HILLMAN MARSH CONSERVATION AREA

RESTORATION PLAN

PREPARED BY

ESSEX REGION CONSERVATION AUTHORITY

PREPARED FOR

ENVIRONMENT AND CLIMATE CHANGE CANADA

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Canada

Acknowledgments

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Executive Summary

In the Great Lakes, wetlands are facing a systemic threat due to the multiple and repeated stresses from land-based activities and the compounding impacts of climate change. In response to these climatic and non-climatic stressors, barrier-protected wetlands experience accelerated erosion, overwash, and breaching leading to the removal or burial of vegetation, damage to infrastructure, and the loss of valuable habitat, species, and ecosystem services.

The Hillman Marsh Conservation Area, located in Leamington, Ontario, is a barrier-protected coastal wetland that exists on a historically eroding shoreline. Erosion was accelerated with the construction of the Wheatley harbour in the early 1900's, and the attached jetty and breakwater later that century that resulted in significant impacts on the movement of sediment in the littoral cell. To protect shoreline development and homes from erosion and flooding, the shoreline was hardened, cutting off the natural supply of sediment that nourished and maintained the barrier beach, and likely accelerated nearshore downcutting of the lakebed. The barrier beach historically sheltered the marsh from lake waves and allowed wetland vegetation to thrive, however, in 2017, a sudden rise in water levels and increase in wave exposure resulted in significant barrier beach erosion. Record high lake levels and storms, and near record low ice cover in the following years resulted in the rapid expansion of a breach to a record of 500 metres, leaving Hillman Marsh exposed to the forces of Lake Erie. Over time, what is left of the barrier is rapidly eroding, resulting in the loss of more marsh habitat, aquatic vegetation, and endangered and rare species. Ice-free winters and higher lake levels due to climate change are expected to exacerbate these challenges to the overall resilience of the marsh and barrier beach.

Hillman Marsh contains spawning, nesting, and feeding habitat for a diverse number of species, including many species at risk. Most notably, populations of Common Hop Tree and Scarlet Ammannia, which were originally located on the barrier beach, have been completely lost due to the extensive erosion that occurred in 2017. Other rare, threatened, or endangered species that nest along the shoreline or in the marsh include the American Lotus, King Rail, Large Yellow Pond-lily, Least Bittern, Prothonotary Warbler, Swamp Rose-mallow, and several turtle species including Northern Map, Snapping, Spiny Softshell, Midland Painted, and Blanding's Turtle. Its diverse range of species and habitats, and continuously changing conditions provides a plethora of opportunities for environmental education and scientific research. Hillman Marsh is situated on the traditional territory of Caldwell First Nation and is a location of traditional use and knowledge. It has been a community staple in Essex-County for many decades hosting summer camps, nature tours, bird watching, educational field trips, and hunting events. There are vast amounts nature-based opportunities that benefit human health and give a source of identity, spiritual fulfillment, and cultural connection to the Great Lakes.

This restoration plan aims to restore and enhance the Hillman Marsh barrier beach and wetland plant community to withstand future climate change extremes, provide optimal habitat for native species, and safeguard surrounding homes and businesses. Data collection, analysis, and literature review have guided the process of preparing three potential restoration concepts. These concepts include an artificial barrier made of a rock core and topped with sand, habitat islands, fish refugia, and extensive revegetation of both the beach and the marsh. The three concepts vary mainly by the difference in barrier size, with Concept A being high-crested and not allowing for overwash and sediment deposition along the backbarrier, and Concept B and C having a low crested barrier that does allow for overwash, making the barrier more dynamic. Based on the opinion of experts on our Core Team and Steering Committee, and the opinion of the majority of the general public, ERCA recommends this project moves forward with Concept A as the preferred approach. The high crested barrier protects the marsh more effectively than the low crested barrier, providing the greatest opportunities for habitat restoration and vegetation re-establishment both on the barrier and behind it. Concept A is more robust and therefore more resilient against wave action, storm events, erosional forces, and future climate change extremes. Through in-depth discussions with various experts, ERCA recognizes that a low crested barrier presents a more dynamic system that will be better suited for wildlife and provides the fundamental services and structure for a healthy wetland. However, concerns remain that Hillman Marsh may not be able to handle this dynamic system, without failing, given its current state. Moving forward, numerical and physical modelling will be conducted by engineers to test the possibility of a structure that has variable crest elevations. If areas of both high and low crested barrier beach can be accommodated without compromising the wetland, then it will provide for a more biologically diverse outcome and will be pursued.

Caldwell First Nation has been part of the steering committee since its inception, but as the only other landowners in the marsh, staff would prefer to not commit to any preferred option, but instead to continue ongoing consultation with their leadership and community regarding their opinions. Administration has committed to continuing to work and communicate with and seek feedback from Caldwell First Nation if funding for this project is approved and it can move forward.

An increase in habitat quality, water quality, and biodiversity can be expected with the successful implementation of this project. The variety of habitats, which support hundreds of rare and endangered birds, fish, and other wetland organisms will be restored, and native species will be able to thrive. Economic damages will be avoided with a barrier to act as a buffer between the lake and the marsh, protecting hundreds of homes and businesses that currently reside below lake level.

Hillman Marsh Conservation Area Restoration Plan

1.0 Introduction

Great Lakes coastal wetlands provide indispensable benefits to the freshwater ecosystem, people, and the economy. Coastal wetlands absorb and cycle nutrients, accumulate sediments, and trap pollutants, subsequently improving water quality, mitigating erosion, and sequestering carbon. They provide crucial habitat for a wide range of species, many of which are endangered or threatened. In the Great Lakes, these wetlands are facing a systemic threat due to the multiple and repeated stresses from land-based activities and the compounding impacts of climate change. In response to these climatic and non-climatic stressors, barrier-protected wetlands experience accelerated erosion, overwash, and breaching leading to the removal or burial of vegetation, damage to infrastructure, and the loss of valuable habitat, species, and ecosystem services.

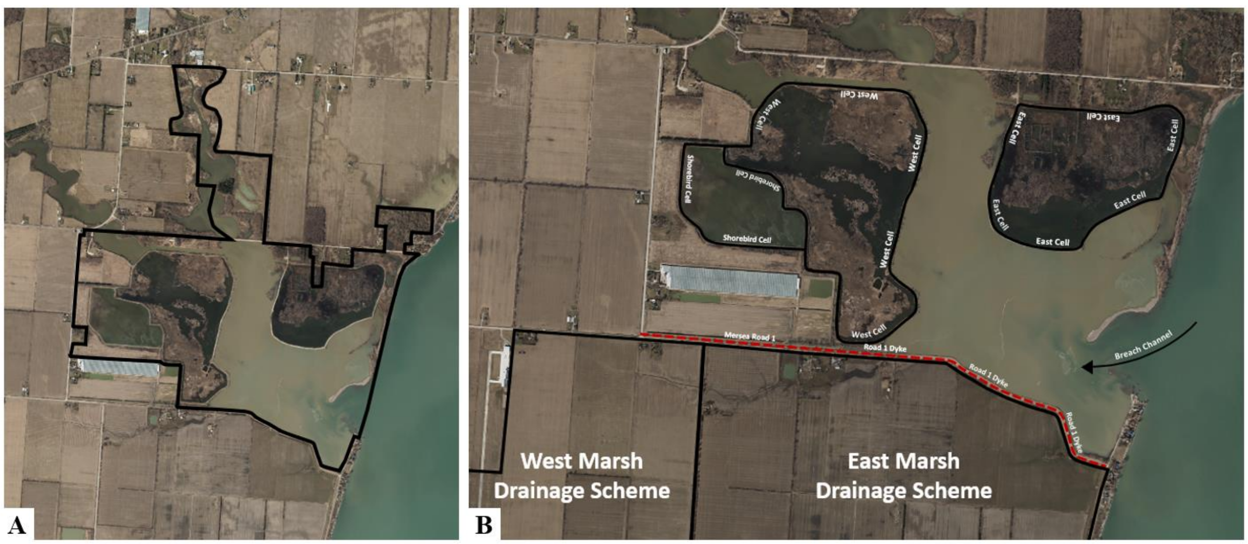


Figure 1: (A) Map of the extent of HMCA (covers 980 acres). (B) Map that depicts location of the West, East, and Shorebird Cells, the Road 1 dyke, and the East and West Marsh Drainage Schemes.

The Hillman Marsh Conservation Area (HMCA) is located in Leamington, Ontario, on the eastern shore of the Point Pelee Peninsula (a low-lying glacial sediment shoreline), and covers 980 acres (Fig. 1A, 3). It is a part of the Carolinian Canada region, preserving rare and endangered species (Baird, 2007). HMCA is a part of the Hillman Creek watershed that drains into Lake Erie, and falls under the jurisdiction of the Essex Region Conservation Authority. Hillman Marsh is a historically eroding shoreline however this erosion was accelerated with the construction of the Wheatley harbour in the early 1900's and the attached jetty and breakwater later that century. This development resulted in significant impacts on the movement of sediment in the littoral cell and in many cases created new sub-cells with little to no sediment bypassing. To protect shoreline development and homes from erosion and flooding, the shoreline was armoured, cutting off the natural supply of sediment that nourished and maintained the barrier beach, and this likely accelerated nearshore downcutting of the lakebed (Fig. 2; Zuzek Inc., 2021).

Figure 2: Shore parallel armour stone structures along Pulley Road.

The sudden rise in water levels and increase in wave exposure in 2017 resulted in significant barrier beach erosion. Record high lake levels and storms in the following years resulted in the rapid expansion of a breach to a record of 500 metres (Fig. 3B), leaving Hillman Marsh exposed to the forces of Lake Erie and exposing the Road 1 dyke to direct wave attack (Zuzek Inc., 2021). Due to a combination of factors in the updrift portion of the littoral cell including the breakwater and jetties at Wheatley Harbour, extensive shoreline armouring, and a deep nearshore due to ongoing lakebed downcutting, the Hillman barrier beach is being starved of the sediment that it needs to naturally recover from breaching events. Over time, what is left of the barrier is rapidly eroding, resulting in the loss of more marsh habitat, submerged aquatic vegetation, and endangered and rare species. Ice-free winters and higher lake levels due to climate change are expected to exacerbate these challenges to the overall resilience of the marsh and barrier beach.

This project highlights a need for the restoration and climate adaptation of the Hillman Marsh Conservation Area, as well as the need for the Essex Region Conservation Authority to address its core mandate related to managing the risk of natural hazards. Restoring the barrier beach and marsh will provide substantial co-benefits to the region, including restoring the ecological services offered by the wetland, and mitigating the risk of catastrophic flooding due to a breach in the Road 1 dyke.

2.0 Project Background

HMCA is classified as a(n):

- Environmentally Significant Area: remnant forests, wetlands, and prairies that have survived extensive land clearance (ERCA, 1983);
- Provincially Significant Wetland: areas identified by the province as being most valuable (MNRF, 2021);
- Area of Natural and Scientific Interest: areas containing natural landscapes or features identified as having life science or earth science values related to natural heritage, protection, scientific study, or education (MNRF, 2021).

Hillman Marsh is an extensive, shallow marsh interspersed with channels and areas of open water (Fig. 4). Agricultural fields surround the marsh on most sides, with Lake Erie bordering the east side. In 1989, dykes were constructed creating two wetland cells in the marsh that allow for water level control carried out by a pumping station (Fig. 1B). Drawdowns are completed every 10-15 years, removing most of the water from the cell, exposing the mudflats and allowing for seeds to germinate. In the past, this has resulted in a 30-48% increase in vegetation cover (Lebedyk, 2008). The original marsh that formed at the confluence of the Lebo and Hillman Creeks was historically sheltered from Lake Erie by the Hillman Marsh barrier beach, a 1.5 km long eastern facing barrier beach. The sheltering from lake waves allowed wetland vegetation to thrive, however, in 2017, a storm-induced breach removed the buffer between the marsh and Lake Erie.

Figure 3: Hillman Marsh is located on the Point Pelee Peninsula, extending south of the shore of Essex-County. (A) The Wheatley Harbour and attached jetty have trapped or removed 525,000 m^3 of sediment from the downdrift shoreline. directly affecting (B) the Hillman Marsh Barrier Beach, a 1.5 km long, eastern-facing shoreline.

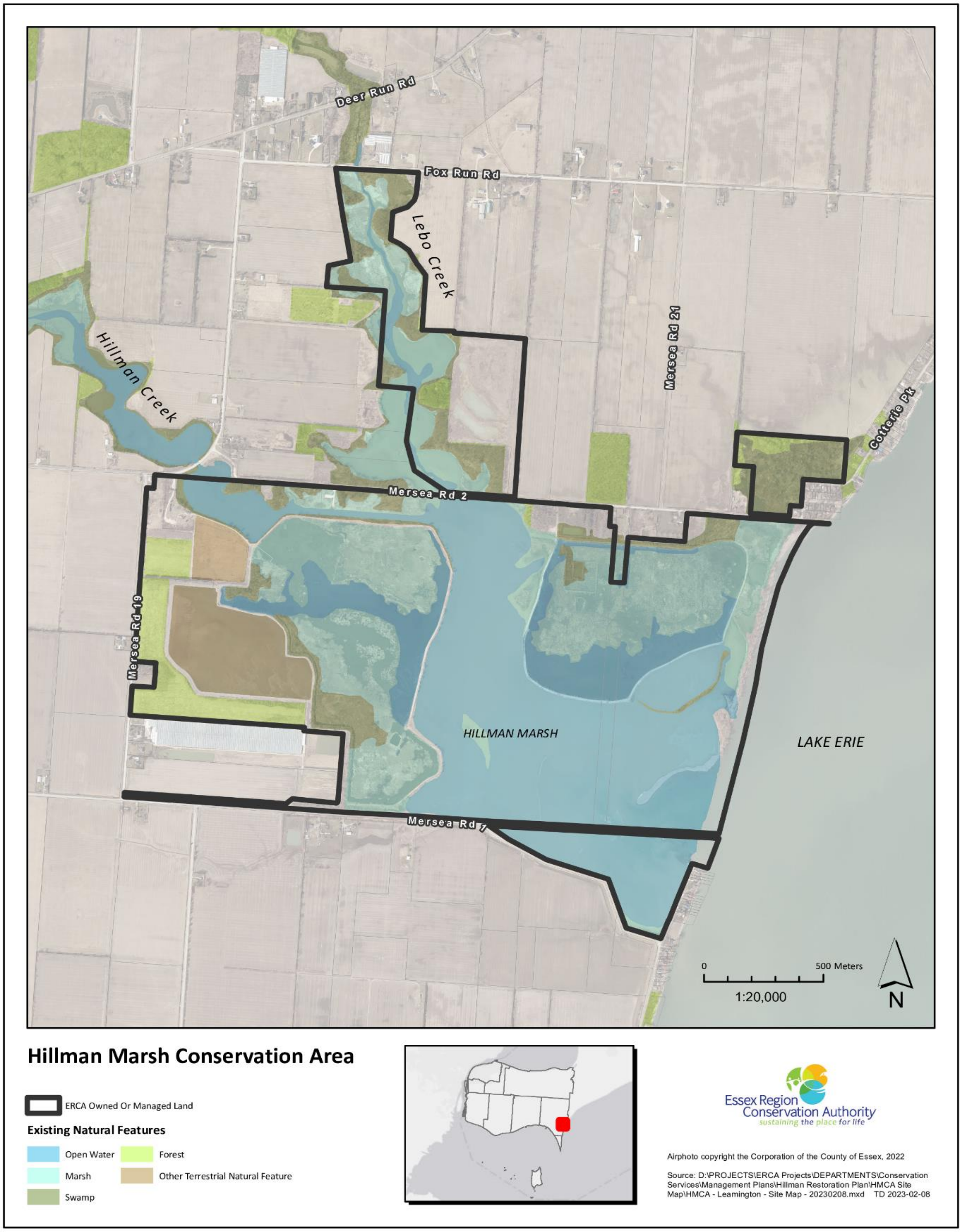


Figure 4: Map of the Hillman Marsh Conservation Area, showcasing existing natural features including open water, marsh, swamp, forest, and other terrestrial natural features. ERCA owned or managed land outlined in black. Developed by Tom Dufour, ERCA, 2023.

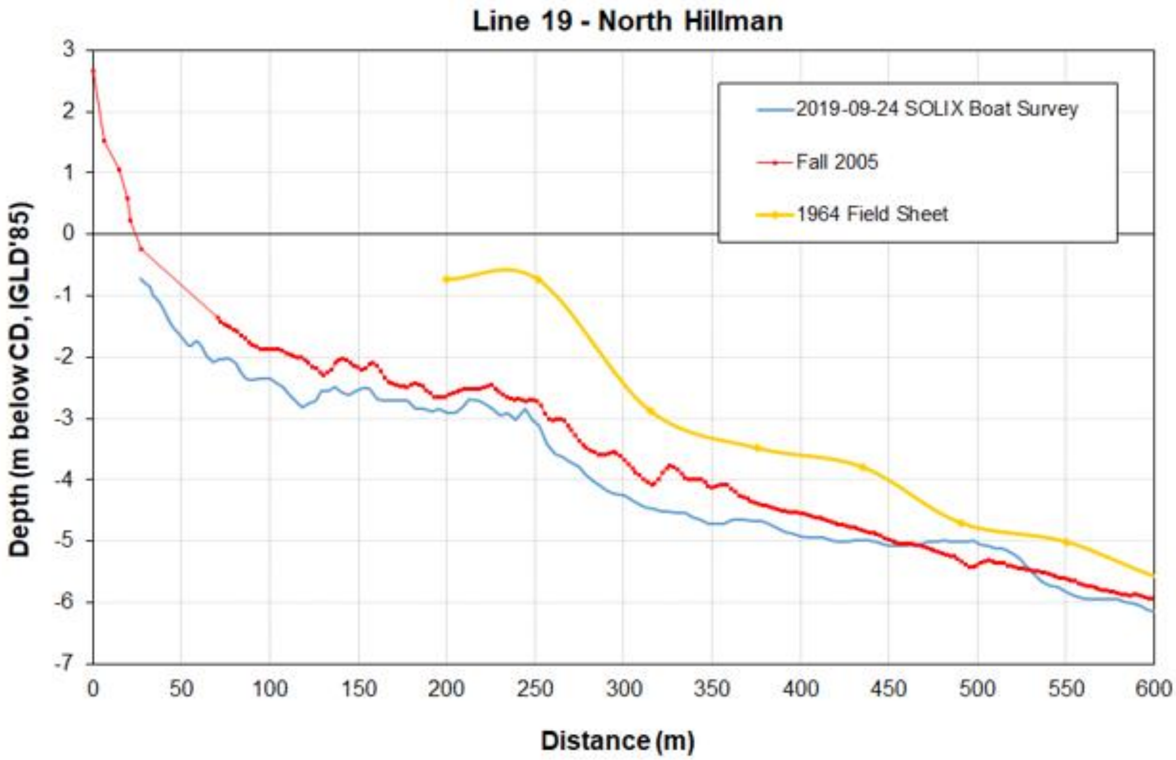
3.0 Hillman Marsh Evolution in a Changing Climate

Recent and projected future evolution of the Hillman Marsh barrier beach and wetlands in a changing climate are discussed in Section 3.0.

3.1 Influence of Sediment Supply, Erosion, Water Levels, and Ice Cover

Adequate sediment supply is essential in maintaining the resilience of Great Lakes barrier beaches, coastal wetlands, and shorelines against wave activity and storm events (Gharib et al., 2023; Liu et al., 2021). Sediment supply directly influences barrier sand volume, subsequently controlling barrier inertia, which determines how quickly a barrier beach can be respond to external forces, such as storm events (Cooper et al., 2018).

The natural delivery of longshore sediment transport to the Hillman Marsh barrier beach has been negatively impacted by the Wheatley Harbour jetty since its construction in 1951 (Baird, 2007). The Wheatley Harbour (built in early 1900’s), attached jetty (1951), and offshore breakwater (1978) have collectively trapped or removed 525,000 m^3 of sediment (Fig. 3A), but since ~2010, Small Craft Harbours and the Wheatley Harbour Authority have been mechanically bypassing dredged sediment from the navigation channel at Wheatley and placing it at the north end of the barrier beach (Zuzek Inc., 2018). Waterfront development between Wheatley Harbour and Hillman Marsh, as well as communities in East Beach and Marentette Beach, began in the 1920’s when there was a lack of understanding of hazards, but has continued despite an eroding shoreline, flooding, and sediment supply concerns (Baird, 2007). While hardening at the southern spit slowed the erosion of East Beach Road, the lake bottom continues to experience significant downcutting along the stretch of shoreline from Wheatley to Point Pelee National Park. A 2019 survey found that the north end of the Hillman Marsh barrier beach nearshore area roughly 200 m offshore was 2 m deeper compared to the conditions from the 1964 survey (Fig. 5, Line 19). Similarly, approximately 2.5 km south of the site along East Beach, the entire nearshore area was more than 1 m deeper in 2019 compared to 1964 out to depths of 5 m below Chart Datum (Fig. 5, Line 21).



