have been removed to suppress future regrowth, and/or • Pile on site for future use	Depends on stage of reproduction: • if chipped after fruit/seed production, leave chips on site. Chipped materials should be spread only in areas from which they were removed • if chipped before fruit/seed production, chips can be moved off site, or spread outside of invasive species area • if chipped material potentially contains invasive insects, leave chips on site	If smothering of native species is a concern, then depth of mulch should not exceed four (4) cm
Decomposing	Variety; method depends on reproduction type	• Prior to fruit/seed: o seedlings and small plants: leave material on ground with roots exposed o larger plants: pile material • After fruit/seed: pile and cover • If plant reproduces vegetatively: pile	Leave in place to decompose across area where invasive species were removed; pile or scatter	Decision to leave materials on site should be made on a site basis. Where it is preferable to leave materials on-site, it may not be feasible to leave materials (e.g., proximity to public, trails, visual appearance)	Consider a minimum distance when allowing materials to decompose on site (e.g., minimum 30 m from the edge of the natural area) Remove plant materials from site for areas within 30m of trail Cut down brush piles to minimal size (e.g., do not exceed 0.5 m, or 1.0 m in length/width for exposed piles) in height for areas >30 m from trail and leave on site Leave logs on site to rot, spread out in long lengths Avoid smothering desirable herbaceous vegetation
Composting	Herbaceous plants	Plants collected into black bags (contractor grade)	Disposal of inert materials in municipal waste facility	Off-site	

[2] Dahlquist et al., 2007

CO-25-22
Attachment 3

September 2024

Oshawa Second Marsh

Forest Management Plan

Prepared for

City of Oshawa

north-south ENVIRONMENTAL

North-South Environmental Inc. • 101B King Street West • Cambridge, Ontario • N3H 1B5

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Oshawa Second Marsh: Forest Management Plan

1. Introduction

Emerald Ash Borer (E.A.B.) (*Agrilus planipennis*) is a highly destructive, non-native insect tree pest that feeds exclusively on and kills ash trees (genus *Fraxinus*) in urban, suburban and natural forests alike. Ash wood decays quickly, and as a result, dead and dying trees quickly become hazards. In Oshawa Second Marsh (O.S.M.), herein called "the Marsh" (Figure 1), the largest treed community is a Green Ash (*Fraxinus pennsylvanica*) swamp, named Ghost Road Bush, with a canopy of over 97% ash trees. The impacts of E.A.B. in Ghost Road Bush have been severe, with nearly 100% mortality of ash trees. As E.A.B.-killed ash trees are known to become structurally compromised within a few years of mortality, the risk of partial or whole tree failure increases significantly, which may lead to personal injury in publicly accessible areas. These hazardous conditions have prompted the closure of the boardwalk trail that runs east-west through Ghost Road Bush. In order to mitigate the hazardous conditions, ash trees have been removed within 30 m of Colonel Sam Drive, the berm and along the Marshland Trail adjacent to Ghost Road Bush at the request of General Motors, the former property owner (the lands at McLaughlin Bay are now owned by the City of Oshawa).

The Forest Management Plan (F.M.P.) contributes to the O.S.M. Management Plan (N.S.E. and Schollen 2023) and must be read, interpreted, and implemented in conjunction with the Management Plan. The purpose of this F.M.P. is to provide a set of sustainable, cost-effective management strategies to address hazardous conditions resulting from E.A.B. infestation in Ghost Road Bush (including the north and south side of Colonel Sam Drive). This management plan provides a recommended management approach to preserve, restore and maintain a healthy forest/swamp community through priority actions in the short, medium and long term, evaluates various management options with risks, threats and opportunities and provides recommended timeline and a cost estimate. This management plan is intended to guide decision making, implementation and budgeting.

Hazardous conditions have also been reported along the trail west of the maintenance berm that connects the Marsh to the Waterfront Trail via a boardwalk and foot bridge. Due to the desire to maintain connectivity of the Marsh with the Waterfront Trail system this F.M.P. has

also examined the hazardous conditions along the trail segment between the berm and the Waterfront Trail (a portion of the Bob Mills Boardwalk Trail).

In addition to addressing hazards, this F.M.P. will consider ecological impacts resulting from the loss of the ash canopy and propose management options to maintain or enhance the ecological functions associated with the forest communities, particularly those impacted by E.A.B.

Therefore, the goals of forest management are to:

1. Reduce hazardous conditions resulting from E.A.B.
2. Restore the forest canopy following the loss of ash trees.
3. Improve native biodiversity.

2. Site Evaluation Methods

The consultant team (U.F.I. and N.S.E.) conducted several site visits within the study area to characterize and evaluate the site and inform the Forest Management Plan (F.M.P.). The primary purpose and date of each site visit were:

- 20th June 2018 – Basal Area Inventory and assessment of regeneration
- 4th September 2018 - Tree Risk Assessment
- 20th May, 12th and 20th July, 24th August and 2nd September, 2018- Ecological Land Classification (E.L.C.)

2.1. Ecological Land Classification

As part of the update to the Management Plan for Oshawa Second Marsh (NSE and Schollen 2023), the E.L.C. mapping was updated. Vegetation communities within the study area were characterized and mapped according to E.L.C. for Southern Ontario: First Approximation and Its Application (Lee et al. 1998). E.L.C. surveys included the investigation of soils using an auger to determine moisture regime. Two soil sampling locations were chosen. Generally, communities at least 0.5 ha in size are mapped following E.L.C. protocols; however, vegetation communities less than 0.5 ha were may also be included in this delineation if they represent a rare community or important feature (e.g., wetland). Physical characteristics and dominant vegetation species were recorded for vegetation communities.

The terminology used to describe each of the vegetation communities is based on E.L.C. sampling protocols that collect information on four vegetation layers (note: some layers may not be present within a vegetation community sampled). The four layers are:

- Canopy consists of tall vegetation which reaches the light first; typically composed of tall trees (in a forest community).
- Sub-canopy includes vegetation growing just under the canopy; vegetation that receives filtered sunlight through the canopy; typically composed of trees and tall shrubs (in a forest community).
- Understory includes vegetation growing below the sub-canopy; typically composed of both tall and low-growing shrubs (in a forest community).
- Ground layer consists of the vegetation which is closest to and covering the ground; typically composed of herbaceous vegetation.

2.2. Stand Density

Stand density is a measure of the density of trees in a forest based on the number of trees per unit area and Diameter at Breast Height (D.B.H.). Stand density can be approximated using Basal Area (B.A.), which is the cross-sectional area of a tree at breast height (1.3 m above ground level) and is a measure of tree stem area per hectare (m^2/ha). Essentially, B.A. measures "how much wood is in a forest" (Canadian Institute of Forestry, 2018). While B.A. is used in a forest management sense as a measure of forest productivity, B.A. can also be used to inform management decisions related to resources (e.g., costs) required for hazard tree removal, forest regeneration needs and restoration options.

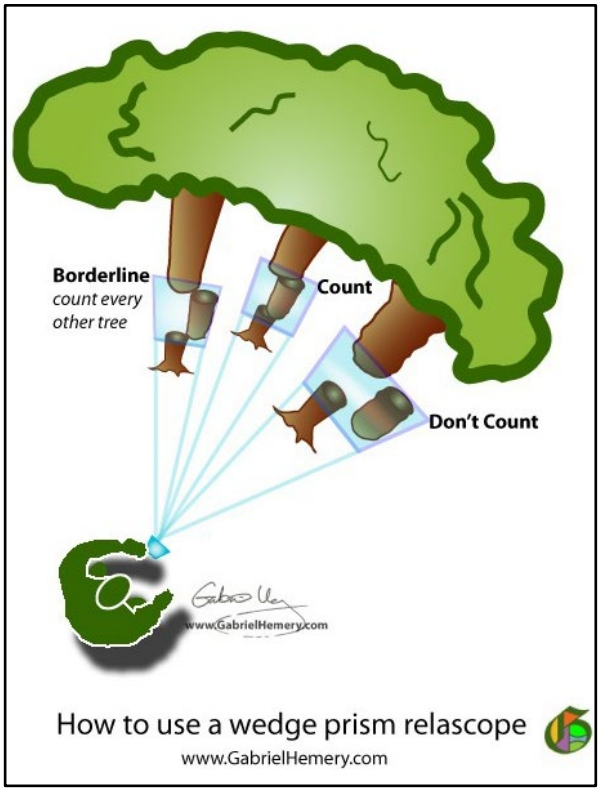
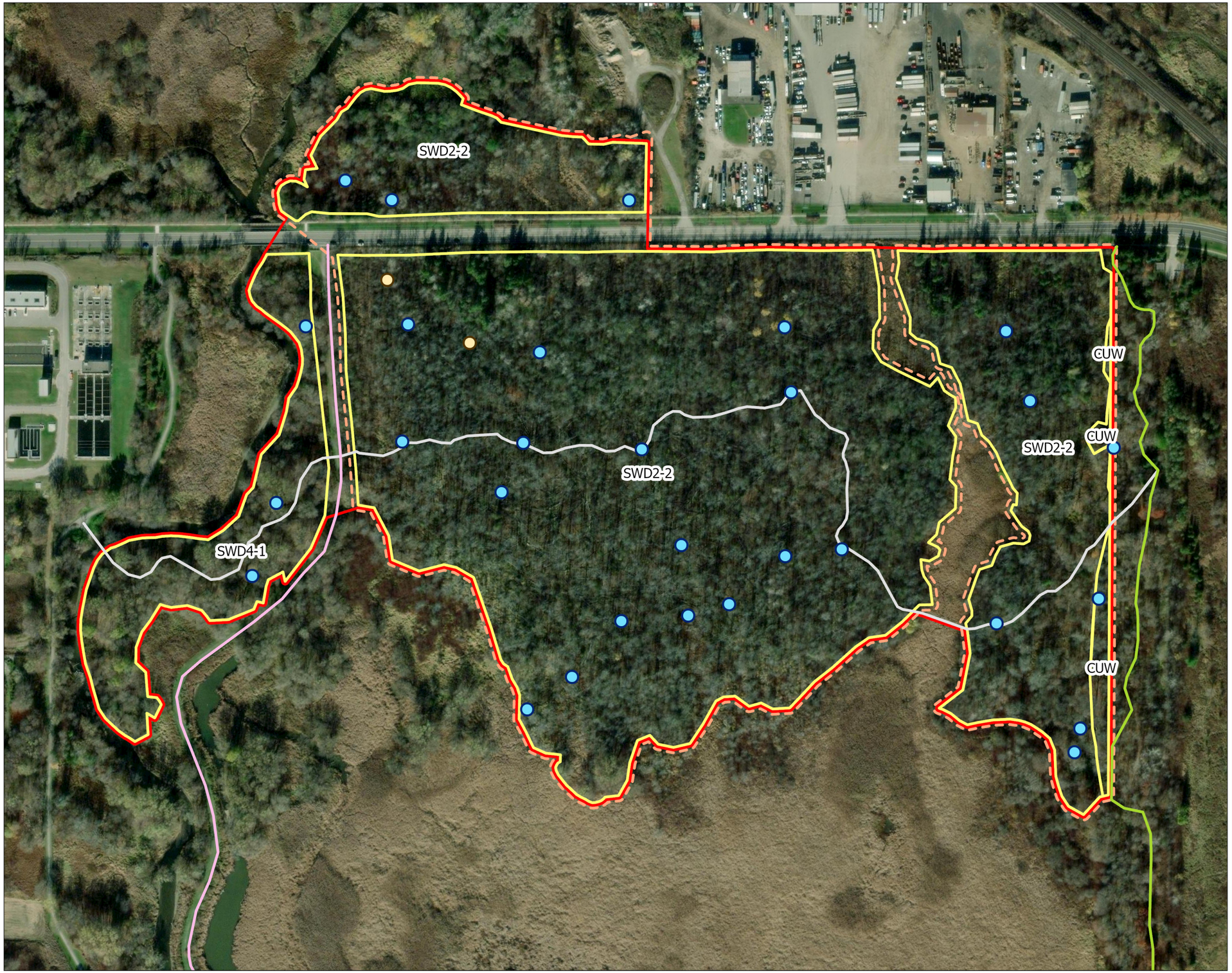


Figure 1. Example of how to count trees using a prism.

To assess the Basal Area a metric clear glass wedge prism with a Basal Area Factor (B.A.F.) of 2 was used. The plots were inventoried using a 360º sweep of the prism at breast height (Figure 1). The prism is accurate to ±1 % of rated B.A.F. (Cruise

Master Prisms Inc., 2018). Trees were counted as either “in”, “between”, or “out”. All trees deemed “in” and every other tree “between” are counted towards a final tally, thus providing a tally of trees within each plot. To estimate B.A. the number of counted trees is multiplied by the B.A.F. of two (B.A.F.2). B.A.F.2 is a value of 2 m^2; therefore, the results are represented in m^2/ha. The relative abundance of trees in the forest can also be determined in this way.

In order to approximate the stem density within the study area, 29 randomly selected variable radius plots were selected using ArcGIS, to undertake the stand density survey (Figure 2). Due to the relative homogeneity of the tree species composition and vegetative structure in the study area, and the size of the study area, 29 plots was considered a sufficiently high sample size to provide a representative sample of the study area. Each plot was no closer than 10 m from the forest edge and separated from each other by 30 m or more.



Stand Density Plot Locations

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Ghost Road Bush
- Ecological Land Classification
- Bob Mills Boardwalk
- Marshland Trail
- Maintenance Access/Berm
- Basal Stand Area Stations
- Soil Sample Locations

Vegetated Communities

CUW - Cultural Woodland
SWD2-2 - Green Ash Mineral Deciduous Swamp Type
SWD4-1 - Willow Mineral Deciduous Swamp Type

0 25 50 75 100 130 150 180 200 Meters

Project Number	Date:	N
23-1354	2024-08-09	

north-south ENVIRONMENTAL

2.3. Tree Risk Assessment

Scoped areas in the study area were assessed in conformance to a Level 1 – Limited Visual Assessment of the new American National Standards Institute (A.N.S.I.) A300 (Part 9)-2010 Tree Risk Assessment a. Tree Structure Assessment standard for tree risk assessment, for the assessment of tree condition. The scope of the inventory included trees located within a tree-height striking distance (in the event of whole-tree failure, such as uprooting) of trails within the study area, along the berm, and along the south side of Colonel Sam Drive. Tree height was visually estimated. Trees located beyond a tree-height striking distance of existing trails, the berm and Colonel Sam Drive were not considered a hazard and therefore were not assessed.

Each assessed tree was assigned a qualitative risk rating. The risk rating was based upon the two-part Tree Risk Rating matrix (Table 1 and 2) outlined in the International Society of Arboriculture (I.S.A.) Tree Risk Assessment Best Management Practices, the companion document to "A.N.S.I. A300 (Part 9)-2010 Tree Risk Assessment a. Tree Structure Assessment". The Tree Risk Rating matrix considers the likelihood of tree failure, the likelihood of target impact, the likelihood of failure and impact, and the consequences of tree failure, to determine a qualitative risk rating expressed in various categories (e.g. low, medium, high). Trees within the scoped area of the study area that were assessed as either high or extreme risk were included in the inventory.

