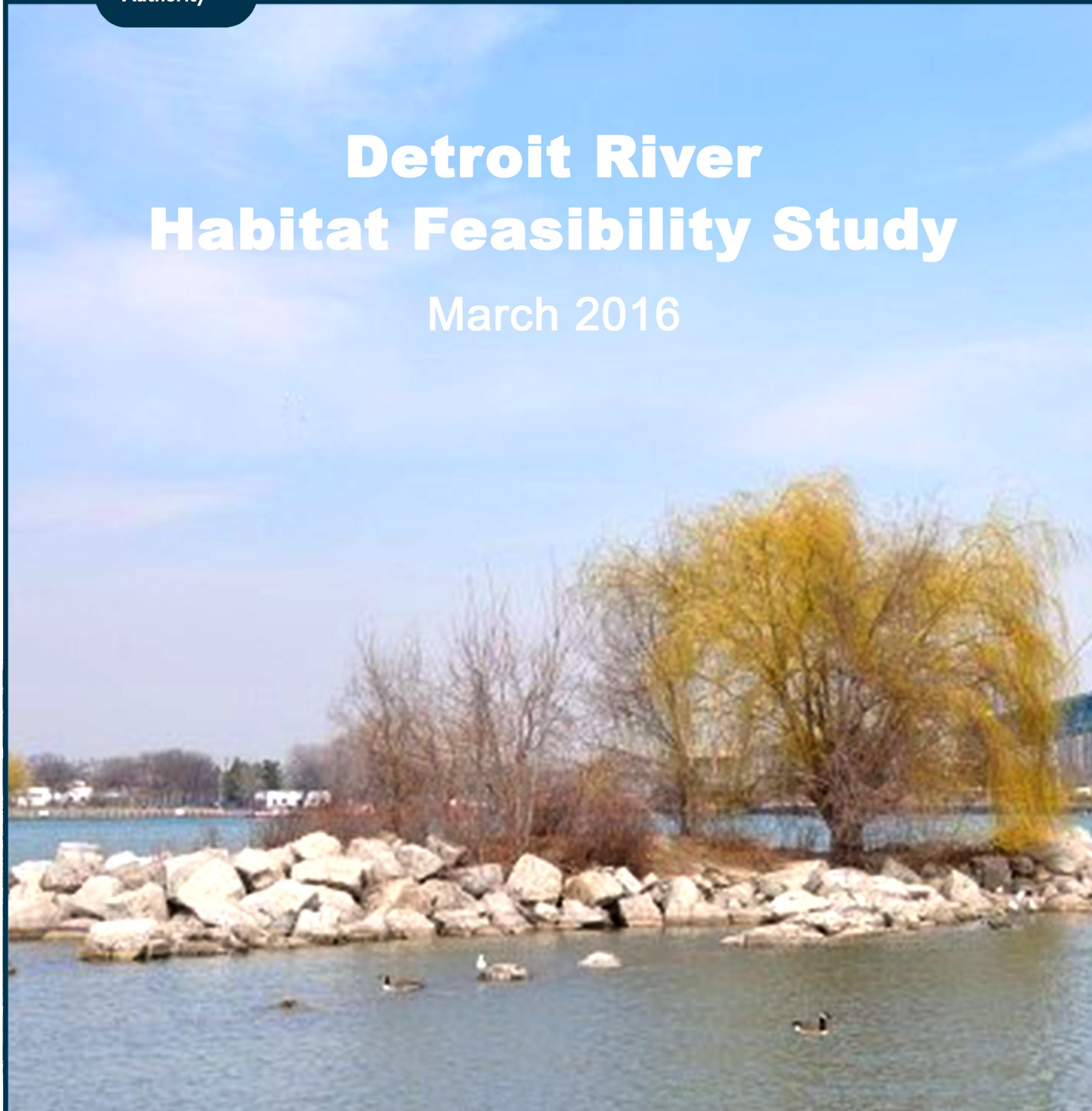
Essex Region Conservation Authority

Detroit River Habitat Feasibility Study

March 2016



Detroit River Habitat Feasibility Study
Summary Report

for the
Essex Region Conservation Authority

A. Background Info

Landmark Engineers Inc. (hereafter Landmark) was retained by the Essex Region Conservation Authority (hereafter ERCA) on behalf of the Habitat Work Group for the Detroit River Remedial Action Plan, to undertake a feasibility assessment of seven (7) potential habitat creation sites within the Detroit River Area of Concern (AOC). This study was intended to serve as the first step toward addressing the habitat-related beneficial use impairments (BUIs) that were identified in the Stage 2 Remedial Action Plan for the Detroit River AOC. It is anticipated that the information presented herein will help to guide restoration efforts aimed at achieving the delisting criteria for both the *"Loss of Fish and Wildlife Habitat"* and the *"Degradation of Fish and Wildlife Populations"* BUIs.

In carrying out this assignment, Landmark has reviewed and compiled all of the information from the Ministry of Natural Resources and Forestry's (MNRF) Summer 2015 Field Survey of the candidate sites. Landmark has also reviewed and compiled the relevant information provided by the Department of Fisheries and Oceans (DFO) with regard to the bathymetry and hydraulics of each site. This information was used to help assess the physical, ecological, and economic feasibility of undertaking actions to create aquatic habitats with the Detroit River.

The general objectives of this feasibility study assessment were:

- to examine and assess the non-biological aspects of developing the candidate habitat sites; and,
- to determine the overall feasibility of developing the sites from a physical habitat, hydrographic, cost, and navigational perspective.

B. Candidate Habitat Creation Sites

This study looked at seven (7) separate potential habitat creation sites along the Detroit River; specifically, two (2) at Peche Island, three (3) at Fighting Island, one (1) at Boblo Island, and one (1) at the Old Boblo Dock in Amherstburg. The site locations are depicted in Figure 1.

The location, description, and restoration opportunities at each site (as provided by ERCA) are listed in the table below:

Site Name	X	Y	Location Description	Restoration Opportunity	Proposed Benefits
Peche Island: Site 2	341,164	4,690,224	North of Island	Construct series of breakwaters in shallow water are north of island	Induce establisment of aquatic vegetation providing spawning & nursery areas
Peche Island: Site 4	341,563	4,689,976	Inner Canals	Open island's inner canals; construct small current deflector at mouth	Improve water quality and reduce sedimentation
Fighting Island: Site 4	324,686	4,675,438	Western shore @ south most disposal cell	Construct current deflector at northern point of site and extend 200m into river; construct off-shore islands in cell water created by current deflector	Create open water wetland
Fighting Island: Site 5	324,645	4,674,226	Western shore and southernmost disposal cell	Series of off-shore islands in area of shallow water shelf	Create open water wetland
Fighting Island: Site 6	325,039	4,673,183	South end of Island	South end of island: reconstruct historical islands previously lost due to wave action	Create open water wetland
Bois Black (Boblo) Island: Site 3	324,865	4,662,523	Cove on east side of Island	Expand existing break wall by installing large boulders; construct similar breakwater to the south of the existing dock	Protect cover from wave anc current in the main river; induce aquatic vegetation to establish and provide for increased spawning & nursery areas
Amherstburg Old Boblo Dock	325,253	4,661,443	East shoreline	Treatment type unknown. Consultant to recommend treatment.	

C. Background Information

The technical information needed to complete this study was obtained from a variety of sources including:

- Environment Canada (EC)
- Ministry of Natural Resources and Forestry (MNRF)
- National Oceanic and Atmospheric Administration (NOAA)
- Fisheries and Oceans Canada (DFO)
- Essex Region Conservation Authority (ERCA)

Bathymetric data was provided by EC. The data was provided in a digital elevation model (DEM) format that was assembled from bathymetric data collected by Canadian Hydrographic Service (CHS) and National Oceanic and Atmospheric Administration (NOAA), and Light Detection and Ranging (LiDAR) data from Natural Resources Canada. This information was supplemented with commercially-obtained BlueChart information and water depth measurements that were recorded during field studies completed by ERCA and MNRF staff. Substrate and fish population data from the MNRF's Summer 2015 Field Survey of the Detroit River was obtained through ERCA.

The original 1993 MNRF concept plans for Potential Habitat Rehabilitation / Enhancement sites on the Detroit River were obtained from MNRF through ERCA. River velocity information was obtained from EC. This information, which was provided in text and graphic formats, was developed using hydraulic modeling techniques.

D. Site Baseplans

In order to create a baseplan for each of the candidate sites, bathymetric data was required to create a model of the river bottom. The following sources of data were used to create the bathymetric models:

1. Sounding data provided by DFO;
2. Water depths recorded during MNRF site surveys;
3. Commercially-obtained Navigational BlueCharts;
4. High resolution aerial photos obtained through ERCA; and,
5. Water level information from gauges on the Detroit River obtained through the NOAA website.

The information received from DFO was brought into the baseplan and reviewed for discrepancies. Based on our review and our familiarity with the subject sites, it appeared that the bathymetric data in the nearshore areas (where most of the habitat restoration works will be located) did not accurately represent the actual site conditions. Through discussions with DFO staff, it was confirmed that the sounding data was reliable in close proximity to the shipping channel (i.e., in the deep water areas) and was less accurate toward the shorelines. It was therefore decided to make use of the DFO data to model the bathymetry of the shipping channel adjacent to each of the subject sites, and to supplement this data from other available sources to model the shallow water nearshore areas.

For each site, the water depths recorded by MNRF staff during the Summer 2015 Field Survey were converted into bathymetric elevations by determining the water level elevations at the time the water depths were recorded (from the Detroit River gauges on the NOAA website). These points were then brought into the model.

Commercially-obtained navigational BlueCharts were also downloaded for each site. The images were brought into AutoCAD and scaled to the size of each site. Elevation points were added for each water depth present on the chart. The combination of points from the navigation charts and the MNRF water depths were used to create a 3D model in AutoCAD. The DFO data was used in the deeper areas as a boundary for the 3D model.

High resolution aerial photos were also brought into each baseplan and the approximate water's edge was traced around each island and/or shoreline. Based on the date that the aerial photos were taken, an approximate water level could be determined and the corresponding elevation was applied to the water's edge line. This line formed the shoreward boundary for the 3D model.

E. Design Considerations and Site Analysis

The following summarizes the key design considerations that govern the technical feasibility of the proposed habitat enhancements:

- Water Depth / River Bottom Elevations
- Water Level Fluctuations
- River Current and Flow Velocities
- Wave Climate

- Commercial and Private Vessel Navigation
- Soil Conditions

Each of the seven sites was evaluated based on the above-noted considerations and criteria. The site analysis and evaluation process is described in more detail below:

i) Water Depth / River Bottom Elevations

Representatives of the Habitat Work Group were consulted in order to establish a suitable water depth for the habitat enhancement areas. A target depth of 600mm at low water level was selected. Alternative alignments for the proposed perimeter protection works were developed and evaluated on this basis.

In addition to impacting the function of the habitat enhancement works, water depths also have the potential to influence constructability. It is significant to note that the subject sites are not accessible to land-based construction equipment. Therefore, any construction will need to be undertaken from barge-mounted construction equipment. Furthermore, significant economies may be realized by bulk transporting construction materials via barge to the proposed enhancement sites. Our evaluation of alternative alignments for the habitat enhancement works took into consideration the draft requirements of the transport vessels.

A sample of the river bottom contours that were developed for this study is provided in Figure 2. Existing bottom contours are presented on all the concept plans.

ii) Water Level Fluctuations

Water levels on the Great Lakes change seasonally each year. A review of historic water levels on the Great Lakes illustrates the dramatic extent to which water levels can vary over longer periods.

Short-term changes are generally of greater magnitude than the monthly averages. Short-term fluctuations frequently occur due to storms or ice jams, lasting from a couple hours to several days - and can be very dramatic. Lakes such as Lake Erie that have an east-west orientation experience the most drastic fluctuations due to prevailing west winds in the area. Water levels on the Detroit River, particularly the central and lower segments of the river, are profoundly impacted by water levels in the Western Basin of Lake Erie.

Seasonal water level fluctuations average about 300mm to 450mm on an annual basis between the winter lows and the summer highs.

Long-term water level fluctuations occur over a period of consecutive years. Consecutive years of wet or cold weather can cause lake levels to rise, while warm and dry weather over the entire Great Lakes basin causes levels to decline.

In the past century, the total range of water level fluctuation between the maximum and minimum monthly means on Lake Erie has been approximately 1800mm. This level of fluctuation has also been observed on the Detroit River. The issue of water level fluctuations factored into the establishment of the top elevation of some of the habitat features. In particular, the top elevation of sheltering islands was set at an elevation 1m above the approximate maximum monthly mean water level. This elevation also ensured that islands remain above the 1:100year water level.

iii) River Current and Flow Velocities

River currents impact the feasibility of the proposed habitat enhancements in two ways.

First, river currents have the potential to impart erosion forces on any shore protection or perimeter protection structures. In addition to applying tractive erosion forces, the river currents have the potential to deliver flow ice, which can impart damaging forces. These factors need to be given due consideration during conceptual and detail design of any habitat enhancement features.

River current information was obtained from EC and iso-velocity contours were plotted on the site baseplans. River velocity information was provided in to forms – graphical and tabular. A sample of the graphical information is presented in Figure 3.

In order to ensure that river currents do not significantly impact the project (or vise-versa), the habitat areas and associated features should be located in the lowest velocity areas practical. For the purpose of this study, a value of 0.3 m/s was selected as a maximum velocity threshold. All habitat enhancement areas and features will be located in areas with less than a 0.3 m/s river current.

iv) Wave Climate

Proper design of any coastal engineering project requires knowledge of the local wave climate and the selection of a design wave height. The principal objective of the project is to create areas of low current and wave energy in order to promote the propagation of macrophytes in the Detroit River. Accordingly, any new perimeter protection measures would need to sufficiently attenuate wave energy. For the purpose of this study, a simplifying assumption was made that all sites located along the interior of the Detroit River were exposed to waves with heights not exceeding 0.75 m. This assumption is based on a consideration of the findings of prior shoreline management plans that were undertaken for the Essex Region Conservation Authority.

v) Commercial and Private Vessel Navigation

Any works undertaken in the Detroit River have the potential to impact, or to be impacted by, commercial and private vessels from a navigation perspective. A critical component of this study involved assessing the navigability of the habitat sites.

Avoiding impacts to commercial vessel navigation is relatively simple. Provided that a reasonable separation is maintained from the shipping channel, the in-water works will not impact commercial navigation or vise-versa. The location of the commercial navigation channel was determined from the BlueCharts. A sample of the chart information is provided in Figure 4.

Avoiding impacts to the navigation of smaller pleasure craft, including personal watercraft (PWC), is more of a challenge. The introduction of any new shore-detached structures (i.e., sheltering islands, shoals, etc.) will inherently introduce a new navigational hazard to the boating environment and increase the risk of future impacts. Such hazards can be mitigated, but not completely eliminated with the incorporation of navigation aids, separation allowances, and other warning measures into the design.