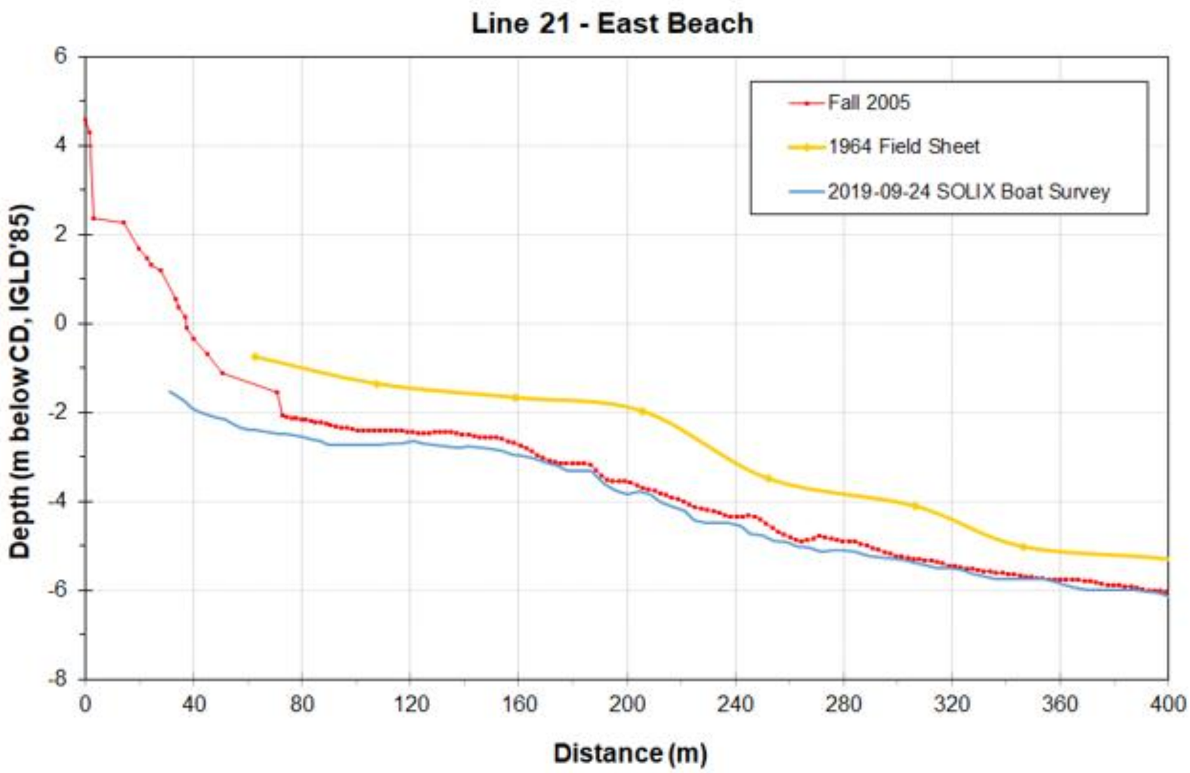


Figure 5: Bathymetric survey results show extreme lakebed downcutting at the Hillman Marsh barrier beach and East Beach (Zuzek Inc., 2021). "Depth below CD" refers to the depth below Chart Datum (173.5 m).

Great Lakes coastal habitats, and in particular coastal wetlands, are highly sensitive to fluctuations in water levels. Water level variability can occur on hourly, seasonal, and interannual scales, with hourly variations having the potential to cause the most damage, reaching up to 2 m at the eastern and western ends of Lake Erie during severe storm events (Quinn, 2002; Danard et al., 2003). Storm surge, an abnormal, sudden rise of water level associated with a strong wind event, causes the most destruction as it results in flooding and erosion of large sections of the coastline (Danard et al., 2003). Recent years have shown record high water levels (Fig. 6; GLERL, 2022b), making barrier beaches more susceptible to breaching (Kraus, 2003).

In 2013, a channel was excavated through the Hillman Marsh barrier beach to lower water levels in the marsh. This opening remained stable until 2016, when rising water levels initiated its rapid expansion. Rising water levels resulted in peak shoreline retreat at 5.46 m/y between 2016 and 2020 (Fig. 9; Gharib et al., 2021). This breach removed the protective barrier between the marsh and Lake Erie, negatively impacting marsh vegetation, and directly impacting and compromising both the controlled wetland cells and the Road 1 dyke, which protects more than 2,000 hectares of farmland and residential land located below lake level (Baird, 2007). The wetland cell dykes were upgraded in 2021 with materials that can withstand future high water level projections, but the Road 1 dyke was never designed to withstand even current lake waves.

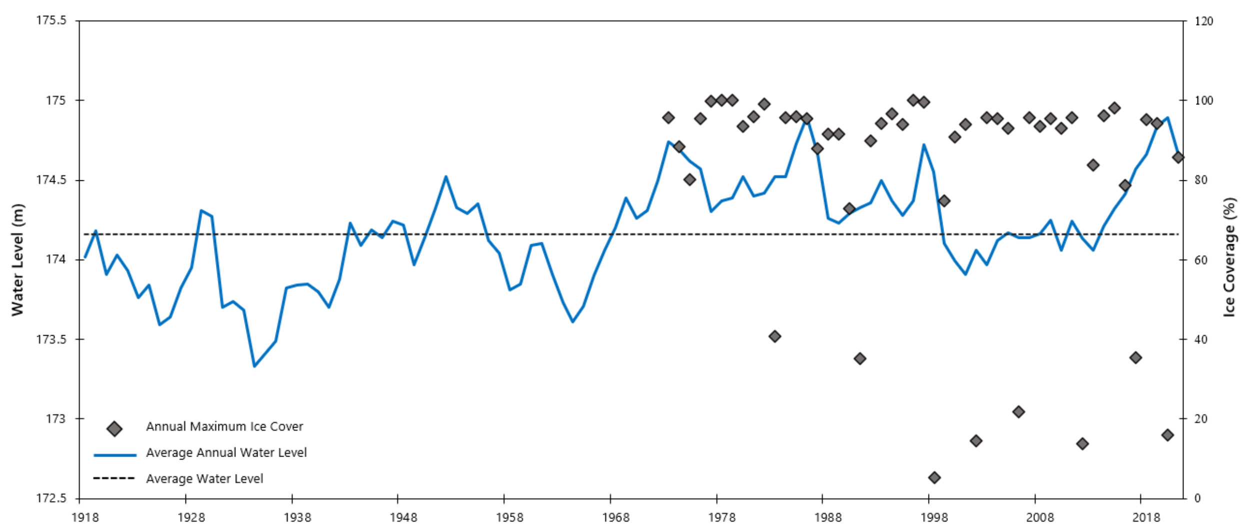


Figure 6: Average annual water levels (1918 – 2021) and long-term average water level (174.16 m) for Lake Erie were obtained from US Army Corps of Engineers. Annual Maximum Ice Cover (AMIC) from 1973 to 2021 was obtained from NOAA's Great Lakes Environmental Research Laboratory (GLERL).

Due to the shallow bathymetry of Lake Erie's west basin (average depth of 8 m; Assel, 2004), ice develops quickly around Hillman Marsh, protecting the beach and marsh from winter storm-driven waves and sediment loss (BaMasoud and Byrne, 2012). However, rising temperatures and milder winters will reduce the amount of protective ice cover. Most notably, the winter of 2019/2020 had a near record low Annual Maximum Ice Cover (AMIC) of 15.9%, which had not been observed in almost a decade (Fig. 6; GLERL, 2022). Due to the collective factors of inadequate sediment supply, an eroding lake bottom, rising water levels, warming temperatures, and climate driven extreme storm events, Hillman Beach has decreased in both elevation and width, to such a degree that 3,000-year-old chunks of underlying peat are being exposed in the breach channel and dislodged (Zuzek Inc., 2021; Fig. 7).

Figure 7: Decrease in width and elevation of the barrier beach has resulted in 3000-year-old chunks of peat to be exposed and dislodged. Photos taken (A) November 2nd, 2022 and (B) December 30th, 2022. Photos courtesy of Wayne King.

In summary, Hillman Marsh was once protected by a healthy but eroding barrier beach. Following decades of sediment deficit from the littoral system and erosion impacts due to the complete armouring of the adjacent shoreline, the barrier beach has crossed a tipping point (Fig. 8). The breach channel is so deep today, and the natural supply of sediment is so small, that natural deposition from longshore sediment transport will likely not repair the breach, as it has repaired smaller breaches in the past. Therefore, the Hillman Marsh has evolved from a barrier protected riverine wetland to an open coast wetland, which features significant exposure to lake waves and storm surge, and thermal influences from Lake Erie.

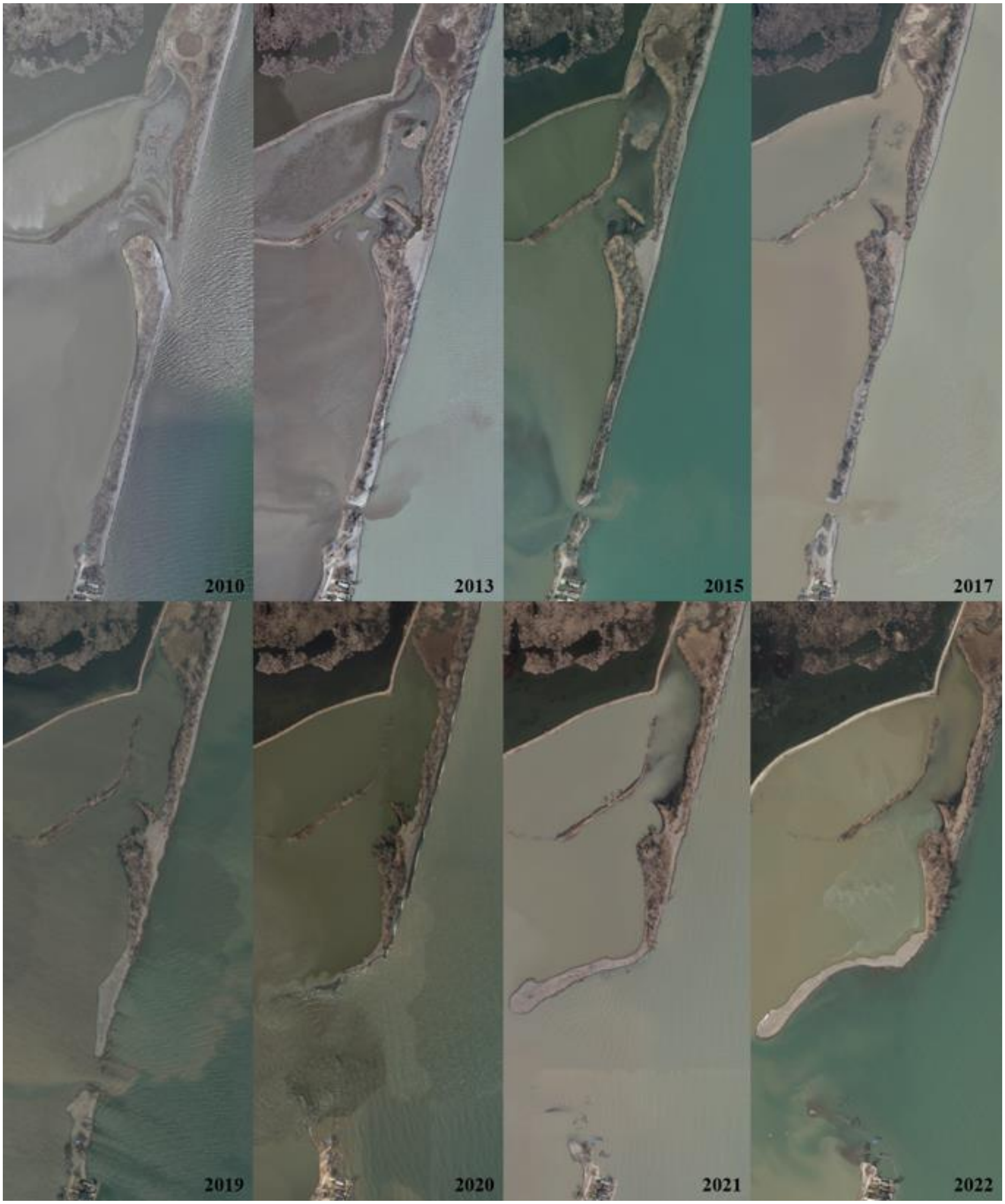


Figure 8: Hillman barrier beach from 2010 to 2022, photos retrieved from Essex Geocortex Database. Barrier is narrowing and retreating, and vegetation cover continues to diminish.

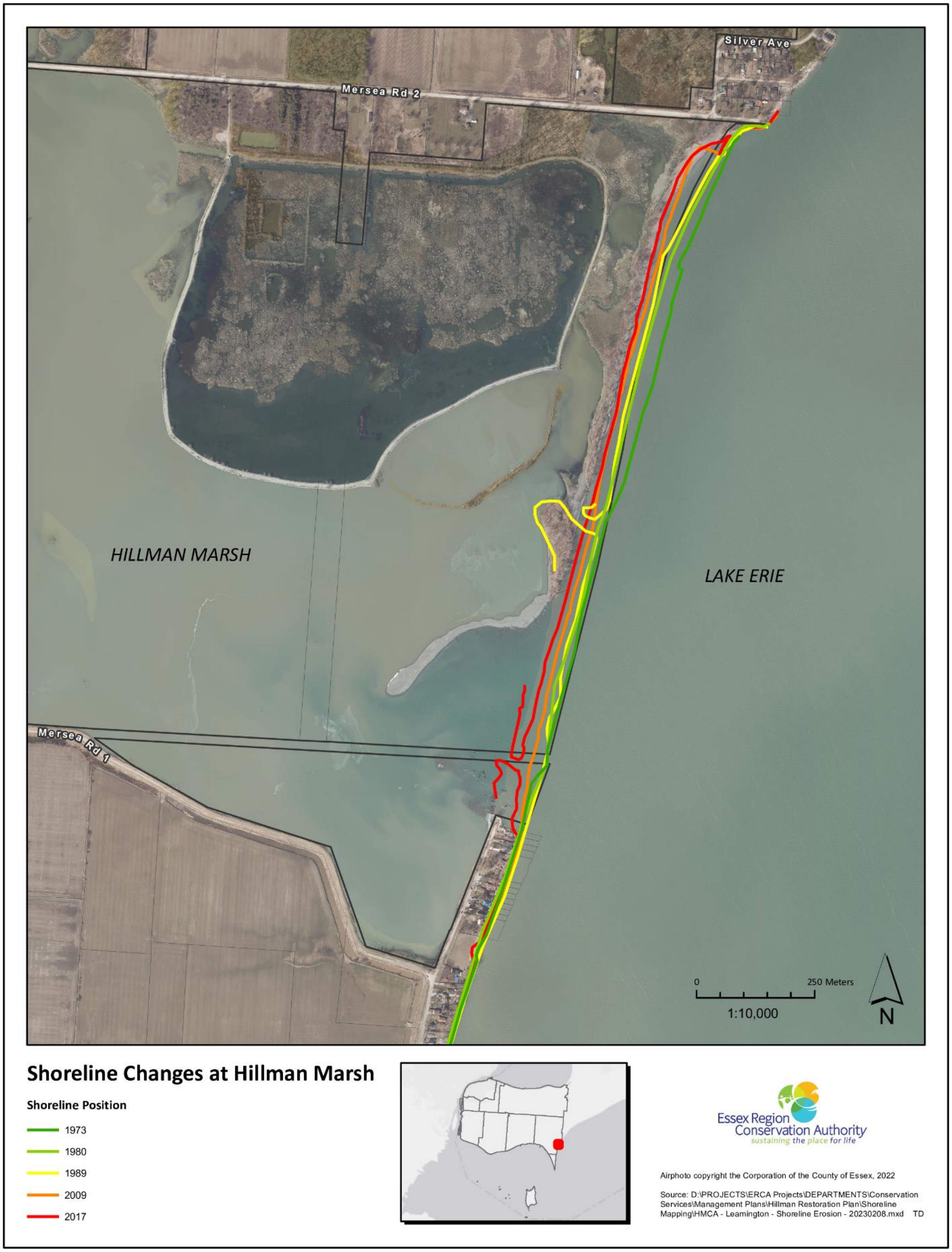


Figure 9: Map of Hillman Marsh barrier beach (2022) with previous shorelines digitized to visualize shoreline retreat since 1973. Map developed by Tom Dufour, ERCA, and shoreline digitized by Jenny Gharib, ERCA.

3.2 Loss of Marsh Habitat

Vegetative cover acts as a stabilization feature for barrier beaches. Buried root structures can increase soil cohesion, essentially anchoring down sediment, and exposed vegetation and root systems can provide resistance and wave energy dissipation. A plant community can also add organic matter directly to the soil, increasing clay content and trapping finer sediments. These processes reduce erosion over the long term (Feagin et al., 2015). Revegetation of the Hillman Marsh barrier beach occurred during a period of stable and near average lake levels (2000 to 2013); however, water levels began to rise and submerged vegetation leading to erosion of the barrier. Considerable vegetation loss began on the southern spit in 2017, and by 2019 the majority is lost, and barren land starts to expand to the northern spit. In present day, sparse vegetation remains, but as the breach continues to widen, much of the woody vegetation is being dislodged, and can be seen sitting on the lakebed where the barrier once was (Fig. 10).

Figure 10: Dislodged and submerged vegetation along eroding shoreline in original barrier location. A) View from the southern spit looking north, B) aerial view between both spits. Photos taken March, 2021.

As the Hillman Marsh barrier beach retreats landwards, more of the marsh habitat will be lost. A decrease in the wetland area will result in a decrease in native biodiversity – as certain species that require large patches of habitat will lose the foundation of their existence (Rodrigo, 2021). The creation of the four drainage schemes between 1900-1950 resulted in the conversion of approximately 2,000 hectares of wetland habitat to agricultural land south of Hillman Marsh (Baird, 2007). Since then, significant breaching and erosion of the barrier beach, and shoreline development, hardening, and other forms of alteration have resulted in natural habitat loss. At present, Essex County has only 8.5% of its natural cover remaining (ERCA, 2022), and these remains are fragmented, resulting in small habitat patches that are more vulnerable to predators and invasive species, and less viable for wildlife populations including species at risk (Baird, 2007).

3.3 Declining Habitat Quality

Agricultural activities in the Hillman Creek watershed result in an increase in total phosphorus, organic nitrogen and TKN, and E. coli in Hillman and Lebo Creek (ERCA, 2022b). Excess nutrients in tributaries can result in harmful algal blooms, making water toxic for humans and wildlife. These algal blooms have increased in size and severity in recent years throughout the western basin of Lake Erie due to a prevalent agricultural industry, a large population, and warming surface waters as a result of climate change (ECCC, 2018). A common method of evaluating wetland health is through the Index of Biological Integrity (IBI). IBI is a method of evaluating the variety of organisms and their response to human disturbance, with higher scores representing healthier wetlands. Most recent data from the Coastal Wetland Monitoring Program (2021) gives Hillman Marsh a Vegetation IBI score of 2.4 out of 5, meaning it is moderately degraded, an Amphibian IEC (Index of Ecological Condition, analogous with IBI) score of 7.2 out of 10 or mildly impacted, a Bird IEC of 5.4 out of 10 or moderately degraded, and a Fish IBI score of 1 out of 5, meaning it is degraded for fish and fish habitat.

The Island Biogeography Theory suggests that when an area of habitat becomes isolated from the surrounding matrix of similar habitat, over time these isolated species may become locally extinct, either due to stochastic events, habitat change, inbreeding depression, resource scarcity, or predation, resulting in a decline in species richness (MacArthur and Wilson, 1967; Losos and Ricklefs, 2010). Based on this theory, ephemeral breaches are a necessary and beneficial event that can restore the ecological integrity of a marsh, but this also assumes adequate sediment supply and proper conditions to allow for the natural recovery of a barrier beach. Long-term and sustained breach events at the Hillman Marsh can directly impact the physical and chemical composition of marsh habitat through sediment accumulation, concentration of pollutants, higher temperatures, and low dissolved oxygen (Surette, 2006). These new conditions may favour more tolerant or invasive species, and indirectly result in species migration, change in composition, and subsequently introduce predators, more competition, and ultimately the extirpation of native species. This can lead to long-term changes in the composition of fish assemblages (Surette, 2006), and may explain the low fish IBI at the Hillman Marsh.