Table 1: Two-part Tree Risk Rating matrix in accordance with "A.N.S.I. A300 Part 9: Tree, Shrub and Other Woody Plants Management – Standard Practices" (Tree Risk Assessment a. Tree Structure Assessment) and International Society of Arboriculture (ISA) Tree Risk Assessment Best Management Practices. Part A: Likelihood/target assessment (shade one)

Likelihood of Failure	**Likelihood of Impacting Target**			
	Very Low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Table 2: Two-part Tree Risk Rating matrix in accordance with "A.N.S.I. A300 Part 9: Tree, Shrub and Other Woody Plants Management – Standard Practices" (Tree Risk Assessment a. Tree Structure Assessment) and International Society of Arboriculture (ISA) Tree Risk Assessment Best Management Practices. Part B: Risk Rating (shade one)

Likelihood of Failure and Impact	Consequences			
	Negligible	**Minor**	**Significant**	**Severe**
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

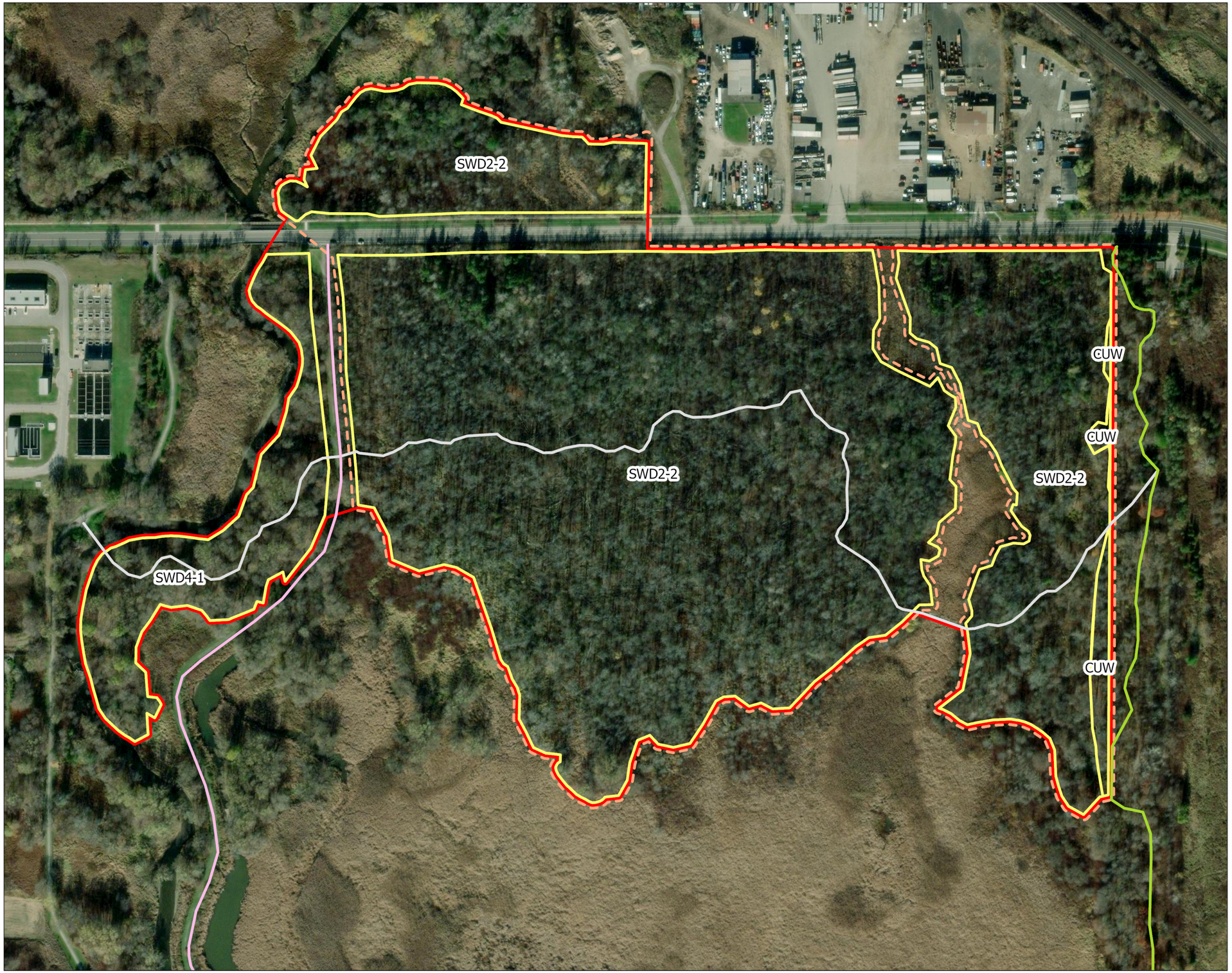
3. Results of Site Evaluation

3.1. Ecological Land Classification

The evaluation of hazard trees and evaluation of forest health focused on the treed vegetation communities where E.A.B. has resulted in hazardous conditions, as well as the forested vegetation community west of the berm through which a trail segment connects Second Marsh to the Waterfront Trail via a foot bridge and boardwalk (herein referred to as the 'study area'; Figure 3). The three vegetation types that comprise the study area include:

- Green Ash Mineral Deciduous Swamp Type (SWD2-2)
- Willow Mineral Deciduous Swamp (SWD4-1)
- Cultural Woodland (CUW)

A description of these vegetation communities is provided in Section 3.2.



Study Area and ELC

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Ghost Road Bush
- Ecological Land Classification
- Bob Mills Boardwalk
- Marshland Trail
- Maintenance Access/Berm

Vegetated Communities

CUW - Cultural Woodland
SWD2-2 - Green Ash Mineral Deciduous Swamp Type
SWD4-1 - Willow Mineral Deciduous Swamp Type

0 25 50 75 100 130 150 180 200 Meters

Project Number	Date:	N
23-1354	2024-08-09	

north-south ENVIRONMENTAL

3.2. General Description of Forest Communities in Study Area

Field visits were conducted at O.S.M. in 2018 to refine the Ecological Land Classification (E.L.C.) mapping previously delineated by the Central Lake Ontario Conservation Authority in 2004 on the most recent aerial photography (2015) and informed by Unmanned Aerial Vehicle (U.A.V.) imagery obtained within the study area. The forested vegetated communities within the study are include a Green Ash Mineral Deciduous Swamp Type (SWD2-2), referred to as Ghost Road Bush, a Willow Mineral Deciduous Swamp (SWD4-1), and a Cultural Woodland (CUW) (Figure 4).

3.2.1. Ghost Road Bush (SWD2-2)

Ghost Road Bush is located south and north of Colonel Sam Drive and is approximately 21 ha in area with a Basal Stand Density of 646m^2/ha, of which 97% of the canopy consists of ash. The remaining proportion of the canopy and sub-canopy consists of such species as Black Cherry (*Prunus serotina*), White Pine (*Pinus strobus*), Red Oak (*Quercus rubra*), Sugar Maple (*Acer saccharum*), Manitoba Maple (*Acer negundo*), Trembling Aspen (*Populus temuloides*) and Balsam Poplar (*Populus balsamifera*); these species tend to be located on small ridges and small knobs between the wet pools and depressions (also referred to as sloughs) located throughout this vegetation community. Dead and dying Green Ash (*Fraxinus pennsylvanica*) occur throughout the site as a result of E.A.B. infestation. Ash trees are the tallest in the community (20-25 m height) with an average D.B.H. of 30-35cm; however, in light of the widespread mortality of ash in the upper canopy, the functional canopy layer is considered to be 2-10m in height with 35-60% cover and comprising Trembling Aspen, Black Cherry, and European Buckthorn (*Rhamnus cathartica*), the species with the highest relative abundance (Figure 5 and Figure 6).

The portion of Ghost Road Bush north of Colonel Sam Drive is smaller than the swamp south of Colonel Sam Drive. As a result of the hazard tree removal up to 30 m north of the road, the size of the treed swamp has been reduced, in size leaving the cleared area to regenerate into a Red-osier Dogwood (*Cornus sericea*) thicket interspersed with young ash.

While ash trees comprise over 97% of the canopy in Ghost Road Bush, the composition of the canopy varies slightly near its edges. South of the Bob Mills Boardwalk, along the edge of the Green Ash swamp, Trembling Aspen is found in higher numbers than elsewhere within Ghost Road Bush. In the north of Ghost Road Bush, south of Colonel Sam Drive, sporadic clumps of White Pine are found in the canopy. Balsam Poplar, growing in small colonies interspersed around the edges of Ghost Road Bush, makes up a small proportion of the canopy. In the

southeast portion of Ghost Road Bush, where the swamp borders an adjacent thicket, hawthorn species (*Crataegus* species) and Manitoba Maple are interspersed in the canopy.

The sub-canopy (1-2m, >60% cover) is comprised of a variable mixture of European Buckthorn, Manitoba Maple, ash regeneration, Black Cherry, hawthorn, and Trembling Aspen. The understory (0.5-1m, >60% cover) is compositionally similar in woody species to the sub-canopy with the addition of Nannyberry (*Viburnum lentago*), Choke Cherry (*Prunus virginiana*), and Red-osier Dogwood. European Buckthorn seedlings dominate the ground layer (0.2-0.5m, >60% cover), along with Fringed Loosestrife (*Lysimachia ciliata*), Spotted Jewelweed (*Impatiens capensis*), Fringed Sedge (*Carex crinita*), and Canada Wood Nettle (*Laportea canadensis*). Common throughout is Sensitive Fern (*Onoclea sensibilis*), Canada Anemone (*Anemonastrum canadense*), Spreading Dogbane *(Apocynum androsaemifolium*), Shinleaf (*Pyrola elliptica*), Black Raspberry (*Rubus occidentalis*), and Alleghany Blackberry (*Rubus allegheniensis*). In wetter pockets, the ground layer contains true Forget-me-not (*Myosotis scorpioides*), Square-stemmed Monkeyflower (*Mimulus ringens*), Blue Flag Iris (*Iris versicolor*), dock species (*Rumex* species), and Water Hemlock (*Cicuta maculata*).

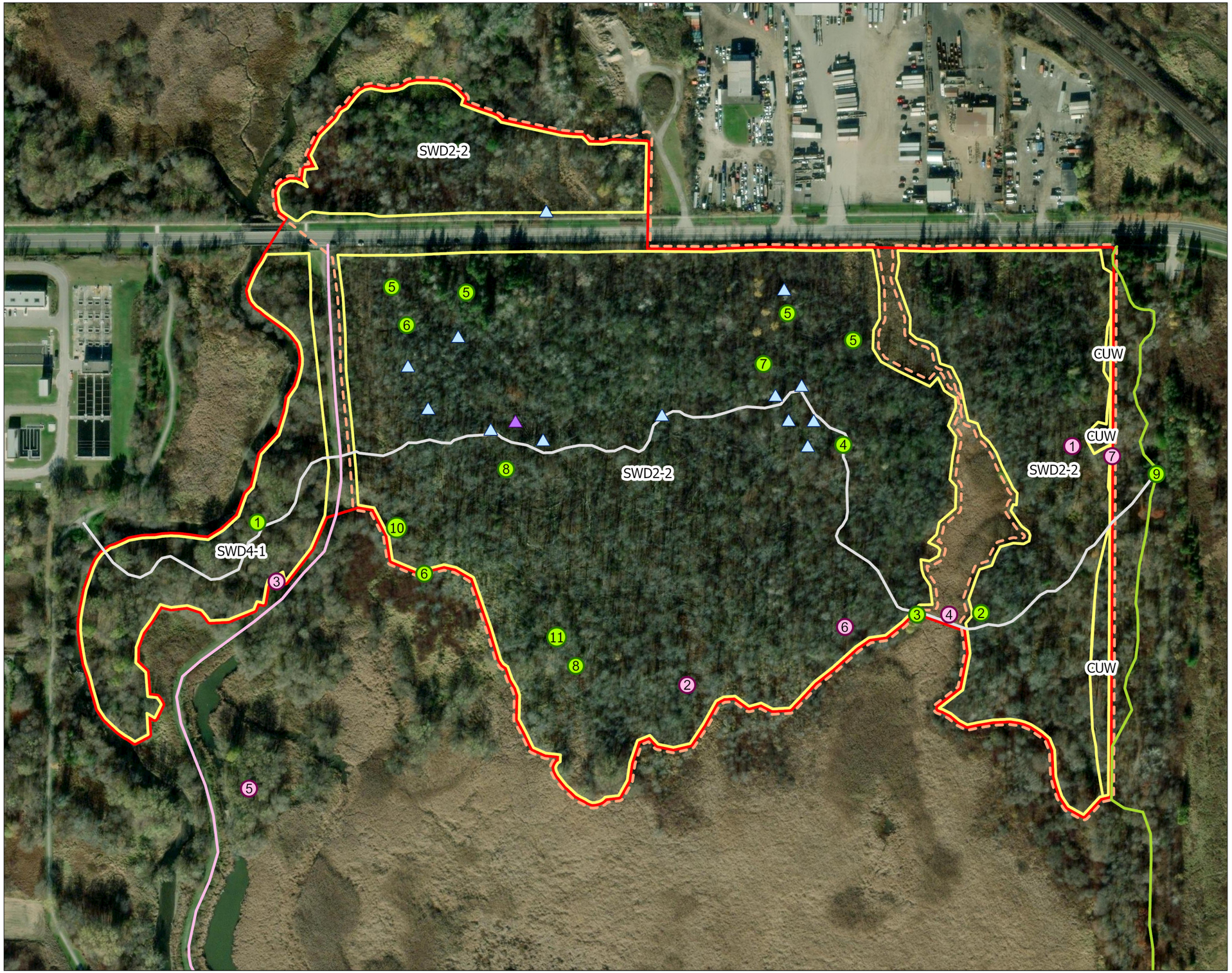
From soil mapping, it is documented that Ghost Road Bush has poorly drained, stone-free, calcareous lacustrine materials, with high organic matter (Canada Department of Agriculture, Ottawa, and Ontario Department of Agriculture, Toronto, 1956). Background reports record the soils in Ghost Road Bush as fine-textured mineral soils (Bobolink Enterprises, 1999, and Gartner Lee Limited, 1997) with less than 40cm of organics (Gartner Lee Limited, 1997). Two soil cores were completed in Ghost Road Bush (Figure 2) in 2018 at randomly selected locations on the mid-slope (i.e., between the height of a ridge and the surface of water in depressions) to inform potential restoration:

- Core Sample 1 - Dark sandy clay loam to 26 cm, over loamy fine sand to 110 cm. Mottles at 32 cm and gley at 70 cm. Water table was at 70 cm.
- Core Sample 2: Sandy clay loam to 32 cm over loamy fine sand to 86 cm. Mottles at 32 cm and gley at 62 cm. Water table at 14 cm.

Based on the stratification of soil texture and depth of layers, the effective texture is loamy fine sand. With the mottles at a depth between 20-40 cm, the soil moisture regime is classified as moist (5).

Background reports and field surveys confirmed that Ghost Road Bush has a variable topography with north-south running sloughs. In the Vegetation Monitoring at Oshawa

Second Marsh, 1996 (Gartner Lee Limited, 1997) background report it was noted that the consistent, and sustained, high water table was ideal for Green Ash colonization. The flooding regime is also variable with vernal pooling in the spring. The soils on the ridges are drier in the summer except in the swales, which remain moist or even flooded throughout the year. As noted above, the water table ranged from 14 to 70 cm below surface at mid-slope on the ridges; where depressions (or sloughs) were located, the water table was above ground surface resulting in flooded/inundated soils.