Measures can be taken to reasonably mitigate navigation impacts and the risk of future impacts, namely:

1. Sheltering islands and shoals should be located in shallow areas of the river that are less accessible to watercraft.
2. The alignment and slope of the outer face of sheltering islands and habitat features should be regular and wherever appropriate, substantially parallel to the existing shoreline.
3. Wherever practical, the alignment of the sheltering islands should enclose existing embayment areas between existing land promontories.
4. Associated habitat features and structures (i.e., armour rock structures) should be situated between the outer face of the sheltering islands and the adjacent shoreline.

Provided the above objectives are generally achieved, the inherent navigation hazards imposed by constructing new features in the river will be minimized to the extent practicable.

vi) Soil Conditions

No geotechnical investigations were undertaken as part of this study. However, along most exposed segments of the Detroit River, bottom characteristics generally consist of a thin layer of sand and gravel underlain by silty-clay or clayey-silt.

For the purpose of this study, based on experience amassed with other projects, it has been assumed that the river bottom in the vicinity of the candidate habitat enhancement sites has sufficient bearing capacity to support proposed works. This assumption should be confirmed during detail design stages.

F. Design Concepts

The study undertook to develop conceptual designs and assess the technical feasibility of implementing habitat enhancements at 7 candidate sites. This section presents the general design approach, the recommended design components that can be implemented, and the concept plans that have been developed for each site.

i) Design Approach

Proper conceptual design of the habitat enhancements required an evaluation of multiple interrelated design parameters, considerations, and criteria - some of which are in direct conflict.

For example, in order to achieve the principle objective of creating calm backwater areas that will promote the establishment and preservation of macrophytes, it will be necessary to construct islands to adequately shelter areas of existing open water. The water depths within the sheltered areas need to be suitably shallow to sustain macrophite growth, accounting for the complete range of long-term water level fluctuations. To achieve this, sheltering islands should be constructed where the river bottom elevation is no more than 600mm below low water datum (chart datum). The fact that shallow areas of the Detroit River are also associated with lower flow velocities is favourable.

However, constructing the sheltering islands in shallower areas of the river significantly complicates the process of construction. In general (with only one exception), the proposed habitat creation sites are inaccessible by land-based construction equipment. Therefore, construction of the sheltering islands and other features will need to be undertaken using barge-mounted equipment. The minimum draft depths of loaded barges (and of the tugboats that maneuver them) require at least 1.8m of water to function properly.

Ideally, from an ease of construction perspective, the sheltering islands should be located in deeper waters, nearer the shipping channels. However, constructing the sheltering islands nearer deeper water increases the potential for boaters to impact the islands. Locating them in deeper water also increases the quantity of materials that would be needed for construction, and the potential for the features to adversely impact river hydraulics.

All of these design considerations needed to be appropriately balanced in the process of developing the design concepts for each site.

ii) Design Components

a) Sheltering Islands

A common element of this habitat creation initiative involves the construction of sheltering islands to effectively cordon off shallow water areas so that submergent and emergent wetland vegetation can be preserved or established and sustained. Two design options for the sheltering islands have been developed.

One option consists of constructing the islands entirely from rock. The design section of this option consists of smaller gabion-sized core material, overlain by a layer of larger filter rock, overlain by a single layer of armour rock. It may be more cost effective to utilize gabion size (100mm and larger) stone for the island core, since gabion stone can be bulk transported by ship to the sites. If there is no cost advantage to using gabion-sized stone, however, then rip rap sized rock can be substituted. A typical cross-section of this design option is provided in Figure ?.

A second option consists of constructing the sheltering islands with an earth fill core. This variation is similar to the all-rock option, except that the island is constructed wider to accommodate the earth fill. The earth fill can be planted with an assortment of vegetation types including grasses, shrubs and trees. Once vegetated, the visibility of the islands will be enhanced - particularly during periods of high water levels. Plan and cross-section drawings that illustrate this design feature are provided in Figures 5 and 6.

b) Rock Shoals

Rock shoals can be constructed between the sheltering islands to enhance wave attenuation during periods of low water levels, and to diversify the river bottom substrates. Inbound waves will shoal and break over these features when water levels are low. During periods of higher water levels, the features will provide less of a sheltering or wave attenuating benefit, but should function as spawning habitat for some fish species. In order to avoid creating a navigation hazard, construction of the shoals should be limited to the areas immediately between the sheltering islands. This concept is illustrated in Figures 5 and 6.

c) Rock Reefs

Rock reefs can be constructed perpendicular to the sheltering islands in order to provide additional habitat. Such structures were constructed at McKee Park in Windsor, which is located immediately downstream of the Ambassador Bridge. It is proposed that the reefs be constructed in sets of three or more. These features are depicted conceptually in Figure 7.

d) *Preliminary Unit Construction Cost Estimates*

For each of the above-noted design components, a unit cost has been estimated. The costs are provided in $/unit. The preliminary unit costs that were used to estimate the construction costs of the design concepts are tabulated and attached to this report.

It should be pointed out that the unit cost for sheltering islands is (in part) a function of the water depth. Islands constructed in deeper waters require a much larger quantity of rock in order to achieve the design top elevation. In order to provide the most utility from this study, we have summarized the typical cost per sheltering islands for a range of water depths. That way, should the selected alignment of the sheltering islands vary significantly from what has been recommended herein, the preliminary cost estimates can be updated to suit.

The unit cost estimates that have been provided account for material costs, transportation costs, and placement (equipment) costs. No allowances have been made for plantings since these costs are relatively minor in comparison to the cost to construct the rock features. As well, except where noted, no allowances have been made for dredging. Should it be desired to alter the river bottom contours behind the sheltering structures, additional construction amounts should be allotted.

iii) Design Concepts

Based on the findings of this study, habitat enhancement works are recommended for each of the seven (7) habitat enhancement sites that comprised the approved study scope. In addition, a conceptual design has been developed for the segment of shoreline along the northeast shore of Peche Island.

For most of the habitat sites, more than one design variation is provided. The alternatives vary in terms of the proposed alignment of the sheltering islands. The calm water area that is protected by each alternative alignment varies significantly and is summarized on the concept plan. For comparison purposes, the proposed alignment of the sheltering islands as envisioned original 1993 MNRF concept plans is depicted.

In order to simplify the presentation of the concepts, the proposed alignment of the sheltering islands is depicted rather than the individual island. This was done in recognition that the final selection of the mix of island types and shoal locations is flexible and can be made at the final project scoping or detail design stage. In order to illustrate the total impact of the island construction, the width of the islands that would result from the alignment is depicted with a grey shaded border. It is important to note that it is not intended that a continuous berm be constructed along the alignments.

Furthermore, since the purpose of this study was to explore technical feasibility, the location of the reefs has not been depicted on the individual concept plans. It would be more appropriate to make a final selection of the specific habitat enhancement components that will be constructed at each site at the stage of final project scoping or detail design.

In order to present the approximate cost of undertaking a general assumption was made that both types of sheltering islands would be constructed at each site at a ratio of two Type 1 berms for every one Type 2 berm.

The following sections of this report provide a brief description of each concept plan.

a) Peche Island Site 2

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Two optional alignments are depicted. The principal difference between the options is the proposed alignment of the sheltering islands, which has been varied substantially in order to illustrate the sensitivity of the construction cost and area of habitat created that result from varying the alignment.

The overall length of the perimeter protection (sheltering island alignment), area of habitat created, number of units of each habitat feature, and estimated construction cost is tabulated in this concept plan, and the other concept plans.

b) Peche Island Site 4

The objective of the habitat enhancements at this site is to improve water quality within the network of canals that exist throughout the island. The recommended concept consists:

- constructing a hooked groyne at the mouth of the historic inlet;
- enclosing the remaining inlet with a rock berm constructed entirely from coarse armour rock; and,
- dredging/excavating the accumulated sand from the historic channel to restore flow.

The intent of the design is to re-establish the historic inlet and to construct protective structures to prevent the inlet from fouling with sand and gravel in the future. The hooked groyne will deflect and littoral sediment past the inlet. In order to reduce the rate of flow through the inlet, an armour rock berm should be constructed across the mouth of the inlet. In addition to throttling flow the rock berm will prevent flotsam from entering the inlet.

The rock berm will be substantially permeable which will allow some river water to flow through the inlet. Flow will be induced by the natural hydraulic gradient of the river.

c) Peche Island – Northeast Shoreline

This site was not included in the original scope of the study. However, over the course of the study the benefit and prospect of implementing a combined erosion protection and habitat enhancement project at the northeast shoreline of the island was explored. The recommended concept consists of:

- constructing a series of offshore island or headlands along the shoreline;
- constructing small shore-connected groynes at the extents of the subject shoreline; and,
- nourishing the shoreline with a sufficient quantity of beach pebble or gravel to sustain a gravel/pebble beach in a pocket beach tombolo formation.

The intent of the design is to mitigate further erosion of the shoreline in a manner that enhances fish habitat. The offshore islands will partially shelter the shoreline from the local wave climate and promote the establishment and maintenance of a series of pocket beaches. There is insufficient existing littoral material to establish a sustainable beach profile. Therefore, it is recommended that the beach be nourished sufficiently. Instead of sand, the nourishment material should consist of fine gravel in order to sustain a steeper beach profile.

d) Fighting Island Site 4

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Two optional alignments are depicted. Again, the principal difference between the options is the proposed alignment of the sheltering islands, which has been varied substantially in order to illustrate the sensitivity of the construction cost and area of habitat created that result from varying the alignment.

At the south limit of the site, the alignment of the sheltering islands is deflected or returned to the east in order to substantially close the south end of the site. If the project is combined with the works at Site 4, then the return can be eliminated.

e) Fighting Island Site 5

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Again, in order to illustrate the sensitivity of the construction cost and area of habitat created that result from varying the alignment, two optional alignments are depicted.

Again, the alignment of the sheltering islands is deflected or returned to the east in order to substantially close the south end of the site. If the project is combined with the works at Site 5, then the return can be eliminated.

This concept is essentially an extension of the Fighting Island Site 4.

f) Fighting Island Site 6

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Two optional alignments are depicted for the purpose of comparing the construction costs and area of habitat created.

This site may provide the most potential for habitat enhancement. Historic aerial photographs depict that the area once consisted substantially of marsh environments. Therefore restoration of portions of these areas to the original form should be more easily accomplished.

g) Boblo Island Site 3

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Again, two optional alignments are depicted north and south of the old dock for the purpose of comparing the construction costs and area of habitat created.

This site is the most accessible from a constructability perspective, due to the sites proximity to deep water. However, due to greater water depths, the cost of constructing sheltering islands at this site is most expensive on a linear metre basis.

h) Amherstburg Boblo Dock

The recommended concept consists of constructing a mixture of sheltering island, shoals and reefs. Again, two optional alignments are depicted for the purpose of comparing the construction costs and area of habitat created.

This site is the only site that is accessible by land-based construction equipment. Construction could occur by either land-based equipment or barge-based equipment. Material can be delivered to the site by land transportation means. This is a significant advantage from an economic perspective. The site is also closest to a source of the principal construction material – the Amherst pit of Walker aggregates.

iv) Other Relevant Issues and Considerations

There are a number of other issues and considerations that relate to potential implementation of the proposed habitat enhancements that warrant some brief discussion.

a) Species at Risk and Endangered Species

There are several species of fish that are identified to be at risk by provincial and federal registries on the Detroit River. Implementation of habitat enhancements must give due consideration to the potential impact on existing endangered species habitat.

A prime example pertains to the habitat enhancement works that are proposed in the vicinity of Peche Island. A significant population of Northern Madtom are believed to inhabit the upper Detroit River, and in particular the waters surrounding Peche Island and Belle Isle. The final permissibility and overall feasibility of implementing the proposed habitat enhancements at Peche Island needs to be assessed from the perspective of impact to species at risk habitat.

All of the candidate sites may have potential existing species at risk or endangered species habitat associated. Although it is considered that the proposed enhancements work would positively influence species at risk, it is beyond the scope of this assessment to make a definitive determination in this regard. Therefore, the final permissibility of the habitat enhancement works proposed herein will need to be addressed in consultation with DFO and MNRF.

b) Impact of Water Levels on Construction

The issue of long-term water level fluctuations has been previously addressed. Given that the proposed works are located in relatively shallow water, and except for at one site, are inaccessible to land-based construction equipment, the water level that exists at the time of construction will have a significant influence on construction process and approach.

Low water levels have the potential to complicate construction, depending on the site and selected alignment of the sheltering islands. As noted, the sheltering islands are proposed at, or inside, the minus 600mm bathymetric contour (relative to chart datum). Depending on where the sheltering islands are aligned relative to deeper water areas, it may not be possible to construct the islands using barge-based equipment. In such case, it would be possible to construct the sheltering islands and other habitat features by first constructing a temporary access road along the alignment of the islands with the rock materials, then building the islands and shoals from the road materials while backing out of the site.

Alternatively, if water levels at the time of construction are above average, or significantly higher, then access to the shallower areas of the candidate sites would be improved. Barge-mounted construction equipment requires approximately 1.8 m of water depth to access an area. During average water levels, there would be approximately 1.4 to 1.5 m of water over the minus 600mm bathymetric contour. During periods where water levels approach maximum monthly mean water levels, there would be approximately 2.0 to 2.2 m of water over the same areas. Therefore, construction of the habitat enhancements using barge-mounted equipment would be facilitated during periods of above average to high water level.

In conclusion, the water levels that are forecasted to occur during construction should be taken into due consideration during the final planning and design process.

v) Net Benefit to Detroit River AOC

On objective of this study was to apply the recently developed Habitat/Ecosystem Assessment Tool (HEAT) to assess the net impact of implementing habitat enhancements at each site. Complete application of HEAT is beyond the scope of this undertaking. However, in order to facilitate application of the assessment tool, a summary of the quantity of areas that would be changed and impacted by implementation of habitat enhancements was assembled. These areas are tabulated in Appendix _.

A simplified map of each site, showing a composite image of all physical changes that are being proposed, has been prepared. An estimate of the significant areas would also be made for input into the model to determine overall habitat gain. It is envisioned that this information will be later input into the HEAT model to assess the impact of the enhancements. Thereby, a final determination of the overall feasibility of restoring and/or enhancing habitat to the Detroit River AOC can be made.

vi) Coordination of Works with Dredging Undertakings

An opportunity may exist to coordinate construction of the habitat features with maintenance dredging undertakings of Transport Canada. For example, it may be feasible to construct the core of the sheltering Islands using TenCate GeoTubes® technology or other similar soil-containment structures.

A process could be developed for disposing of dredgate material into the GeoTubes® as an initial construction stage. The GeoTubes® could then be encapsulated with a layer of gabion stone and capped with armour rock to form the sheltering islands.

This approach has the potential to yield obvious financial benefits. First, it provides a dredgate disposal option to Transport Canada. Secondly, the incorporation of GeoTube® soil-containment structures would substantially reduce rock quantities that are needed to complete the sheltering islands.

The feasibility of this strategy should be further investigated.