4.0 What's at Stake? The Significance of Hillman Marsh

4.1 Ecological Significance

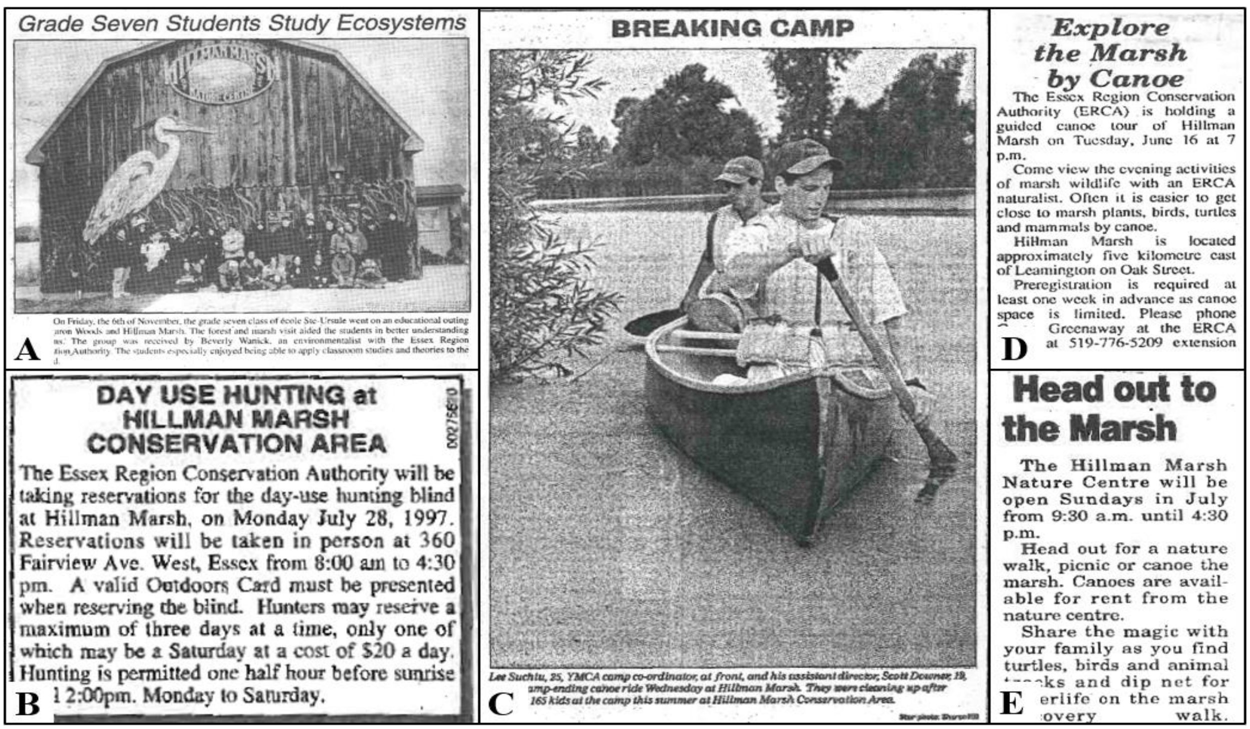
Hillman Marsh contains spawning, nesting, and feeding habitat for a diverse number of species, including many species at risk. According to data from the Natural Heritage Information Centre (NHIC), 13% of provincially tracked species at Hillman Marsh are classified as "special concern" and may become threatened, 20% are "threatened" and likely to become endangered, 29% are "endangered" and facing imminent extinction or extirpation, and 7% are "extirpated" meaning they are locally extinct (MNRF, 2021). Most notably, populations of Common Hop Tree and Scarlet Ammannia, which were originally located on the barrier beach, have been completely lost due to the extensive erosion that has occurred at Hillman Marsh. Other rare, threatened, or endangered species that nest along the shoreline or in the marsh include the American Lotus, King Rail, Large Yellow Pond-lily, Least Bittern, Prothonotary Warbler, Swamp Rose-mallow, and several turtle species including Northern Map, Snapping, Spiny Softshell, Midland Painted, and Blanding's Turtle (MNRF, 2021).

Marsh management is undertaken in two controlled wetland cells at Hillman Marsh in order to maintain a degree of wetland interspersion of approximately 50% (a 50/50 ratio of water to emergent, submergent, and floating wetland vegetation). When necessary, occasional drawdowns (typically every 10-15 years) are conducted in the early spring to trigger seed germination within the marsh mud substrate and re-initiate the marsh successional cycle. It is widely accepted that this water management tactic has shown positive relationships with occupancy and relative abundance of water birds (e.g., Least Bittern, Purple Gallinule, Dabbling Ducks, and many species of shorebirds), as well as provide substrate and litter for invertebrate populations (Fredrickson and Reid, 1988; Alexander and Hepp, 2014; Bradshaw et al., 2020). As a result of this active wetland management, species that are seldom seen in Ontario are frequently seen in the controlled wetland cells at Hillman Marsh. The revegetation efforts of this project aim to achieve a 50% interspersion rate in the open marsh, which is currently 90.2% open water.

4.2 Social Significance

Hillman Marsh is situated on the traditional territory of Caldwell First Nation and is a location of traditional use and knowledge. It's diverse range of species and habitats, and continuously changing conditions provides a plethora of opportunities for environmental education and scientific research. There are vast amounts nature-based opportunities that benefit human health and give a source of identity, spiritual fulfillment, and cultural connection to the Great Lakes.

The Hillman Marsh Conservation Area has been a community staple in Essex-County for many decades. Over the years, Hillman Marsh has hosted summer camps, nature tours, bird watching, educational field trips, and hunting events (Fig. 11). With natural resilience to lake level fluctuations, the marsh was able to function through periods of rising and falling lake levels. However, for those that live along the eroding and flood prone shoreline in the proximity of the Hillman Marsh, periods of high-water levels and intense storm events can cause extensive property damage and limit emergency ingress and egress on local roads (refer to specific events and impacts shown in Fig. 12). The Mersea Road 1 dyke at the southern boundary of the marsh is now the only line of defense between Lake Erie and hundreds of homes and agricultural businesses situated on lands below lake level. This dyke was not designed to withstand direct wave attack from Lake Erie and repairs have been designed (Dillon, 2013) but to this point not implemented. Re-establishing the Hillman barrier beach can create multiple co-benefits, such as sheltering the marsh from intense waves to facilitate habitat restoration, while also reducing the risk of a devasting dyke breach that would flood more than 2,000 hectares of land situated below lake level (Zuzek Inc. 2021).



A

Grade Seven Students Study Ecosystems

On Friday, the 6th of November, the grade seven class of école Ste-Ursule went on an educational outing ...aron Woods and Hillman Marsh. The forest and marsh visit aided the students in better understanding ...ns. The group was received by Beverly Wanick, an environmentalist with the Essex Region ...tion Authority. The students especially enjoyed being able to apply classroom studies and theories to the ...d.

B

DAY USE HUNTING at HILLMAN MARSH CONSERVATION AREA

The Essex Region Conservation Authority will be taking reservations for the day-use hunting blind at Hillman Marsh, on Monday July 28, 1997. Reservations will be taken in person at 360 Fairview Ave. West, Essex from 8:00 am to 4:30 pm. A valid Outdoors Card must be presented when reserving the blind. Hunters may reserve a maximum of three days at a time, only one of which may be a Saturday at a cost of $20 a day. Hunting is permitted one half hour before sunrise ... 12:00pm. Monday to Saturday.

C

BREAKING CAMP

Lee Suchlu, 25, YMCA camp co-ordinator, at front, and his assistant director, Scott Downer, 19, ...amp-ending canoe ride Wednesday at Hillman Marsh. They were cleaning up after 165 kids at the camp this summer at Hillman Marsh Conservation Area.

D

Explore the Marsh by Canoe

The Essex Region Conservation Authority (ERCA) is holding a guided canoe tour of Hillman Marsh on Tuesday, June 16 at 7 p.m.

Come view the evening activities of marsh wildlife with an ERCA naturalist. Often it is easier to get close to marsh plants, birds, turtles and mammals by canoe.

Hillman Marsh is located approximately five kilometre east of Leamington on Oak Street.

Preregistration is required at least one week in advance as canoe space is limited. Please phone ... Greenaway at the ERCA at 519-776-5209 extension

E

Head out to the Marsh

The Hillman Marsh Nature Centre will be open Sundays in July from 9:30 a.m. until 4:30 p.m.

Head out for a nature walk, picnic or canoe the marsh. Canoes are available for rent from the nature centre.

Share the magic with your family as you find turtles, birds and animal ...ks and dip net for ...erlife on the marsh ...overy walk.

Figure 11: Historical newspaper articles showcasing Hillman Marsh's role in the local community. (A) "Grade Seven Students Study Ecosystems" Essex Free Press, November 18, 1998. (B) "Daily Use Hunting at Hillman Marsh Conservation Area" Windsor Star, July 26, 1997. (C) "Breaking Camp" Windsor Star, August 29, 1996. (D) "Explore the Marsh by Canoe" Essex Free Press, June 10, 1998. (E) "Head out to the Marsh" Tilbury Times, June 24, 1998.


WEATHER

Windsor Star Sat Mar 15/97

Flood waters damage dozens of home

By Doug Schmidt
Star County Reporter
MERSEA TOWNSHIP

A flood watch remains in effect in Essex County until this afternoon for shoreline areas and other low-lying areas, the Essex Region Conservation Authority said Friday.

After strong easterly winds brought flooding Thursday night to dozens of low-lying Lake Erie properties on the eastern shoreline area of Mersea Township, the winds changed Friday to equally strong westerlies and local flood watchers had to switch their focus.

A combination of high lake levels and runoff from heavy rains resulted in a series of extensions to the initial flood watch issued Thursday. As of Friday afternoon, the west sides of Pelee Township, Mersea, Rochester and Tilbury North were all on flood watch.

Much of damage experienced late Thursday and early Friday occurred in ...age area between Point Pelee ...eatley, where dozens of homes ... to a half-metre of floodwater as unseasonably high and rough waters crashed over Lake Erie breakwalls.

John Bridgeman had to park his car outside the Elmdale neighborhood and then use a boat to ferry supplies to his home on a completely flooded street. Drivers who dared the local roads, particularly Lakeshore Drive/Cotterie Park, had to correctly guess where the asphalt was to avoid ending up in the abutting flooded fields.

Bridgeman angrily blamed much of his neighborhood's flood woes on work done to adjacent Hillman Marsh by ERCA, which he claimed prevented inland runoff from escaping to the lake. His son Dan said it was probably the worst flooding in nine years.

Ken Schmidt, the general manager and flood response co-ordinator of the conservation authority, said the high lake levels and the strong easterlies were to blame, as well as the low elevations of the victims' homes.

"Those homes should be flood-proofed ... they were built too low," said Schmidt of the worst-hit homes along the lakeshore.

Lakeshore homes along Mare... Park, which lies to the east of Poin... Pelee National Park, were still being pounded by waves Friday morning as the winds began to shift. Flocks of seagulls swooped down on front yards, scooping up beached fish thrown there by the powerful waves crashing against seawall barriers.

Laurene Waghorn, another Elmdale resident, also had to wade through water to get to her home. But the structure itself, unlike the others in the neighborhood, remained high and dry.

She said the house was flooded two weeks after her family moved in from London six years ago, and a decision was made to invest in a new foundation and footings to elevate it above the flood level.

Surveying the damage to her neighborhood, Waghorn said there's not a lot else that can be done to prevent the naturally low-lying area from occasional floods.

"Not unless you stop the wind ... if you get the east winds, this is what happens."

A

MAR 20 1997 — Wheatley Journal

Living along the lake can be a "love – hate relationship"

Low-lying shoreline areas south of the village in Mersea Township flooded Thursday night.

Winds 30 km gusting to 50 to 70 km spilled Lake Erie into the Coterie Park and Elmdale subdivisions.

The high winds coupled with run-off from heavy rainfall left dozens of homes sitting in flood water up to a half metre deep.

Lakeshore Drive and Coterie Park Road were under water as were abutting lawns and fields.

Homes further down the shoreline toward Point Pelee Park were bashed by water and spray with the strong easterly winds churning up the high water levels in Lake Erie.

HILLMAN MARSH
CANOE LAUNCH

...Hillman Conservation Area canoe launch could have been at the roadside sign last week. The swollen ...looded the parking lot and other lowland areas along the roadside that skirts the marsh and connects to ...le Subdivision.
...cene from the entrance to Julien Street at Elmdale illustrates the extent of the flooding in the area.

B

Marsh neighbours fear flood

Property owners near Hillman Marsh are claiming dikes pose a flooding threat, but ERCA says not so

Story and photo
by Rob Hornberger
Star Staff Reporter

A group of Mersea Township residents says man-made changes to a marsh owned by the Essex Region Conservation Authority (ERCA) have increased the flood threat to their homes.

Bill Braun, a spokesman for 15 East Beach Road homeowners, said dikes built to control water levels in portions of Hillman Marsh are restricting the dispersal of water flowing into the wetland from Lake Erie.

He said the dikes act like dams and could cause water levels in the open part of the 360 hectare marsh to rise to dangerous levels this fall.

"A lot of people are apprehensive about going away for the winter. They're worried about leaving and their property being damaged," he said.

East Beach residents living along the thin strip of land between Lake Erie ...an Marsh have spend thou...he dollars on breakwalls to ...ir homes from high lake lev... But the sides of their homes facing the marsh are virtually unprotected.

To protect his home from possible flooding, Braun has recently purchased four pumps and a generator. He also has a stockpile of sandbags to ring his home.

ERCA executive director Ken Schmidt said the authority and its partner, Ducks Unlimited, made extensive use of engineering studies in the late 1980s before the dikes were built, to insure they didn't add to the flood threat.

Maximize plant growth

The enclosed "cells" created by the dikes allow the authority to control water levels in 40 per cent of the marsh through the use of pumps.

By controlling water levels inside the cells, the authority is able to create conditions which maximize plant growth for nesting ducks and other wildlife.

Schmidt said the two major sources of Hillman Marsh flooding are heavy rainfall and high lake levels. He said the absence of major flooding during the 1989 storm which swamped much of southern Essex County proved the engineering studies are "very sound."

Braun said he would like to see a two-foot high berm built on the north side of the roadway.

He has also suggested to the authority that removable concrete structures be placed near the entrance of the channel to slow the flow of lake water coming into the marsh.

Stan Taylor, ERCA's water management specialist, said the type of flooding feared by Braun and his 14 neighbours is a "one-in-one hundred year" possibility.

He said a unique set of circumstances -- high water combined with strong winds blowing from the northeast for at least six hours — is needed for an "extreme event" to occur.

Lake Erie is approaching record water levels, but Taylor said the gale-force winds from the northeast necessary to cause flooding are still a rarity.

He said lake levels determine the water level of the marsh — whether all of it is open to the lake or just a portion. Because of the huge amounts of lake water capable of entering the marsh through the channel, placing concrete structures near the channel would have no affect reducing the flood threat, Taylor said.

If a one-in-one-hundred year storm occurred, only "six to eight inches" of water would cover the road, he said. Taylor said in such a scenario just as much water would be coming over the breakwalls as from the marsh.

Braun said water has spilled over onto the road three times this year. Schmidt said there was some minor flooding at an ERCA parking lot, but said the water come directly from the lake — not the marsh.

Improvements being made

Mario Musso, a Kitchener real estate broker who owns a home along East Beach Road, also known as Hillman Road, said the authority should be a good neighbour and erect a 750-foot marsh-side berm. He said he will sue if there is any flood damage to his home.

"I don't feel it's my responsibility to protect somebody else's property to protect my own. If there is any damage, I'll sue," he said.

Schmidt said it is the policy of the authority to prevent alterations to the physical landscape that can increase the likelihood of flooding.

"(At Hillman Marsh) ... the philosophy of no adverse impact has been upheld."

Ducks Unlimited is currently making $350,000 in improvements to the berms protecting the cells.

C

Flood victims have 'had it'

Story and photo by Ron Preston
Star County Reporter
WHEATLEY

Cheryl and Bill Baltzer are fed up with Lake Erie.

For the third time in a year, their two-bedroom home in Elmdale subdivision has flooded, with up to 13 cm of water.

The northeast winds gusted up to 45 km/h on the weekend, whipping waves on the eastern shoreline of Mersea Township.

"We were fortunate the winds didn't reach the forecast intensities," said Tim Byrne, senior water management technician with the Essex Region Conservation Authority. Winds had been forecast for up to gale force, 80 km/h. "I'm not trying to minimize the problem (for those whose property flooded) but it's no worse than what we've seen in the recent past."

The "splash effect" of high winds driving the waves on to the beaches and hitting vertical breakwalls throws the water on to shoreline properties. Some roads in the Pulley, Elmdale, East Beach and Marentette Beach subdivisions were under up to 15 cm of water Saturday. The main road in Point Pelee National Park was flooded from the visitors' centre to the tip.

"If we were renting, we'd be out of here," said Bill Baltzer, "but we pay a mortgage, so we're stuck."

The couple aren't happy with the Shoreline Protection Program that would see them borrow up to $20,000 to raise their 50-year-old winterized cottage. The Baltzers said they received quotes of up to $32,000 for the job, an amount they simply can't afford.

They believe ERCA should provide grants to home... ...it Byrne said there are no such govern...ams available. ...the conservation authority pushed to continue this program to help those living in floodplain near the shoreline, most of which were built prior to planning regulations. Houses built today must meet strict requirements to prevent similar problems.

Byrne said the mild winter and heavy rainfall have resulted in very high water levels throughout the Great Lakes Basin. Projections by the conservation authority said lake levels this summer could exceed record highs set in 1986.

Bill Baltzer, of Elmdale subdivision in Wheatley, stands at the flooded intersection near his home Saturday. Northeast winds flooded many residences in Mersea Township.

A resident of East Beach Road said he's disappointed the conservation authority hasn't done more to protect residents in the Hillman Marsh area.

Bill Braun said ERCA recently spent thousands of dollars improving wildlife habitat, but didn't bother to build a berm between the marsh and East Beach Road.

See also Winter's parting shot / C10

D

Figure 12: Historical newspaper articles showcasing long history of shoreline homeowners and lake-induced flooding and damage. (A) "Flood waters damage dozens of homes" Windsor Star, March 15, 1997. (B) "Living along the lake can be a love-hate relationship" Wheatley Journal, March 19, 1997. (C) "Marsh neighbours fear flood" Windsor Star, September, 1997. (D) Flood victims have had it" Windsor Star, March 23, 1998.

4.3 Economic Significance and Avoided Damages

Hillman Marsh is vital to the local economy as it is a focal point for outdoor recreation including hiking, canoeing, nature viewing, and hunting. Hunting revenue is roughly $10,000 annually, and entrance fees generate roughly $8,000 annually. Other indirect economic impacts for the surrounding area and local businesses include food and accommodation spending during the spring bird watching season, and spin-off tourism and recreation from the proximity to Point Pelee National Park.

As noted previously, the barrier beach once protected the surrounding land from Lake Erie waves and flooding, but since breaching, the Road 1 dyke has become the only barrier between Lake Erie and hundreds of homes and businesses, and Point Pelee National Park. A recently completed flood vulnerability study for Southeast Leamington determined that a breach of the Road 1 dyke would flood more than 300 structures and could result in $50 million in building and content damages for the agricultural lands below lake level. The potential economic damages exceed $100 million when higher lake levels due to climate change were considered (Zuzek Inc., 2021; the extent of flooding under both scenarios is shown in Fig 13 and 14).

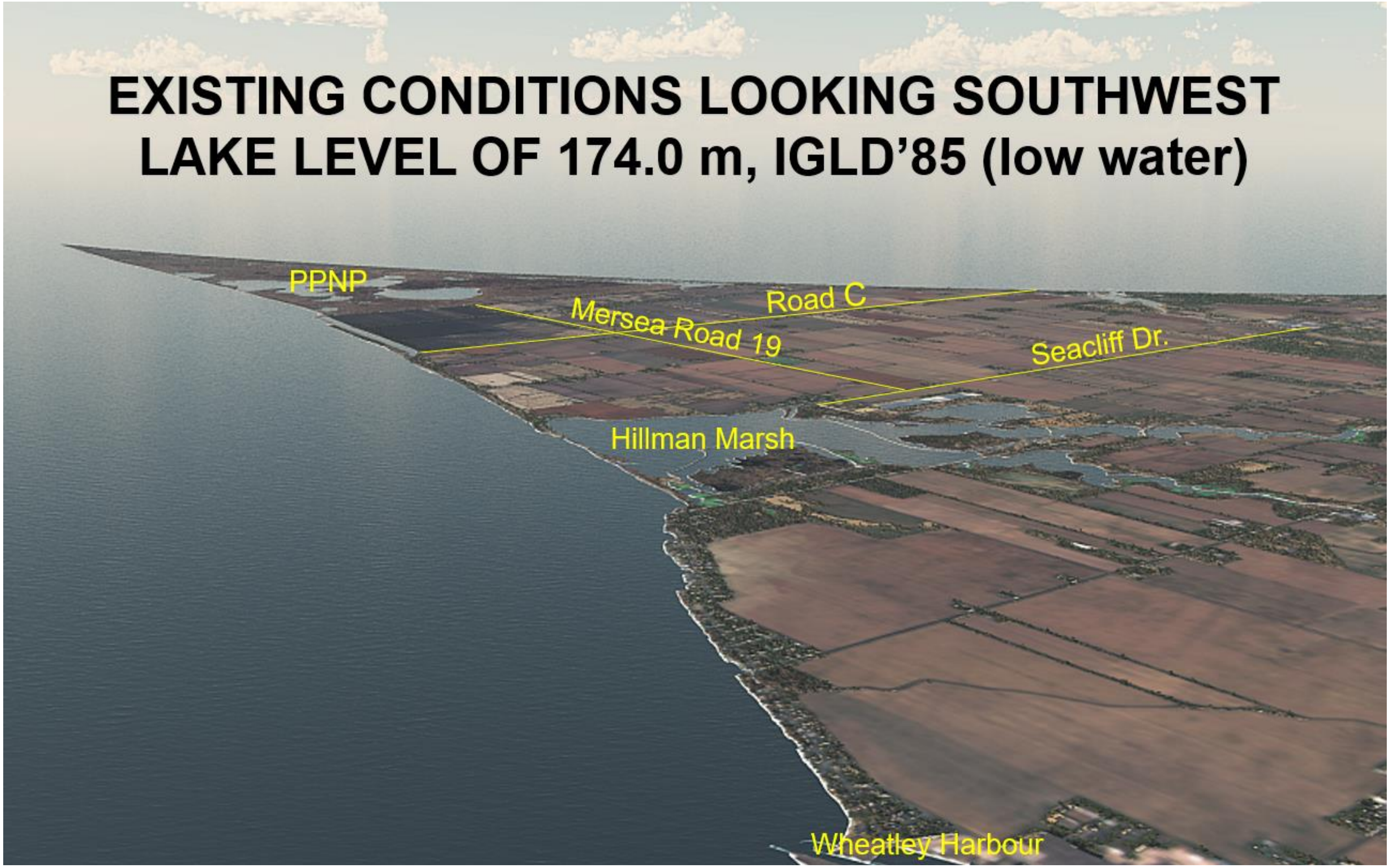


Figure 13: Existing conditions on the Point Pelee Foreland, looking southwest, with lake levels at 174.0m (IGLD'85).