Rare Plants, Uncommon Plants and Wildlife Habitat

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Ghost Road Bush
- Ecological Land Classification
- Maintenance Access/Berm
- Marshland Trail
- Bob Mills Boardwalk

Rare Flora

1. American Cow-Parsnip
2. Marsh Speedwell
3. Pale Jewelweed
4. Pickerelweed
5. Rush Aster
6. Swamp Rose
7. Virginia Stickseed

Uncommon Flora

1. American Bindweed
2. Great Duckweed
3. Marsh Vetchling
4. Meadow Horsetail
5. Small Yellow Lady's Slipper
6. Spotted Water-Hemlock
7. Steeplebush
8. Swamp Yellow Loosestrife
9. Tall Blue Lettuce
10. Virginia Wildrye
11. White Turtlehead

Wildlife Habitat

- Vernal Pool
- Several Vernal Pools

Vegetated Communities

CUW - Cultural Woodland
SWD2-2 - Green Ash Mineral Deciduous Swamp Type
SWD4-1 - Willow Mineral Deciduous Swamp Type

0 25 50 75 100 130 150 180 200 Meters

Project Number	Date:	N
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north-south ENVIRONMENTAL

Figure 5. High density of European buckthorn in understory.

Figure 6. European buckthorn germination is prevalent in the ground layer among native vegetation, with abundant newly sprouted seedlings (red arrow).

3.2.2. Willow Mineral Deciduous Swamp Type (SWD4-1)

The Willow Mineral Deciduous Swamp (SWD4-1) is located between the berm and Farewell Creek. The canopy is dominated by Hybrid White Willow (*Salix x fragilis*) and Manitoba Maple, ranging in height from 10-25 m. The canopy cover is greater than 60% of the vegetation community. The sub-canopy and shrub-layer is sparse (less than 10-25% cover) and consists of the same species as the canopy. The sub-canopy is 2-10 m in height and the shrub-layer is 1-2 m in height. Ground flora is under one meter in height and consists of Stinging Nettle (*Urtica dioica*), Dame's Rocket (*Hesperis matronalis*), Garlic Mustard (*Alliaria petiolata*), and Spotted Jewelweed. The ground layer covers greater than 60% of the vegetation community. Due to the brittle nature and form of the willows (e.g., split stems, excessive lean), downed trees and limbs are scattered throughout this community including across the Bob Mills Boardwalk that connects the Waterfront Trail with the berm.

No soil samples were taken in the Willow Mineral Deciduous Swamp community.

3.2.3. Cultural Woodland (CUW)

The Cultural Woodland (CUW) is located between the SWD2-2 vegetation community and the Marshland Trail. The canopy is patchy; areas in the south of the community are dense with large hawthorn species (*Crataegus sp.*), while areas in the north of the community are more open. In general, the canopy is comprised of Manitoba Maple and hawthorn, 5-20 m in height and covers 35-60% of the vegetation community. The sub-canopy and understory is generally sparse but is comprised of hawthorns, Manitoba Maple and young ash. The ground layer is partly comprised of goldenrod species, Garlic Mustard, and Spotted Jewelweed.

No soil samples were taken in the Cultural Woodland community.

3.2.4. Floristics

The update to the Oshawa Second Marsh Management Plan (NSE and Schollen, 2023) provides statistics on total numbers of species, percent native vs. non-native species, and the Floristic Quality Index (F.Q.I.)[1] for the vegetation communities. Vegetation surveys were conducted between 1971 and 2004 and again in 2018 to document vegetation communities and plant species. Based on past vegetation inventories in Ghost Road Bush, there are 252

[1] F.Q.I. is a measure of the naturalness or quality of a feature based on native species richness and the rank of a species tolerance to a range of conditions (e.g., the more narrow the habitat requirements of a species, the higher the measure of conservatism).

species, of which 73.6 % are native. The percent of native species is in line with the provincial average of 73% (Kaiser 1986). This vegetation community (SWD2-2) has a Floristic Quality Index of 46.3 (calculated by compiling a list of species from the 1971,2004 and 2018 inventories), which is considered high for an urban wetland; this is based on long-term monitoring in the City of Mississauga, where natural areas with an F.Q.I. ≥ 40 are considered Significant Natural Sites (North-South Environmental Inc., 2014).

3.3. Invasive Species

Several non-native invasive species, such as European Buckthorn, Garlic Mustard, True Forget-me-not, and Tartarian Honeysuckle (*Lonicera tatarica*), are widespread throughout Ghost Road Bush. A few small (<0.1 ha) stands of Manitoba Maple are also present. Manitoba Maple is native to parts of Canada, but not considered native to southern Ontario, and the species has known invasive qualities such as regularly colonizing and dominating disturbed areas. European Buckthorn is widespread and established throughout, while the other invasive species are present in localized patches or individually dispersed.

European Buckthorn in Ghost Road Bush has an average DBH of 5-10cm. The following average measures were noted for European Buckthorn as observed within the sampled plot areas in Ghost Road Bush (Figure 2):

- At least one (up to three) stem(s) / m2 measuring 5-10cm DBH (Figure 5);
- Three to ten saplings / m2 (Figure 5); and,
- 10-25 cotyledons and seedlings / m2 (Figure 6).

European Buckthorn is a highly invasive non-native species, with a lack of natural predators, wide habitat tolerance, rapid growth and vegetative regeneration, and prolific seed production. Moreover, the fruit and leaves of European Buckthorn exhibit allelopathic effects on other species (Seltzner and Eddy, 2003). A metabolite released from European Buckthorn is also known to negatively affect embryonic development of Western Chorus Frog (*Pseudacris triseriata*) and contribute to declines in populations through depressed hatching success and poor larval survival (Sacerdote and King, 2014). Additionally, leaves of European Buckthorn persist into the winter and are the first to appear in the spring, decreasing light availability to ground layer and understory vegetation therefore reducing available resources for other vegetation.

The loss of ash as the dominant canopy tree in the unit has created an open canopy that allows for more light penetration to the ground, providing for more optimal conditions for

growth and proliferation of European Buckthorn in the sub-canopy and understory. European Buckthorn is by far the most dominant invasive species in Ghost Road Bush and has the highest potential to inhibit the successful regeneration of a native tree canopy and understory community. As such, European Buckthorn is considered the greatest threat to the regeneration of the forest following the loss of the ash canopy and is the focus of the invasive species management as part of the restoration proposed for this F.M.P. Other invasive species are discussed in detail in the Invasive Species Management Plan (N.S.E., 2024).

3.4. Rare or Uncommon Species

One historical record of a provincially rare plant species has been recorded in Ghost Road Bush: Short-stemmed Iris (*Iris brevicaulis*) – S1. The precise location of this species has not been determined based on a review of historical records and reports.

A total of 33 locally rare plant species have been recorded in the study area based on historical records and recent (2018) vegetation surveys:

- 14 locally rare species (R1-R10)
- 19 uncommon species

Historical records and reports do not include the specific location (e.g., UTM) of these species. Species recorded during recent surveys (2018) have been mapped on Figure 4. It is important to note the location of rare or uncommon species as any management initiatives undertaken should avoid impacting provincially rare species and uncommon or locally rare plant species. If avoidance is not possible, translocation of rare species should be considered; in addition, mitigation of impacts should include avoiding working with heavy machinery for hazard tree removal while soils are soft (i.e., work should be undertaken during the winter when impacts to extant vegetation and soils can be minimized. A more fulsome discussion on rare or uncommon species is provided in the updated Management Plan (NSE and Schollen 2023).

3.5. Stand Density and Successional Trajectory of Ghost Road Bush

The current successional trajectory of a vegetation community can in part be determined by assessing the composition of woody species in the understory, shrub layer and ground cover. This is particularly important in Ghost Road Bush where the dominant canopy tree is ash (approximately 97% relative abundance), which is dead or dying as a result of Emerald Ash Borer infestation. The resulting decline in canopy cover has an effect on the vegetative

composition and microclimate conditions (e.g., more light), leaving other woody species to potentially replace the canopy. European Buckthorn dominates the woody vegetation making up approximately 80% of the relative cover in the understory, shrub, and groundcover layers. Native tree and shrub regeneration is mainly comprised of Green Ash, Black Cherry, Trembling Aspen, Red-osier Dogwood, Nannyberry, and Choke Cherry.

Presently, without any intervention (the "Do Nothing" approach), the successional trajectory of Ghost Road Bush is anticipated to develop into a European Buckthorn thicket.

Other than European Buckthorn dominance, the death of the ash canopy will result in more fundamental changes in forest functions. The loss of the native canopy also results in a change of natural habitat for native wildlife, soil chemistry, moisture regime, and nutrients available for native species. Trees transpire large amounts of water from the soils (which end up as vapour in the air), and without the dominance of mature trees in the canopy of Ghost Road Bush there is the potential for the swamp to evolve into a mosaic of standing water wetland (e.g., shallow marsh) and thicket. A recent study found that when trees are removed the water table becomes more shallow and/or the hydro-period (flooded conditions) persist for a longer period of time; therefore, the removal or planting of trees in and around wetlands needs to be considered in a land management context if water table levels and hydro-periods are to be maintained (Woodward, C. et al., 2014). Also, depending on changes in hydrology, the combination of an open canopy with deeper pools / prolonged flooding in depressions may support marsh species, including the invasive non-native, Common Reed (*Phragmites australis* subspecies *australis*).

With the change in forest structure to a thicket and the dominance of European Buckthorn it is anticipated that Ghost Road Bush will decline in native plant species and wildlife dependent on forest conditions as a result of the low-light conditions and allelopathic effects of buckthorn. Currently, the Marsh supports bird species dependent on interior forest conditions (e.g., Hairy Woodpecker, Red-breasted Nuthatch, Black-and-white Warbler, Blue-gray Gnatcatcher, American Redstart) (N.S.E. and Schollen 2023). Changes to the vegetation structure (thicket vs. forest) are expected to change the birds that utilize these habitats. It is anticipated the vegetation structure will support wildlife species dependent on thicket / shallow marsh communities, but that overall biodiversity will decline.

3.6. Tree Risk Assessment

A tree risk assessment survey undertaken by Urban Forest Innovations tallied 1,081 high-risk trees located within striking distance of the berm, Bob Mills Boardwalk Trail, and Colonel Sam

Drive (Table 3). At the time of the risk assessment, there were clear and abundant signs of E.A.B. in Ghost Road Bush, including widespread ash mortality, observed among the inspected ash trees suggesting that infestation has progressed to an advanced stage. The findings of the assessment identified the vast majority (99%, n=1019) of high-risk ash trees as dead, with the balance of high-risk ash trees being in fair or poor condition. According to the generalized ash mortality curve (Figure 7) (from Zwack, 2010), mortality of greater than 95% of the ash tree population may be expected in the latter years of an E.A.B. infestation, suggesting that the Ghost Road Bush infestation has run its course and E.A.B. populations will begin to drastically decline as the available food sources are soon depleted. The beetle is unlikely to disappear; however, as recovering ash in natural forest stands will continue to provide a limited food source to a smaller population of the E.A.B. beetle.

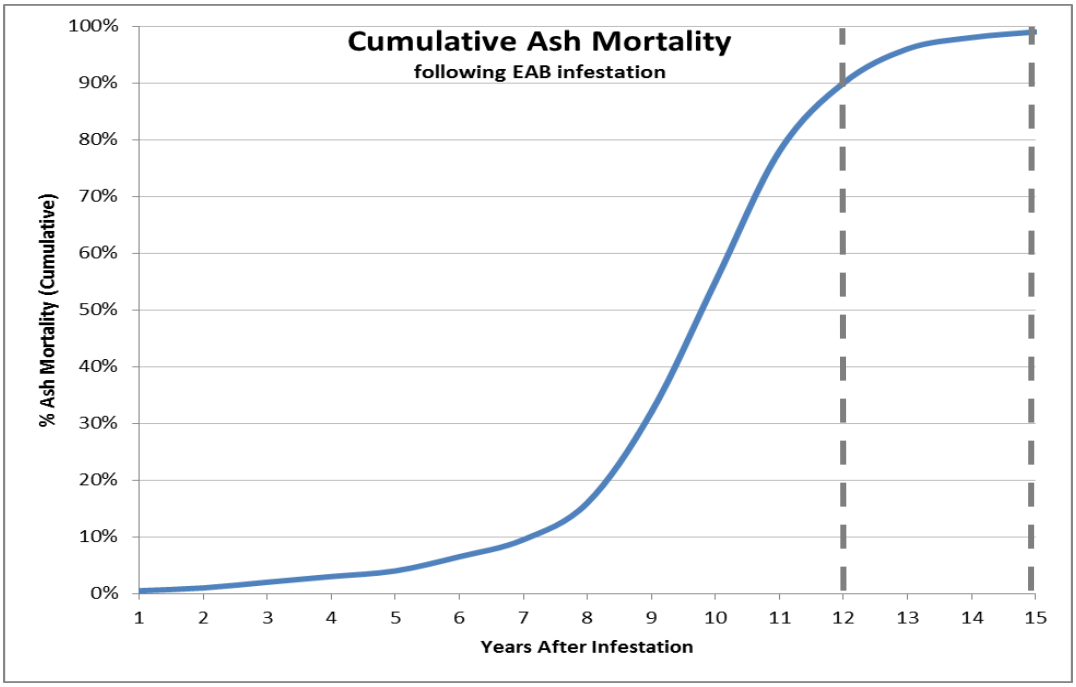


Figure 7. Generalized E.A.B./ash mortality curve (from Zwack, 2010). Area between dashed grey lines shows likely position on the mortality curve of E.A.B. infestation in Ghost Road Bush.

Non-ash trees accounted for a minority of high-risk trees encountered in Ghost Road Bush. Of these trees, nearly half were assessed as standing dead (47%, n=23) and requiring removal to mitigate their associated risk (Table 3).

Table 3. Species composition and condition classes among trees assessed in Ghost Road Bush.

Species	Count	Condition			
		Good	Fair	Poor	Dead
Manitoba maple (*Acer negundo*)	18	-	6	7	5
Paper Birch (*Betula papyrifera*)	1	-	1	-	-
Hawthorn (*Crataegus* sp.)	1	-	1	-	-
Ash (*Fraxinus* sp.)	1032	-	5	8	1019
White Spruce (*Picea glauca*)	1	-	-	-	1
Poplar (*Populus* sp.)	8	-	-	2	6
Cherry (*Prunus* sp.)	1	-	-	-	1
Buckthorn (*Rhamnus* sp.)	1	-	1	-	-
White Willow (*Salix alba*)	12	2	4	2	4
White Elm (*Ulmus americana*)	2	-	-	-	2
Other	4	-	-	-	4
Sum:	**1081**	**2**	**18**	**19**	**1042**

4. Forest Management Strategies

4.1. Tree Risk Management

Treed vegetation communities provide significant ecological functions (e.g., wildlife habitat, nutrient, carbon, and water cycling) and other recreational benefits to Oshawa residents and users of the Marsh. However, with those benefits come responsibilities to manage the trees and forest stands of the Marsh safely and responsibly. As living and growing organisms, trees are subject to health, structural and environmental conditions that may increase their risk of undergoing failure, in whole or in part. The active management of trees with a degree of non-zero risk to human safety is both necessary and unavoidable. The purpose of this section is to describe the City's means for managing tree risk within the Marsh.