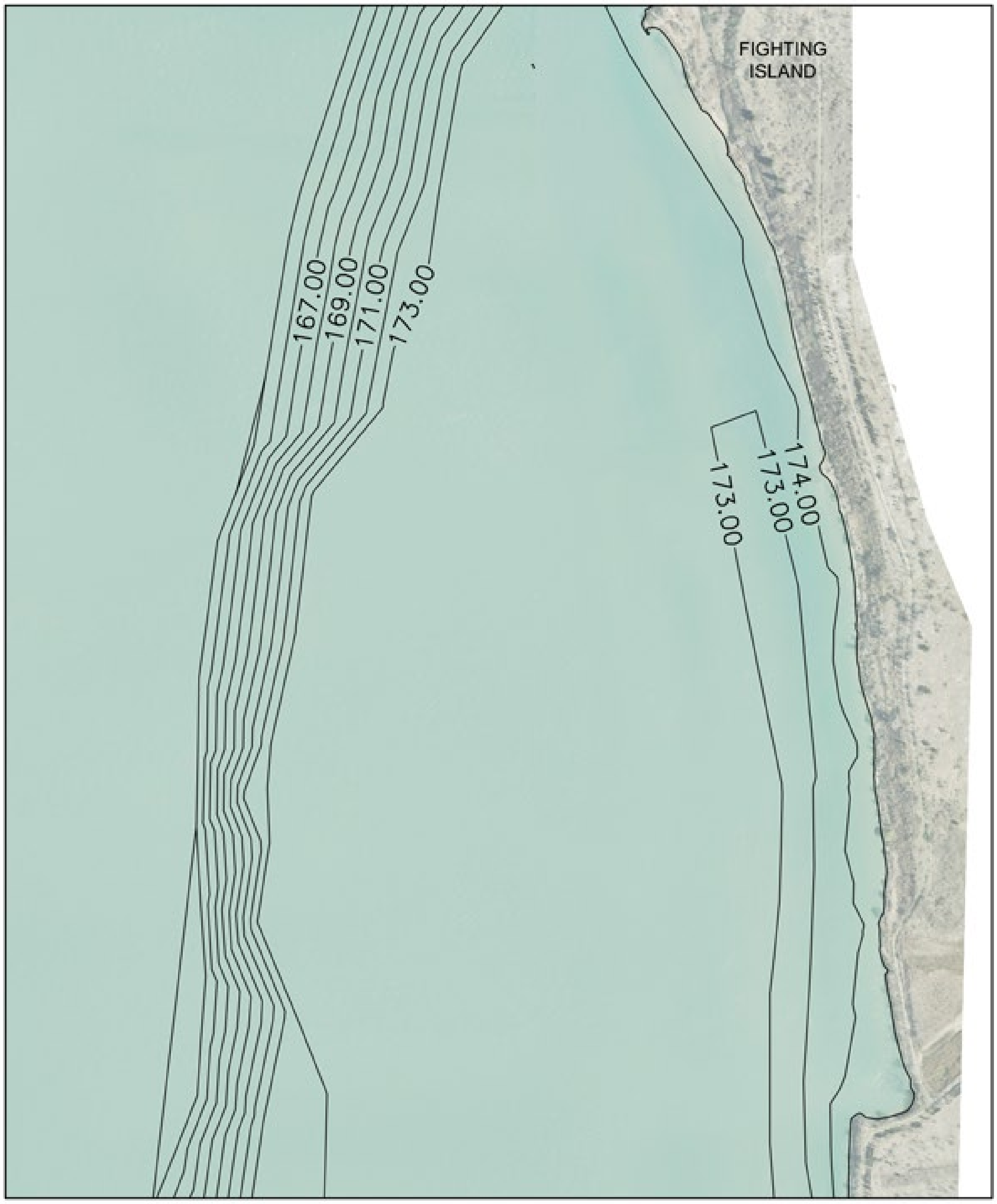
vii) Site Prioritization

A component of this study included the development of a site prioritization matrix. For the purpose of this study, factors that influenced the prioritization of the habitat enhancement sites include:

FIGURES & TABLES

Landmark Engineers Inc.

Title	Date	FIGURE
SITE LOCATION MAP	MARCH 2016	1
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	

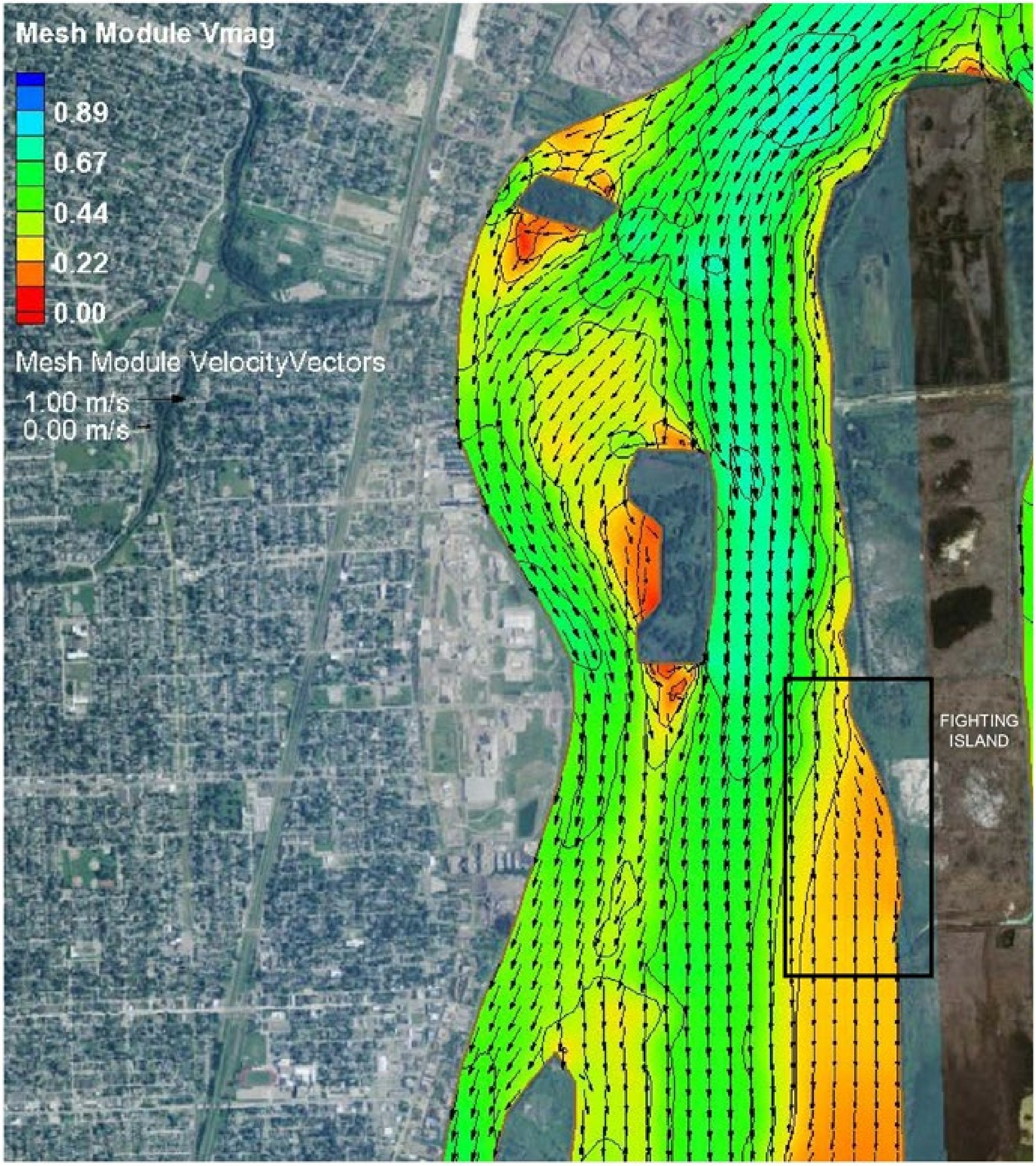


TYPICAL SITE PLAN - FIGHTING ISLAND (SITE 4)

SCALE: 1:7500

Landmark Engineers Inc.

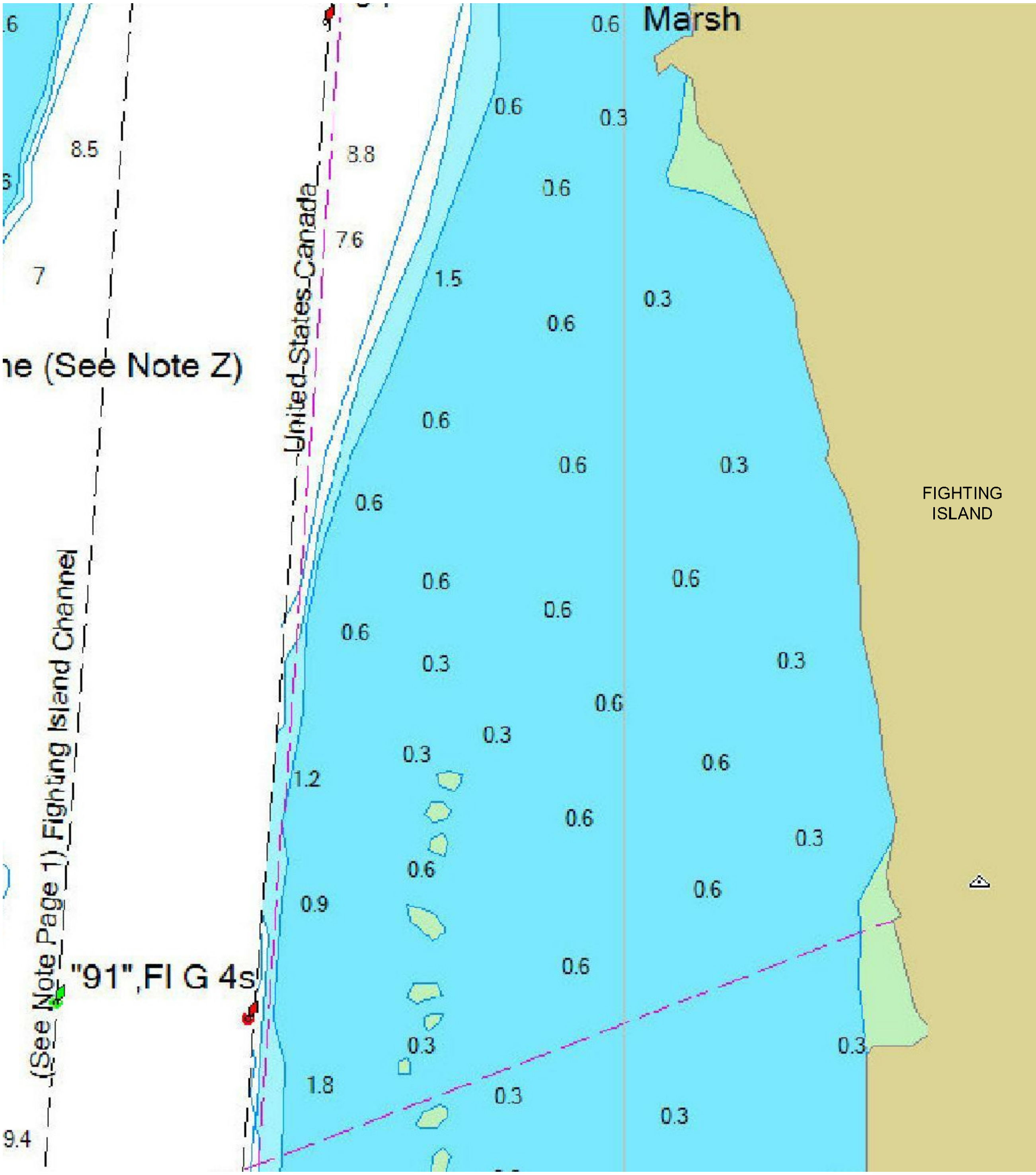
Title	Date	FIGURE
TYPICAL CONTOUR PLAN	MARCH 2016	2
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	



FLOW VELOCITY MAP - FIGHTING ISLAND (SITE 4)

Landmark Engineers Inc.

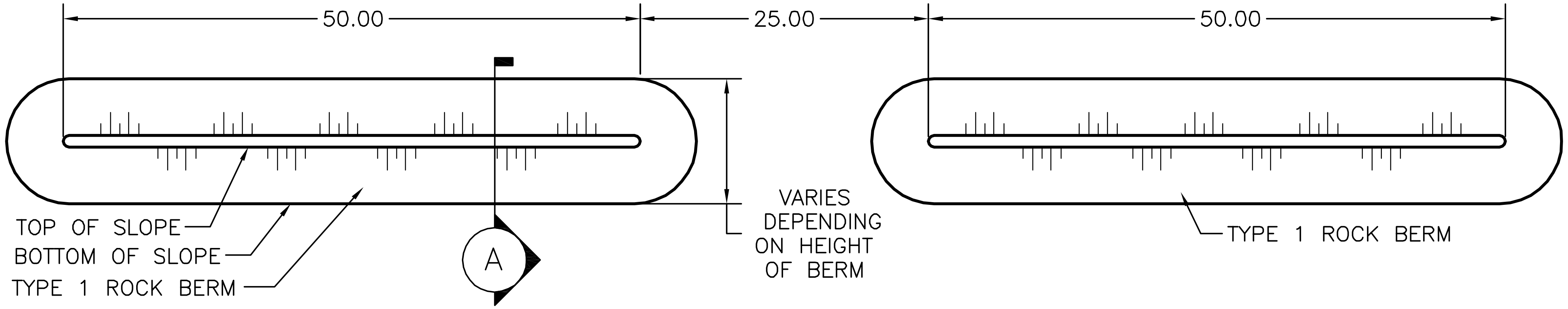
Title: TYPICAL FLOW VELOCITY MAP	Date: MARCH 2016	FIGURE 3
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	



NAVIGATION 'BLUE' CHART - FIGHTING ISLAND (SITE 4)

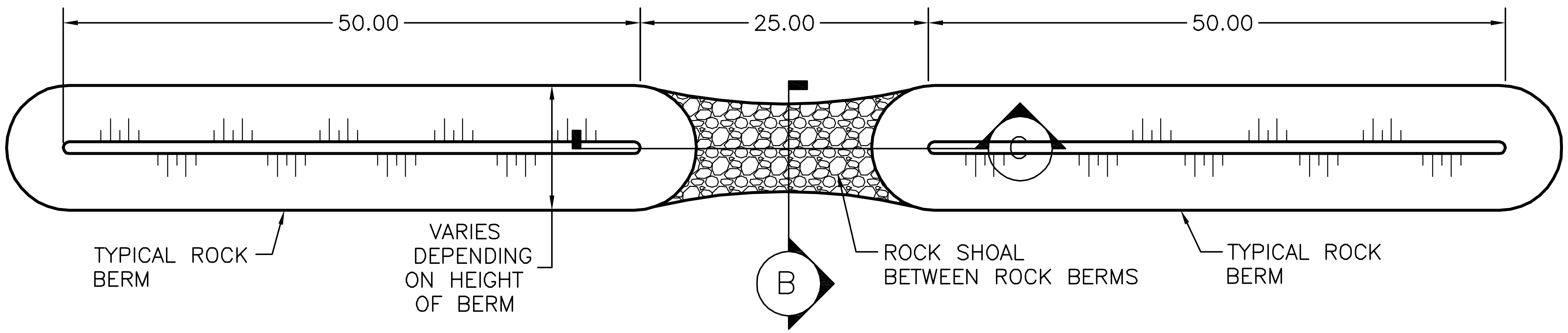
Landmark
Engineers Inc.