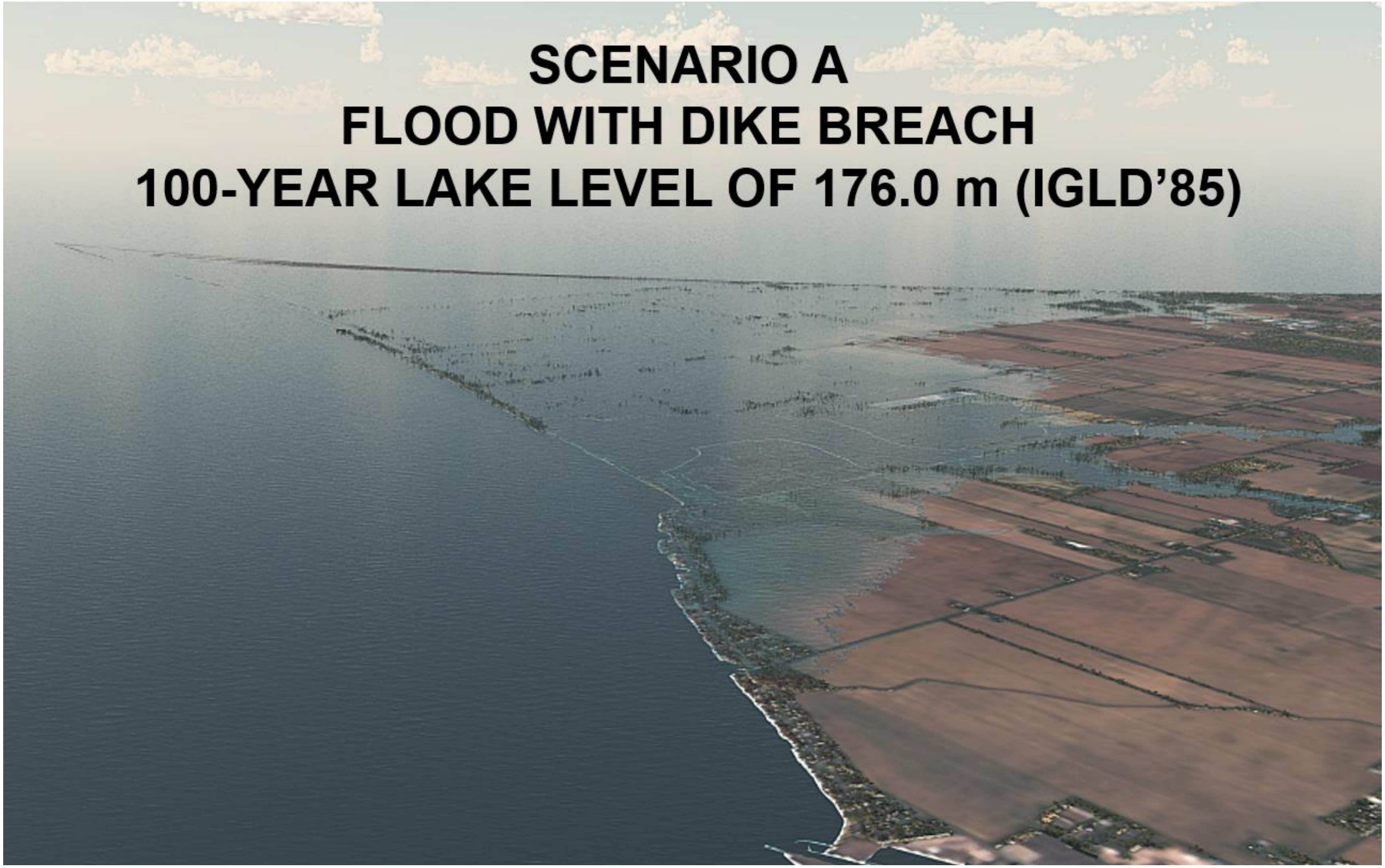


Figure 14: Simulated scenario of a Road 1 dyke breach for the 100-year lake level of 176.0m (IGLD'85).

5.0 Threats and Consequences of Climate Change

5.1 Climate Change Trends and Projections

A recent study by Environment and Climate Change Canada (2022) classified coastal wetlands in the Essex County region as "highly vulnerable" to climate change. Climate model results show wetter (7 to 15% increase in annual precipitation) and warmer (2.4–5.0°C increase in annual mean temperature) future conditions in the Great Lakes area. Results from a hydrological model show a projected decrease in snowpack (29–58%), and increase in evapotranspiration, especially during summer months (up to 0.4 mm/day) (Shrestha et al., 2022). Under the highest greenhouse gas emissions scenario, the model predicts extreme water level changes close to a metre above historical record highs toward the end of the century (ECCC, 2022). Although projected future average water levels may be higher or lower and not an exact prediction, the range of variability of water levels are expected to expand with more extreme highs and lows in the future (Theuerkauf and Braun, 2021; Seglenieks and Temgoua, 2022). These projected climate change trends pose a significant threat to Hillman Marsh's structure, function, and productivity and will lead to increased runoff, flooding, shoreline erosion, loss of biodiversity, and an increase in invasive species.

Environment and Climate Change Canada (2022) developed climate projections with two forcing scenarios called Representation Concentration Pathways (RCP). The first scenario, RCP 4.5, represents an intermediate future greenhouse gas concentration trajectory where emissions peak around 2040 and then begin to decline, projecting warming of 2.5°C above pre-industrial levels by 2100. The second scenario, RCP 8.5, represents an increasing emissions trajectory, one in which no actions are taken to reduce emissions, projecting warming of 5°C above pre-industrial levels by 2100.

5.1.1 Air Temperatures

The Great Lakes Basin has seen an increase in temperature of 0.7°C between 1985 and 2016. The range between minimum and maximum temperatures has decreased as minimum temperatures have increased. Warming air temperatures result in warmer winters, earlier spring warming, extreme heat, heavier precipitation, and less ice cover. In Lake Erie specifically, under RCP 4.5, annual land air temperatures could increase by 2.5°C by mid-century, and 3°C by the end of the century. Under RCP 8.5, annual land air temperatures could increase by 3.1°C by mid-century, and 4.8°C by the end of the century (Fig. 15; ECCC, 2022). Less ice cover is predicted to decrease substantially with warmer temperatures. Under RCP 8.5, average ice cover during the winter and spring could decrease by 19% and the average length of the ice season may decrease by 66 days in Lake Erie by the end of the century, compared to 1981-1999 (ECCC, 2022b).

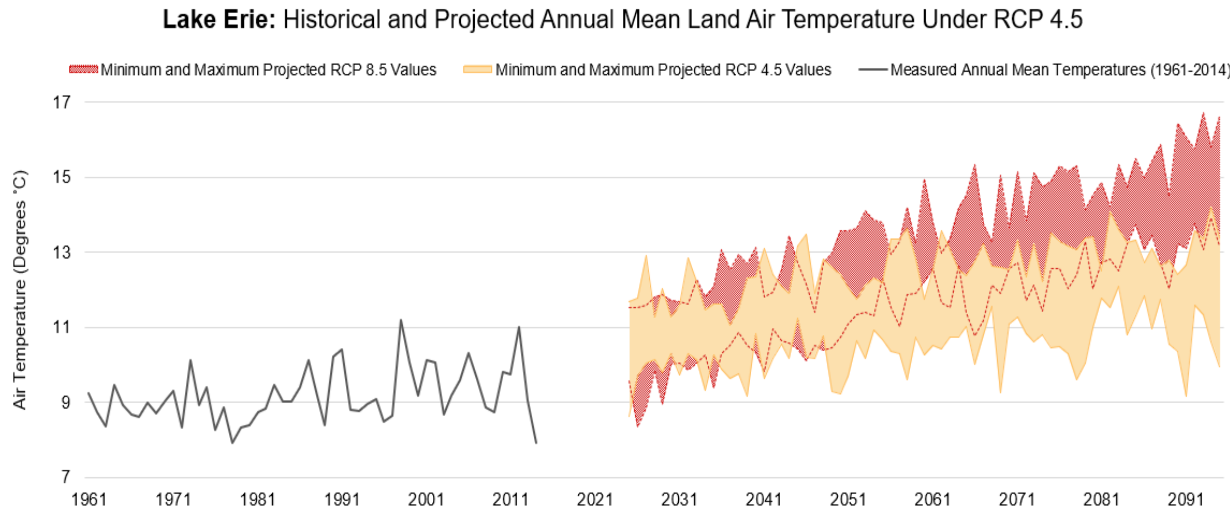


Figure 15: Historical and projected land air temperatures for Lake Erie under both RCP 4.5 and RCP 8.5. Projected for 2025-2095 (ECCC, 2022).

A recent climate change investigation by Zuzek Inc. (2021) investigated the impacts of an ice-free Lake Erie on winter wave energy exposure by comparing the amount of historical wave energy from 2000 to 2013 to an ice-free scenario for the same temporal period. The increase in winter wave energy reaching the shoreline of the Pelee Peninsula ranged from 80 to 120% (Fig. 16).

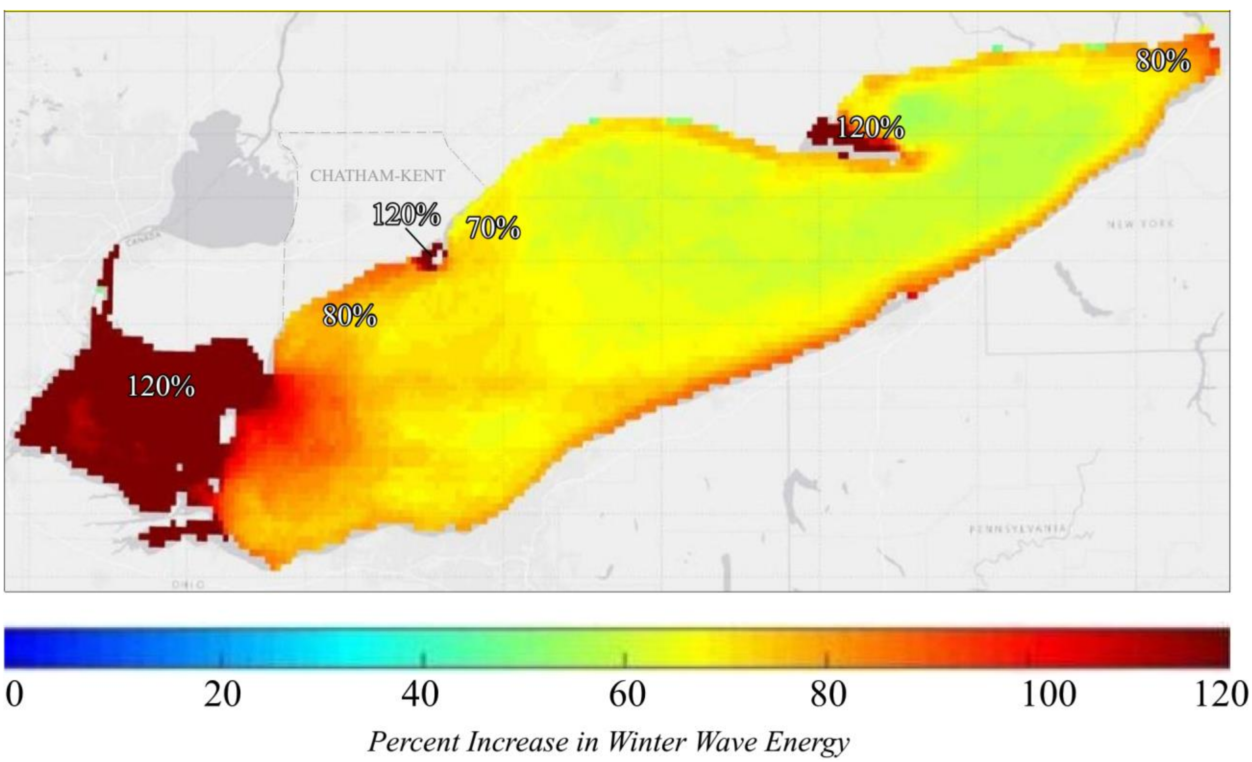


Figure 16: Percent increase in winter wave energy on Lake Erie for an ice-free scenario (Zuzek Inc., 2021).

5.1.2 Precipitation

With warmer winters, the Great Lakes region will experience less snowfall and more precipitation will fall as rain. The average annual total over-lake precipitation (1961-2000) for Lake Erie has been 909 mm. Under RCP 4.5, annual over-lake precipitation for Lake Erie could increase by 9% by end of century. Under RCP 8.5, annual over-lake precipitation for Lake Erie could increase by 18% by end of century (Fig 17; ECCC, 2022). These projections indicate a shift in the seasonality of precipitation with more precipitation falling in winter, spring, and fall, and potentially experiencing drier conditions in the summer (Dehghan, 2019).

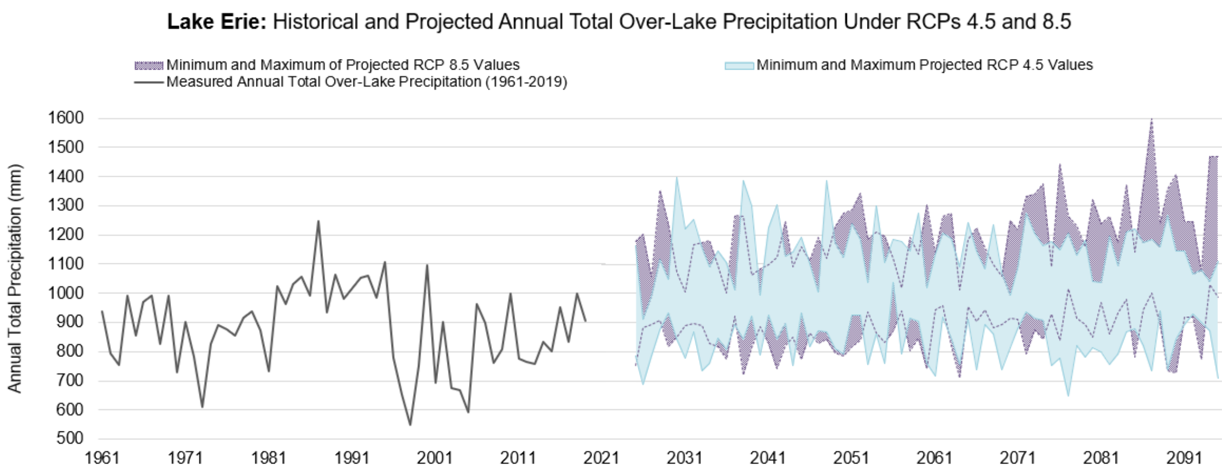


Figure 17: Historical and projected over-lake precipitation for Lake Erie under both RCP 4.5 and RCP 8.5. Projected for 2025-2095 (ECCC, 2022).

5.1.3 Lake Levels

Static lake levels (non-storm conditions) have fluctuated by as much as two metres over the last 100-years on Lake Erie, and lake-levels are projected to increase in variability, resulting in more extreme highs and lows (Theuerkauf and Braun, 2021). Under RCP 4.5, average annual lake-levels for Lake Erie are expected to rise by 0.3 m by the end of the century. Under RCP 8.5, average annual lake-levels are expected to increase by 0.5 m by the end of the century (Fig. 18; ECCC, 2022). In addition to higher average lake level conditions, the extreme high levels associated with wet periods such as 2019 are expected to be on the order of 0.4 to 0.5 m higher with 2.0°C to 2.5°C of global warming (Seglenieks and Temgoua, 2022). Higher average lake levels and higher extreme water levels during wet periods will increase the exposure of infrastructure, transportation, natural environment, and recreation facilities to natural hazards such as erosion and flooding.

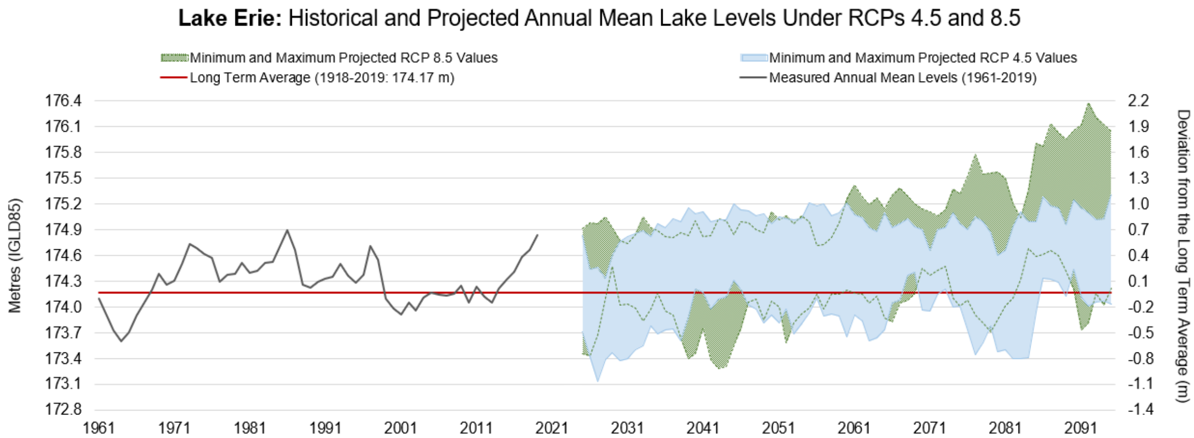


Figure 18: Historical and projected lake levels for Lake Erie under both RCP 4.5 and RCP 8.5. Projected for 2025-2095 (ECCC, 2022).

5.2 Climate Change Threats and Impacts

5.2.1 Changes in Hydrologic Regime and Water Quality

In general, water level regimes define wetland processes, soil moisture conditions, vegetation dominance, and maintain shoreline marshes. Water level changes need to be gradual to optimize wetland function and structure. A rapid rise in water levels can result in a loss of wetland habitat in areas where shorelines do not have the accommodation space to retreat and transition landwards. Wetland vegetation that is unable to germinate under high lake levels can rapidly grow in exposed mudflats during low water levels, however long periods of low lake levels, combined with increased temperatures, can lead to wetland drying and stranding, in turn altering species found within a wetland, and a decline in biodiversity and ecosystem services (ECCC, 2022).

The increased frequency and intensity of storm events can lead to increased sediment and nutrient runoff, which will result in water quality impairments such as high turbidity, eutrophication, and algal blooms. Excess sediments will lead to the burial of plant communities, a decrease in light penetration and photosynthesis, and a lack of oxygen (ERCA, 2022b).

5.2.2 Altered Coastal Processes

Warming air and water temperatures have already reduced winter ice cover across the Great Lakes (Fig. 6). Winter ice is imperative in protecting shorelines from extreme storms and waves that can lead to overwash and inland migration of barrier systems. The absence of ice will also leave shoreline properties vulnerable to more winter flooding and erosion and also cause damage to existing shoreline structures. This may lead to more or upgraded protection structures, which will contribute to further disruptions of natural erosion processes, sediment supply, transport, and deposition in beach environments. Moreover, with a rise in water levels and increased storm events, these coastal structures can become breached and damaged, reducing their protective function for coastal infrastructure (Fig. 19). The increased exposure to coastal storms is a pressing issue at HMCA, as the Road 1 dyke is vulnerable to failure, which could lead to extensive in inland flooding due to the low-lying nature of the agricultural lands in the drainage schemes (Zuzek Inc., 2021).

Figure 19: Failed seawall and home damage along Marentette Beach (south of HMCA) following the April 2018 ice storm.

5.2.3 Loss of Wetland Biodiversity

A vulnerability assessment of the Great Lakes showed that 62% of assessed species are vulnerable to climate change, with water dependent species being most at risk (Brinker et al., 2018). Climate change projections are in exceedance of several thresholds that can result in loss of or variability in species productivity, recruitment, abundance and overall composition. As a result of higher water levels, floating and submerged plants are less likely to persist, reducing fish and wildlife habitat. Severe storms and high lake levels result in nest abandonment for birds that nest on or near the water surface. Lower water levels, coupled with warm water temperatures and excess nutrients and sediments, provide conditions for algae growth and prominence of invasive phragmites and cattail. Lower water levels can result in the revegetation of marshes from the native seed bank but over the long-term can result in the loss of winter underwater habitat, and the loss of spawning access and submerged aquatic vegetation for fish. Exceedance of optimal temperature ranges and thresholds can result in possible phenology mismatches (affecting migration patterns and other ecological functions), loss of native species, introduction of new temperature tolerant species, and the emergence of pests and disease (ECCC, 2022).

6.0 Identifying Restoration Actions

This plan will propose recommended actions to reduce climate change risks to the Hillman Marsh and surrounding community, and enhance coastal wetland resilience for long-term health, function, and the provision of wetland goods and services. The Plan aims to address the need to conserve and manage lands owned by the Conservation Authority that are subject to flooding, erosion, and associated hazards, while simultaneously protecting people and property surrounding the marsh from this natural hazard. When implemented, the project will restore, enhance, and increase the resilience of the barrier-beach, along with the diversity and extent of the native wetland plant community in the marsh.

6.1 Project Partners

This Restoration Plan was developed with the help of the Steering Committee that provided feedback on the proposed restoration concepts, advised on relevant research, identified gaps and possible sources of information, and identified opportunities for First Nation engagement. The Steering Committee was comprised of the individuals from the following institutions:

- Caldwell First Nation
- Ducks Unlimited
- Environment and Climate Change Canada
- Fisheries and Oceans Canada
- Leamington Shoreline Association
- Ministry of Natural Resources and Forestry
- Ministry of the Environment, Conservation and Parks
- Municipality of Leamington
- Parks Canada, Point Pelee National Park
- SJL Engineering
- University of Windsor
- University of Waterloo
- Zuzek Inc.

The Essex Region Conservation Authority (ERCA) is receiving financial support from Environment and Climate Change Canada (ECCC) to coordinate the above committee and providing research and support for the project. The Ministry of the Environment, Conservation and Parks is providing ERCA with financial support to complete the first phase of the project (reconstruction of the south headland at East Beach Road and pilot barrier beach section) in 2023/2024.