Tree risk management can be described in simple terms as a process of inspecting trees to identify tree components (e.g., limbs, stem, root butt) that could fail and cause injury to people or cause damage to property, and to then determine the most appropriate courses of action to reduce or limit identified risks to within tolerable thresholds. In traditional tree risk

literature, the term “hazard” describes trees with a defect, i.e., a condition that predisposes it to failure. However, where the consequences of failure are low, a structurally unsound tree represents no hazard. The term hazard should, therefore, be reserved for trees that have significant structural defects and have a significant target that could be meaningfully impacted if tree failure were to occur. Using this definition, not every tree that has a defect is hazardous, and once described as a hazard, a tree will conjure fears of immediate failure. It is, therefore, preferable to use terms such as “Low”, “Medium” or “High” risk in the context of discussing tree conditions.

These descriptive risk categories can help determine how soon a tree will require corrective action. A tree rated high risk may require immediate attention, i.e., prior to the initiation of restoration activities; whereas a tree with a low-risk rating should be considered a lower priority and may be addressed at a later time during regular maintenance activities. In this context, the risk assessment undertaken for the study area focuses on trees that present with defects and targets that are significant enough to consider the trees high risk and to warrant immediate attention. Although not included in the formal results of the risk assessment, Low and Medium risk trees are nevertheless present in the study area. The failure potential and possible consequences of failure among such lower risk trees are; however, sufficiently low at this time that management intervention (i.e., risk mitigation treatments) is neither recommended nor economically practical to achieve any meaningful improvements to the safe public use of Ghost Road Bush.

In contrast to low-risk trees, a high-risk tree is one having a high potential to undergo failure that impacts a target with significant consequences and within in a specified time frame. Once a tree has been noted as high risk, there are a variety of approaches to managing the risk associated with its defect. Three mitigation treatment options are appropriate for use in the study area: target relocation, tree pruning (including standing stem retention), and tree removal.

4.1.1. Target Relocation & Access Control

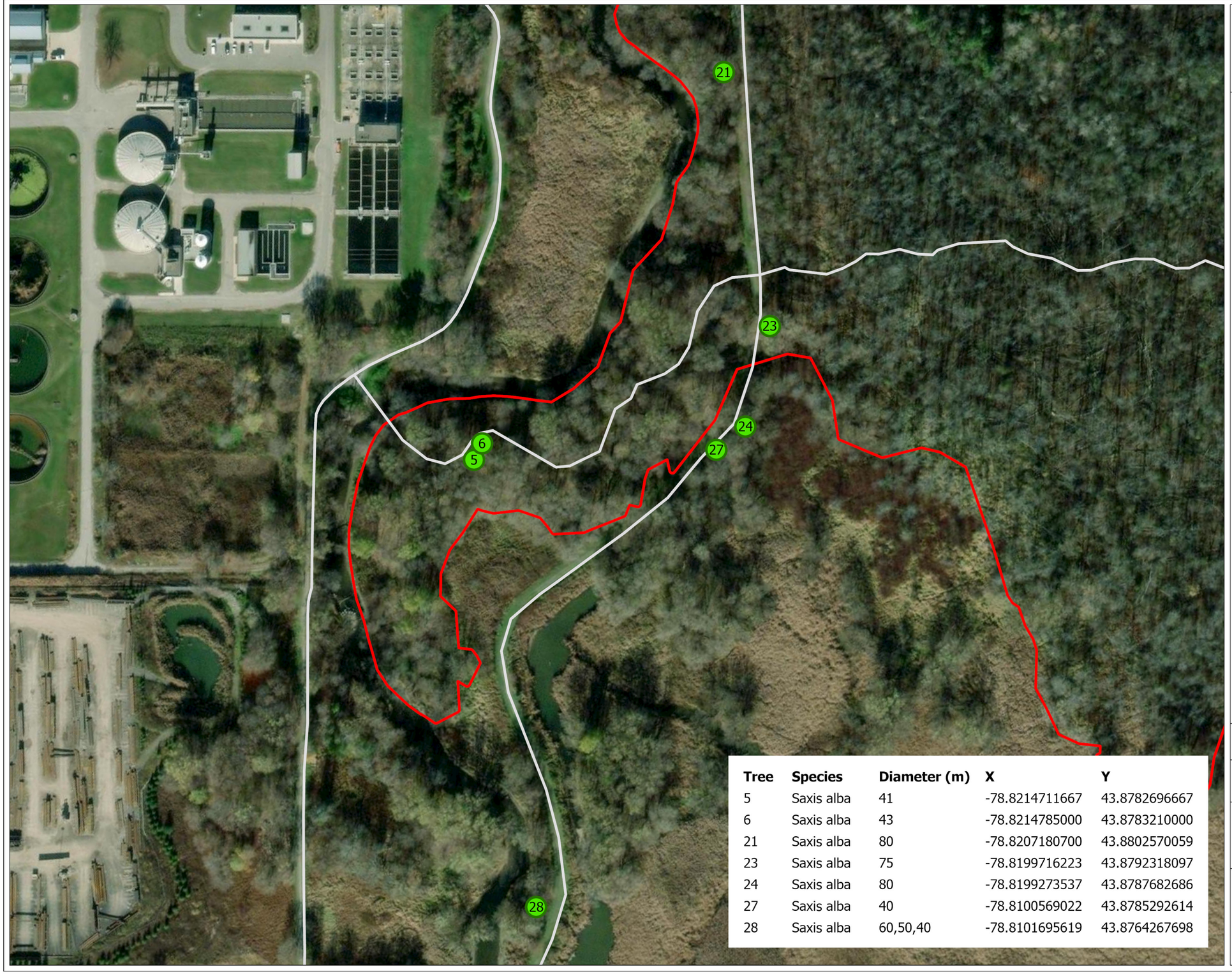
In the simplest recourse to tree risk identification, tree risk can be managed by removing or limiting access to targets that would be impacted by the potential tree failure. In general, this risk mitigation strategy involves limiting liability exposure by closing formal, City-sanctioned trails; the risk mitigation strategy does not include informal user trails; however, there are no informal trails identified in the study area. In addition to closing trail access, signage is installed along access points in order to notify the public of trail closures, thus fulfilling the

City's duty of care, that is, taking reasonable steps to avoid public injuries resulting from trail use. Although this risk mitigation strategy has been implemented through trail closures in Ghost Road Bush, it may not be a permanent solution in all cases. Instead, risk mitigation could be achieved through trail re-alignment or through a tree-based approach to risk reduction that focuses on the elimination of trees and tree parts that are contributing to the high risk.

4.1.2. Tree Pruning

Under this approach to risk reduction, the high-risk tree is preserved while component dead or defective parts are removed, thus limiting the possibility of tree failure impacting targets in publicly accessible areas. Tree pruning is often the preferred treatment option for trees that are otherwise in good to fair condition (i.e., structurally sound and not in declining health); this would not generally be considered as a viable option for addressing risk associated with E.A.B.-infested trees, but rather could be applied to non-ash component of the Ghost Road Bush. Pruning achieves its aims by reducing the likelihood of failure of component parts (limbs or branches) and reducing leverage upon the main limbs and base of the subject tree, thus limiting the likelihood of major limb and/or stem failure in the future. Care should be taken during pruning to preserve enough leaf area to maintain photosynthetic capacity and avoid inducing excessive stress on the tree. Furthermore, tree topping, or the indiscriminate reduction of overall tree height by removing large limbs, should be avoided.

Only a handful of trees included in the September 2018, risk assessment inventory have been recommended for risk reduction pruning (Figure 8). Most of these are large stature willows (*Salix* species) located between the berm and Farewell Creek (i.e., within the Willow Mineral Deciduous Swamp [SWD4-1]) and other non-ash trees that are considered to be in otherwise fair to good condition and require only the removal of dead or broken limbs to achieve a reduction in their risk profile.



High-Risk Trees

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Trails
- High Risk Trees

Tree	Species	Diameter (m)	X	Y
5	Saxis alba	41	-78.8214711667	43.8782696667
6	Saxis alba	43	-78.8214785000	43.8783210000
21	Saxis alba	80	-78.8207180700	43.8802570059
23	Saxis alba	75	-78.8199716223	43.8792318097
24	Saxis alba	80	-78.8199273537	43.8787682686
27	Saxis alba	40	-78.8100569022	43.8785292614
28	Saxis alba	60,50,40	-78.8101695619	43.8764267698

0 25 50 75 100 130 Meters

Project Number	Date:	N
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north-south ENVIRONMENTAL

4.1.3. Standing Stems

While most high-risk (i.e., hazardous) trees assessed in the study area are recommended for outright removal to reduce or eliminate their risk to the public using the existing trail network, there may be opportunities to achieve comparable risk reduction through the selective retention of standing stems. These standing stems (or 'snags') provide a source of food (e.g., insects) for wildlife and possible habitat (e.g., cavities in trees for nesting). It should be noted; however, that while there may be a desire to retain standing stems on site for their ecological services and value as wildlife trees, several key management considerations must be weighed carefully.

Recent research and experience suggest that E.A.B.-killed ash trees become structurally compromised and increasingly prone to whole-tree or component failure within 12 to 24 months following death. As such, any ash trees considered as candidates for standing stem retention must be of large stature with generally good trunk integrity and wide flaring bases. Moreover, to achieve safe retention, both ash and non-ash dead trees must be delimbed and reduced in overall height to eliminate the possibility of tipping out into publicly accessible areas (i.e., eliminate the hazard potential). Considering the brittle wood characteristics of dead ash trees, which comprise most high-risk trees within areas of Ghost Road Bush, a suitable guideline for the height of retained standing stems may be considered one half of the distance to the nearest target. For example, a dead ash tree located within 10 meters of a trail, road, or maintenance berm should be reduced to a standing log measuring no more than 5 meters in height.

In addition to careful candidate selection, trees retained for wildlife value will necessitate periodic monitoring to ensure that risk is maintained at acceptable (low) residual levels, particularly for retained trees that are located nearer to public areas. Such regular monitoring would inspect for the presence of progressive decay within or at the base of the tree, which renders the dead stem more prone to failure. Ongoing monitoring would also track the presence and extent of re-sprouted ash stems, which are likely to encourage resurgent E.A.B. infestations within 3-5 years, thereby increasing the risk potential among such retained stems.

Only a very small selection of ash trees would be considered suitable candidates for standing stem retention, given the added management costs and resources required to ensure continued safe use of public spaces in Ghost Road Bush. Furthermore, there will be an abundance of standing stems throughout Ghost Road Bush (i.e., in areas not in proximity to trails, roads or the maintenance berm where dead or dying trees do not pose a hazard) that

will provide habitat functions for wildlife. As such, retaining a limited number (e.g., up to 10) of standing stems for wildlife habitat values within view of trails may be more valuable as a public education / nature interpretation opportunity than to provide habitat for wildlife.

4.2. Hazard Tree Removal

Removal of hazard trees in the Marsh is intended to reduce risks to public safety. Recommendations for hazard tree removal are based on the existing trail network. Removal methods and equipment use will vary based on access and the amount of hazard trees to remove and as a result 'Zones' have been identified (Figure 9) to assist in interpretation and implementation and evaluate options (see Section 8):

- Zone 1 includes a 30m buffer (previously cleared) on the east side of the maintenance access berm and south side of Colonel Sam Drive (completed in 2017)
- Zone 2 includes a 30m buffer on each side of the existing Bob Bills trail east of the maintenance access berm (a 60m swath with the boardwalk in the center, based on the expected tip-out distances of assessed trees)
- Zone 3 covers the rest of Ghost Road Bush
- Zone 4 includes a 30m buffer on each side of the existing Bob Bills Mills Trail west of the maintenance access berm up to the footbridge spanning Farewell Creek that connects to the Waterfront Trail (a 60m swath with the boardwalk in the center, based on the expected tip-out distances of assessed trees)

Given the near 100% ash tree mortality caused by E.A.B. infestation within Ghost Road Bush, it is anticipated that nearly all ash trees within 30 m of trails and other public areas will require removal, particularly within Zone 2 where high-risk trees have not yet been removed. While hazard trees located in proximity to frequently used public areas must be removed, removal options (i.e., methods and equipment use) will vary by zone, based primarily on stand density and accessibility of tree removal equipment. Tree risk mitigation may include all, some, or none (the 'Do Nothing' approach) of the options for managing hazards in Zones 1 through 4, as presented in the following sections. However, if nothing is done, trails in proximity to hazard trees will need to remain closed.

4.2.1. Hazard Tree Removal – Zone 1

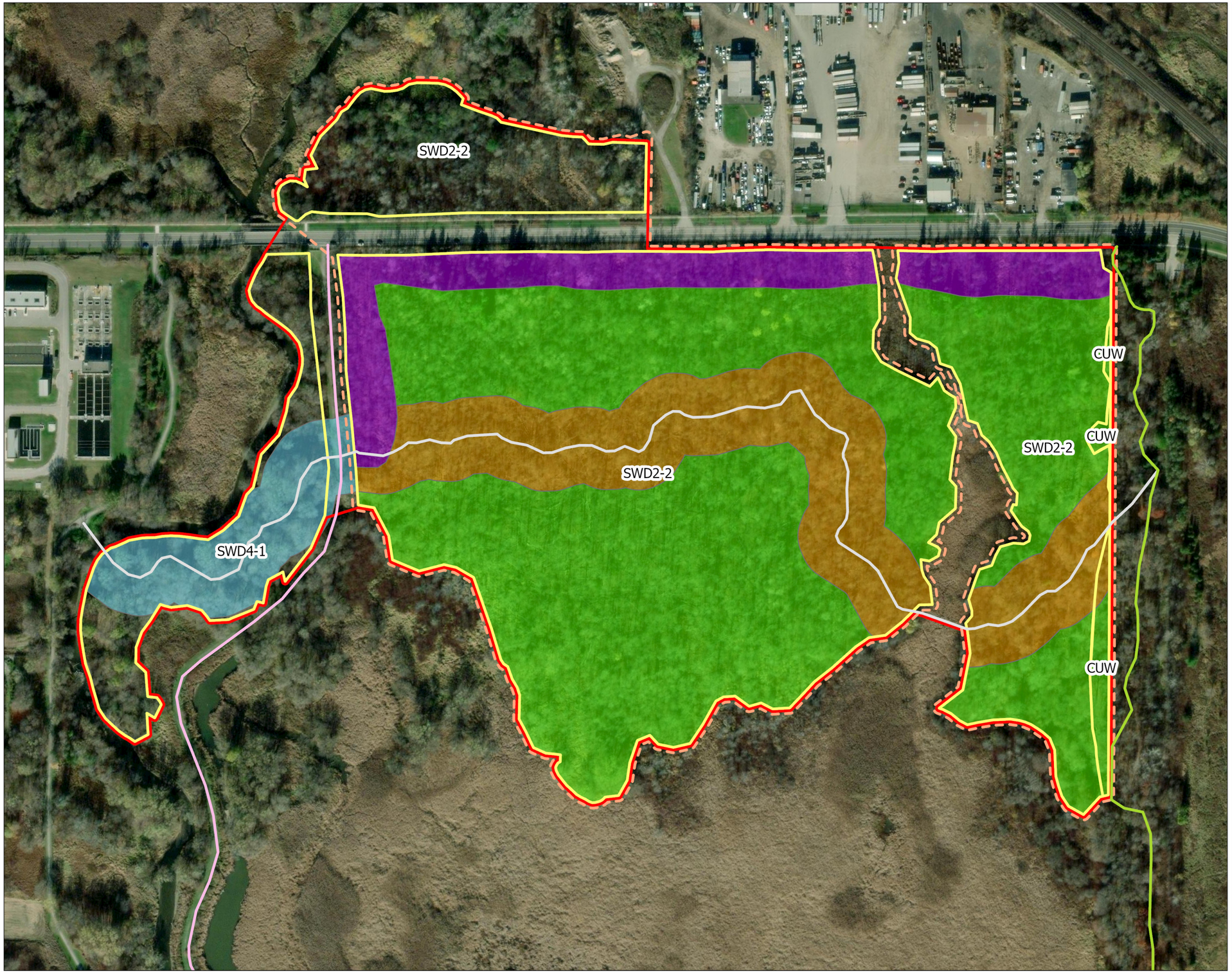
Zone 1 encompasses a 30m buffer on the south side of Colonel Sam Drive that has previously been cleared of ash trees at risk of failure and within striking distance of the Drive. The purpose of the September 2018 risk assessment in this zone was to identify any additional

hazard trees requiring removal and to evaluate costs for removal of excess woody debris left from the cutting of hazard trees (e.g., slash and large stems). The results of the risk assessment noted that only six additional trees in Zone 1 are presently regarded as high-risk and require removal at this time. Given the open conditions of the site, a small felling crew using manual removal techniques and tools should suffice to remove these trees and excess woody debris from the zone efficiently.