Title: TYPICAL NAVIGATION CHART	Date: MARCH 2016	FIGURE 4
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	



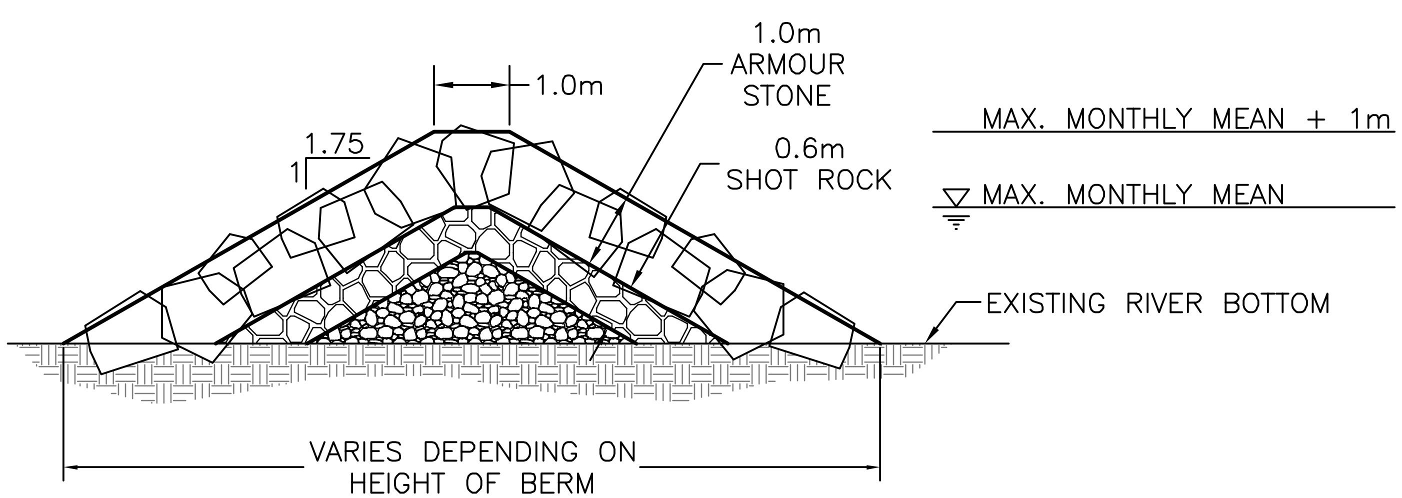
TYPE 1 ROCK BERMS - TYPICAL LAYOUT

SCALE: 1:500



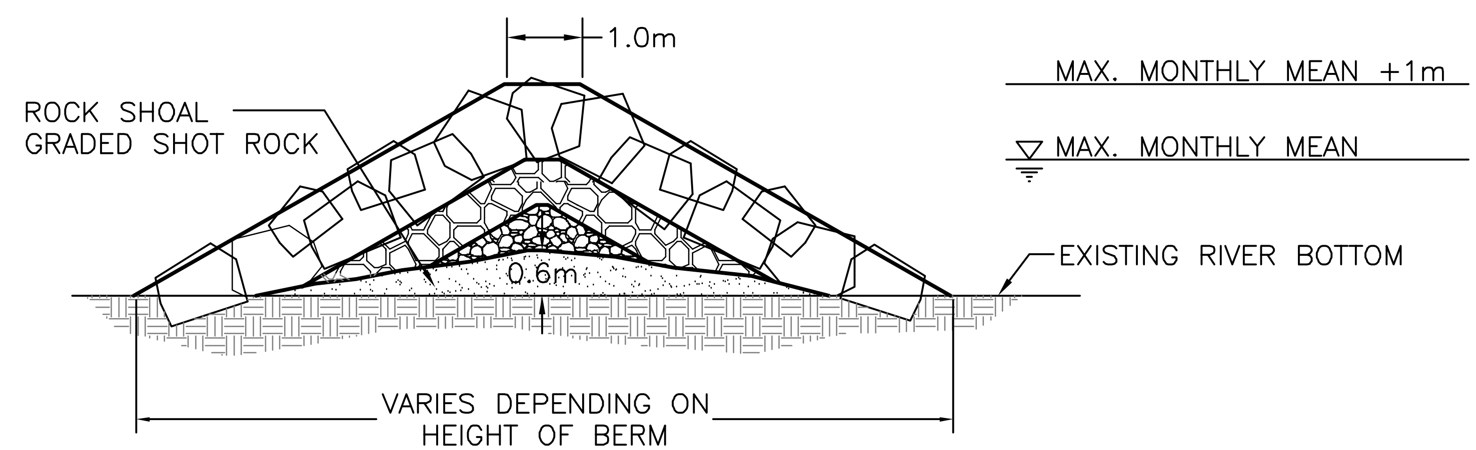
TYPE 1 ROCK BERMS WITH ROCK SHOAL - TYPICAL LAYOUT

SCALE: 1:500



SECTION A - TYPE 1 ROCK BERM (TYP.)

SCALE: 1:100

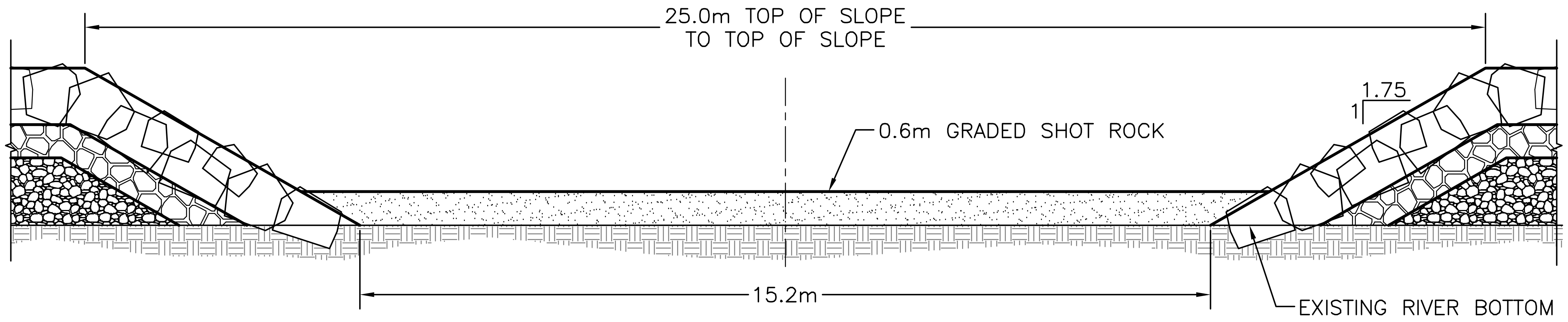


SECTION B - ROCK SHOAL (TYP.)

SCALE: 1:100

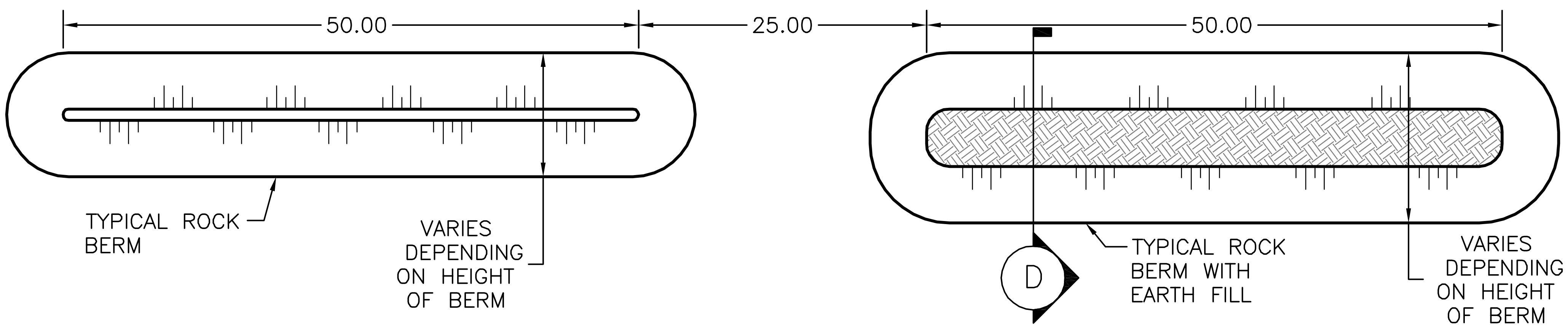
Landmark Engineers Inc.

Title: TYPICAL DETAILS 1		Date: MARCH 2016	FIGURE 5
		Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY		Project No. 15-030	



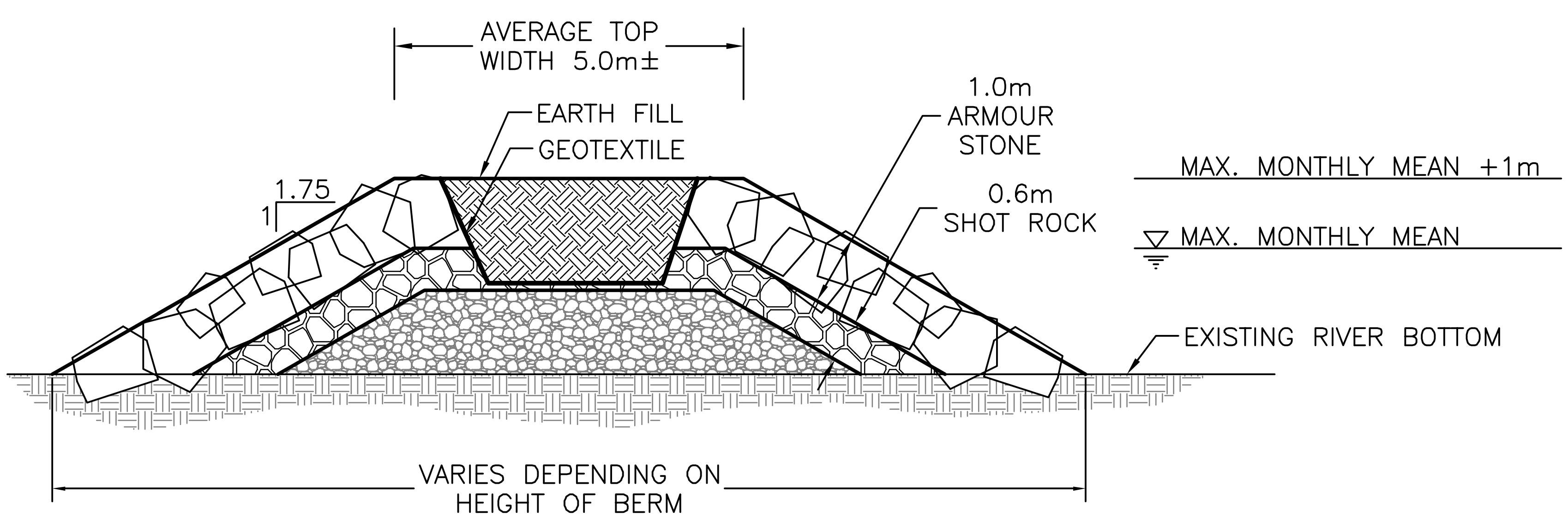
SECTION C - ROCK SHOAL (TYP.)

SCALE: 1:100



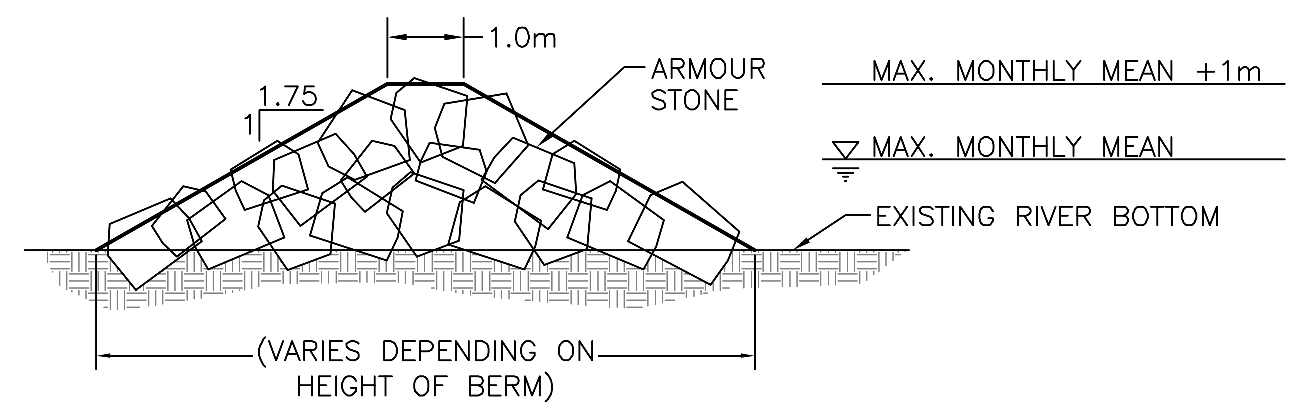
TYPE 1 AND TYPE 2 ROCK BERM - TYPICAL LAYOUT

SCALE: 1:500



SECTION D - TYPE 2 ROCK BERM (TYP.)

SCALE: 1:100

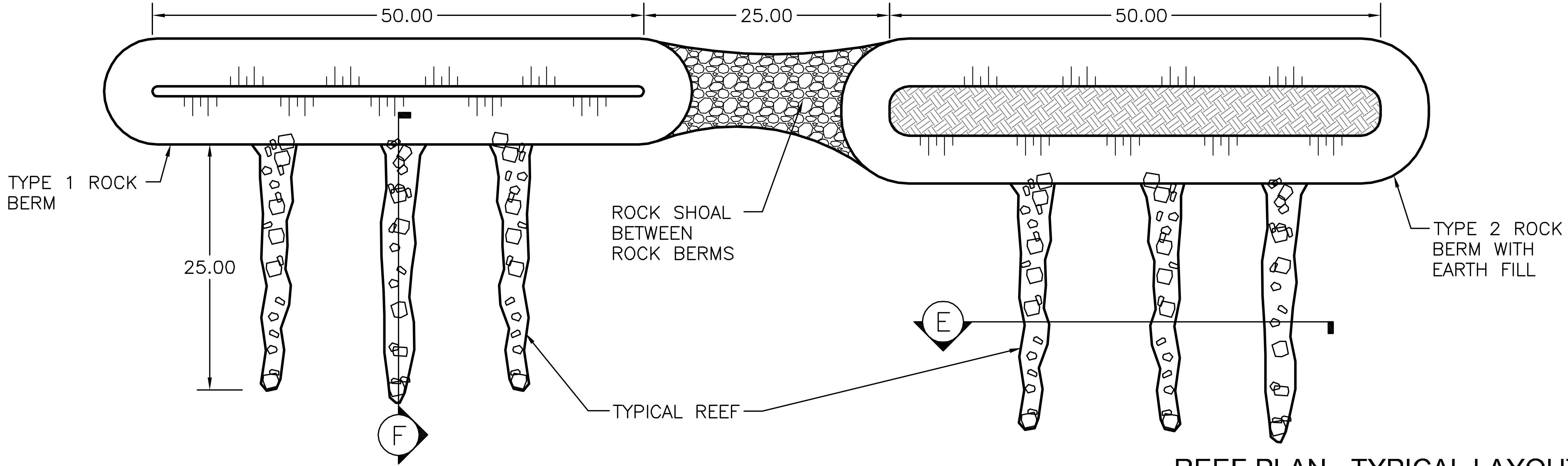


SECTION - TYPE 3 ROCK BERM (TYP.)