6.2 Project Goals

Hillman Marsh and barrier beach ecosystem has passed its tipping point and it is very unlikely the breach in the beach will recover naturally. An adaptive transformational approach can restore this wetland using hybrid approaches of traditional engineering structures and nature-based solutions. With this context, there are three main goals for this project:

1. Employ a transformational adaptation approach to restore and enhance the Hillman Marsh barrier beach feature to withstand climate change extremes, protect the wetland ecosystem, and safeguard homes and businesses.
2. Restore the wetland plant community within the approximate 115 hectares of open water behind the barrier feature to enhance wetland structure, function, diversity, and resilience to climate change impacts using historical records and expert opinion.
3. Make the restored and enhanced Hillman Marsh ecosystem accessible to all of society and future generations to enjoy.

6.3 Project Objectives

This project is broken up into four phases to successfully achieve the aforementioned goals.

Phase 1A:

- By March 2024, and in consultation with the Steering Committee, develop a high-level adaptation and restoration plan for a 1,500 metre barrier beach feature and for 115 hectares of a diverse and functional wetland plant community.
- Throughout all years of the project, effectively communicate with stakeholders, rightsholders, and the local community to inform, garner support, and seek feedback and approval through quarterly meetings, consultation events, and consistent updates to the project website.

Phase 1B:

- By Fall 2024, implement upgrades to the south headland at East Beach Road and construct a 40 m test section of the proposed artificial barrier, anchored on the west side of East Beach Road at the south end of Hillman Marsh, to mitigate ongoing erosion and anchor the future phases of work.

Phase 2:

- Beginning in Spring 2024, utilize available resources and expertise to conduct numerical modelling of natural conditions (waves, sediment transport, and hydrodynamics) and physical modelling of design components (alignment and elevation of the barrier, offshore rock shoals, artificial reefs, and outlet geometry) with a collective aim to minimize wave agitation, ensure infrastructure and vegetation survival, and determine optimal dimensions and materials of critical design components.

Phase 3:

- By early 2025 and into 2026, and with permits and approvals secured, integrate the results of numerical and physical modelling to complete the final detailed design and cost estimate of project elements (including the artificial barrier beach, permanent outlet, habitat islands, hardpoints, aquatic vegetation, and submerged rock shoals), and begin construction to stabilize the north headland.
- By Spring 2026 and into 2027, develop both an adaptive management plan and a comprehensive set of construction ready drawings and specifications, including tender packages that will be utilized to secure quotations for the various phases of construction.

Phase 4:

- By Spring 2026 and into 2027, commence construction of the artificial barrier beach and permanent outlet.

Phase 5:

- By Spring 2027 and into 2028, begin construction of hydraulic training structures and extensive wetland restoration.
- Implement an adaptive management plan involving continuous monitoring, risk identification and mitigation, and stakeholder engagement, allowing for future adjustments in response to changing conditions and unforeseen challenges.

6.4 Project Outputs

The main outputs of this Restoration Plan are:

- A report that summarizes historical and current information on Hillman Marsh, including shoreline development, barrier breaching, water quality, vegetation, and wildlife;
- A community outreach strategy to involve appropriate rightsholders, stakeholders, and the local community and provide opportunities for participation and feedback;
- Restoration concepts for a reconstructed barrier beach with nature-based and engineered components, and new wetland vegetation zones;
- A consensus-based restoration and adaptation strategy with recommended actions, approximate timelines, and a preliminary opinion of costs.

6.5 Anticipated Outcomes

As a result of the collaborative efforts with the project rights holders and stakeholders, it is expected that this project will:

- Improve understanding of the factors responsible for the degradation of a barrier beach and former protected coastal wetlands and the limiting factors for restoration;
- Restore and enhance the resilience of the barrier beach to future high-water levels, ice-free winters, and storm events;
- Restore habitats and ecosystems previously lost in the marsh;
- Create an example of barrier beach and wetland restoration in Canada and a template to follow for other threatened and degraded barrier beaches;
- Create multiple community co-benefits such as wetland restoration, expanded recreational use of the marsh, and disaster risk reduction for the properties and farms located south of the marsh on lands below lake level;
- Improve public awareness of the climatic and non-climatic threats on the Great Lakes, and engage and empower future investment in the restoration of Hillman Marsh.

6.6 Restoration Targets

This restoration project will affect approximately 115 hectares of open marsh. An ELC classification completed by ERCA in 2019 classified that the open marsh area was 90.2% open water, and only 9.8% floating and emergent vegetation. Although submerged vegetation was not formally included in this classification, observational evidence confirmed that there is minimal left in the marsh. This data approximates the extent of present-day vegetation communities, but since then some of these features have been lost, including a prominent cattail island, and it is likely that the marsh is more than 90.2% open water. A main target in this project's restoration efforts is to achieve an interspersion rate of 50% (a 50/50 ratio of water to submergent, emergent, and floating wetland vegetation).

7.0 Restoring the Hillman Barrier Beach and Wetland

7.1 Ongoing Design and Restoration Considerations

This restoration plan report has been informed by a series of completed and ongoing technical studies described in the following sections.

7.1.1 Land Use Change in the Hillman and Lebo Watersheds

The land use in the Hillman and Lebo Creek watersheds, which drain into Hillman Marsh, was qualitatively evaluated in 1968 and 2022 (Fig. 20). Though there does not appear to be any substantial increase in residential development and the majority of the lands feature agricultural land uses in both years, there is a large increase in greenhouses in the 2022 aerial photograph, as highlighted by the yellow rectangles in Figure 20. In 2019, the floor area of greenhouses in Essex County was 1,120 hectares, and it is predicted to grow to 1,360 hectares by 2041 (ERCA, 2022b). The greenhouses are comprised primarily of vegetables and fruit (96%), flowers and potted plants (3%), and greenhouse cannabis (1%) (ERCA, 2022b).

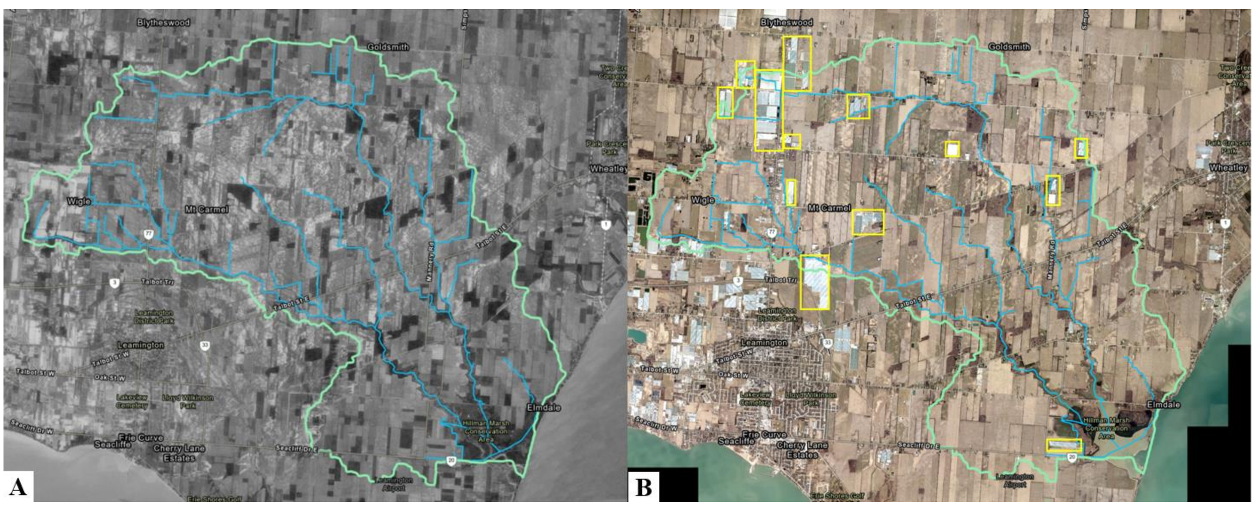


Figure 20: Comparison of land use in the Hillman and Lebo Creek Watersheds in (A) 1968 and (B) 2022. The main difference is the increase in greenhouse (yellow rectangles).

7.1.2 Water Quality in the Hillman Marsh

Turbidity, which makes water appear cloudy or muddy, is caused by the presence of suspended and dissolved matter (USGS, 2005) and is measured by the degree to which light is scattered by particles in a liquid (USGS, 2022). Typically, suspended particles are the dominant influence on light attenuation in natural waters, negatively impacting water clarity and reducing the penetration of light required for photosynthesis (Davies-Colley and Smith, 2001). This limited light penetration also affects fish predator prey interactions and impacts foraging and reproductive habitats (Carter et al., 2022). Excess suspended particles can absorb heat, increase water temperature, and decrease dissolved oxygen content (Schroeder, 2003). Pollutants are often bound to fine particles that cause turbidity, and in some cases, these may be toxic metals or nutrients that can enhance eutrophic conditions (Carter et al., 2022). Therefore, if water is too turbid, it loses the ability to support a wide variety of aquatic plants and animals.

A water quality monitoring instrument (YSI 600OMS V2 Optical Monitoring Sonde; Fig. 21A) was deployed at Hillman Marsh in July 2023 to collect continuous measurements of temperature and turbidity at an interval of 15 minutes. The sensor was placed in a sheltered area of the marsh, roughly 80 m offshore (Fig. 21B), to get an accurate understanding of turbidity levels in the area that would be the main focus in revegetation efforts further along in the project. Discrete measurements were taken of pH, dissolved oxygen, specific conductivity, and ambient conductivity roughly every 3 weeks using a YSI ProDSS Multiparameter Digital Meter (Table 1). Water samples were collected and sent to a laboratory for measurements of total suspended solids (TSS). The sensor was retrieved in late October 2023, with a total of 111 full days and 2 partial days of data.

Figure 21: (A) Set up of deployed turbidity sensor. (B) Location of turbidity sensor in the Marsh.

Table 1: Discrete measurements of temperature, dissolved oxygen (DO), specific conductivity, ambient conductivity, and pH taken every ~3 weeks at location of turbidity sensor. Water samples grabbed and sent to Caduceon Environmental Laboratories for TSS measurements.

Date	Time	Temp (°C)	DO (mg/L)	Specific Conductivity (µs/cm)	Ambient Conductivity (µs/cm2)	pH	TSS (mg/L)
07-07-2023	12:17 PM	23.5	9.3	284.5	276.4	9.3	
07-28-2023	11:13 AM	16.6	4.82	287.8	243.6	7.4	19
08-16-2023	10:18 AM	20.8	7.85	294.5	270	8.2	40
06-08-2023	11:05 AM	20.4	8.11	270.1	246.2	8.0	43
09-29-2023	10:40 AM	18	8.5	291.1	251.7	7.9	64
10-27-2023	10:26 AM	16.2	11.39	352.1	292.8	9.2	27

Preliminary results show the median turbidity for the Summer 2023 season as 24.2 NTU with frequent spikes ranging between 68.65 NTU and 205.15 NTU (Fig. 22). These peaks in turbidity often lined up with periods of precipitation that result in increased sediment and nutrient loads from non-point source agricultural runoff (Table 2; Carter et al., 2022). Most notably, 18.1 mm of precipitation on October 14, 2023, that yielded a median turbidity of 205.15 NTU. Although the exact cause for spiked turbidity in the absence of precipitation cannot be confirmed, studies suggest increased turbidity can be a result of algae growth (USGS, 2018), wave action (Paul et al., 1982), or resuspension from carp and other bottom-feeding fish (Weber and Brown, 2009). Turbidity standards set out by the Provincial Water Quality Objectives (PWQO) state that turbidity should not change by more than 10% above the natural levels for the protection of aquatic life (MECP, 2021). Although this dataset is only one season and is not enough to make final conclusions, turbidity often spiked above this 10% threshold this season. Monitoring of Hillman Marsh water quality should continue to grow a large enough data set to do proper statistical analysis.

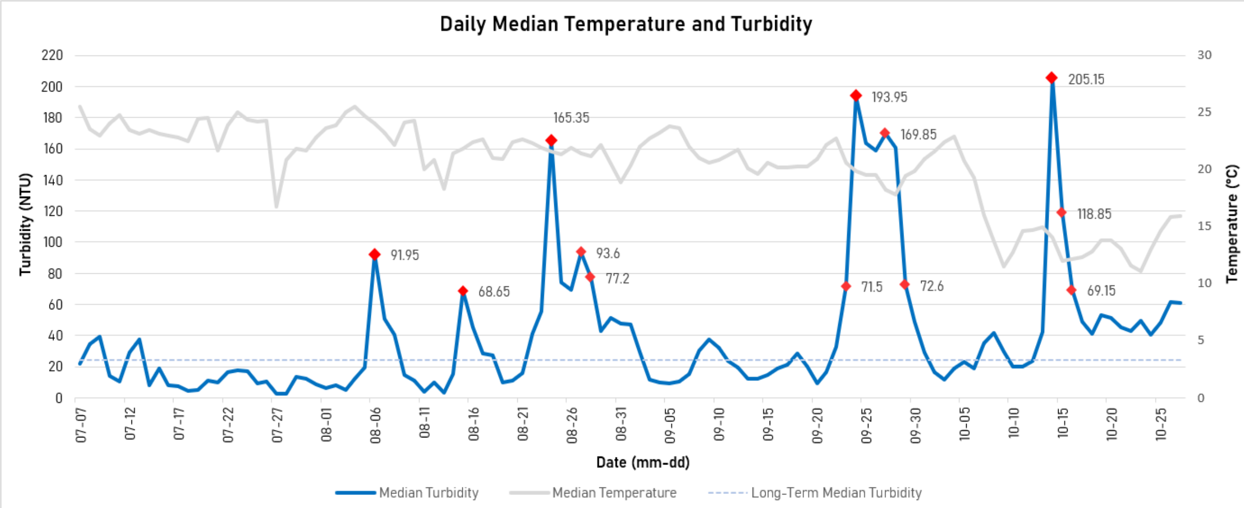


Figure 22: Daily median temperature and turbidity from July 7, 2023, to October 27, 2023. Peaks in turbidity marked in red, often lining up with precipitation events.

Table 2: Total rainfall (mm), average wind speed (km/h), and average wave height (m) on days with high median turbidity. Colour blocks represent consecutive days of high turbidity.

Date	Median Turbidity (NTU)	Total Rainfall (mm)	Avg Wind Speed (km/h)	Avg Wave Height (m)
08-06-2023	91.95	14.5	23.6	0.7
08-15-2023	68.65	13.7	18.9	0.5
08-24-2023	165.4	16	14.4	0.4
08-25-2023	73.9	0	14.9	0.3
08-26-2023	69.1	0.7	12.4	0.2
08-27-2023	93.6	0	14.9	0.4
08-28-2023	77.2	0	7.3	0.2
09-24-2023	194.0	0	19.3	M
09-25-2023	163.6	0.2	20.8	0.6
09-26-2023	159.1	0.3	23.4	0.7
09-27-2023	169.9	0.3	24.1	0.8
09-28-2023	160.9	7.3	20.9	0.7
10-14-2023	205.2	18.1	31.1	1.3
10-15-2023	118.9	0.2	24.6	0.7
10-16-2023	69.2	0.6	20.0	0.4
10-26-2023	61.4	1.1	23.9	0.6
10-27-2023	61.0	0.5	24.5	0.6

Since breaching of the protective barrier beach, wave agitation may have resulted in sediment stirrup in Hillman Marsh, and the subsequent increased turbidity levels resulted in the loss of submerged aquatic vegetation. Although emergent and floating vegetation can grow in turbid waters (floating vegetation has resurfaced this summer; Fig. 23), clear water is needed early in the growing season for new seedlings to establish (Austin et al., 2017). Once the barrier beach is restored, there will be a buffer between the marsh and the harsh conditions of Lake Erie, which should result in less sediment stirrup - allowing for the successful reestablishment of aquatic vegetation. Additionally, an increase in aquatic vegetation will help reduce future turbidity levels caused by bottom-feeding fish by trapping sediment (McNair and Chow-Fraser, 2003). Re-establishing aquatic vegetation will also help attenuate waves, regulate nutrients, and absorb CO_2 (Austin et al., 2017).

Figure 23: Floating aquatic vegetation in Hillman Marsh re-establishing this summer (June 2023).

7.1.3 Barrier Erosion and Downcutting in the Breach Channel

A bathymetric survey of the Hillman Marsh and Lake Erie shoreline was completed on May 26, 2023, and compared to data collected in 2007 and 2020 (Fig. 24). The most dramatic example of lakebed downcutting at Hillman Marsh is in the breach channel, which starts in the East Marsh Drainage Scheme, goes over the Road 1 dyke, through the marsh and over the former barrier beach (Profile B). The depths in the breach channel are up to 2 m deeper in 2023 as compared to 2007 (500 to 700 m on the x-axis), when the barrier beach was still in place.

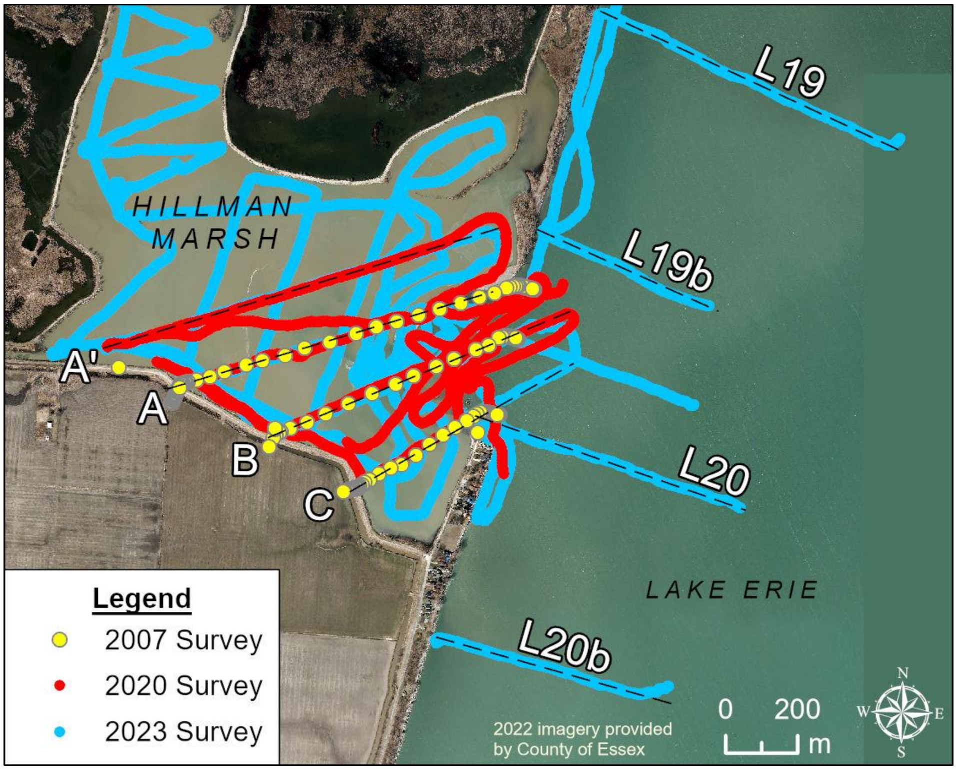


Figure 24: Tracklines of bathymetric surveys done in 2007, 2020, and 2023.

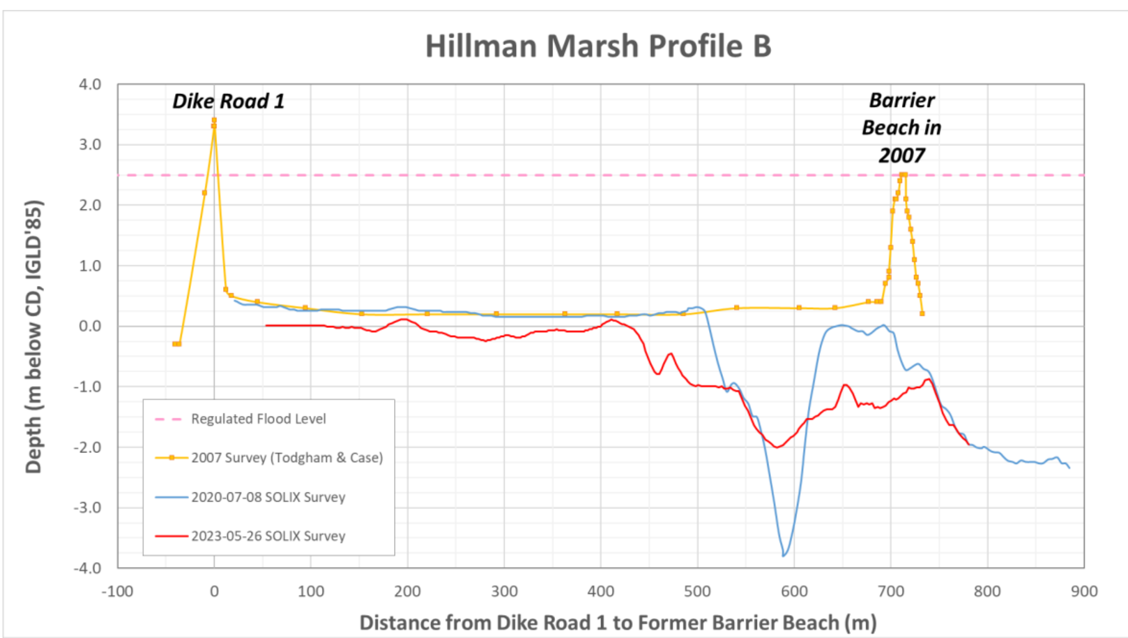


Figure 25: 2007 to 2023 Comparison of Marsh and Barrier Depths at Profile B in Figure 24.