4.2.2. Hazard Tree Removal – Zone 2

The density of high-risk ash trees found in Zone 2 demands a different approach, with the almost complete removal or clearing of trees anticipated if the Bob Mills Trail will be reopened. However, the Public Use portion of the OSM Management Plan proposes that this trail be permanently closed to reduce human impacts on the significant functions of Second Marsh. With an area of approximately 4 hectares and a density of roughly 250 dead stems per hectare, tree removal over much of the zone lends itself to the use of mechanized, full tree felling and extraction methods, as opposed to exclusively manual logging techniques. Tree removal in this zone calls for the combined use of small, 3-person felling crews and large harvesting equipment, such as skidders or 60-HP farm tractors outfitted with skid winches. Access roads for the movement of such equipment between felling and landing areas must be selected to ensure efficient and safe operations. Although in most cases specific operational planning decisions will need to be made by contractors and fellers, based on ground conditions and safe working conditions, existing trails/roads and the designated boardwalk alignment should be utilized wherever possible to avoid undue disturbance to interior forest areas. Other guidelines for the removal of trees in Zone 2 include:

- The use of heavy machinery must be avoided during wet weather conditions (winter operations are strongly recommended), both for safe operations and to minimize damage to forest soils.
- Pre-clearing of forest undergrowth (e.g., buckthorn) will be necessary to ensure access to marked trees and safe working conditions for contracted workers.
- To limit the risk to felling operators, tree felling operations should be undertaken and concluded before wood extraction operations.
- Trees intended for site extraction should be planned for a fall direction towards the designated skidding trail (or boardwalk alignment).
- Wherever feasible, downed wood intended for site extraction should be forwarded (carried off-ground) to designated skidding (access) trails.



Forest Management Zones

Oshawa Second Marsh Management Plan

Legend

- Study Area
- Ghost Road Bush
- Ecological Land Classification
- Bob Mills Boardwalk
- Marshland Trail
- Maintenance Access/Berm

Zones

- Zone 1 - 2.19 ha
- Zone 2 - 4.30 ha
- Zone 3 - 12.71 ha
- Zone 4 - 1.42 ha

Vegetated Communities

CUW - Cultural Woodland
SWD2-2 - Green Ash Mineral Deciduous Swamp Type
SWD4-1 - Willow Mineral Deciduous Swamp Type

0 25 50 75 100 130 150 180 200 Meters

Project Number	Date:	N
23-1354	2024-08-09	

north-south ENVIRONMENTAL

The processing of downed wood (e.g., delimbing, bucking, chipping) may be undertaken either at felling locations or trail- or road-side landings, depending on several factors, including the restoration goals for each working zone and the ability of chippers to access felling locations in the presence of large, downed logs. For trees processed at felling locations, operators should be instructed to avoid leaving large uncut slash (i.e., limbs) scattered in in the felling zone that would interfere with restoration objectives. Slash (including native and non-native species such as European Buckthorn) should be left in smaller piles that will function as wildlife habitat. Larger limbs and stems (e.g., greater than 10 cm d.b.h.) should be placed on the bottom of the brush pile in a crisscross layered type of formation, with 3-4 layers, thereby providing space for small mammals and other wildlife to find shelter. Smaller limbs and branches can be placed on the top. The size of the slash piles should not exceed 4-5m in diameter with a height of 1.5-2m, and not placed within 15m of trails. This will limit the visibility of these woody debris piles which will quickly be hidden by surrounding vegetation. Spacing between slash piles is not as much of a concern; however, piles spaced between 15-40m is considered beneficial for wildlife and will leave ample space for natural regeneration and restoration.

All woody material (that is not included in slash piles) in Zone 1 and 2 should be mulched and left in zones in stockpiles (no higher than 2m) to be spread at the time of planting. Spreading within the tree removal area during the growing season will allow targeted use of mulch on invasive plant species (e.g. European Buckthorn saplings) for suppression, while avoiding concentrations of native plant species to facilitate regeneration. The targeted use of mulch by restoration crews in areas of planting also permits easier access for maintenance. Mulch used for the purpose of supressing invasive species should not be comprised of invasive species (e.g., Black Locust, European Buckthorn, etc.).

Since it is labour intensive and costly to move woody debris, including non-native species (e.g., European Buckthorn) off site during tree removal, all woody debris should be managed on-site, whether chipped or placed in slash piles. European Buckthorn should be used in slash piles rather than mulched to avoid spreading seeds that could potentially germinate. Although there may be seeds that germinate from within slash piles, treatment of new growth will be easier to manage in slash piles.

If there is a desire to prevent resprouting from stumps of cut trees, the stumps of removed trees in actively managed zones may be ground out to prevent resprouting to prevent potential future hazards, and to provide space for replanting and other restoration activities. Stumps would be ground to a depth of at least 15-30cm to prevent resprouting, which is

often prolific. Anecdotal evidence strongly suggests that stump sprouts are susceptible to E.A.B. infestation within 3-5 years, and require future management (i.e., removal) to limit the development of hazards. However, given the access constraints and moist soil conditions over much of Ghost Road Bush, stump grinding is not recommended beyond the mechanical reach of machinery from the maintenance access berm or Colonel Sam Drive.

4.2.3. Hazard Tree Removal – Zone 3

Because there isn't a target (trail/ public use) the trees in Zone 3 are not considered hazardous. Trees within interior areas, away from recreational trails or other facilities, such as in Zone 3, should be allowed to fall and decay naturally.

4.2.4. Hazard Tree Removal – Zone 4

The trail is currently closed in this Zone. Recommendations in this section are based on the assumption that the trail will be reopened in its current location. Treatment of Zone 4 will be characterized by the selective felling of the trees identified as hazardous based on the September 2018, risk assessment inventory, of which there are a handful of individual trees. A small (e.g., 3 person) felling crew using manual logging techniques and tools should suffice to fell hazardous trees in Zone 4. Access is less of a concern in the zone, as no heavy machinery should be necessary. All woody debris generated during tree felling should be processed and retained on site – no woody biomass should be removed. Downed wood should primarily be delimbed and bucked and retained in scattered brush piles to provide large wood material to contribute to local ecology. Chipping downed woody material is neither necessary nor desirable to achieve the zone 4 management objectives, which include only hazard abatement and no restoration work.

4.2.5. Hazard Tree Removal – Elsewhere

Finally, where any high-risk trees located in wooded areas that are within potential tip-out distances into roadsides or other potential targets, but beyond Zones 1, 2, or 3, these trees should be managed like Zone 1, where small felling crews and single-tree removal methods are appropriate. This approach will minimize environmental disturbance to retained trees and forest communities in these areas.

4.3. Wood Waste Management

The felling of hazard trees in Zones 1 and 2, is anticipated to generate a substantial amount of wood waste that must be managed effectively within specific environment, economic and

regulatory constraints. In Zone 4 only a small number of trees are recommended for removal and wood waste should be left on site.

Although most wood waste generated by tree felling should be retained on site, the option to remove wood from the study area remains available. The Canadian Food and Inspection Agency prohibits the movement of wood materials where an Emerald Ash Borer presence has been confirmed, and all of Oshawa has been identified as part of the larger E.A.B. Regulated Area (refer to http://www.inspection.gc.ca for Regulated Area boundaries). This directive pertains to the movement of regulated materials beyond the limits of the Regulated Area. Ash wood materials may be removed from the Marsh and beyond the Oshawa city boundaries, and subsequently disposed of within the broader boundaries of the Regulated Area; however, the movement of ash wood and wood products beyond the outer limits of the Regulated Area is strictly prohibited. E.A.B. Regulated Articles prohibited from removal from Regulated Areas include:

- ash trees (whole or parts)
- ash logs and branches
- ash lumber
- ash wood or bark
- ash wood chips or bark chips

Market factors largely constrain options for innovative and revenue-generating wood waste management. Given the elevated availability of ash wood on the market since the outbreak of E.A.B. in Southern Ontario, opportunities for generating meaningful revenues from processed wood (i.e., commercially valuable timber) or even wood waste (chips, biomass, etc.) are currently limited and generally considered unfeasible. As such, the management of any wood waste generated and removed from the study area will likely involve the stockpiling and processing (chipping) of large volumes of wood waste. Some jurisdictions faced with a surplus of dead ash wood currently stockpile the wood in municipal yards and as required, contract tub-grinding services once or twice annually.

Ground chips (or mulch) can be used for several purposes, such as supporting Oshawa's young tree establishment programs through mulching or used locally for mulching Second Marsh pathways where appropriate. The expected influx of wood chips from dead ash trees can also be given away to Oshawa residents for use in private gardens. Giving away mulch is a common practice in many jurisdictions and is often a key component of community environment days and other similar activities. Notwithstanding the current poor market

opportunities for ash waste wood, very high-quality ash logs (clear, long lengths) may be stockpiled separately and given or sold to local businesses or artisans. Invasive plant material (e.g., European Buckthorn or invasive honeysuckles) should not be included in mulch that is distributed to the public or moved offsite.

5. Ecological Restoration

Ecological restoration is considered an essential component of forest management in response to a large-scale disturbance, as has occurred in Ghost Road Bush due to loss of the ash canopy caused by E.A.B. infestation. The Society for Ecological Restoration defines ecological restoration as, "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (Society for Ecological Restoration International Working Group, 2004). By applying ecological principles and implementing various ecological restoration techniques, forest management goals can be achieved.

Restoration is being examined as an option to support the management objectives of this F.M.P. Ghost Road Bush, south of Colonel Sam Drive, should be the focus of restoration efforts due to the significant negative impacts to the ecological functions and integrity of this large continuous forest as a result of E.A.B. (i.e., the loss of the native canopy) and the dominance of European Buckthorn in the understory. The portion of Ghost Road Bush north of Colonel Sam Drive is fragmented from the large swamp to the south of Colonel Sam Drive and active restoration in this portion of the swamp would have a minimal contribution to the ecological functions associated with the larger swamp to the south of Colonel Sam Drive, relative to the cost (i.e., resources and expense of active restoration).

Restoration of Ghost Road Bush will be a challenging and long-term effort that requires considerable planning, implementation, and adaptive monitoring. Often, restoration aims to restore a degraded area to its original state. However, Second Marsh has endured a long history of anthropogenic influence, particularly during the past 90 years (The Scientific and Technical Committee, 2000), so the original state is not well documented and thus unknown. Furthermore, the more recent vegetation community dominated by an ash canopy cannot be the target restoration goal due to the continued threat of E.A.B. The goals for the restoration of Ghost Road Bush are to:

- Maintain a forested vegetation community comprised primarily of native species;
- Increase the native biodiversity in Ghost Road Bush;

- Increase resilience to future threats (e.g., climate change, current and future invasive plant and insect species); and
- Maintain existing ecological function (e.g., interior forest habitat for birds).

Based on past vegetation inventories conducted in Ghost Road Bush between 1971 and 2004 and again in 2018, the composition of species includes 73.6 % native species and the vegetation community (SWD2-2) has a F.Q.I. of 46. Ghost Road Bush provides habitat for a diversity of forest dependent wildlife species, such as area sensitive birds that rely on large continuous forests with interior forest habitat (i.e., at least 100 m from the forest edge). In addition, Ghost Road Bush provides important ecological functions, such as water and nutrient cycling, and migratory bird stopover habitat. In order to achieve the goals noted above, the following objectives for the restoration of Ghost Road Bush have been proposed:

1. Maintaining a native species richness and relative abundance that is greater than 73% and a F.Q.I. that is greater than 40 (i.e., the threshold that is considered high quality);
2. Maintain a canopy cover of greater than 60% (i.e., the canopy cover that defines a community as a forested community) to support the interior forest habitat of Ghost Road Bush;
3. Increase native tree species diversity in the canopy and ensure that the relative abundance of the dominant species is less than or qual to 50%; and
4. Reduce relative abundance of European Buckthorn below 10%[2].

5.1. Restoration Zones

Similar to Hazard Tree Removal, restoration options are based in Zones (Figure 9) in order to breakdown costs and evaluate options. The same Zones for hazard tree removals will be used when discussing restoration actions as restoration should be considered as a management option to achieve the objectives for the F.M.P. Zones are listed below:

- Zone 1 includes a 30m buffer on the east of the maintenance access berm and south side of Colonel Sam Drive
- Zone 2 includes a 30m buffer on each side of the Bob Mills boardwalk trail (a 60m swath with the boardwalk in the center), or any new trail in that area proposed where

[2] 10% relative abundance is considered feasible to achieve, manageable, and a population that would not have a significant impact on native species diversity and habitat function.

EAB is impacting surrounding trees located within striking distance of the trail or public access areas.

- Zone 3 includes the rest of Ghost Road Bush
- Zone 4 includes the portion of Bob Mills Boardwalk between the maintenance access berm and the footbridge connecting to the Waterfront Trail

5.2. Invasive Species Management

With the increase in exposure of direct sunlight to the understory, shrub layer, and forest floor resulting from the mortality of ash trees in the canopy, there will be an increased proliferation of invasive plant species, mainly European Buckthorn. Additionally, with the option to remove approximately 1,029 hazard trees in Zone 2 and the previously removed trees in Zone 1, the remaining forest microclimate will change in part due to edge effects benefitting the growth and regeneration of buckthorn. As European Buckthorn poses a challenge to achieving the objectives of the F.M.P. and restoration goals, management and removal of European Buckthorn should be considered as part of the management options to achieve a resilient, high functioning community that contributes to the biodiversity of the Marsh.

The options to managing European Buckthorn should consider both the ecological impacts to the forest and the financial resources necessary to achieve the objectives of the F.M.P. and restoration goals. Since European Buckthorn comprises a large proportion of the vegetation in the sub-canopy, shrub layer and understory, removal should be sensitive to changes to the microclimate of the forest that could result from an increase in wind and light penetration (i.e. edge effects). Effects to microclimate (e.g., high temperature, reduced shade, etc.) that could alter conditions extant native vegetation is adapted to, have been considered in the options for buckthorn removal. Removal of European Buckthorn without planting of native vegetation will leave a void/gap that may be later filled by European Buckthorn or other invasive species (e.g., Common Reed) as the extant native flora that have established and evolved in the shaded conditions of the swamp will be less tolerant of increased exposure to direct sunlight and potential changes in hydrology (e.g., faster drying of soils on ridges, prolonged flooding and extent of flooding in depressions or sloughs).