SCALE: 1:100

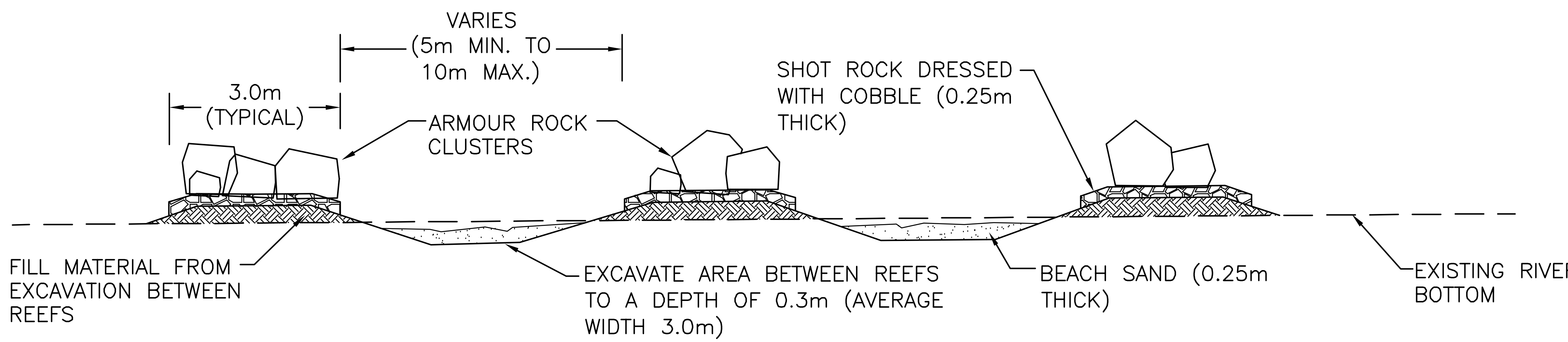
Landmark Engineers Inc.

Title: TYPICAL DETAILS 2	Date: MARCH 2016	FIGURE 6
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	



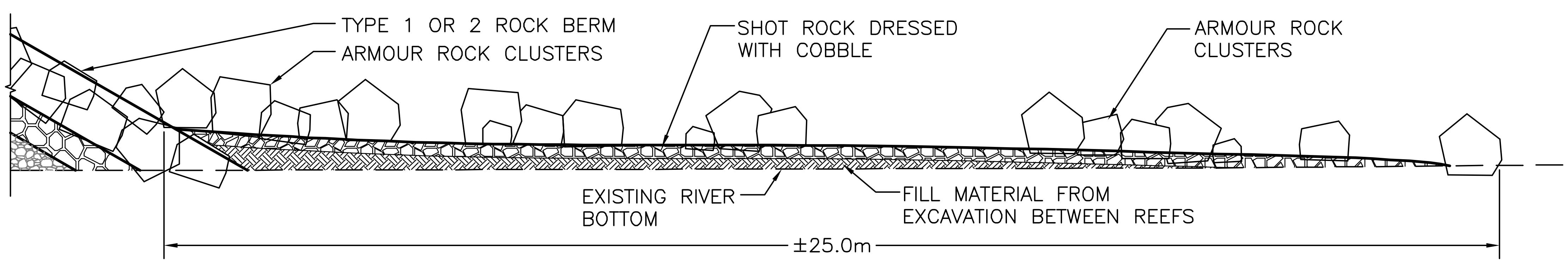
REEF PLAN - TYPICAL LAYOUT

SCALE: 1:500



SECTION E - MULTIPLE REEFS

SCALE: 1:500

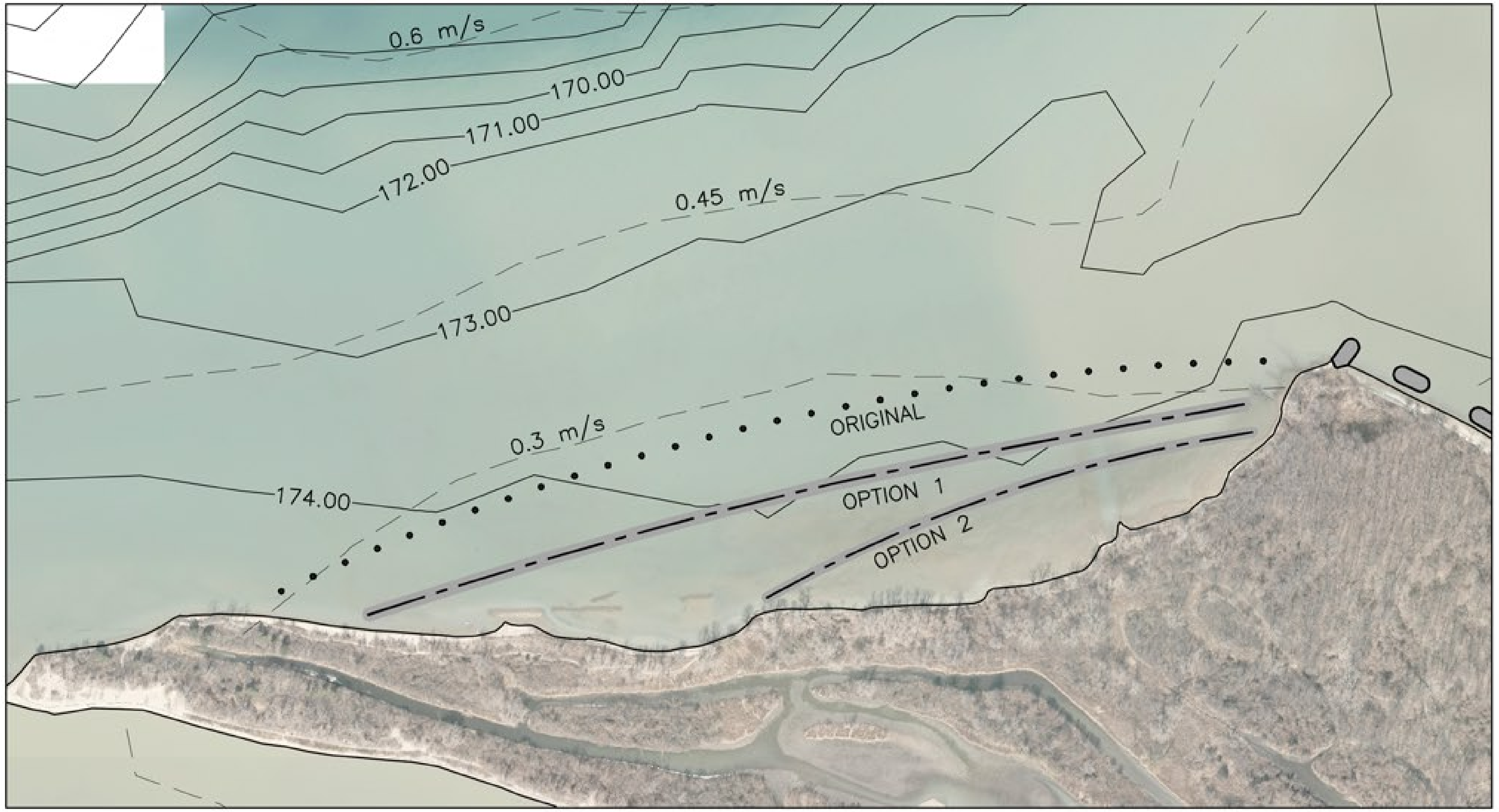


SECTION F - REEF CENTERLINE

SCALE: 1:100

Landmark Engineers Inc.

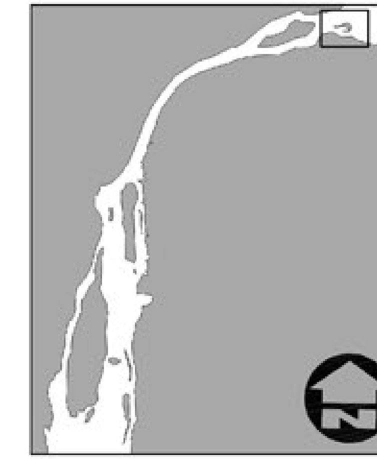
Title: TYPICAL DETAILS 3	Date: MARCH 2016		FIGURE 7
	Scale: AS SHOWN		
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030		



SITE PLAN

SCALE: 1:5000

SITE MAP



KEY PLAN

LEGEND

- ORIGINAL ALIGNMENT
- PROPOSED ALIGNMNET
- ROCK FOOTPRINT
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoals	Reefs	
Peche Island Site 2	Original	900	176.8 m (Max Monthly Mean + 1m)	174.0	2.8	115,250	11.5	8	4	4	12	$ 2,275,000
	Option 1	850		174.1	2.7	70,400	7.0	8	3	4	12	$ 2,075,000
	Option 2	450		174.3	2.5	25,100	2.5	4	2	2	6	$ 975,000

Landmark Engineers Inc.

Title: PECHE ISLAND - SITE 2

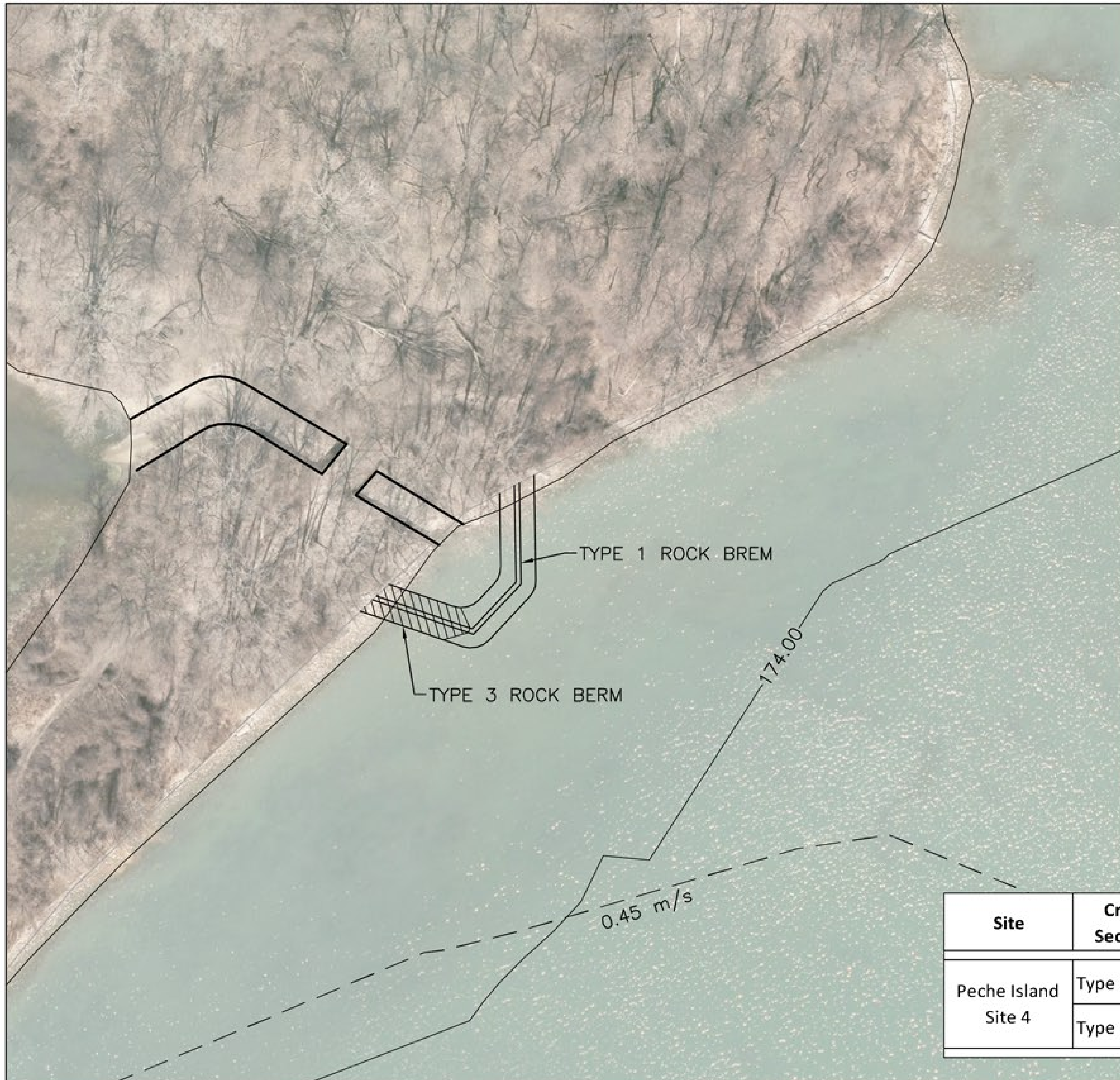
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY

Date: MARCH 2016

Scale: AS SHOWN

Project No. 15-030

FIGURE 8



SITE MAP

KEY PLAN

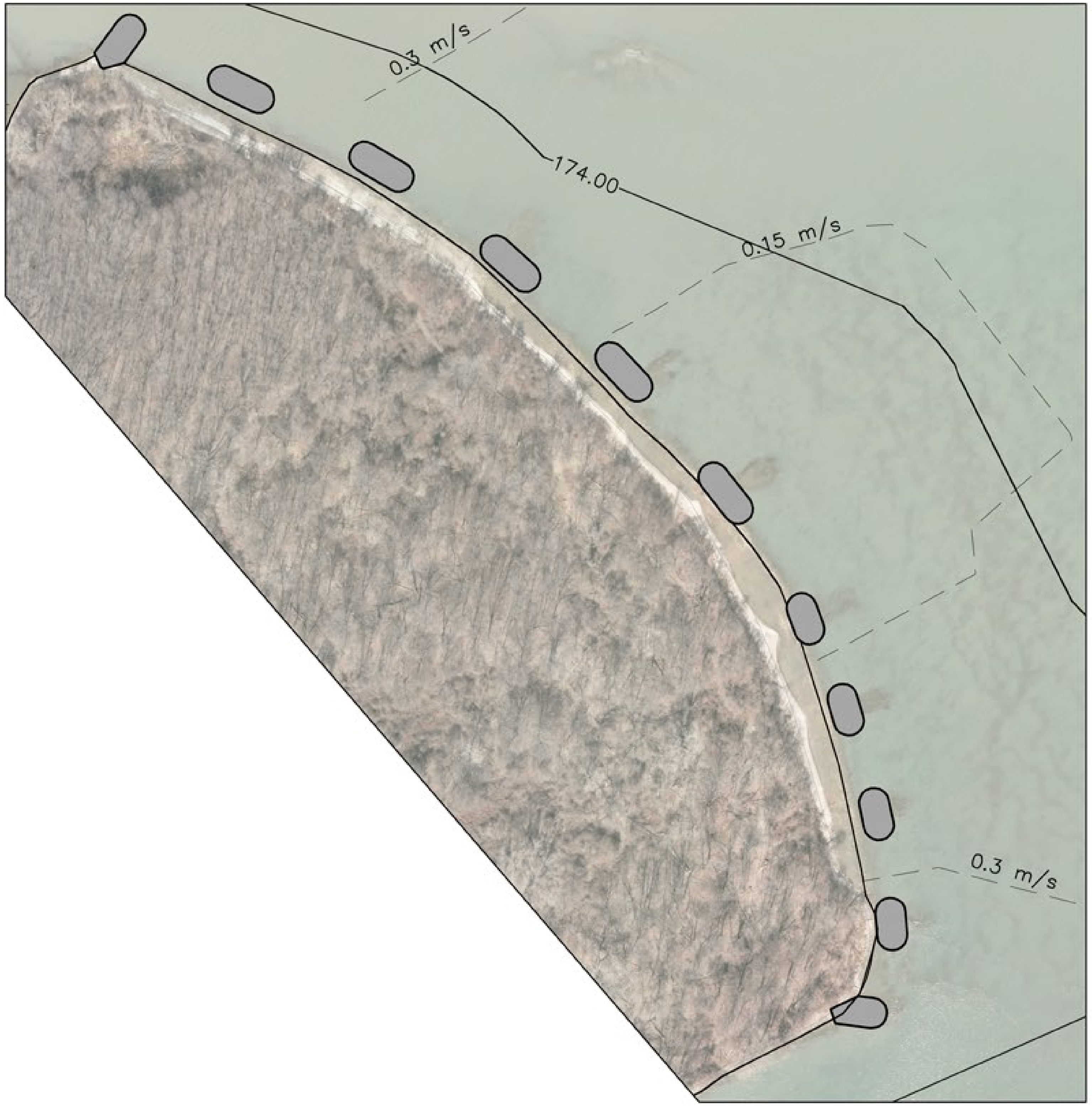
Site	Cross Section	Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berm (m)	Estimated Cost	
Peche Island Site 4	Type 1 Berm	38	176.8 m (Max Monthly Mean + 1m)	174.6	2.2	$ 90,000	$ 135,000.00
	Type 3 Berm	18		174.6	2.2	$ 45,000	

SITE PLAN

SCALE: 1:1000

Landmark Engineers Inc.

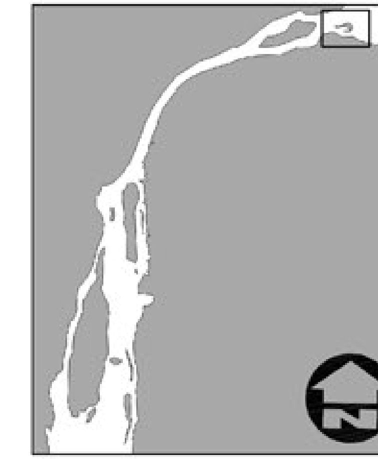
Title: PECHE ISLAND - SITE 4	Date: MARCH 2016	FIGURE 9	
	Scale: AS SHOWN		
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030		



SITE PLAN

SCALE: 1:2500

SITE MAP



KEY PLAN

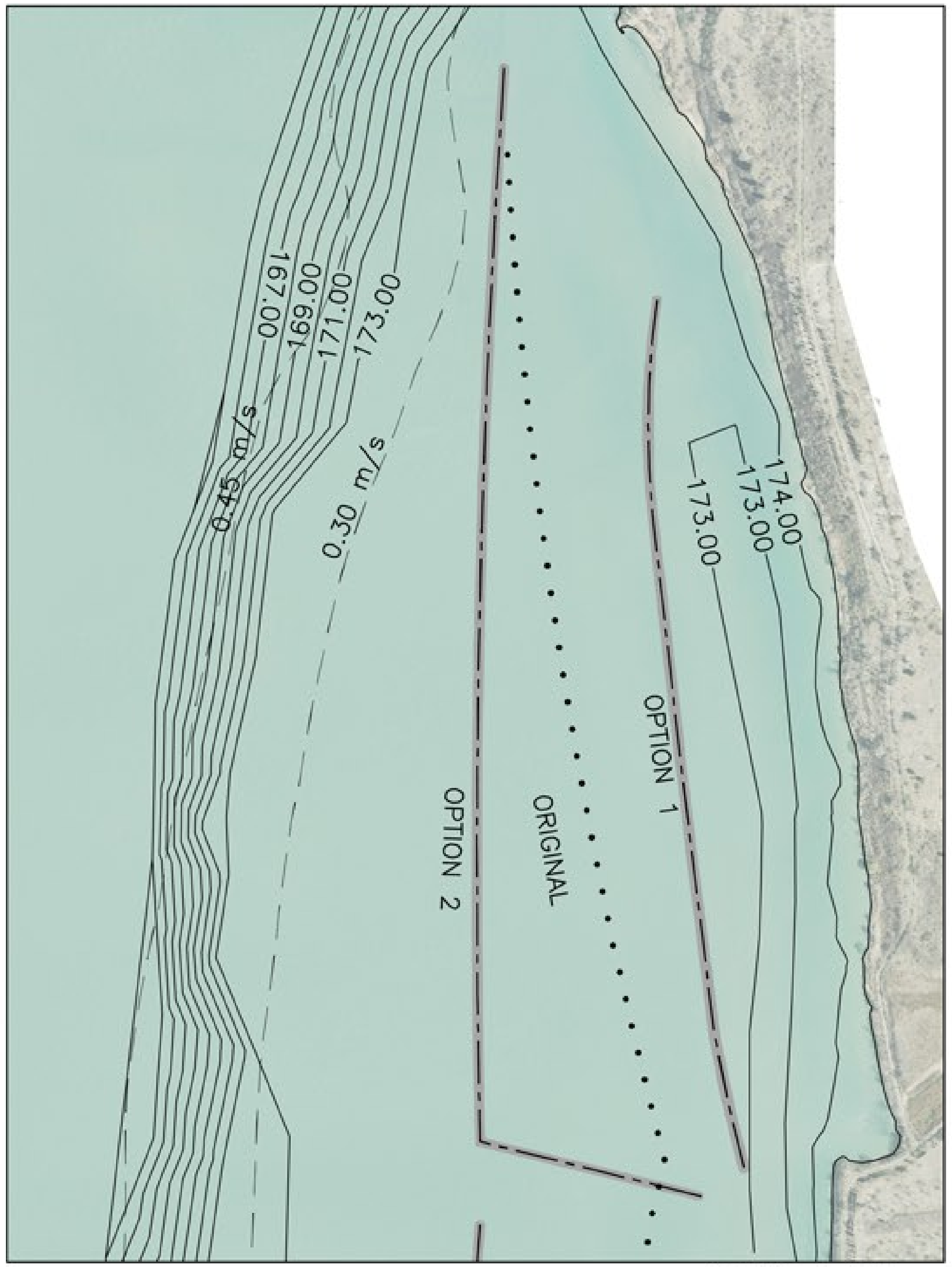
LEGEND

- PROPOSED ROCK BERMS
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR

Site	Cross Section	Total Length of Berms (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berm (m)	Estimated Cost
Peche Island North East Shore	Type 1 Berm	250	176.8 m (Max Monthly Mean + 1m)	173.2	3.6	$ 1,300,000

Landmark Engineers Inc.

Title: PECHE ISLAND - SITE 2	Date: MARCH 2016	FIGURE 10
	Scale: AS SHOWN	
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030	



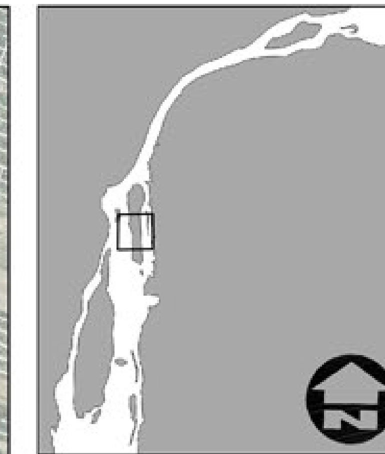
SITE PLAN

SCALE: 1:7500

LEGEND

- • • • • • • • ORIGINAL ALIGNMENT
- — - — - — PROPOSED ALIGNMNET
- ▬▬▬ ROCK FOOTPRINT
- — — — — VELOCITY CONTOUR
- —174.00— ELEVATION CONTOUR

SITE MAP



KEY PLAN

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoals	Reefs	
Fighting Island Site 4	Original	1300	176.35 m (Max Monthly Mean + 1m)	173.3	3.0	334,700	33.5	12	6	6	18	$ 3,925,000
	Option 1	950		173.2	3.2	164,750	16.5	9	4	5	12	$ 2,825,000
	Option 2	1400		173.0	3.3	437,500	43.8	13	6	6	18	$ 4,700,000

Landmark Engineers Inc.

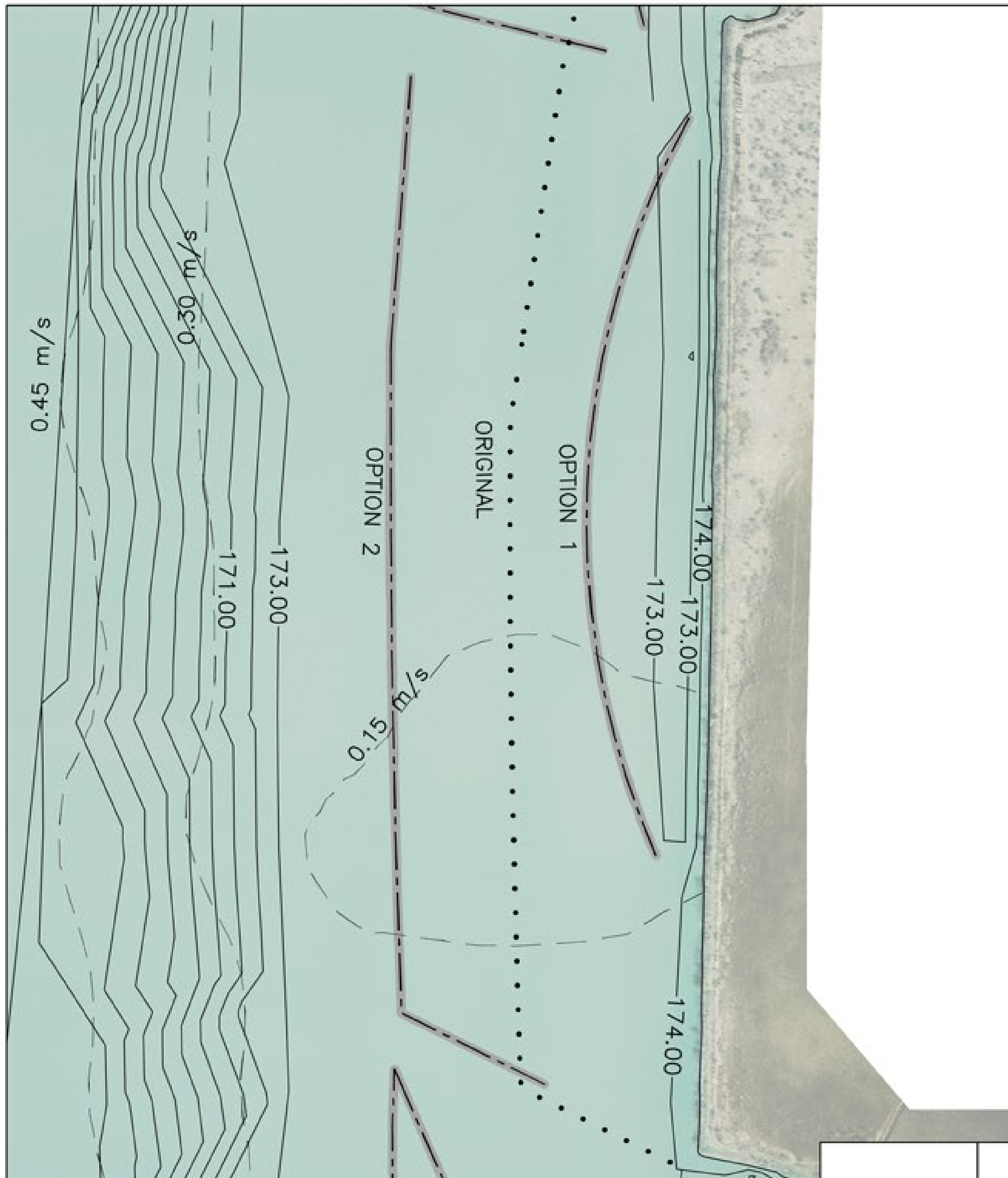
Title: FIGURE 11 — FIGHTING ISLAND - SITE 4

Project: DETROIT RIVER HABITAT FEASIBILITY STUDY

Date: MARCH 2016

Scale: AS SHOWN

Project No. 15-030



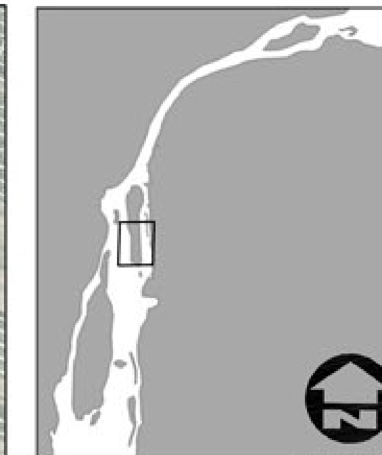
SITE PLAN

SCALE: 1:7500

LEGEND

- ORIGINAL ALIGNMENT
- PROPOSED ALIGNMNET
- ROCK FOOTPRINT
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR

SITE MAP



KEY PLAN

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoals	Reefs	
Fighting Island Site 5	Original	1450	176.35 m (Max Monthly Mean + 1m)	173.3	3.0	306,350	30.6	13	6	6	18	$ 4,125,000
	Option 1	950		173.1	3.3	106,200	10.6	9	4	5	12	$ 3,200,000
	Option 2	1350		173.1	3.3	496,700	49.7	12	6	6	18	$ 4,450,000

Landmark Engineers Inc.