7.1.4 Potential Role of Cumulative Stressors

Dramatic changes in the wetland plant communities at the Hillman Marsh occurred between the late 1960s and early 1970s (Fig. 26). The potential role of cumulative stressors was investigated based on published literature and other data sources. The greenhouse industry expansion in the Hillman and Lebo watersheds was already discussed and did not correspond to the period of vegetation die-off from the late 1960s to early 1970s. However, a 1988 (ERCA) water quality report comparing the Hillman Creek to Ruscom River and Big Creek that drain north is Essex County into Lake St. Clair found that the Hillman Creek featured the highest sediment and phosphorus concentrations, presumably from field crops.

Following rapid expansion of the greenhouse industry in the Leamington area in the late 1990s and early 2000s, monitoring by the Ministry of the Environment (2012) determined Sturgeon Creek and the Lebo Drain were the most polluted waterways in the province of Ontario with respect to phosphorus and nitrate, two key ingredients in fertilizer. Subsequently, in 2015 the Leamington and Kingsville tributaries were identified as a priority watershed for action in the Great Lakes Water Quality Agreement. In 2022, ERCA reported on a detailed 10-year monitoring program of local tributaries in Kingsville and Leamington, with a focus on greenhouse and non-greenhouse systems. Following extensive water quality monitoring, the study showed the greenhouse industry was directly responsible for elevated phosphorus and nitrate concentrations in local tributaries draining to Lake Erie. In agricultural dominated watersheds, phosphorus concentrations ranged from 0.12 to 0.3 mg/L but increased to 2.9 to 6.0 mg/L for the Kingsville and Leamington tributaries (~20 times higher). The measured phosphorus concentrations were 100 to 200 times higher than the Provincial Water Quality Objective of 0.03 mg/L, which is the benchmark for nuisance algal growth in streams (ERCA, 2022b).

A prolonged period of record setting lake levels in the early 1970s is one potential stressor that contributed to the wetland vegetation die-off and loss as a result of rapid drowning (Fig. 6). In 1973, the summer peak levels had established a new record high lake level, that was subsequently exceeded in 1986, 1998, and 2019.

Chemical pollution in Lake Erie is another potential contributor to the vegetation die-off. For example, mercury contamination from the St. Clair and Detroit Rivers resulted in the closure of the walleye fishery from 1970 to 1973 (Nepszy et al, 1991). More recently, the return of high phosphorus loads to Lake Erie has resulted in the return of toxic algal blooms in the Western and Central Basin of Lake Erie. Satellite derived concentrations of Chlorophyl, a measure of bloom intensity, routinely see Lake Erie local concentrations above the threshold of 3.6 ug/L for the central basin (Zuzek Inc., 2018b). A satellite derived cyanobacteria index (NOAA) also routinely tracks concentrations greater than 1 ug/L, which is a threshold established by the World Health Organization, along the east coast of the Pelee Peninsula (Zuzek Inc., 2018b).

Continued water quality monitoring in the Hillman watershed, which ultimately drains through the planned restoration, should continue. Remediation efforts to reduce nutrient losses from closed-loop operations in the Greenhouses is also required.

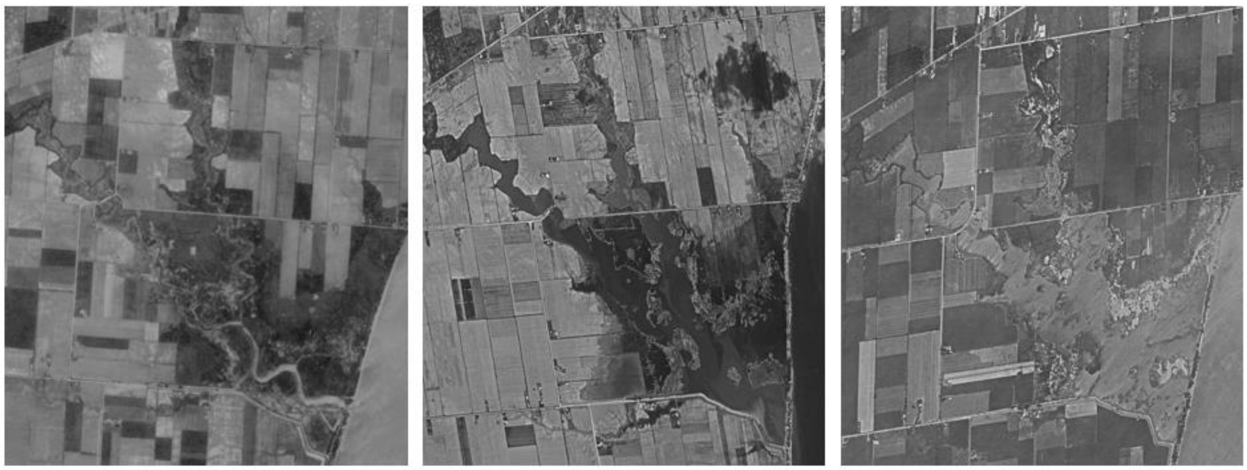


Figure 26: Dramatic changes in the wetland plant communities at Hillman Marsh between the late 1960s and early 1970s.

7.2 Concept Sketches for Barrier Beach and Wetland Restoration

Based on knowledge gained from this restoration study, three restoration concept sketches were developed for Hillman Marsh by Zuzek Inc. and SJL Engineering that focus on re-aligning the barrier beach further inland. They are described in the following report sections.

7.2.1 Concept A – High Crested Barrier

In Concept A, the barrier beach location is fixed further inland with a rock core and armoured outlet channel that is fixed in place (Fig. 27). The rock core (E & G) for the barrier beach is covered with sufficient sand to minimize wave overtopping events and restored with appropriate native vegetation (Fig. 28). Submerged rock shoals (H) reduce incident wave energy and help to stabilize the toe of the beach. A new feeder beach for the Wheatley Harbour dredged sediment is located on the back side of the north barrier beach and a construction road is used to haul sand for a new pocket beach (F).

Habitat islands and training structures (J) are used in the marsh to direct the Hillman and Lebo Creeks flow towards the fixed outlet structure. Potholes are excavated in the sheltered marsh to create fish refugia during periods of low lake levels or storm surges that can drain the marsh. The excavated sediment is used to raise the grades against the

Road 1 dyke. Swamp and marsh restoration will be undertaken once the barrier beach is reconstructed and sheltered waters are returned.

7.2.2 Concept B – Low Crested Barrier

Concept B (Fig. 29) features the same elements of Concept A with one major difference: the crest elevation of the restored barrier beach (G) is lower than Concept A to facilitate wave overtopping events (Fig. 30). This type of natural disturbance makes the system more dynamic and natural but will result in overwash deposits (K) and more wave energy in the marsh. The increased wave energy will limit the spatial extent of the marsh and swamp restoration compared on Concept A. This would be a less expensive option as compared to Concept A.

7.2.3 Concept C – Meandering Channel and Large Pocket Beach

Concept C features many of the same elements as Concept A and B, with the exception of the fixed outlet channel (Fig. 31). It is located further lakeward and centred on the existing breach channel, making use of existing bathymetry. Discharge from the watershed is directed towards the outlet by a series of habitat islands that create meandering channel. By extending the fixed outlet further lakeward in Concept C, a large pocket beach is constructed north of the outlet (F).

The elements of these concepts will be refined in the future with the completion of more technical studies, including additional field data collection to characterize the geotechnical properties of the soils, numerical modelling of waves and currents, and optimization of the barrier beach layout and outlet structure.

7.2.4 No Action Approach

The fourth option is to take a "No Action" approach, leaving Hillman Marsh to continue on its current trajectory. If this approach is taken, various environmental and economic consequences can be anticipated. Environmentally, the barrier beach will continue to erode and retreat landwards, and the breach will remain open, prolonging wave agitation in the marsh. Hillman Marsh will continue to see a decline in habitat quality, water quality, and biodiversity. There will be an increase in the risk of invasive species as they will be more tolerant to these harsh conditions compared to native species. Economically, significant damage is expected without a barrier to act as a buffer between the lake and the marsh. Incoming waves will directly impact the Road 1 Dyke, which can lead to a structural breach, as this dyke was not built to withstand the conditions of Lake Erie. A dyke breach would flood more than 300 structures and could result in $50-100 million in building and content damages for the agricultural lands below lake level.

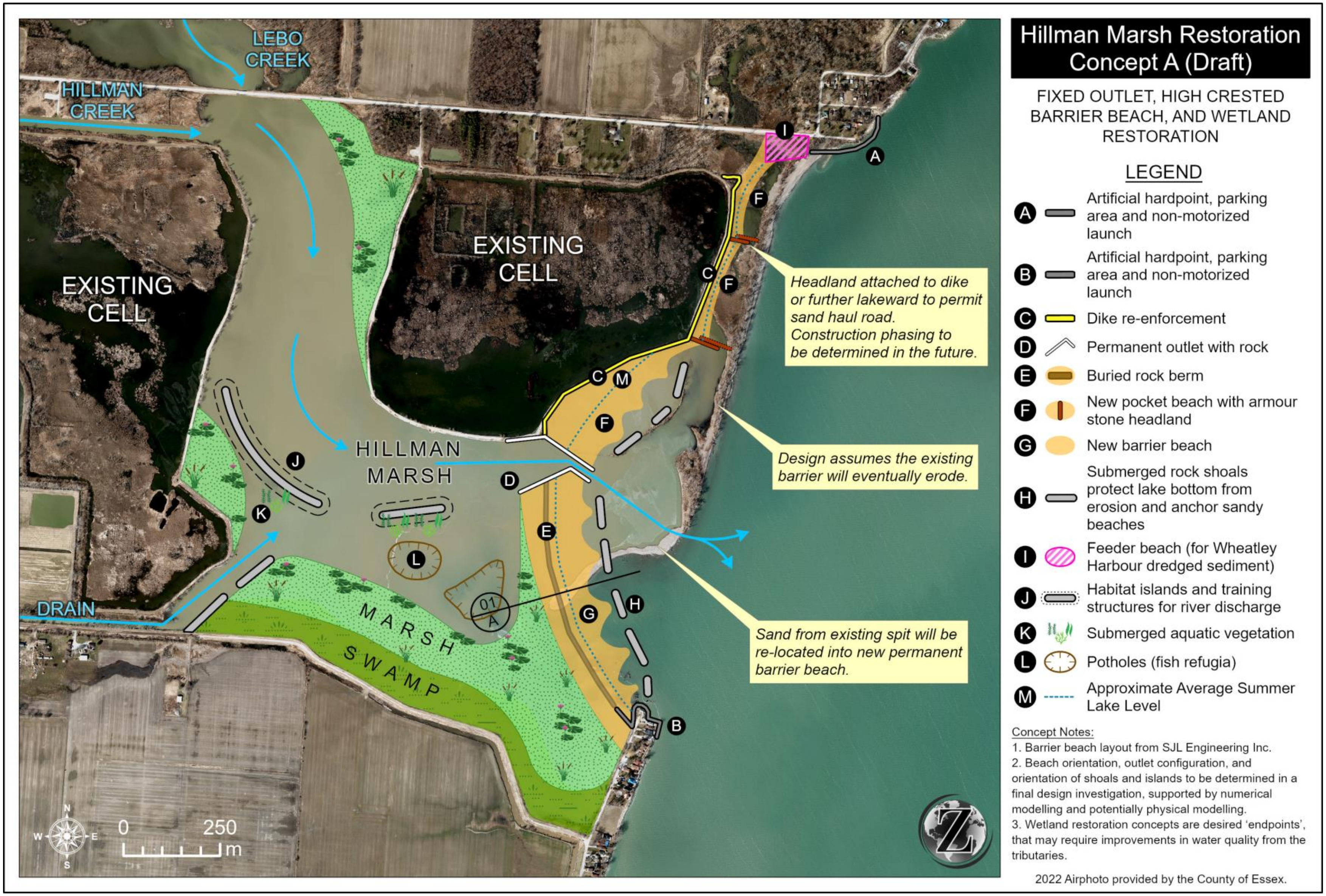


Figure 27: Concept A – High crested barrier.

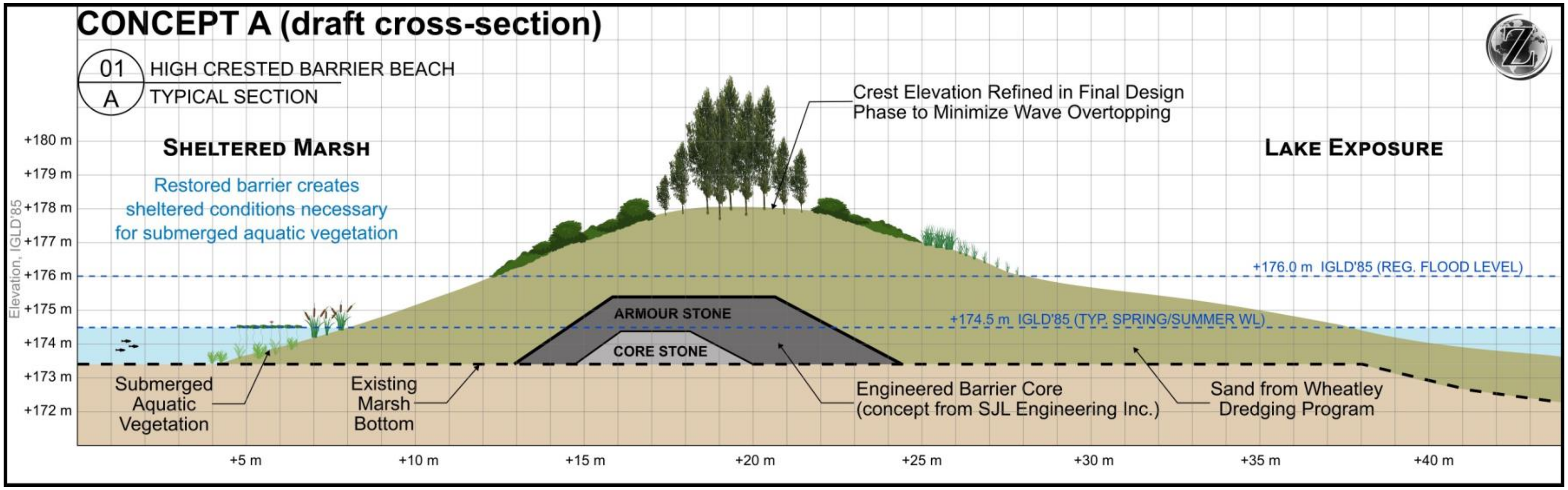


Figure 28: Concept A - High crested barrier cross-section.

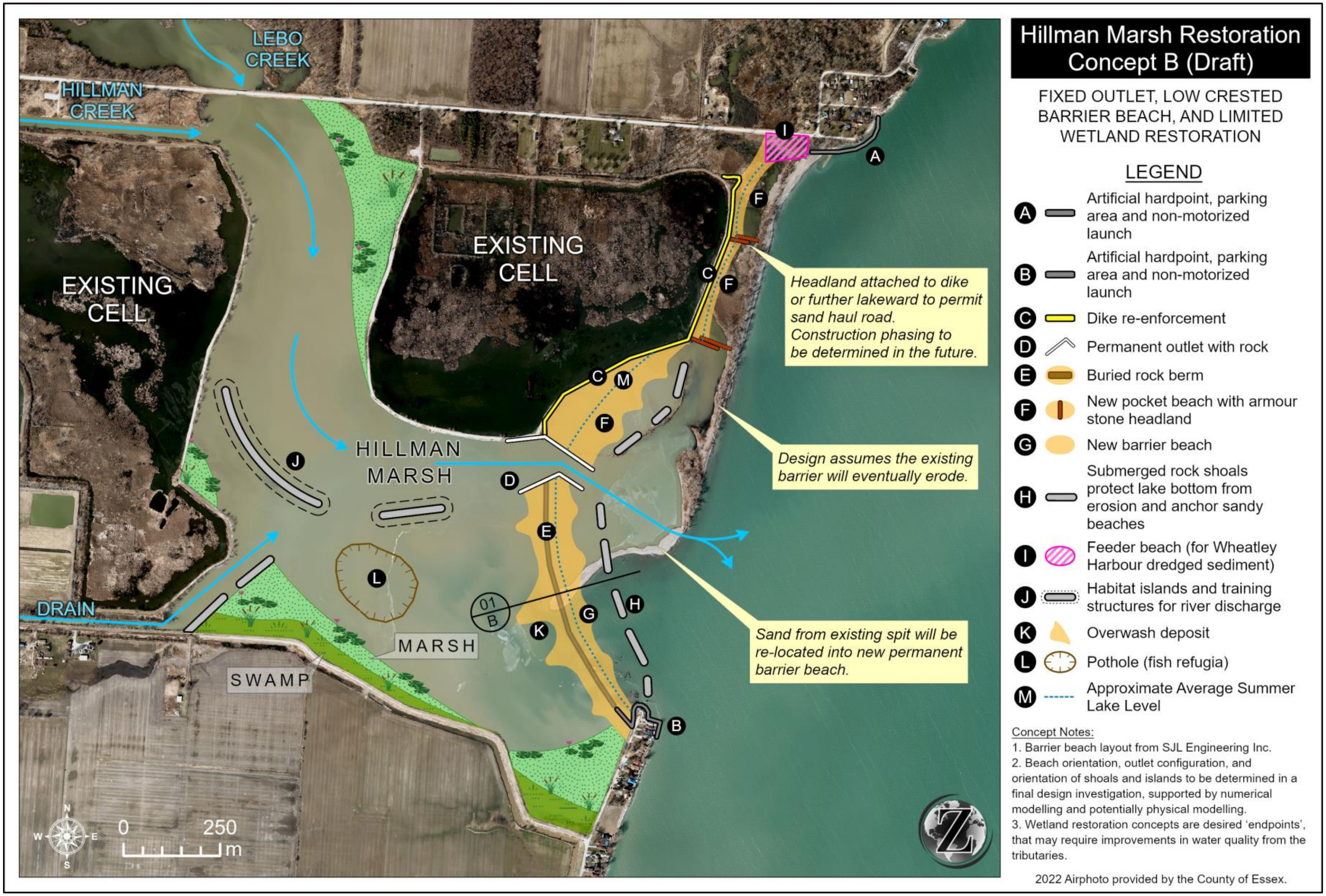


Figure 29: Concept B – Low crested barrier.

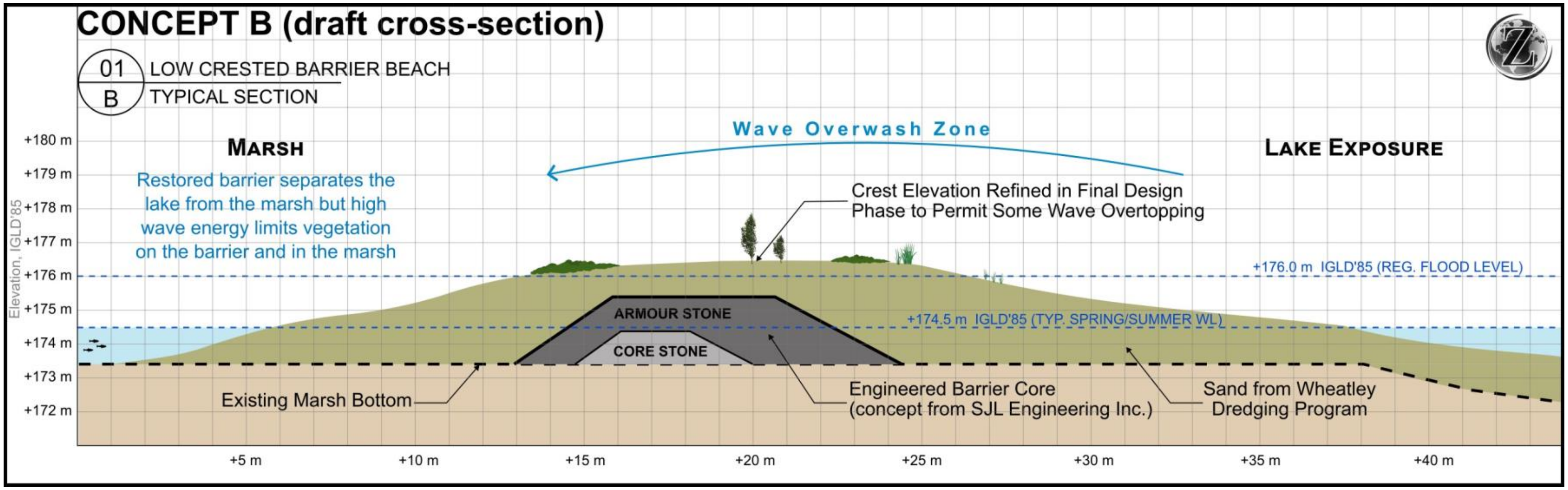


Figure 30: Concept B/C – Low crested barrier cross section.