The strategies for buckthorn removal and control have considered best management practices as described in the following documents:

- Anderson, Hayley. 2020. Invasive Common (European) Buckthorn (*Rhamnus cathartica*): Best Management Practices in Ontario. Ontario Invasive Plan Council, Peterborough, ON.

- Nature Manitoba. 2014. European Buckthorn best management practices – a manual for managers and stewards of natural areas. Winnipeg, Manitoba
- United States Department of Agriculture. 2012. Non-native Invasive Species Best Management Practices: Guidance for the U.S. Forest Service Eastern Region.

5.2.1. Options for Buckthorn Removal

There is concern that European Buckthorn could take over all zones described in this F.M.P. Zones 1, 2 and 3 are described as high priority for invasive species removal in the Oshawa Second Marsh Invasive Species Management Plan (N.S.E. 2024).

Option #1 - Remove European Buckthorn from areas that have previously undergone and are proposed for hazard tree removal (i.e., Zone 1 and 2). Zone 1 and 2 are the most accessible from the existing trail system. Removal of woody invasive species would further increase accessibility for hazard tree removal. Removal of hazard trees prior to or in conjunction with invasive species removal may reduce the risks hazard trees pose to removal personnel. Removal of European Buckthorn in conjunction with hazard tree removal may reduce costs. Zone 1 and 2 represent only a portion of the area where European Buckthorn occurs.

Option #2 – Remove European Buckthorn from the remainder of the woodland (i.e., Zone 3). It is recommended that if Option #2 is implemented, this be undertaken once woody vegetation plantings in Zones 1 and 2 are established (plantings should be well established after five years with proper maintenance). The establishment of plantings in Zones 1 and 2 will provide a denser edge to reduce edge effects to Zone 3 and impacts on the microclimate of the remainder of Ghost Road Bush. Trees in Zone 3 are to be allowed to fall naturally and there are increased hazards/barriers to invasive species removal in this zone. Additional planning for access routes and safety will be necessary. Implementing removals in Zone 3 would assist in preventing reintroduction to Zone 1 and 2 and help achieve the objective of less than 10%[3] relative cover of European Buckthorn.

5.2.2. Considerations for Cutting and Removal of Woody Invasive Species

Removal of invasive species is considered a priority it itself and has been detailed separately in the Invasive Species Management Plan (NSE, 2024); however, combining hazard tree removal and woody invasive species removal may be more cost effective. As such, removal of

[3] 10% relative abundance is considered feasible to achieve, manageable, and a population that would not have a significant impact on native species diversity and habitat function.

woody invasive species is also discussed in this F.M.P. If hazard tree removal is implemented in Zone 2, and invasive species management is selected as an option to achieve the objectives of the F.M.P., European Buckthorn should be removed from Zone 2 prior to hazard tree removal. This will permit easier access to mark and remove hazard trees from Zone 2 and advance the first treatment of European Buckthorn.

If European Buckthorn removal is to occur in the winter at the same time as hazard tree removal it is recommended that a contractor qualified to identify European Buckthorn and other woody species in leaf-off conditions is selected as European Buckthorn can look very similar to other native alternative leaved tree and shrub species such as hawthorns (*Crataegus* species) and cherries (*Prunus* species).

It is recommended that woody invasive species removal take place between September 10 and March 31 as to avoid nesting birds. Removals of any vegetation during the breeding bird season (April 1 to September 1) must adhere to the Migratory Birds Convention Act. Any vegetation removal during the breeding bird season must be surveyed for nests prior to any work.

Disposal of debris from woody invasive species should follow the specific Best Management Practices for the species being disposed. Mulch from invasive woody species should not be transported offsite as the debris may contain seeds that could germinate. Slash piles are recommended for European Buckthorn. While slash piles may be a source of seeds, treatment of new growth in slash piles will be easier to manage as it is restricted to a smaller area.

5.2.3. Options for Methods of Control of Woody Invasive Species

5.2.3.1. Chemical Treatment

Chemical treatment can be an effective tool to reduce the population of European Buckthorn in Ghost Road Bush. This can be undertaken by application of pesticides to cut stumps, brushed on live foliage of smaller specimens (under 1 m in height), or through basal bark application. Ideally, chemical treatment would occur during the leaf-on period when there is less chance native species (e.g., *Prunus* sp.) is mistaken for invasive species. Application of herbicides must be undertaken by a professional with a Pesticide Applicator's License. The Ontario Pesticides Act and Ontario Regulation 63/09 provides natural resources and forestry exceptions which may enable chemical control of invasive plants in Ghost Road Bush. Chemical control may fall under the exception for forest management, and a letter of opinion (that would be required under the natural resources exception) may not be required. Class 9

pesticides can be used under the forestry exception, as it relates to "maintaining or establishing a forest". It is important to note that the use of glyphosate or triclopyr over water, including wetlands is prohibited (refer to the Ontario Pesticides Act 2009, for guidance and regulations). That said, European Buckthorn does not grow in wetlands that are permanently inundated with water (such as shallow marsh wetlands). Since European Buckthorn will be located in areas of the swamp that do not have water above the surface of the soil at least for most of the year, herbicides can be an option to control buckthorn.

Instructions for various treatment approaches to chemical application are described below:

Treat Cut Stumps

Cutting buckthorn stems followed by brushing of glyphosate to the fresh stump is one of the most common methods to control European Buckthorn (Nature Manitoba, 2014). Ensure a fresh cut of stems at ground level and paint cut stumps with Roundup WeatherMAX® (glyphosate), a Class 9 pesticide, within 30 minutes of cutting to ensure uptake of pesticide. If cutting is undertaken in the winter, then trees should be marked, and herbicide applied following a fresh cut in the spring. Late fall (October – November) is considered the optimal time for painting or spraying herbicides; this is when most native species have senesced, European Buckthorn leaves are still green, and downward transport of nutrients increases the effectiveness of herbicide treatment.

Basal Bark Application

Basal bark applications have been recommended for dense stands of European Buckthorn such as in Ghost Road Bush. However, basal bark application typically requires oil as a dilutant and has a higher efficacy on younger smooth-barked trees (1-5 cm D.B.H.). It is recommended that a 12% concentration of GarlonTM RTU (triclopyr) (or 4:1 oil to Garlon 4) be applied using a handheld sprayer or herbicide wand around the base of stems (lower 15 cm swath). The advantage of the technique is that it can be applied most of the year (between -15°C to 25°C) as long as the base of the tree is not snow covered. In addition, a triclopyr-based herbicide can treat upwards of two-times more stems compared to glyphosate.

Spray foliage of remaining small European Buckthorn stems that are too small to treat by basal bark application (i.e., less than 1cm across at the base) with Roundup WeatherMAX® (glyphosate).

No further action is required following chemical treatment provided that the individual is killed. Individuals that are not killed will re-sprout and will require additional treatment.

Additional Considerations for Herbicide Use

Overspray has the potential to kill desirable native plant species. As such, application of herbicides in late fall or winter is recommended to reduce impacting desirable species.

Planting can occur immediately following treatment by painting or basal bark application or following herbicide spray as long as planting is not completed on the same day as spraying and planting stock does not touch wet sprayed foliage.

5.2.3.2. Use of Mulch to Suppress Invasive Species

Mulch can be used in targeted areas in Zones 1 and 2 to suppress germination and growth of undesirable plants. These targeted areas would include around the base of planted trees/shrubs (a radius of 1 m) and in areas where the abundance of European Buckthorn seedlings is high. Mulch should avoid areas where the ground cover is greater than 50% native species. Mulching to a minimum depth of 10cm (and up to 15cm) contributes to weed suppression. Mulch eliminates sunlight and stem elongation or seed sprouting, and undesirable plants (e.g., buckthorn) growing on top of mulch are easier to pull out. Additionally, application of a broad-spectrum herbicide to European Buckthorn seedlings before mulching increases suppression of "strong stemmed plants" such as European Buckthorn (Greenly, K., and Rakow, D., 1995).

5.2.4. Ongoing Invasive Species Management

Ongoing invasive species management will be required to control invasive species at Ghost Road Bush. European Buckthorn is ubiquitous within Southern Ontario and will continue to be a nuisance in Ghost Road Bush. Long-term monitoring and removal of new growth of European Buckthorn and other invasive species is required on an annual basis. Chemical treatment is recommended for a minimum of five years post-completion of restoration plantings to ensure native woody trees and shrubs are well established and able to outcompete the regeneration of European Buckthorn.

5.3. Restoration Planting

The sub-canopy, understory, shrub layer and ground cover contain the species that will make up the future canopy of the Ghost Road Bush; fundamentally, these layers inform the successional trajectory of the vegetation community. The most abundant species in these layers is European Buckthorn. Therefore, as it is expected that as the ash canopy continues to succumb to the infestation of E.A.B., the vegetation community will succeed into a European Buckthorn thicket with scattered Manitoba Maple and to a lesser extent Balsam Poplar, Black

Cherry, and White Pine. To guide the successional trajectory towards a more desirable vegetation community that will meet the restoration objectives, selective planting of native species is required. The type and mix of vegetation selected for restoration will vary depending on the biotic and abiotic characteristics of a site, include the extant vegetation, soil moisture (e.g., upland, lowland, or wetland), slope, light, and canopy conditions (open or closed). Specific species proposed for planting in Ghost Road Bush have taken into consideration the current composition of native vegetation, species adapted to Eco-region 6E, and selecting species that will be well suited to the biotic and abiotic conditions in Ghost Road Bush.

Restoration planting is a strategy to achieve the objectives described in Section 5.0. The benefits of planting native species in Ghost Road Bush include:

- Out-competing non-native and invasive species;
- Enhancing native species composition; and,
- Directing the future successional state of the forest to a desirable vegetation composition and ecological function with a high degree of ecological integrity.

Planting of native woody plants should be completed following the removal and management of woody debris (as described in Section 3.1.3 – Wood Waste Management). General instructions for restoration plantings are described below.

- Ensure mulch is applied appropriately, with new plantings.
- Plant potted and bare root stock in Zones 1 and 2.
- Utilize native plant stock of local genetic provenance (i.e., originating from within seed zone #34)
- Plant a diversity of species that are tolerant of a high-water table.
- Promote regeneration of non-ash trees by retaining all native tree species as seed sources. In other words, non-high-risk native trees can be retained as shelterwood.
- Incorporate native natural regeneration into planting plans where possible.
- Planting should be completed in the fall and spring to reduce disturbance to the site and increase the survivorship of plantings.
- Bare Root (BR) and Container-grown (CG), hickory and conifers should be planted only in the spring. Bare root balsam poplar and trembling aspen should be planted only in the spring. Shrubs tend to respond well to fall plantings. All other stock may be planted in the spring or fall.

5.3.1. Nodal Planting

Planting of trees and shrubs can be installed in nodes (aka nuclei, pods, modules, etc.). Nodes act as 'islands' of planted woody material, often installed in open settings (e.g., old fields and riparian meadows). They are intended to mimic the natural form and progression of woody succession in open areas: these are typically comprised of a core (nucleus) of slightly larger woody plants, with bands of shrubs and seedlings extending from the core. This approach to planting can support micro-climate development using clearly defined planting areas that reduce monitoring effort and allow for focused management within nodes. Use of seed and smaller materials beyond nodes can reduce costs and the need for over-planting to permit natural thinning.

Biodiversity is enhanced through the density and diversity of trees and shrubs selected. The node plantings are expected to expand once established to a 'free to grow' stage, a measure recognized in the forestry sector. Nucleation has been used to promote the regeneration of a mixed-aged forest in southern Ontario, including urban settings. The proposed density for nodal planting in Zones 1 and 2 is 1 tree and one shrub per five square metres or 2,000 trees and 2,000 shrubs/ha. Nodes should be approximately eight meters in diameter (approximately 50 m^2); as such, each node should include a diversity of ten trees and ten shrubs. Nodes should be spaced five to ten metres apart, resulting in approximately 30 to 40% coverage of the restoration zone. An additional benefit of planting nodes is this provides the opportunity to installing exclusion fencing if herbivory from deer is excessive.

The proposed approach for planting in Zone 3 varies from Zones 1 and 2. The planting of nodes is not proposed in Zone 3, as nodal plantings are more appropriate for open areas. As such, the proposed density for Zone 3 is one tree per ten square metres or 1000 trees/ha that should be selectively planting in gaps created by the loss of the ash canopy. Shrubs are also proposed for planting at the same density as trees, therefore one shrub per ten square metres or 1000 shrubs/ha.

5.3.2. Recommended Species for Planting

Existing and predicted conditions of the planting area (e.g., seasonal changes in water levels, changes in environmental condition related to climate change) should be considered when selecting species for planting. Table 4 outlines the recommendations for preferred species, sizes of material to plant and percent composition for each species.

Table 4. Type and size of the material to plant per recommended species.

Scientific Name	Common name	Stock Type	Stock Size	% of planting	Notes
Trees					
Carya cordiformis	Bitternut Hickory	BR or CG	100 cm	5	BR is best if available
Pinus strobus	White Pine	BR or CG (fibre pot) or B&B	100 cm	5	B&B and fibre pots best
Populus balsamifera	Balsam Poplar	BR or CG 5 gallon	120 cm	10	BR is best if available
Populus tremuloides	Trembling aspen	BR or CG 5 gallon	120 cm	10	BR is best if available
Quercus macrocarpa	Bur Oak	BR or CG 7 gallon	180 cm	5	BR is best if available
Thuja occidentalis	White Cedar	BR or CG (fibre pot) or B&B	100 cm	10	B&B and fibre pots best
Larix laricina	Tamarack	BR or CG (fibre pot) or B&B	100 cm	5	B&B and fibre pots best
Betula alleghaniensis	Yellow Birch	BR or CG 5 gallon	120 cm	5	BR is best if available
Acer rubrum	Red Maple	BR or CG	100 cm	25	BR is best if available
Acer x freemanii	Freeman's Maple	BR or CG	100 cm	20	BR is best if available
Shrubs					
Sambucus canadensis	Common Elderberry	BR or CG 3 gallon	60 cm	5	BR is best if available
Lindera benzoin	Spicebush	BR or CG 3 gallon	60 cm	15	BR is best if available
Cornus stolonifera	Red-osier Dogwood	BR or CG 3 gallon	60 cm	5	BR is best if available
Cornus obliqua spp. *amomum*	Silky Dogwood	BR or CG 3 gallon	60 cm	10	BR is best if available
Ribes americanum	American Currant	BR or CG 2 gallon	60 cm	15	BR is best if available

Ribes triste	Swamp Red Currant	BR or CG 2 gallon	60 cm	10	BR is best if available
Viburnum lentago	Nannyberry	BR or CG 3 gallon	60 cm	20	BR is best if available
Viburnum trilobum	Highbush-cranberry	BR or CG 3 gallon	60 cm	20	BR is best if available

BR = bare-root
CG = container grown, usually plastic
B&B = balled in burlap
fibre pots = paper containers; plant is dug just before shipping and put into the fibre pot

5.3.3. Installation of Restoration Plantings

Professionals with planting experience should supervise restoration plantings to ensure plants are installed properly (e.g., ensuring root collar of stem flush with ground, roots properly pruned in bare root stock, etc.). In areas where hazards have been removed (Zone 1 and Zone 2) volunteers may assist with restoration activities. However, in Zone 3 the swamp area is considered hazardous, and any planting should be undertaken by professionals with proof of liability insurance.