Title: FIGHTING ISLAND - SITE 5

Project: DETROIT RIVER HABITAT FEASIBILITY STUDY

Date: MARCH 2016

Scale: AS SHOWN

Project No. 15-030

FIGURE 12

SITE PLAN

SCALE: 1:7500

LEGEND

- ORIGINAL ALIGNMENT
- PROPOSED ALIGNMNET
- ROCK FOOTPRINT
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR

SITE MAP

KEY PLAN

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoals	Reefs	
Fighting Island Site 6	Option 1	1650	176.35 m (Max Monthly Mean + 1m)	173.5	2.8	518,757	51.9	15	7	7	21	$ 4,150,000
	Option 2	1350		173.5	2.8	362,925	36.3	12	6	6	18	$ 3,425,000
	Option 3	450		173.5	2.8	69,500	7.0	4	2	2	6	$ 1,150,000

Landmark Engineers Inc.

Title: FIGHTING ISLAND - SITE 6

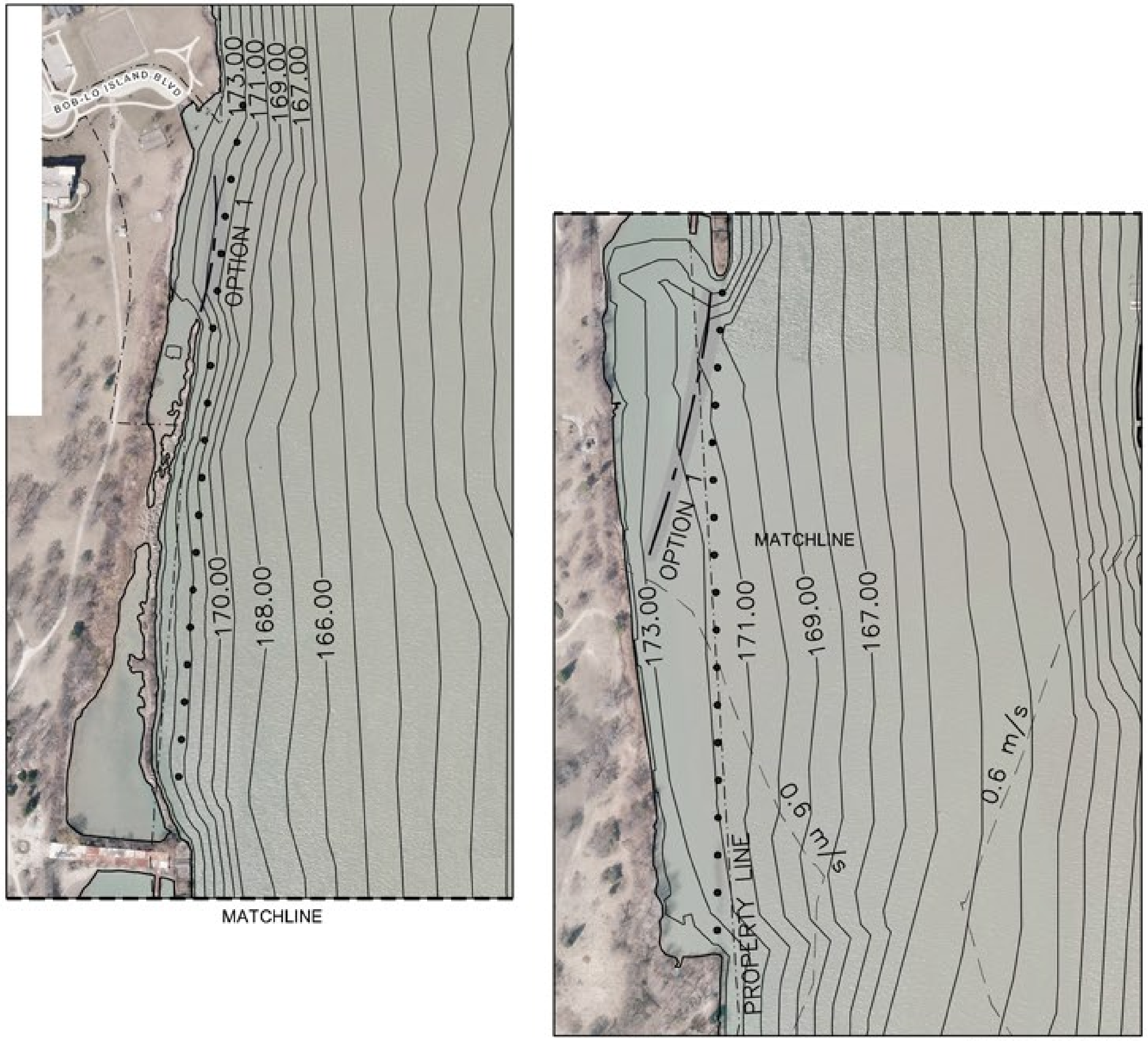
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY

Date: MARCH 2016

Scale: AS SHOWN

Project No. 15-030

FIGURE 13



LEGEND
- ORIGINAL ALIGNMENT
- PROPOSED ALIGNMNET
- ROCK FOOTPRINT
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR
- PROPERTY LINES

SITE MAP

KEY PLAN

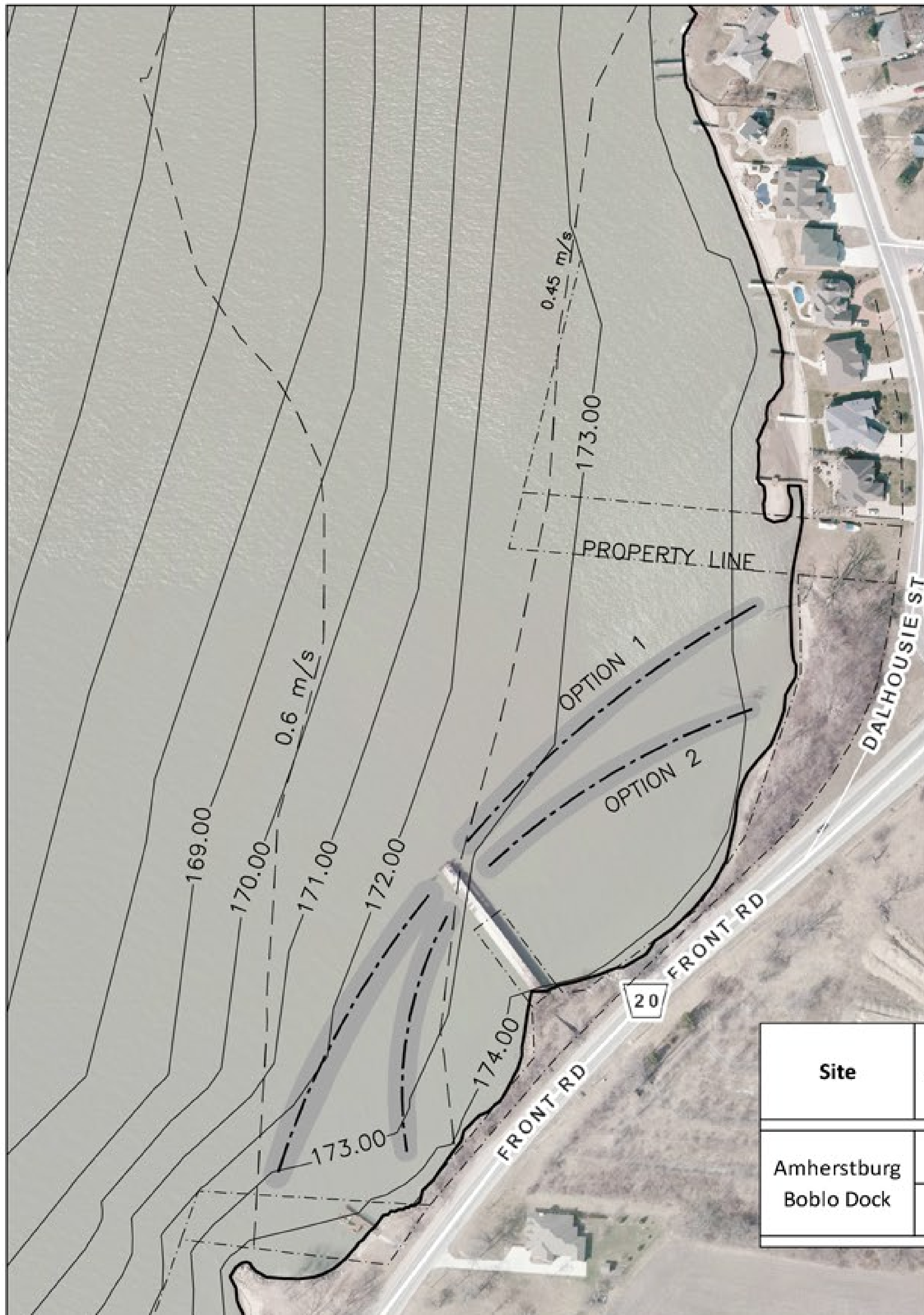
SITE PLAN

SCALE: 1:5000

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoal	Reefs	
Boblo Island Site 3	Original	1000	175.98 m (Max Monthly Mean + 1m)	171.4	4.6	54,300	5.4	14	0	5	0	$ 6,750,000
	Option 1	215		172.0	4.0	20,000	2.0	4	0	0	0	$ 1,175,000

Landmark Engineers Inc.

Title: BOBLO ISLAND - SITE 3	Date: MARCH 2016	Scale: AS SHOWN	FIGURE 14
Project: DETROIT RIVER HABITAT FEASIBILITY STUDY	Project No. 15-030		



PLAN

SCALE: 1:2500

LEGEND

- PROPOSED ALIGNMNET
- ROCK FOOTPRINT
- VELOCITY CONTOUR
- 174.00 ELEVATION CONTOUR
- PROPERTY LINES

SITE MAP

KEY PLAN

Site	Alignment	Alignment Length (m)	Top of Stone Elevation	Average Bottom Elevation (m)	Height of Rock Berms (m)	Area Protected		Quantity of Each Feature Type				Estimated Cost
						(m2)	(Ha)	Type 1	Type 2	Shoal	Reefs	
Amherstburg Boblo Dock	Option 1	300	175.98 m (Max Monthly Mean + 1m)	173.0	3.0	22,150	2.2	3	1	1	3	$ 850,000
	Option 2	230		173.1	2.9	11,600	1.2	3	1	1	3	$ 750,000

Landmark Engineers Inc.

Title: AMHERSTBURG BOBLO DOCK

Project: DETROIT RIVER HABITAT FEASIBILITY STUDY

Date: MARCH 2016

Scale: AS SHOWN

Project No. 15-030

FIGURE 15

APPENDIX A

Sediment Sampling Data Used to
Create Baseplan Models

Sampling Point Locations and Elevations

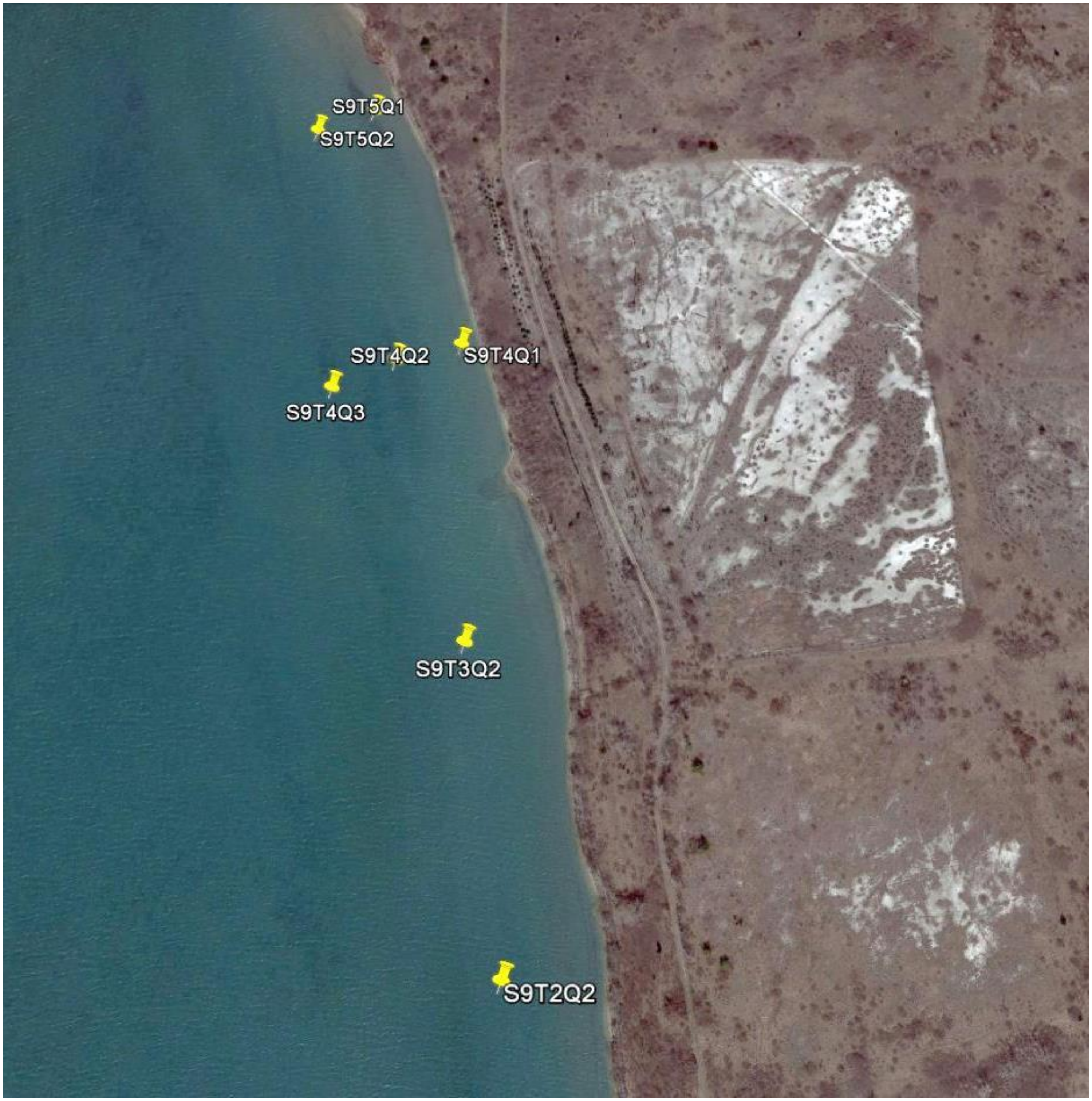
(See attached sampling point aerial maps for point locations at each site)