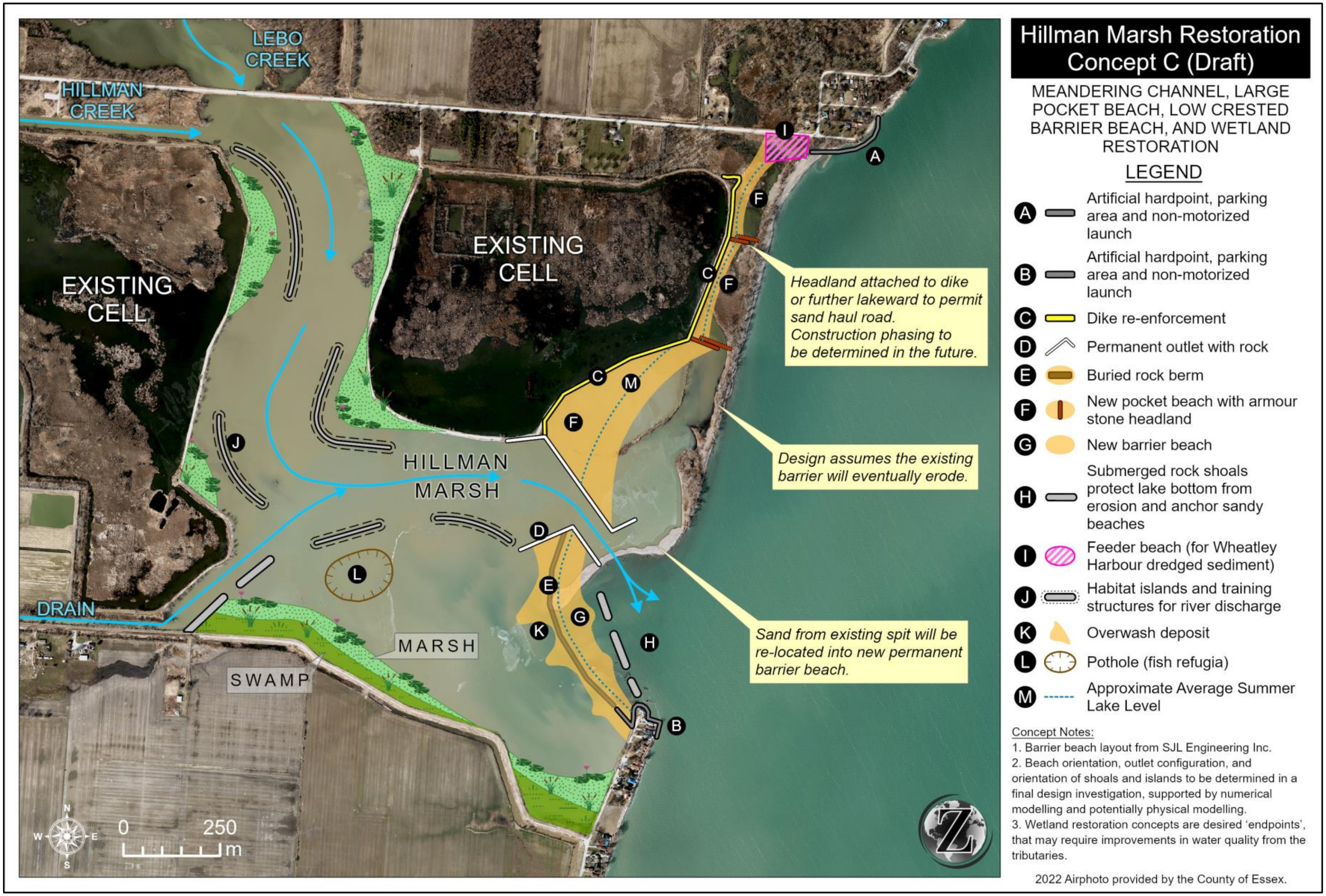


Figure 31: Concept C – Meandering channel and large pocket beach.

7.3 Preferred Option

Based on the opinion of experts on our Core Team and Steering Committee, and the opinion of the majority of the general public, ERCA recommends this project moves forward with Concept A as the preferred approach. The high crested barrier protects the marsh and provides the greatest opportunities for habitat restoration and vegetation re-establishment both on the barrier and behind it. Concept A is more robust and therefore more resilient against wave action, storm events, erosional forces, and future climate change extremes. Through in-depth discussions with various experts, ERCA recognizes that a low crested barrier presents a more dynamic system that will be better suited for wildlife and provides the fundamental services and structure for a healthy wetland. However, concerns remain that Hillman Marsh may not be able to handle this dynamic system, without failing, given its current state. Moving forward, numerical and physical modelling will be conducted by engineers to test the possibility of a structure that has variable crest elevations. If areas of both high and low crested barrier beach can be accommodated without compromising the wetland, then it will provide for a more biologically diverse outcome and will be pursued.

Caldwell First Nation has been part of the steering committee since its inception, but as the only other landowners in the marsh, staff would prefer to not commit to any preferred option, but instead to continue ongoing consultation with their leadership and community regarding their opinions. Administration has committed to continuing to work and communicate with and seek feedback from Caldwell First Nation if funding for this project is approved and it can move forward.

7.4 Phase 1 - East Beach Road South Headland and Pilot Restoration

Funding was received from the Ministry of the Environment, Conservation and Parks (MECP) to initiate work on the broader barrier beach and wetland restoration plan, referred to hereafter as Phase 1. The focus of the Phase 1 work was to implement upgrades to the south headland at the north end of East Beach Road, and to construct a test section of the artificial barrier with pilot wetland restoration efforts in its lee (Fig. 32). Phase 1 work is denoted “B” in the concepts shown above in Figures 27, 29, and 31. The stability of the south headland was determined to be a high priority component of all three concepts given that the north end of East Beach Road continues to erode both beneath and behind the existing stone erosion protection structure that was placed by the municipality in the fall of 2020.

The proposed Phase 1 work is set to go to construction tender in 2024, with implementation to occur shortly thereafter. The initial test section of artificial barrier will be monitored post-construction for settlement and performance in terms of its stability under wave loading and ability to dissipate wave energy entering the south portion of the marsh. The pilot restoration works in lee of the test section will be led by ERCA and will feature both sand and organic infill that will be graded to achieve several vegetation zones. The zones will be planted with a variety of emergent marsh species native to the region. Monitoring of all components of the Phase 1 works will be carried out in parallel with the technical work required to advance the concepts presented for the broader Hillman Marsh Barrier Beach and Wetland Restoration project (Phase 2).

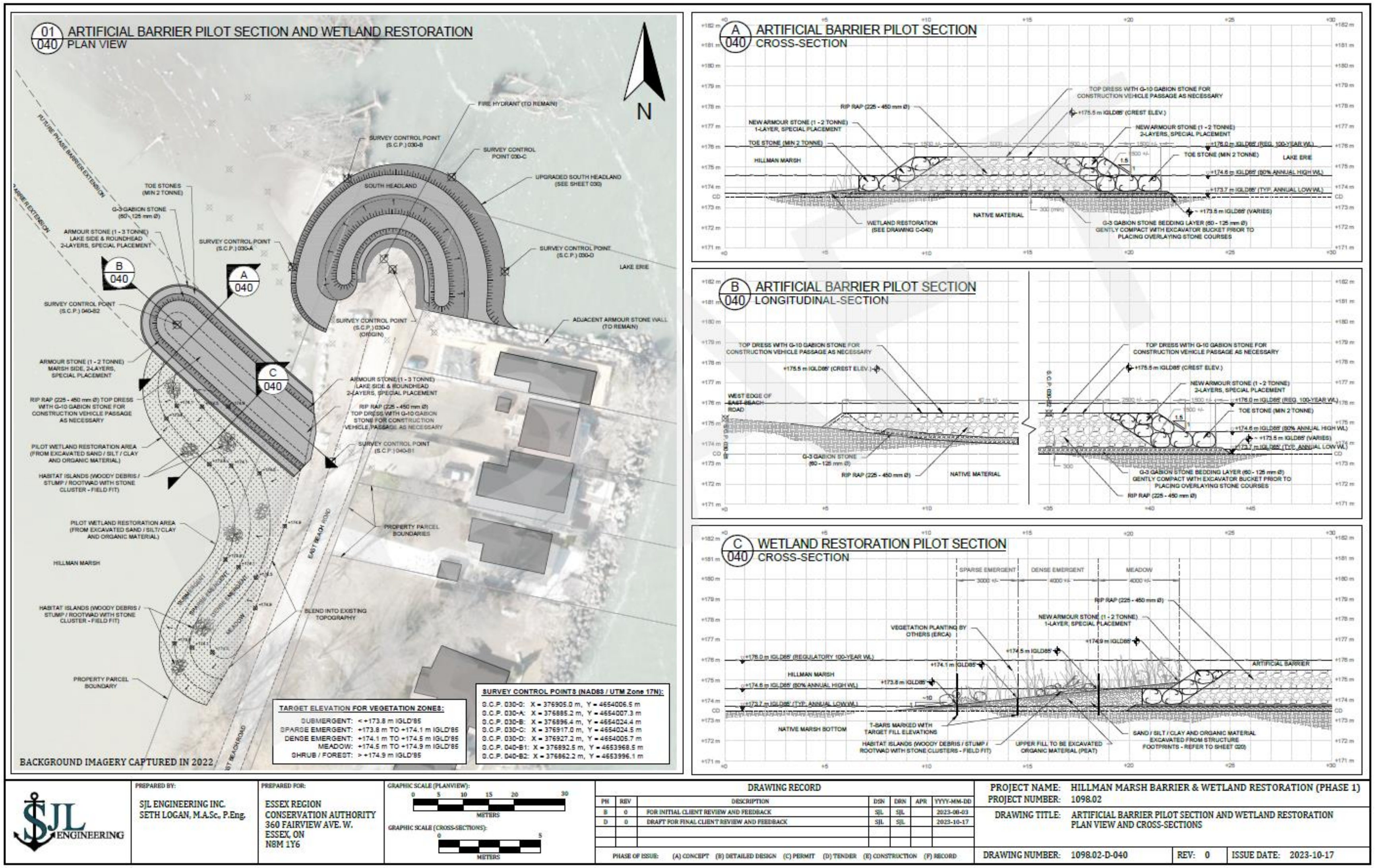


Figure 32: Map of the south headland upgrade, the pilot section for the artificial barrier, and the pilot wetland restoration.

8.0 Next Steps for Design and Project Implementation

The strategies and concepts presented in Section 7.0 will require a great deal of scientific and technical engineering work before a single concept can be selected, advanced, and ultimately designed to a level at which it can be tendered and constructed. The work required to advance the project to implementation has been divided into two additional phases of work, which are summarized in the sections that follow and in Table 3.

8.1 Phase 2 – Technical Work to Support Detailed Design

Phase 2 would begin with the acquisition of additional field data necessary to execute the technical tasks required for the assessment of concepts and detailed design of the overall barrier beach and wetland restoration plan. Following the field work, design conditions for the project would be developed both in terms of coastal and geotechnical considerations, and ecological restoration targets would be identified. A series of technical tasks would follow including detailed numerical and physical modelling of hydrodynamics, waves, and sediment transport to support the selection, advancement, and optimization of the overall concept to be carried forward to detailed engineering design. Finally, wetland restoration and beach nourishment plans would be developed to accompany the detailed engineering design work. Tasks expected to be included in Phase 2 are listed as follows:

- Field work and data acquisition;
- Evaluation of ecological baseline conditions and restoration targets;
- Development of design conditions and advanced concepts;
- Numerical modelling of nearshore and marsh hydrodynamics, waves, and sediment transport;
- Physical modelling of coastal processes and their interaction with the proposed works to facilitate layout and cross-section optimization for the various project components;
- Detailed engineering design and Class C cost estimating;
- Development of wetland restoration plan assuming a restored barrier;
- Development of beach nourishment plan;
- Assessment of construction feasibility and construction phasing.

8.2 Phase 3 – Final Design, Approvals and Preparation of Tender Documents

In Phase 3, the selected concept subjected to detailed engineering design will be finalized and drafted in construction ready drawings. All other components of a construction tender will be prepared including construction specifications and cost estimates. A long-term monitoring and adaptive management plan will be developed for the implemented project, and all necessary permits and agency approvals will be sought such that the project can advance to the implementation stage (to be Phase 4). Anticipated tasks included in Phase 3 are listed as follows:

- Final engineering design;
- Production of construction-ready engineering drawings;
- Development of long-term monitoring and adaptive management plan;
- Preparation of tender documents and technical specifications;
- Securing of permits and other agency approvals required for project implementation and project tendering.

8.3 Phase 4 – Tender and Construction

In Phase 4, the project will be tendered for construction and the barrier beach restoration will be carried out by a suitable contractor(s), with wetland restoration works to follow once sheltered waters return to the Hillman Marsh. All wetland restoration work will be led by ERCA.

8.4 Phase 5 – Monitoring and Adaptive Management

In the final project Phase, ongoing monitoring of all project elements including wetland survival and beach stability will be carried out, within the scope of the adaptive management plan developed in Phase 3. Monitoring of the barrier beach and wetland restoration should continue indefinitely to learn from the project, modify management approaches as required, and continue to build resilience to coastal storms and climate change.

Table 3: Operational plan breakdown by year, phase, scope, and budget.

Year	2022 –2024	2023-2024	2024-2025	2025-2026	2026-2027	2027+
Phase	**PHASE 1a: Engagement and Restoration Concept Development**	**PHASE 1b: Interim Improvements to South Hardpoint**	**PHASE 2: Technical Work to Support Final Design**	**PHASE 3: Final Design and Approvals**	**PHASE 4: Tender and Construction**	**PHASE 5: Adaptive Management**
Scope	1) Establish Steering Committee for the Hillman Marsh Conservation Area Restoration Plan (hereafter referred to as the Restoration Plan). 2) Development of high-level Restoration Plan concepts. 3) First Nations, community and stakeholder engagement and consultation. 4) Environmental and ecological monitoring and baseline assessment for restoration. 5) Physical data collection including bathymetric and topographic surveying. 6) Develop Technical Terms of Reference for restoration plan. 7) Develop funding strategy for Phase 2 technical work to support detailed design of Restoration Plan, Phase 3 final design and approvals, and Phase 4 tender and construction.	1) Coastal and geotechnical engineering for the design of upgrades to the south hardpoint and root section of artificial barrier beach. 2) Design of initial pilot restoration works in lee of East Beach Road South Hardpoint (southeast corner of marsh). 3) Project permitting and approvals from DFO, MNRF, ERCA, and the Municipality (as required). 4) Construction tendering. 5) Construction of Phase1b works during the in-water work window (Jul 15 - Sep 15). 6) Monitoring of interim south hardpoint upgrades and root section of artificial barrier beach for settlement, and monitoring of pilot restoration works.	1) Project communications 2) Additional field work and data collection as needed. 3) Numerical modelling of waves, hydrodynamics, and sediment transport. Integrate watershed flows and lake forcing. Optimize design through numerical modelling to minimize wave agitation in the marsh, develop design wave conditions for infrastructure and vegetation survival, assess necessary outlet width, configuration, and alignment, and to provide stability to newly created beach cells and artificial barrier. 4) Further optimize design through physical modelling of critical design components, including elevation, alignment, and cross-section of artificial barrier, north and south headlands, outlet geometry, and offshore rock shoals/artificial reefs. 5) Assess available water depths, substrate, exposure, and circulation throughout marsh to support development of wetland restoration plan. 6) Review potential sources of sediment for barrier restoration and develop beach nourishment plan. 7) Assess construction feasibility. 8) Seek funding for Phase 3 final design, Phase 4 tender/construction, and Phase 5 adaptive management and long-term monitoring.	1) Project communications (continued) 2) Complete detailed design of project elements including: a) North and south hardpoints; b) Artificial barrier beach / buried rock berm; c) Permanent Outlet; d) East dyke reinforcement with armour stone headlands and new pocket beach; e) Submerged rock shoals; f) Habitat islands and training structures for river discharge; g) Submergent and emergent aquatic vegetation; h) Pothole creation and sediment placement against Road 1 dyke; 3) Develop construction-ready drawing set, restoration plan, and specifications; 4) Material volumes and cost estimate 5) Develop adaptive management plan; 6) Secure permits and approvals from all relevant agencies including ERCA, MNRF, DFO, Municipality.	1) Tender packages will be prepared to secure quotations for the various phases of construction and restoration. 2) Secure contractors and commence construction with appropriate oversight. 3) Once heavy/civil construction is complete, marsh restoration can commence. This would be a multi-year effort.	1) Implement adaptative management plan during construction. 2) Ongoing monitoring of all project components.
Budget Estimate	$0.25 million (funded)	$0.5 million (funded)	$0.5 - $1.0 million	$0.5 - $1.0 million	Unknown (> $10 million)	$0.5 million/ 5 years

9.0 Community Engagement

In Fall 2023, ERCA conducted a series of public consultation and community engagement efforts to promote awareness of the Hillman Marsh Conservation Area Restoration Plan, with a goal to engage, inform and seek feedback from neighbouring landowners and the broader community. These efforts began through the launch of a project website, which provided an overview of HMCA's historical context, challenges, and threats, as well as the project's objectives, collaborative partners, and available resources. This website introduced a community feedback form that provided the opportunity for project feedback while also gathering information such as the users' municipality of residence (Fig. 33), user group identification (Fig. 34), and the frequency of their visits to Hillman Marsh (Fig. 35).

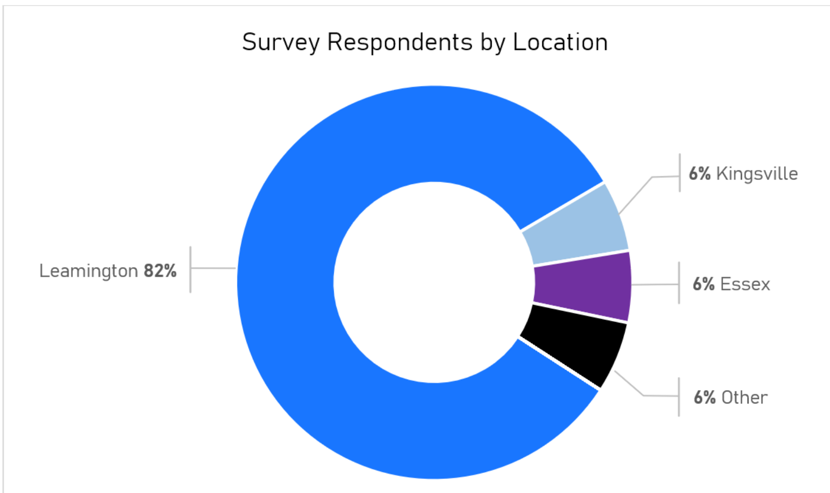


Figure 33: Survey responses for municipality of residence.

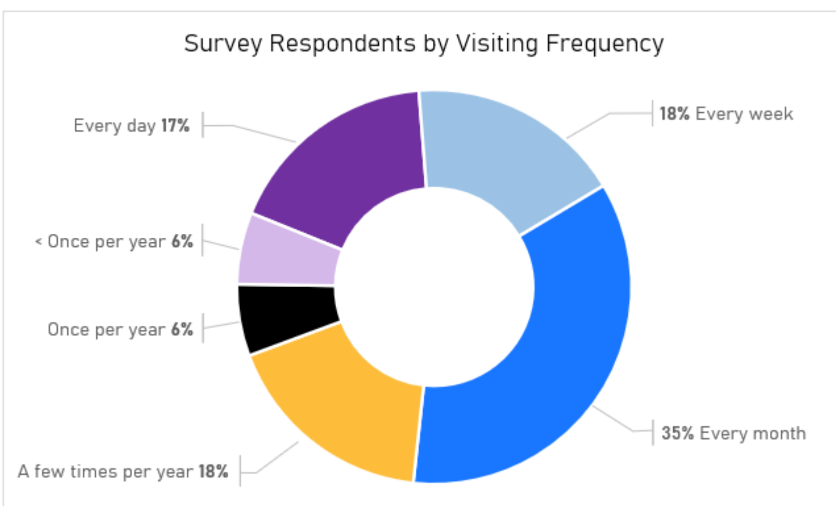


Figure 34: Survey responses for visiting frequency.

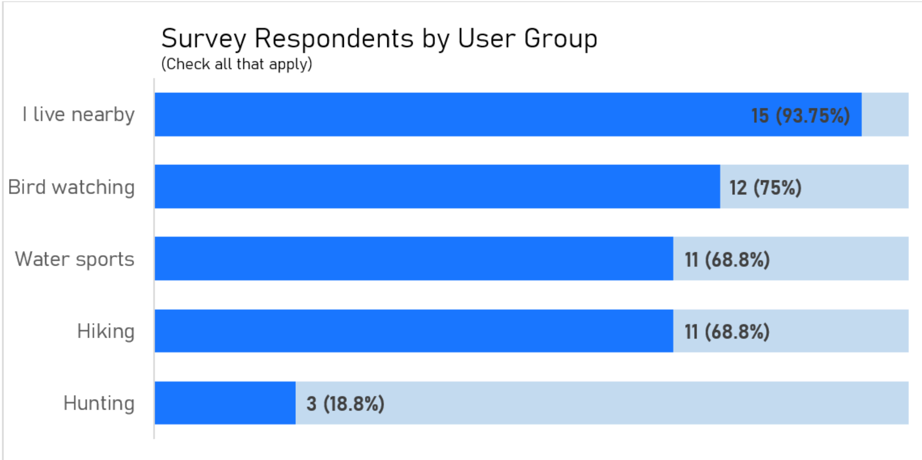


Figure 35: Survey responses for user groups.

The main source of engagement with the community occurred during public consultation meetings, which drew approximately 60 participants. Two evening sessions were conducted on October 3rd and 10th at the Nature Fresh Farms Recreation Centre and were open to the public. The local community was informed of the events three weeks prior through targeted mailing (flyers sent to 3000 homes, farms, and businesses within a 5 km radius of Hillman Marsh), social media (posted 5 times on ERCA's Instagram, Twitter, and Facebook accounts leading up to the event), a press release (sent out to 55 different media outlets, newspapers, and journalists), ERCA's website, and through an advertisement in the main lobby of the Nature Fresh Farms Recreation Centre. Various newspapers and news stations picked up the story and advertised it as well (Fig. 36). Interviews were conducted with AM 800, CBC News, and CTV News, and Windsor News Today, Yahoo!, and Penticton Herald published articles based on the information available on ERCA's website, these are available in the references list. The meetings featured informative posters and a presentation outlining the proposed restoration concepts that had been previously developed. Attendees were encouraged to ask questions, provide feedback, or express any concerns. These concerns will be thoroughly reviewed and considered in the decision-making process. A full list of community feedback can be found in the Appendix.