Following planting, the rooting zone of each planted tree and shrub should receive a good soaking of water (unless planted in an area with high soil moisture content or early spring) and the base of each planted tree or shrub should be mulched to a depth of 8 cm (optimum depth) to 10 cm, as it maintains moisture without reducing temperature (Greenly and Rakow, 1995). Mulch provides a reservoir of moisture to the underlying soil and roots in and outside of the growing season. Mulch slows runoff and increases infiltration, reduces competition, reduces temperature in hot season and increases temperatures in cold seasons. Mulch should be added in a manner that does not compromise healthy growth and establishment; placed at the base of the plant and spread to a minimum 70 cm diameter circle around the stem of each plant, and must be pulled away from the immediate stem, in a tapered profile, to prevent stem rot (i.e., no volcano mulching).

It is recommended that at the time of planting pruning be followed by the successful contractor (or supervised volunteers) to preserve or encourage the natural form and

character of plants and reduce the potential for insects or diseases to infest damaged limbs or roots:

- Cut off any broken or damaged roots with a sharp implement from bare root stock prior to planting
- During planting prune only as necessary to remove dead and broken branches

5.3.4. Ongoing Maintenance of Restoration Plantings

Watering, mulching, and pruning are the typical ongoing maintenance measures recommended for restoration plantings in Zone 1 and 2 where access is more feasible and the establishment of vegetation in these cleared areas is highly desirable. Due to the size of Zone 3, the difficulty in navigating this zone due to downed woody material, and the more sheltered conditions, ongoing maintenance is not recommended. In Zone 1 and 2, ongoing maintenance may be completed by volunteers under the supervision of an experienced professional. Ongoing maintenance will no longer be required after the restoration plantings become established (i.e., once trees have grown to three metres tall and shrubs have grown to one metre tall). At this point, natural processes will support forest regeneration and the re-establishment of a forest canopy within the restoration area.

5.3.4.1. Mulching

Mulching of restoration plantings should be maintained until plantings are established. Professionals or volunteers can reapply mulch according to the following instructions:

- Wood chip mulch must be applied to a depth of between 10 and 15 cm placed at the base of the plant and spread to a minimum 70cm diameter circle around the stem of each plant.
- Mulch must be pulled away from the immediate stem, in a tapered profile, to prevent stem rot (i.e., do not pile mulch upwards towards the stem of the tree).

5.3.4.2. Watering

Watering may be necessary in Zone 1 where the water table is deeper (greater than 70 cm below ground surface) and the planted material is exposed to direct sunlight and drying winds. Watering should occur for a two-year period post-planting in Zone 1 on an as-needed basis, i.e., when conditions are dry. It is recommended that the contractor provide costs for watering up to eight times/year in Zone 1. Watering is not recommended nor required in Zone 2 and 3 as the water table is higher (14 cm below ground surface) resulting in more

moist soil conditions, and the planted material will remain more sheltered from direct sunlight and drying winds.

It is recommended that the following maintenance guidelines for watering be followed by the successful contractor within Zone 1, following restoration plantings:

- The contractor shall be responsible for watering at the time of planting (if soil is dry) and approximately biweekly during the growing season, between June and the end of September until the end of the warranty period (typically two years). Due to wet conditions, watering may not be required at this frequency but will need to be monitored according to weather conditions over the growing season. The contractor shall provide and arrange for appropriate watering equipment and water sources based on the restoration planting plan.
- A watering truck will access Zone 1 along Colonel Sam Drive and the maintenance access berm. Planted material will either be watered by spraying from the road and berm, or by use of a hose extending from the watering truck.
- The following guidelines shall be followed when watering:
    a. Apply water to the point where the soil in the upper 10 cm of the planting area is saturated, avoiding excessive runoff by applying water slowly to allow time for downwards percolation towards the root system of the tree or shrub.
    b. Watering shall be undertaken at appropriate times, such that watering is not done following a rainstorm or when rain is forecast within 24 hours.

5.4. Monitoring

The preferred option for monitoring of plantings and invasive species includes an annual site visit and annual reporting.

The annual report should include the results of the monitoring and evaluate the success of the plantings and invasive species management against the goals of the restoration (see Section 5.0). Furthermore, the annual report should provide recommendations, based on an adaptive management approach, that includes measures to address excess mortality.

5.4.1. Annual Site Visit and Adaptive Management

A site visit to the restoration areas in Ghost Road Bush should be completed on an annual basis to facilitate monitoring, reporting and adaptive management. Key observations on the health of the woodland should be recorded. Key observations include natural forest

regeneration, changes observed, success or failure of restoration plantings, and maintenance and management issues (e.g., invasive species management, mulching, etc.).

In relation to the objectives the following should be measured during each annual site visit:

1. Maintaining a native species richness and relative abundance that is greater than 73% and a FQI that is greater than 40;
    - A plant list documenting all species present, and their relative abundance should be recorded. FQI should be calculated based on the extant species list. Locations of SAR and invasive species should be recorded to inform adaptive management.
2. Maintain a canopy cover of greater than 60% to support the current ecological functions of Ghost Road Bush, including interior forest habitat;
    - Average canopy cover within the study area should be determined and recorded. Locations of canopy gaps should be recorded to inform future tree planting locations.
    - Monitor the success of restoration plantings by documenting the success of plantings (i.e., How many trees were planted? How many shrubs were planted? What percentage of trees and shrubs survived? Recording any other observations, such as herbivory.)
    - Photo-monitoring of restoration planting areas should be completed ideally in mid-June, but between June and August is considered acceptable. To ensure consistency a set location and direction should be chosen for the photo;
3. Increase native tree species diversity in the canopy and ensure that the relative abundance of the dominant species is less than or qual to 50%; and
    - Relative abundance of species in the canopy should be determined and recorded. Monitor regeneration of forest understory by completing annual measurements of the point-centre quarter method (see description in Section 5.4.3).
4. Reduce relative abundance of European Buckthorn below 10%.
    - Visual inspections of invasive species populations (location, abundance, density, age) should be conducted to inform if the removal was successful and if additional action is needed to remove invasive species (note: additional details regarding monitoring of invasive species is provided under separate cover in the Invasive Species Management Plan [NSE 2024]). Locations should be recorded to inform adaptive management.

Adaptive management incorporates trial and error into restoration plans by integrating implementation and monitoring to systematically refine and adapt restoration plans to reflect existing conditions and management requirements.

The adaptive management approach is an iterative process whereby information gathered through monitoring is used to update and refine management initiatives. The following approach to adaptive management is recommended:

1. Implement preferred restoration options identified by the consultant team and stakeholders;
2. Monitor the success of the implemented management initiative towards achieving the goal of improving existing conditions and enhancing the ecological integrity of the woodland;
3. Compare updated natural heritage information and conditions within the restoration area to baseline data; and,
4. Refine restoration recommendations as necessary to achieve woodland restoration goals.

An adaptive approach will allow the City of Oshawa to respond to changes that may occur within the restoration area and will allow for a flexible approach, which will assist in improving the ecological integrity of Second Marsh. Monitoring and adaptive management targets should be evaluated to measure the success of restoration in Ghost Road Bush. Success can be evaluated based on achieving the goals outlined in Section 5.0. Objectives have been identified in Table 5 as they relate to the restoration goals in order to measure success and inform implementation of adaptive management actions.

Table 5. Monitoring and adaptive management objectives and actions to measure success of restoration in Ghost Road Bush.

Measures and Parameters	Objectives	Negative Outcome	Adaptive Management Actions
Native Species Richness	F.Q.I. ≥ 40 Native Species abundance ≥ 75 %	F.Q.I. and native species abundance decrease	• Investigate causes of reductions and document findings • Address causes, such as competition and invasives control, mulch top-ups, or enhanced herbivory control. • Report observations of excellent or poor performance and treatment outcomes, to allow City to adjust future planting plans
Canopy Cover	Canopy cover ≥ 60 %	Canopy remains open and vegetation community no longer functions as a forest	• Investigate survivorship and growth of planted trees • Address causes, such as competition and invasives control, mulch top-ups, or enhanced herbivory control. • Report observations of excellent or poor performance and treatment outcomes, to allow City to adjust future planting plans
Diversity of tree species in canopy	Relative abundance of dominant species ≤ 50%	One species dominates the canopy leaving the forest susceptible to major changes in structure if dominant species becomes threatened by disease or pests	• Investigate survivorship and growth of associate trees species • Install additional plantings of associate tree species that will increase in abundance relative to the dominant species

Measures and Parameters	Objectives	Negative Outcome	Adaptive Management Actions
Abundance of Buckthorn	Buckthorn relative abundance ≤ 10%	Buckthorn outcompetes native vegetation and increases in relative abundance beyond 10% post control efforts	• Implement chemical control regime • Use volunteers to assist in mechanical removal (pulling of saplings under 1 m in height)

5.4.2. Restoration Monitoring Protocol

To effectively collect data on survival rates and document the successional trajectory post planting, it is necessary to collect baseline data at the time of planting. The industry standard in southern Ontario is to monitor a minimum of 5% of the total planting area to sufficiently capture a representative sample of all the trees and shrubs planted. Baseline data should be collected during the first year of restoration and monitoring should occur during years two through five. Recommended monitoring includes an assessment of tree and shrub survival, photo-monitoring, an invasive plant species assessment, and an assessment of site maintenance requirements (i.e., mulching, replanting, infilling or other restoration opportunities). Fixed plots should be established to allow for a comparison of changes year-over-year.

5.4.3. Forest Understory Regeneration Monitoring

The Point-centre Quarter Method is recommended for monitoring regeneration and succession of the forest understory. Following the Point-centre Quarter Method, a number of randomly selected points are determined, and locations are marked with flags. Each point represents the centre of four compass directions, which divide the sampling site into four quarters or quadrants. In each quadrant, the distance from the centre point to the centre of the nearest individual is measured (Figure 10). Only one plant per quadrant is recorded for each point sampled. The plant species is identified, and the area covered by that plant is recorded (Brower and Zar 1984). This method can be used to determine the density of regeneration by measuring point-to-sampling distances in each quadrant.

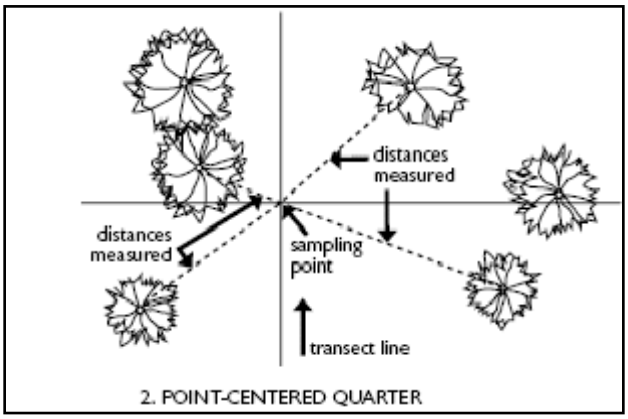


Figure 10. A schematic example of the Point-centre Quarter Method (University of Idaho, 2015).

A minimum of 20, 30 and 50 points should be sampled within Zone 1, 2 and 3, respectively, each year. Sampled points are random, and fixed plots are not necessary or recommended. It is recommended that the Point-centre Quarter Method is completed in year one (i.e., the year that restoration plantings occur), and for the five years following the completion of restoration plantings or until the restoration plantings are established.

5.4.4. Annual Reporting

It is recommended that an annual monitoring report is prepared for Ghost Road Bush (to be a part of the Second Marsh monitoring plan) to document baseline conditions, track the survival of restoration plantings, note the introduction and spread of invasive plant species, and identify maintenance needs. Annual reporting is a critical component of the adaptive management cycle, whereby the opportunity to identify adaptive management measures is provided (e.g., the need to replant certain areas with additional trees or shrubs, the need to manage for a different invasive species).

6. Implementation Challenges and Considerations

The challenges associated with hazard tree removal, invasive species management and installation of restoration plantings have generally been noted and addressed throughout the above sections. The following provides a summary of site implementation challenges and considerations.

6.1. Timing

Ghost Road Bush is a deciduous swamp that is supported by moist soils and a high-water table. The soils in the wetlands have a greater sensitivity to compaction and disturbance as a result of the use of machinery required to undertake the hazard tree removal. In order to avoid leaving deep tracks in the soil, damaging roots and extant vegetation that will occur during hazard tree removals, it is strongly recommended tree removal and the use of large machinery is restricted to mid-winter, when sub-zero temperatures will freeze the ground and reduce the impact to soils and extant vegetation.

Planting of trees and shrubs should be undertaken in early spring (April to mid-May) or late fall to allow roots to begin to grow and reduce stress resulting from higher temperatures in the summer and dryer soils.

Treatment of European Buckthorn with herbicides is best undertaken in late fall in order to avoid unintentional contact with desirable native plants.

6.2. Natural Hazards

Potential natural area hazards at Second Marsh include exposure to biting insects (e.g., ticks, mosquitoes, and fire ants), exposure to poison ivy (*Toxicodendron* species), Stinging Nettle and exposure to tree/limb failure. There is also the potential for tripping or eye injuries. In light of these hazards, personnel working in Ghost Road Bush should be instructed to minimize risks the following actions, as required:

- Wearing protective clothing, safety glasses and rubber boots;
- Scheduling flexible work for winter months when insects and poisonous plants are inactive/dormant;
- Avoiding the undertaking of work on exceptionally windy days;
- Watching for insects that may have dropped onto clothing or skin from surrounding vegetation, or crawled up onto clothing from the ground;
- Brushing insects from skin and clothing to avoid being stung;
- Using insect repellent; and,
- Completing work in pairs or small groups.

In addition, signage should be installed along trails adjacent to Ghost Road Bush informing trail users of the hazards associated with dead and dying ash trees resulting from E.A.B. infestation.

6.3. Changes in Hydrology

The loss of mature trees in the canopy will result in a reduction in evapotranspiration (i.e., water pumping effect) that may alter the hydrologic regime in Ghost Road Bush. Currently, the water table is close to the surface (14 to 70 cm below surface) and where sloughs or depression are located, the water table is above the surface. With a reduction in the evapotranspiration there is a potential that the water table will rise (i.e., be closer to the surface) resulting in extended areas and periods of flooding. This potential for a change in hydrologic regime of the swamp may become less optimal for tree growth and support vegetation more tolerant of flooded conditions, such as a thicket swamp or shallow marsh. This potential change in hydrology may be more pronounced in low lying areas and further south in Ghost Road Bush. Ghost Road Bush is currently bordered by thicket swamp and

shallow marsh to the south indicating the water table is higher in the southern portion of Ghost Road Bush.

As a result of prolonged flooding and a higher water table, planted trees and shrubs less tolerant of flooded conditions may be susceptible to drowning resulting in a higher mortality. In order to mitigate the potential impact to planted material, the proposed planting list includes a diversity of tree and shrub species with a range of tolerances to periods of flooding (i.e., range in coefficient of wetness between -1 to -5). In addition, the smaller planted stock will have a shallower rooting system and have time to adapt to the changes in hydrology, compared with larger more mature trees whose roots may be deeper and susceptible to mortality due to prolonged periods of flooding or a higher water table.

6.4. Permits and Approvals

6.4.1. Species at Risk

The City of Oshawa has indicated that communication with the Ministry of Natural Resources and Forestry (M.N.R.F.) / Ministry of the Environment, Conservation and Parks (M.E.C.P.) has occurred regarding Species at Risk (S.A.R.) that may be impacted by hazard tree removal. The following communication was provided via email from Margaret Berube, M.N.R.F. Management Biologist, on July 10, 2016:

"The likelihood of these species [S.A.R.] using this area are low and that if any birds or bats are present, they are likely only using the area as foraging habitat. Therefore, an authorization under the Endangered Species Act is not required and you do not need to provide any additional information to our office. However, here is a list of mitigation measures that should be implemented to ensure the least amount of potential negative effects:

- all works should only occur between September 1 and April 30 of any given year (outside of the sensitive period for bat and bird processes).
- all trees cut down should remain within the wetland to emulate natural conditions and maintain nutrients within the wetland.
- only those trees that have a potential fall path coinciding with a trail or road should be cut down.
- all works should be undertaken by a qualified contractor using chainsaws.
- no logging or hauling machinery should be used beyond the limits of an existing trail or road.

Also, we think you should consider closing the existing boardwalk as it is likely proposing a significant liability for the town. We also think you should consider the creation of new trail connection immediately alongside Colonel Sam Drive. This would only require that those trees within 30 meters of the road be investigated for removal, as opposed to 30m on either side of the existing trail. However, any new trail could only be constructed using a raised boardwalk."

Given the time that has lapsed since the last communication with the M.E.C.P., and with the anticipated addition of new bat species and other species (e.g., Black Ash) to the Species at Risk in Ontario list, it is recommended that further consultation with the M.E.C.P. be undertaken prior to any tree removal.

6.4.2. Municipal Woodland By-law

In accordance with Section 4 of the Durham Regional Woodland By-law (By-law Number 30-2020, of The Regional Municipality of Durham) local municipalities are exempt from the requirements of its woodland by-law; in addition, exemptions to the to the By-law include the removal of trees that are dead, significantly diseased, or pose a hazard to human safety or property. As such, a permit is not required under the Durham Regional Woodland By-law to remove the hazard trees.

6.4.3. Ontario Pesticide Act

The Ontario Pesticides Act and Ontario Regulation 63/09 provides Natural Resources and Forestry exceptions that may enable chemical control of invasive plants in Ghost Road Bush (Technical Guidance: Pesticides Act and Ontario Regulation 63/09 Municipalities – MOECP). Since Ghost Road Bush is over 1 ha is size and the activity (i.e., herbicide application) is related to maintenance of a forest, a forestry exception may apply. In this case, a letter of opinion (that would be required under the Natural Resources exception) may not be required. Class 9 pesticides can be used under the forestry exception, as it relates to "maintaining or establishing a forest".

If chemical control of invasive species in Ghost Road Bush is not considered under the exception for forest management, it would fall under the Natural Resources exception since the purpose of the use of herbicides is to manage, protect, establish or restore natural resources with the goal of protecting and enhancing Ontario's biodiversity. The criteria for the Natural Resource exception that must be met include:

- controlling an invasive species or benefit a species of plant or animal native to Ontario; and
- be in accordance with integrated pest management (I.P.M.) principles[4]

The Act states that the Natural Resources Management project may be undertaken by:

- M.N.R.F. or Conservation Authority staff or licensed exterminators hired by the Conservation Authority or M.N.R.F.
- Proponents who have an agreement with the M.N.R.F.
- Proponents who receive a letter of opinion from the M.N.R.F. (Regional Director)

The process of obtaining a letter of opinion includes the following:

1. Ensure that no other exception(s) for use of a Class 9 pesticide apply (e.g., Forestry exemption).
2. Contact your local M.N.R.F. office for an application for Letter of Opinion for Natural Resources Management Projects Involving Class 9 pesticide use.
3. Submit application.
4. M.N.R.F. reviews application:
    - Natural Resource Management Project
    - Integrated Pest Management (I.P.M.) Principles
    - M.N.R.F. may issue a written opinion stating that the project is a natural resources management project.
5. If written opinion is issued, the project can proceed as described.

6.4.4. Conservation Authorities Act

The Central Lake Ontario Conservation Authority (C.L.O.C.A.) regulates development within wetlands through Ontario Regulation 42/06: Central Lake Ontario Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. Consultation with C.L.O.C.A. is required prior to undertaking any work within Oshawa Second Marsh, including hazard tree removal and invasive species management. Upon consideration of proposed works, C.L.O.C.A. may issue a permit and provide direction to undertake management initiatives.

[4] I.P.M. is the practice of preventing or suppressing damaging populations of pests by applying multiple comprehensive and coordinated control tactics. In the case of Ghost Road Bush, this would include a combination of herbicide use, mulching and planting of native trees and shrubs to outcompete buckthorn.

6.5. Tender/Procurement Process

Considerations for the tender/procurement process include:

- Prepare separate tenders for the following, as companies tend to specialize in only one of these areas:
  - removal of woody debris and invasive tree and shrub cutting and chipping
  - invasive species management, and,
  - tree and shrub planting;
- Include considerations for machinery and a description of the site conditions:
  - include details on type of machinery recommended (i.e., standard chip truck and chipper);
  - include details on site access;
- Include details on best practices for the use of pesticides:
  - include the requirement that work must be completed in accordance with the Ontario Pesticide Act and Regulations 63/09 (refer to https://www.ontario.ca/page/pesticide-licenses-and-permits);
  - include the requirement that work must be completed by a company holding a valid Pesticide Operators Licence;
  - include the requirements that work must be completed by crew members holding a valid Exterminators Licence, Forestry Class[5];
  - include the requirement that work must be completed per the Ontario Invasive Plant Council's Best Management Practices Library (refer to http://www.ontarioinvasiveplants.ca/index.php/bmp_library);
- Include selection of plant material, planting guidelines, planting maintenance guidelines (mulching, watering, pruning);
- Specify that contractor should provide costs for watering up to eight times per year;
- Include a requirement that best practices related to clean equipment (e.g. Clean Equipment Protocol for Industry, by Peterborough Stewardship Council and Ontario Invasive Plant Council) be followed
- Include details on phasing and timing; and,
- Include daily site visits by City staff to ensure that work is being carried out as specified.

[5] Provided that one crew member holds a valid Exterminators Licence, Forestry Class, the second crew member could be licensed as a Pesticide Technician.

6.6. Community Stewardship

The City of Oshawa is fortunate to have a well-organized Marsh Management Committee including a dedicated group of volunteers with Friends of Second Marsh who can participate in the restoration planting within Ghost Road Bush and engage the larger community and neighbouring landowners (e.g., students from University of Ontario Institute of Technology, Durham College and Sir Sandford Fleming College). The City could also engage the M.N.R.F.'s Stewardship Youth Ranger Program. The City could also extend the restoration planting over several years to disperse costs and allow volunteers to participate in the restoration activities.

7. Forest Management Budget and Timeline

7.1. Budget

Information pertaining to the approximate budget to implement the hazard tree removal and restoration measures described in Sections 4.0 and 5.0 are provided in Table 6. Most of the cost will be incurred in the first three years when the removal of woody debris, intensive invasive species management and restoration plantings are undertaken. However, Table 6 provides costs for five years of invasive species management and monitoring of restoration plantings. The cost to complete the first year of invasive species control will be higher than the remaining four. Invasive species management in years 2 through 5 is viewed as maintenance.

Costing implementation details have been provided based on the assumption that a contractor will complete all management options. This provides the City with the option to budget for the work should they chose to hire a contractor; however, the use of public agency staff (e.g., Central Lake Ontario Conservation Authority.) and volunteers to undertake the restoration planting provides an opportunity to reduce costs associated with the Forest Management Plan.

Table 6. Approximate budget to implement removal of hazard trees, woody debris, invasive species management, and restoration plantings in Ghost Road Bush.

		Hazard Tree Management	Restoration Planting					Invasive Shrub Management	
Work Zone	Size (ha)	Tree Removal and Woody Debris Management	Density of tree and shrub planting	# of trees to plant	Cost to plant and add mulch to trees	# of shrubs to plant	Cost to plant and add mulch to shrubs	Costs for initial removal	Costs for 5-year re-treatment
1	2.19	$40,000	1 tree and 1 shrub per 5 m^2	4,380	$131,400	4,380	$109,500	$67,600	$20,330
2	4.30	$120,000	1 tree and 1 shrub per 5 m^2	8,720	$261,600	8,720	$218,000	$119,400	$52,600
3	12.71	$0	10 trees and 10 shrubs / node	8,480	$254,400	8,480	$212,000	$355,880	$152,520
4	1.42	$15,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total		**$175,000**			**$647,400**		**$539,500**	**$542,880**	**$225,450**

Notes:

- Estimates above assumes the current trail locations will be maintained.
- Costs provided do not include H.S.T.
- Average planting cost of $30/tree and $25/shrub includes cost of material (assumes container grown stock) and labour (assumes professional planting and mulching)
- Costs to plant and mulch trees and shrubs assumes the use of container-grown stock and professional crews.
- Buckthorn and other species cut/stump recut & treat crew is 2 people; 1 with chainsaw and one to treat with herbicide; avg cost $120/hr + H.S.T.
- Average cost per ha to initially cut and treat buckthorn and other woody invasive shrubs and mulch woody debris = $40,000
- Average cost per ha for follow-up buckthorn herbicide application = $2,348/ha/year
- Costs are estimates. Actual costs will require quotes provided by contractor at time work is proposed.

7.2. Timeline

Information pertaining to the recommended timeline and phasing of implementing the hazard tree removal and restoration measures described in Section 5.0 and 6.0 are provided in Table 7. It is recognized that the management options may not all be desirable, economically feasible, or even necessary (e.g., hazard tree removal from Zone 1, 2, and 4 is not necessary if the Bob Mills Boardwalk trail remains closed). These timelines are general and may be modified depending on the preferred option as determined by the Second Marsh Management Committee.

If hazard tree removal and woody biomass management is implemented in Zones 1, 2, and 4, it is strongly recommended tree removal and chipping be undertaken in mid-winter (i.e., early February) when the ground is frozen to minimize soil compaction. It is recommended that woody debris from the hazard tree removals that occurred in 2017 be left in place.

If invasive species management is implemented, management will be required to continue for at least five years, with ongoing spot-treatments thereafter. If active restoration is implemented in Zone 3 following hazard tree removal and restoration in Zone 1 and 2, it is recommended this take place after five years of growth and regeneration within zone 1 and 2 to ensure the vegetation at the edge of the forest will have become denser thereby reducing the edge effects.

Table 7. Recommended phasing and timelines for management options.

	Phase 1 (Zone 4)	Phase 1 (Zones 1 & 2)					Phase 2 (Zone 3)			
Management Options	**Winter - Year 1**	**Winter - Year 1**	**Early Spring - Year 1**	**Fall - Year 1**	**Spring - Year 2**	**Year 2 - 5**	**Year 5**	**Fall - Year 5**	**Spring - Year 6**	**Year 6-10**
Tree risk management										
Hazard tree removal	■	■								
Target relocation & access control	■	■								
Wood waste management	■	■								
Tree pruning	■	■								
Restoration										
Invasive species management		■	■			■		■		
Restoration planting				■	■				■	
Mulching				■	■				■	
Watering				■	■				■	
Pruning				■	■				■	
Monitoring										
Annual site visit				■		■				■
Forest understory regeneration monitoring				■		■				■
Annual reporting				■		■				■

8. Overview of Management Strategies – Risks, Threats, and Opportunities

A key component of this F.M.P. is the evaluation of management strategies to address the impacts of E.A.B. infestation in Ghost Road Bush in part based on the current location of trails. This evaluation considers the ability of each management strategy to mitigate risks, the potential for threats to achieving success of the objective or goal of the management strategy, and the potential for opportunities to better achieve the objectives of the F.M.P. To recap, the goals of forest management are to:

1. Reduce hazardous conditions resulting from E.A.B.
2. Restore the forest canopy following the loss of ash trees.
3. Maintain or improve native biodiversity.

The management options have been based on the evaluation of current conditions and ecological functions in the study area and consider the costs of the proposed management activities (Table 8). The circles in the evaluation matrix indicate the relative extent of success or ability of the management option to achieve the desired result; as such, the larger the circle, the more preferred the outcome relative to other options.

Table 8. Qualitative evaluation of management options as they relate to the risks, threats, opportunities, costs and objectives of forest management. Note: The size of the circles indicates the relative extent of success or ability of the management option to achieve the desired result; as such, the larger the circle, the more preferred the outcome relative to other options.

Management Strategy	Ability to Mitigate Risk		Avoids Threats to Implementation				Opportunities	Cost to Implement	Achieving Goals & Objectives		
	Hazards	Loss of Ecological Functions	Invasive Species	Changes in Hydrology	Permitting	Hazards	Stewardship		Objective 1	Objective 2	Objective 3
HAZARD TREE MANAGEMENT											
Do Nothing		n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a	n/a
Zone 1 only (minimal)		n/a	n/a	n/a		n/a	n/a			n/a	n/a
Zone 1 and 4 only (scoped)		n/a	n/a	n/a		n/a	n/a			n/a	n/a
Zone 1 and 2 only (extensive)		n/a	n/a	n/a		n/a	n/a			n/a	n/a
Zone 1, 2 & 4 (comprehensive)		n/a	n/a	n/a		n/a	n/a			n/a	n/a
ECOLOGICAL RESTORATION											
Do Nothing	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a		
Zone 1 (minimal)	n/a								n/a		
Zone 1 & 2 (scoped)	n/a								n/a		

Management Strategy	Ability to Mitigate Risk		Avoids Threats to Implementation				Opportunities	Cost to Implement	Achieving Goals & Objectives		
	Hazards	Loss of Ecological Functions	Invasive Species	Changes in Hydrology	Permitting	Hazards	Stewardship		Objective 1	Objective 2	Objective 3
(Zones 1, 2 and 3 (Comprehensive Restoration)	n/a								n/a		

9. Summary and Conclusions

The infestation of E.A.B. in Ghost Road Bush has decimated the ash dominated canopy resulting in hazardous conditions as well as severely impacting the ecological functions associated with this swamp. This F.M.P. has evaluated the hazards in Ghost Road Bush and along the length of Bob Mills Boardwalk Trail, characterized the ecological functions associated with Ghost Road Bush, and assessed the impacts to the ecological functions in Ghost Road Bush resulting from the loss of the ash canopy. The objectives of forest management are related to mitigating hazards and maintaining and enhancing biodiversity. Strategies to achieve the objectives were described and evaluated against the potential risks, threats and opportunities.

There are important factors that need to be considered when selecting a preferred option for forest management in the study area, including:

- Financial costs
- Ecological impacts and benefits
- Staff and volunteer resources
- Social benefits (e.g., recreation, wildlife viewing, educational opportunities)

This F.M.P. provides the information necessary to consider the options and select a preferred option (or set of management strategies) based on a review of the above factors by the Second Marsh Management Committee. The F.M.P. should be read in conjunction with the Oshawa Second Marsh Management Plan (N.S.E. and S.C.I., 2023) and the Invasive Species Management Plan (N.S.E., 2024).

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