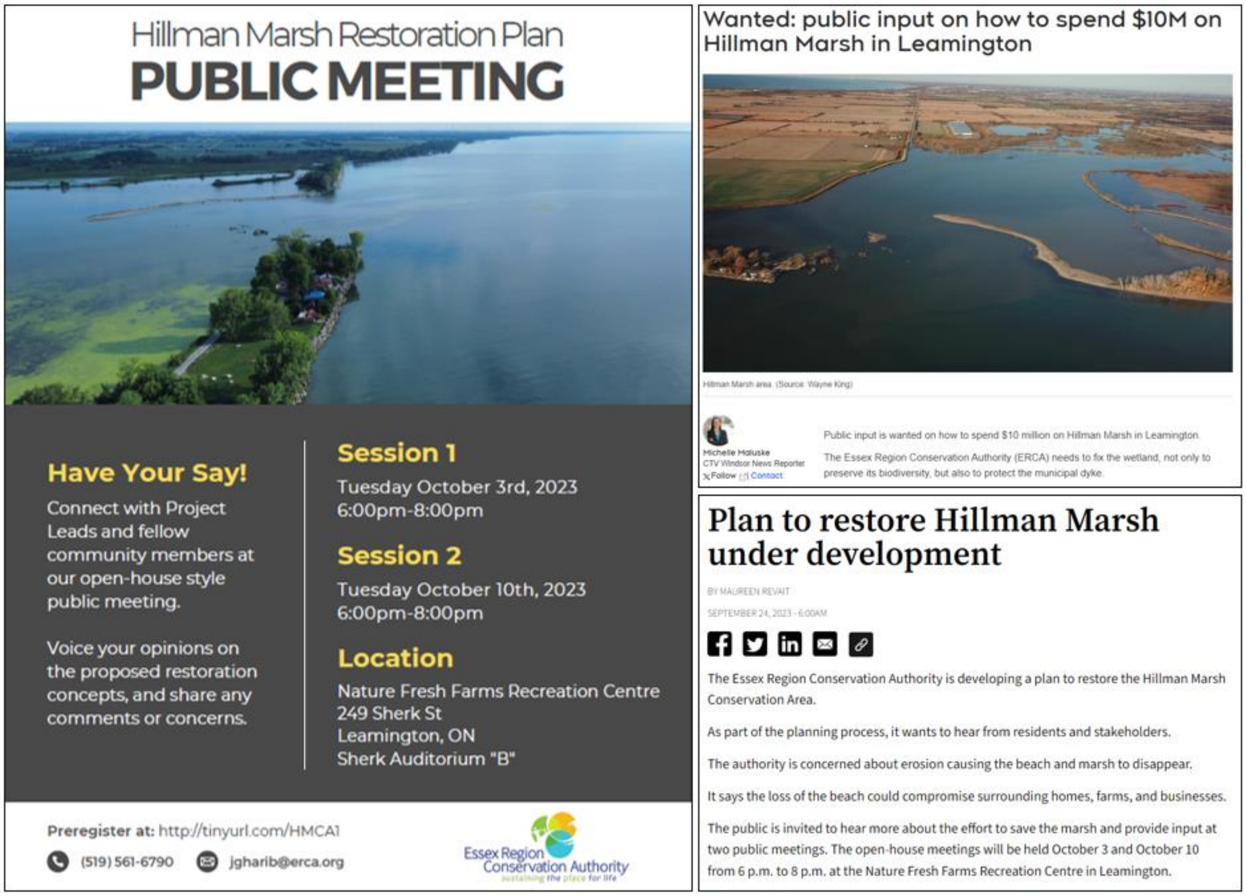


Figure 36: Examples of advertisements for the public consultation meetings.

10.0 Conclusion

Hillman Marsh exists on a shoreline that has been eroding for centuries, even prior to the European Settlement. Coastal infrastructure at Wheatley Harbour was constructed without a sufficient understanding of its impacts on coastal processes, and shoreline armouring was subsequently constructed to protect development from coastal erosion and flooding. Although armouring provided residential protection, it has negatively impacted the natural supply of sediment that nourished and maintained the downdrift shoreline, including the Hillman Marsh barrier beach.

Over time, this limited sediment supply has resulted in a narrow, low-lying barrier beach that is highly susceptible to breaching and overwash processes. In 2017, harsh lake conditions resulted in significant erosion and the initiation of a storm-induced breach. Record high lake levels and storms, coupled with near record low ice cover in the following years resulted in the rapid expansion of the breach to almost 500 metres, leaving Hillman Marsh exposed to the forces of Lake Erie and highly vulnerable to current and future climate change impacts. Due to the limited availability of sediment, the barrier beach has not been able to naturally recover, even as water levels have dropped. This lack of recovery leads to further erosion and barrier retreat, subjecting the sensitive and vulnerable ecosystems in the marsh to altered water quality, disturbed habitat, and the intense conditions of Lake Erie. Without the barrier beach as a buffer, flooding threatens hundreds of surrounding homes, businesses, and farms that are all below lake level.

With the research and data presented in this report, ERCA advises moving forward with Concept A for the restoration of Hillman Marsh. Numerical and physical modelling will be conducted by engineers to test the possibility of a structure that has variable crest elevations. If areas of both high and low crested barrier beach can be accommodated without compromising the wetland, then it will provide for a more biologically diverse project and will be pursued. It is recommended that data collection continues on water quality and bathymetry to strengthen the existing datasets and allow for confident and accurate interpretation and decision making. A long-term monitoring plan will be developed to allow for continuous assessment of project outcomes and impacts, and for tracking of key performance indicators and goals. An adaptive management plan will complement this, by providing a framework for incorporating new techniques or adjustments based on new data, unforeseen changes, and stakeholder and community feedback. Upon approval from the Board of Directors, further funding will be sought to begin numerical and physical modelling, and eventually commence construction.

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Appendices

Appendix A: Logic Model

Table 4: Logic model for first goal of Restoration Plan.

<table>
<tr><th colspan="2">Goal #1</th></tr>
<tr><th colspan="2">Employ a transformational adaptation approach to restore and enhance the Hillman Marsh barrier beach feature to withstand climate change extremes, protect the wetland ecosystem, and safeguard homes and businesses, while permitting natural sedimentation in the restored beach processes, and limited wave overtopping during high lake levels.</th></tr>
<tr><td>Recommended Actions</td><td>Facilitate meetings with Steering Committee to share expertise on coastal geomorphology, coastal management, wetland ecology, and ecosystem restoration.
Complete literature review of previous management and restoration plans to assess successes, failures, and lessons learned.
Contract a coastal engineer to provide restoration and adaptation recommendations and technical guidance.
Secure necessary permits and approvals.
Collect historical data (meteorological data, wave data, aerial imagery, shoreline retreat) and complete new data collection (topo-bathymetric surveys, water quality monitoring).
Begin improvements to south headland, including anchor that will eventually support the artificial barrier.
Use numerical modelling of waves, hydrodynamics, sediment transport, flows, and lake levels to inform climate change adaptation and structural design.
Use physical modelling to replicate design and nearshore conditions, to optimize and finalize the design of the artificial barrier.
Review potential sources of sediment for barrier restoration and develop beach nourishment plan.</td></tr>
<tr><td>Recommended Outputs</td><td>A written restoration plan that includes:
Details and background information on Hillman Marsh
Historical and current trends
Current viability/condition
Problem formulation
Goals, objectives, actions and targets
Potential constraints for adaptation options
Vision of desired state and success in collaboration with the steering committee
A technical design of a protective barrier beach feature.
Reconstructed and improved design for south headland at E Beach Rd.</td></tr>
</table>

	• Reconstructed artificial barrier beach with an effective sand nourishment plan that can withstand future lake levels and storm events.
Short-term Outcome	• Increased understanding and awareness of current and desired state of the Hillman Marsh Conservation Area by local community and Great Lakes community. • Barrier and vegetation loss at HMCA is addressed by federal, provincial, and municipal government. • Preferred option is brought forward to the board of directors for approval.
Mid-term Outcome	• Federal, provincial, and municipal governments provide resources to develop plans and commence construction on South Headland repairs and artificial barrier structure. • Efficient sand nourishment plan is developed and is put in place. • Artificial barrier is constructed.
Long-term Outcome	• Artificial barrier beach is revegetated and can withstand climate change impacts. • Post-implementation and long-term monitoring commence. • Design is optimized based on any noticed discrepancies.

Table 5: Logic model for second goal of Restoration Plan.

<table>
<tr><th colspan="2">Goal #2</th></tr>
<tr><th colspan="2">Restore the wetland plant community within the approximate 115 hectares of open water behind the barrier feature to enhance wetland structure, function, diversity, and resilience to climate change impacts using historical records and expert opinion.</th></tr>
<tr><td>Recommended Actions</td><td>Facilitate meetings with Steering Committee to share expertise on coastal geomorphology, coastal management, wetland ecology, and ecosystem restoration.
Complete literature review of previous management and restoration plans to assess successes, failures, and lessons learned.
Contract a coastal engineer to provide restoration and adaptation recommendations and technical guidance.
Secure necessary permits and approvals.
Collect historical data (meteorological data, wave data, aerial imagery, shoreline retreat) and complete new data collection (topo-bathymetric surveys, water quality monitoring).
Draft and finalize wetland restoration concepts with input from the Steering Committee, Rights Holders, and Stakeholders (planting of vegetation, habitat islands, fish refugia).
Monitor, evaluate, and share project outcome, lessons learned, and next steps.
Alter bathymetry of marsh to create vegetation zones to optimize types of vegetation planted.
Optimize and finalize the planting strategy using appropriate species and physical conditions (bottom profile, substrate, circulation) and features (rock shoals, islands, channels, and potholes).</td></tr>
<tr><td>Recommended Outputs</td><td>A written restoration plan that includes:
Details and background information on Hillman Marsh
Historical and current trends
Current viability/condition
Problem formulation
Goals, objectives, actions and targets
Potential constraints for adaptation options
Vision of desired state and success in collaboration with the steering committee
A wetland restoration plan for the marsh including patterns and zones for revegetation.
A restored wetland plant community that is resilient to climatic disturbances and shocks.</td></tr>
<tr><td>Short-term Outcome</td><td>Increased understanding and awareness of current state of the wetland by local community and Great Lakes community.</td></tr>
</table>

	• State of wetland is addressed by federal, provincial, and municipal government. • Preferred option is brought forward to the board of directors.
Mid-term Outcome	• Federal, provincial, and municipal governments provide resources to develop plans and commence wetland restoration. • Restoration efforts begin after artificial barrier is constructed and marsh is secluded from Lake Erie influence. • Vegetation plugs are planted and successfully protected from carp disturbance.
Long-term Outcome	• Marsh supports a diverse range of species and submerged aquatic vegetation is re-established. • The marsh is more resilient to future climate change impacts. • Post-implementation and long-term monitoring commence. • Design is optimized based on any noticed discrepancies.

Table 6: Logic model for third goal of Restoration Plan.

Goal #3	
Make the restored and enhanced Hillman Marsh ecosystem accessible to all of society and future generations to enjoy.	
Recommended Actions	• Hold public information/consultation sessions. • Develop community engagement strategy with goals, tactics and timelines. • Design and construct a new parking lot. • Design and construct a kayak launch.
Recommended Outputs	• Written community engagement strategy with objectives, targets, timelines, and anticipated outcomes. • Reconstruction of barrier beach that includes a parking lot, kayak launch, and other amenities.
Short-term Outcome	• Local community is aware that plan is being developed to restore and enhance Hillman Marsh and increase property protection. • Local community has the opportunity to attend information sessions and provide feedback both in person and through an online survey on ERCA's website.
Mid-term Outcome	• Construction and enhancement of South Headland makes E Beach Road safer and more stable, allowing for the construction of a parking lot and other amenities.
Long-term Outcome	• Completed barrier feature allows for community access to the beach and marsh. • Restored barrier beach and marsh allows for revegetation and repopulation of various species, allowing the community to enjoy nature and bird watching.

Appendix B: Public Consultation Results

Table 7: All comments and questions from public consultation meetings and feedback forms.

<table>
<tr><th colspan="2">Public Consultation Results</th></tr>
<tr><th colspan="2">Session 1: Tuesday, October 3, 2023</th></tr>
<tr><td>Questions</td><td>Can barrier be built up if low crested option is chosen but doesn't work out?
What is the size of the outlet?
Why is the barrier curved not straight?
Why can't jetties just be placed along the shore?</td></tr>
<tr><td>Comments</td><td>Wheatley Harbour jetty should be deconstructed, change public launch site.
Perhaps there is an opportunity to take material from the marsh for barrier building.
Permanent outlet:
Concern towards lake influence on marsh.
Consider a water tunnel under the beach instead of above water.
How can we ensure the channel doesn't get plugged up with sediment.
North end of the beach should be hardened sooner – instead of being included in the later parts of the project.
Past trough digging may have resulted in the magnitude of this breach.
Parking lot should be reinstated.</td></tr>
<tr><th colspan="2">Session 2: Tuesday, October 10, 2023</th></tr>
<tr><td>Questions</td><td>If Wheatley's sediment trapping issue is fixed, where will we get our sand? How do we know we'll have enough sand?
Is this project using municipal tax dollars?
What stops waves from continuing to erode this artificial barrier?
What slope is being used for the pilot section of the beach?
How much erosion have we seen on road 1 dyke?
Are we paying attention to the impacts/benefits this will have on surrounding shorelines?</td></tr>
<tr><td>Comments</td><td>A lot of the construction projects have a lot of soil that they need to get rid of, maybe the rock core could be topped with some soil as well as sand. May be more stable this way.
Permanent outlet:
Outlet for drainage is a good idea, marsh could be prone to flooding otherwise.</td></tr>
</table>

	◦ The outlet should be moved further south on the barrier, if we leave it where it is now, southerly winds will bring waves through and it can result in more wave agitation. ◦ Outlet should follow natural water flow, where breach is now. • Sand from Leamington Harbour can potentially be used for sand nourishment in the future.
Written/Online Feedback Form Comments	
Would you like to say anything about your connection to Hillman Marsh?	• I grew up on Concession 1 Farm from early 1960's (by present day airport) and have seen many concerning changes in Hillman Marsh. • I have been coming to Hillman Marsh for 20+ years. • It is a special place and needs human intervention or we are going to lose it. • It is a wonderful place to enjoy outdoor activities, watch birds, and go for bike rides. • It would be a great loss not to protect it for future generations. We often enjoy going with our two little girls for canoeing, biking, and swimming. They have known this place since they were born, and enjoy coming back here every time. • I live in Chatham-Kent but Leamington area has been a home and place of work for me for over half of my 71 years - including a couple years on Pulley Rd. It does deeply concern me that so much heritage has been lost and hope for many more projects such as this.
Do you have any comments or feedback regarding this project?	• Definitely worth the effort and money to save this valuable habitat. Hopefully it will be restored quickly as the weather won't wait and is relentless. Looking forward to visiting more. • Excellent presentation. Need to take action now. • Concept A first choice. Then B or C. • First Nation consultation needed. • The will seems to be there to make this restoration project happen. I hope that the money is there to do so. Best of luck! • Back in ~2008, ERCA issued a report indicating that the main reason for sand depletion along Hillman Marsh and Point Pelee coastline, was due to Wheatley Harbour. As indicated, the extended groin at Wheatley Harbour blocks much of the sand migrating down from the eastern coastline. I agree with this report since I have seen on many occasions whereby the east side of the harbour is being dredged for sand build-up. I would have expected the proposed restoration project to specifically

	address this problem, which is a primary root cause of the sand barrier beach being depleted and thus breached. • I observed in the past significant blue/green algae present in Hillman Marsh. This algae is due to herbicide run-off from the local farms that originates upstream at Hillman and Lebo creeks. Prior to the barrier beach being breached, the marsh habitat suffered greatly from these chemicals. Now, with the influx of clean Lake Erie water, the marsh habitat has been greatly improved as can be seen with the greater diversity of fish and bird species. If the barrier beach is restored as planned, then one would expect the blue/green algae to immediately return. This too must be addressed in the project. • This extremely important wetland has been neglected for many years. Hopefully, this is a lesson on the importance of maintenance and the on-going cost of doing so, versus delaying action until it is too late, when the cost to rectify is much higher. • I am encouraged that a Steering Committee is finally being assembled to address this fragile ecosystem. • Everyone needs to come together, and Government Agencies need to commit to funding to complete this effort and show what can be done, so other areas in Canada and the world can follow suit. We have a chance to create a huge success here in Leamington and become an example of what is possible. • I prefer Concept A. It is not clear in the proposal what material would be used to build the barrier beach above the barrier rock berm. Several people I have spoke to indicated they heard at the meeting that it would be built entirely out of sand. If that is the case, it would be a good practice to cover the buried rock berm with clay soil then top it off with sand. That would provide a better soil composition for healthy vegetation regrowth. • I would hope any repairs or updates encompasses the health of the whole shoreline to replenish sand to protect not only the Conservation Area, but Point Pelee National Park and the shoreline that connects both. Moving the sand dredged from Wheatley Harbour to Hillman enables the sand to move along it's natural course and seems to be making a big difference. • I have a cottage at Marentette Beach, and we've often kayaked to the marsh. I hope that this project is successful. • Very happy to hear about this project.

Appendix C: Risk Assessment

This section presents the results of an Environmental Risk Assessment conducted to evaluate potential hazards involved with the construction phases of this project. Likelihood and severity were ranked for each factor, and a final risk rating was assigned from low, low-medium, medium, medium-high, and high.

		Severity				
		Negligible	**Minor**	**Moderate**	**Significant**	**Severe**
Likelihood	**Very Likely**	Low Med	Medium	Med High	High	High
	Likely	Low	Low Med	Medium	Med High	High
	Possible	Low	Low Med	Medium	Med High	Med High
	Unlikely	Low	Low Med	Low Med	Medium	Med High
	Very Unlikely	Low	Low	Low Med	Medium	Medium

Figure 37: Scoring chart for each risk based on likelihood and severity of the event.

Table 8: Results of Environmental Risk Assessment for project construction.

Risk	Mitigation	Likelihood	Severity	Risk Rating
Water pollution due to chemical/oil spill or unclean equipment entering the marsh.	- In-water works to be kept to a minimum. - Refueling will take place at a sufficient distance from the waters edge. - Contractor is responsible for cleaning all equipment of oil, grease, and fuel. - Spills of deleterious substances into waterways and on land will be immediately contained and cleaned up by the contractor in accordance with Provincial regulatory requirements	Unlikely	Significant	Medium Risk
Air pollution from construction (smog, dust, emission of fumes).	- Contractor to control emissions and abide by local authorities' emission requirements.	Very Likely	Minor	Medium Risk
Noise pollution for nearby residents from machinery and moving of materials.	- Contractor will abide by local noise by-laws (51-18) for duration of the works. - Work between 7:00am and 9:00pm, excluding Sundays and Holidays in which the window is 11:00am to 4:00pm.	Very likely	Negligible	Low-Medium Risk
Unintentional introduction of invasive species from equipment.	- Contractor responsible for inspection and cleaning of all machinery and equipment prior to arrival. - Contractor to ensure that no clods of dirt are visible after wash down, and that radiators, grills, and the interiors of vehicles are free of accumulations of seed, soil, mud, and plant materials parts including seeds, roots, flowers, fruit, and or stems.	Unlikely	Moderate	Low-Medium Risk
Unintentional death of fish, or harmful alternation, disruption, or destruction of fish habitat.	- Contractor to work in DFO's prescribed timing window for in-water work to protect fish, including their eggs, juveniles, spawning adults, and/or the organisms upon which they feed. - Minimal in-water work will take place.	Very Unlikely	Significant	Medium Risk

Disturbance or destruction of wildlife and wildlife habitat.	- Disturbance or destruction of wildlife to be avoided where possible. - Proper mitigation measures to ensure area is cleared.	Very Likely	Severe	High Risk
Disturbance or destruction of vegetation.	- Disturbance or destruction of vegetation to be avoided where possible. - Appropriate measures taken to restore vegetated areas to their pre-construction state.	Very Likely	Severe	High Risk
Improper use, handling, storage and/or disposal of waste and hazardous materials.	- Contractor to comply with WHMIS. - Contractor to dispose of all waste materials in a legal manner at a site approved by all local approving authorities and the Engineer.	Very Unlikely	Minor	Low Risk
Damage to residential, municipal, or ERCA owned property.	- No equipment, construction materials, excavated materials or waste shall be left on site after completion of the works unless directed by Owner. - Contractor is required to utilize one of the two specified haul routes.	Very Unlikely	Negligible	Low Risk
Land degradation/ disturbance that would make soil susceptible to erosion.	- Contractor to monitor the weather several days in advance to ensure that works are conducted during favourable weather conditions, avoiding high flow/currents, wet, windy, and rainy periods that may increase risk of erosion, sedimentation, or heightened turbidity.	Very Likely	Moderate	Medium-High Risk
Water quality impairments as a result of increased turbidity and suspended sediment.	- Contractor to monitor the weather several days in advance to ensure that works are conducted during favourable weather conditions. - Sediment curtain to be installed to limit turbidity in areas of wetland revegetation. - Adjustment of operations to produce lower turbidity levels (waiting for more favourable conditions or undertake additional mitigation measures).	Unlikely	Minor	Low-Medium Risk