Site	Location #	Easting	Northing	Depth	Elevation
Peche Island Site 2	S17 T1 Q1	340962.17	4690185.51	1.24	174.176
	S17 T1 Q2	340932.61	4690262.84	1.76	173.656
	S17 T1 Q3	340884.56	4690360.59	2.21	173.206
	S17 T2 Q1	341160.15	4690229.90	1.3	174.116
	S17 T2 Q2	341121.40	4690301.88	1.77	173.646
	S17 T2 Q3	341065.71	4690389.80	2.44	172.976
	S17 T3 Q1	341334.44	4690320.38	1.37	174.046
	S17 T3 Q2	341298.65	4690377.86	1.78	173.636
	S17 T3 Q3	341263.75	4690437.53	2.67	172.746
Peche Island Site 4	S13 T1A Q1	341553.75	4689742.15	1.25	174.199
	S13 T1A Q2	259220.80	4692183.67	0.91	174.539
	S13 T2 Q1	341647.28	4689868.91	0.55	174.899
	S13 T1B Q1	341521.10	4689901.76	0.75	174.699
	S13 T1B Q2	341445.77	4689960.13	0.71	174.739
	S13 T1C Q1	341384.38	4689869.30	0.78	174.669
	S13 T1C Q2	341283.24	4689879.37	0.94	174.509
Fighting Island Site 4	S9 T1 Q1	324820.24	4675036.31	1.4	173.774
	S9 T1 Q2	324770.62	4675034.21	2	173.174
	S9 T2 Q1	324813.82	4675243.13	1.4	173.774
	S9 T2 Q2	324775.41	4675226.31	2.1	173.074
	S9 T2 Q3	324728.88	4675215.25	2.1	173.074
	S9 T3 Q1	324792.88	4675430.32	1.4	173.774
	S9 T3 Q2	324751.52	4675428.02	2.2	172.974
	S9 T3 Q3	324693.40	4675416.13	2.2	172.974
	S9 T4 Q1	324745.96	4675635.93	1.4	173.774
	S9 T4 Q2	324703.59	4675625.87	2.2	172.974
	S9 T4 Q3	324663.47	4675606.87	2.2	172.974
	S9 T5 Q1	324682.18	4675827.52	1.3	173.874
	S9 T5 Q2	324643.79	4675811.81	2	173.174
Fighting Island Site 5	S21 T1 Q1	324761.68	4673812.23	2.4	172.653
	S21 T1 Q2	324717.07	4673812.23	1.71	173.343
	S21 T2 Q1	324763.35	4674012.19	2.46	172.593
	S21 T2 Q2	324703.79	4674009.23	1.86	173.193
	S21 T2 Q3	324626.29	4674015.60	1.91	173.143
	S21 T3 Q1	324770.67	4674206.45	2.31	172.743
	S21 T3 Q2	324705.30	4674202.52	1.96	173.093
	S21 T3 Q3	324624.03	4674190.10	1.95	173.103
	S21 T4 Q1	324774.05	4674408.58	3.18	171.873
	S21 T4 Q2	324712.90	4674407.88	1.84	173.213
	S21 T4 Q3	324641.87	4674408.54	1.87	173.183
	S21 T5 Q1	675227.75	4674601.96	1.88	173.173
	S21 T5 Q2	324705.13	4674593.63	1.78	173.273

Site	Location #	Easting	Northing	Depth	Elevation
Fighting Island Site 6	S4 T1 Q1	324848.01	4673396.76	2.3	172.889
	S4 T1 Q2	324831.63	4673369.39	1.7	173.489
	S4 T1 Q3	324824.69	4673322.90	1.8	173.389
	S4 T2 Q1	324932.37	4673366.89	2.2	172.989
	S4 T2 Q2	324848.01	4673396.76	2.3	172.889
	S4 T2 Q3	324921.26	4673252.72	2	173.189
	S4 T2 Q4	324909.92	4673195.23	1.9	173.289
	S4 T3 Q1	325120.35	4673284.44	1.8	173.389
	S4 T3 Q2	325074.74	4673244.46	1.6	173.589
	S4 T3 Q3	325040.06	4673245.32	1.9	173.289
	S4 T3 Q4	324988.64	4673137.71	1.9	173.289
	S4 T4 Q1	325291.47	4673154.64	1.8	173.389
	S4 T4 Q2	325261.03	4673126.50	1.6	173.589
	S4 T4 Q3	325227.03	4673088.46	1.6	173.589
	S4 T4 Q4	325168.59	4673031.02	1.5	173.689
	S4 T5 Q1	325384.83	4673087.88	1.7	173.489
	S4 T5 Q2	325337.19	4673032.39	1.6	173.589
	S4 T5 Q3	325287.25	4672984.75	1.8	173.389
Bobo Island Site 3	S19 T7 Q1	324873.83	4662749.77	0.475	174.125
	S19 T8 Q1	324881.02	4662806.25	1.02	173.58
	S19 T9 Q1	324886.39	4662856.12	1.147	173.453
	S19 T1 Q1	324851.86	4661830.35	1.15	173.450
	S19 T1 Q2	324885.00	4661831.75	1.792	172.808
	S19 T2 Q1	324842.87	4661935.01	1.503	173.097
	S19 T2 Q2	324875.15	4661935.32	2.528	172.072
	S19 T3 Q1	324826.30	4662034.31	1.409	173.191
	S19 T3 Q2	324858.55	4662033.51	2.543	172.057
	S19 T4 Q1	324817.94	4662131.18	1.434	173.166
	S19 T4 Q2	324847.77	4662132.66	2.558	172.042
	S19 T5 Q1	324808.07	4662233.64	1.277	173.323
	S19 T5 Q2	324840.43	4662237.28	1.893	172.707
	S19 T6 Q1	324811.43	4662335.77	1.782	172.818
	S19 T6 Q2	324846.94	4662332.67	2.768	171.832
Old Boblo Dock Amherstburg	S1 T1 Q1	325212.73	4661396.99	1.49	173.301
	S1 T1 Q2	325193.21	4661410.80	1.95	172.841
	S1 T1 Q3	325178.76	4661428.94	2.03	172.761
	S1 T2 Q1	325262.32	4661461.31	1.5	173.291
	S1 T2 Q2	325240.62	4661487.40	1.8	172.991
	S1 T2 Q3	325224.60	4661508.91	1.74	173.051
	S1 T2 Q4	325202.74	4661528.34	2.54	172.251
	S1 T3 Q1	325329.48	4661532.98	1.3	173.491
	S1 T3 Q2	325296.67	4661544.90	1.6	173.191
	S1 T3 Q3	325263.03	4661556.85	1.7	173.091

Sediment Sampling Locations – Peche Island
(Image provided by MNR)

Sediment Sampling Locations – Fighting Island Site 4
(Image provided by MNR)



Sediment Sampling Locations – Fighting Island
(Image provided by MNR

Sediment Sampling Locations – Fighting Island Site 6
(Image provided by MNR)

Sediment Sampling Locations – Boblo Island Site 3
(Image provided by MNR)

Sediment Sampling Locations – Old Boblo Dock
(Image provided by MNR)

APPENDIX B

Sediment Sampling Data Spreadsheets
and
Background Information Provided by MNR

Broad Characterization of Existing Substrates by Site
based on MNR's 2015 Detroit River Soil Samples

Site	Average Proportions				Notes
	% gravel	% sand	% silt	% clay	
Peche Island 2	28.3	70.1	1.6		% gravel increases significantly in samples closer to shore; similar (less pronounced) trend from downstream to upstream
Peche Island 4	2.4		96.8	0.8	These average proportions do not include S13T2Q1 (at easternmost point in canal system, near former channel to Lake), which was 83.1% sand, 16.6% gravel
Fighting Island Site 4 (nearshore)	0.4	92.3	7.3		Averages of the samples taken closest to shore
Fighting Island Site 4 (offshore)	0.2	27.2	71.2	1.4	Averages of all remaining samples
Fighting Island Site 5	12.7		81.7	5.6	Half of all samples included pieces of wood
Fighting Island Site 6	20.2		76.7	3.1	Samples nearest the shoreline and furthest offshore were predominantly silty; Samples in between were predominantly sand with some gravel
Boblo Island Site 3 (upstream of dock)	55.8	38.3	5.9		Samples taken approx. 400m upstream of dock
Boblo Island Site 3 (downstream of dock)	1.9	36.9	58.1	3.2	Samples taken from downstream side of dock, extending approx. 600m downstream
Old Boblo Dock Site	46.8	40.9	12.2		

EC Sediment Lab Results

Analysis Priority	Site	Sam	Transect	Quadrat	Latitude	Longitude	Depth	Run #	Analysis Method	% gravel	% sand	% silt	% clay	% gravel + sand	% silt+clay (=mud)
1	Peche Island: Site 2	17	1	1	42.348	-82.931	1.24	5758	S	3.082	94.169				2.749
1	Peche Island: Site 2	17	1	2	42.348	-82.931	1.76	5759	S	8.424	88.844				2.732
1	Peche Island: Site 2	17	1	3	42.349	-82.932	2.21	5755	S	9.513	87.52				2.967
1	Peche Island: Site 2	17	2	1	42.348	-82.928	1.30	5760	S	16.803	82.01				1.187
1	Peche Island: Site 2	17	2	2	42.349	-82.929	1.77	5756	S	15.686	84.221				0.093
1	Peche Island: Site 2	17	2	3	42.350	-82.930	2.44	5757	S	14.507	82.618				2.875
1	Peche Island: Site 2	17	3	1	42.349	-82.926	1.37	5761	S	7.464	90.652				1.883
1	Peche Island: Site 2	17	3	2	42.349	-82.927	1.78	5762	S	3.217	94.464				2.32
1	Peche Island: Site 2	17	3	3	42.350	-82.927	2.67	5754	S	2.388	96.115				1.498
2	Peche Island: Site 4	13	1A	1	42.344	-82.924	1.25	5764	H+1 SP			97.691	0.539	1.77	
2	Peche Island: Site 4	13	1A	2	42.345	-83.923	0.91	5765	H+1 SP			97.287	1.706	1.007	
2	Peche Island: Site 4	13	2	1	42.345	-82.922	0.55	5769	S	6.998	92.689				0.313
2	Peche Island: Site 4	13	1B	1	42.345	-82.924	0.75	5766	H+1 SP			98.034	1.32	0.646	
2	Peche Island: Site 4	13	1B	2	42.346	-82.925	0.71	5767	H+1 SP			96.255	0.45	3.295	
2	Peche Island: Site 4	13	1C	2	42.345	-82.927	0.94	5768	H+1 SP			94.655	0	5.345	
3	Boblo Island: Site 3	19	7	1	42.097	-83.118	0.475	5774	S	3.576	92.572				3.853
3	Boblo Island: Site 3	19	9	1	42.098	-83.118	1.147	5775	S+H	3.549	81.3	14.801	0.35		
3	Boblo Island: Site 3	19	1	1	42.089	-83.118	1.150	5776	S	9.254	83.627				7.12
3	Boblo Island: Site 3	19	1	2	42.089	-83.117	1.792	5777	S+H	0	38.576	58.396	3.028		
3	Boblo Island: Site 3	19	2	1	42.090	-83.118	1.503	5778	S+H	0	58.635	38.287	3.079		
3	Boblo Island: Site 3	19	3	2	42.091	-83.118	2.543	5779	S+H	0	21.795	75.489	2.716		
3	Boblo Island: Site 3	19	4	1	42.092	-83.118	1.434	5780	S+H	0	14.124	83.75	2.125		
3	Boblo Island: Site 3	19	5	2	42.093	-83.118	1.893	5781	S+H	0	37.396	59.454	3.149		
3	Boblo Island: Site 3	19	6	2	42.094	-83.118	2.768	5782	H+1 SP			87.711	4.486	7.803	

		Large Gravel Calculation					**Adjusted for large gravel**						
Site	Initial Sample weight (g)	Total wt. excluded from analysis (gravel and shells) (g)	Percent of sample by weight	% of sample of fine analysis	**% gravel**	**% sand**	**% silt**	**% clay**	**% gravel + sand**	**% silt+clay (=mud)**	TOTAL	Analysis Comments
Peche Island: Site 2	322.0	112.3	34.88	65.12	36.88	61.33				1.79	100.00	pre-screened for gravel
Peche Island: Site 2	358.9	39.5	11.01	88.99	18.50	79.07				2.43	100.00	pre-screened for gravel
Peche Island: Site 2				100.00	9.51	87.52				2.97	100.00	
Peche Island: Site 2	284.8	143.7	50.46	49.54	58.78	40.63				0.59	100.00	pre-screened for gravel
Peche Island: Site 2				100.00	15.69	84.22				0.09	100.00	few shells present
Peche Island: Site 2				100.00	14.51	82.62				2.88	100.00	few shells present
Peche Island: Site 2	272.7	170.4	62.49	37.51	65.29	34.01				0.71	100.00	pre-screened for gravel
Peche Island: Site 2	294.6	89.9	30.52	69.48	32.75	65.64				1.61	100.00	pre-screened for gravel
Peche Island: Site 2				100.00	2.39	96.12				1.50	100.00	
Peche Island: Site 4				100.00			97.69	0.54	1.77		100.00	
Peche Island: Site 4				100.00			97.29	1.71	1.01		100.00	
Peche Island: Site 4	270.4	28.0	10.36	89.64	16.63	83.09				0.28	100.00	pre-screened for gravel
Peche Island: Site 4				100.00			98.03	1.32	0.65		100.00	
Peche Island: Site 4				100.00			96.26	0.45	3.30		100.00	
Peche Island: Site 4				100.00			94.66	0.00	5.35		100.00	
Boblo Island: Site 3	312.4	255.6	81.82	18.18	82.47	16.83				0.70	100.00	
Boblo Island: Site 3	242.2	64.1	26.47	73.53	29.08	59.78	10.88	0.26			100.00	pre-screened for gravel, see other notes
Boblo Island: Site 3				100.00	9.25	83.63				7.12	100.00	
Boblo Island: Site 3				100.00	0.00	38.58	58.40	3.03			100.00	
Boblo Island: Site 3				100.00	0.00	58.64	38.29	3.08			100.00	
Boblo Island: Site 3				100.00	0.00	21.80	75.49	2.72			100.00	
Boblo Island: Site 3				100.00	0.00	14.12	83.75	2.13			100.00	
Boblo Island: Site 3				100.00	0.00	37.40	59.45	3.15			100.00	
Boblo Island: Site 3				100.00			87.71	4.49	7.80		100.00	

Analysis Priority	Site	Sam	Transect	Quadrat	Latitude	Longitude	Depth	Run #	Analysis Method	% gravel	% sand	% silt	% clay	% gravel + sand	% silt+clay (=mud)
4	Fighting Island: Site 6	4	1	1	42.193	-83.121	2.3	5783	H+1 SP			87.923	2.715	9.362	
4	Fighting Island: Site 6	4	1	2	42.193	-83.121	1.7	5784	S	8.241	84.67				7.089
4	Fighting Island: Site 6	4	2	1	42.193	-83.120	2.2	5785	H+1 SP			93.964	1.766	4.27	
4	Fighting Island: Site 6	4	2	2	42.193	-83.121	2.3	5786	S	6.207	87.041				6.752
4	Fighting Island: Site 6	4	2	3	42.192	-83.120	2.0								
4	Fighting Island: Site 6	4	2	4	42.191	-83.120	1.9	5787	S+H	0	15.746	74.434	9.821		
4	Fighting Island: Site 6	4	3	1	42.192	-83.118	1.8	5788	H+1 SP			89.484	1.375	9.142	
4	Fighting Island: Site 6	4	3	2	42.192	-83.119	1.6	5789	S	0	91.492				8.508
4	Fighting Island: Site 6	4	3	4	42.191	-83.120	1.9	5790	H+1 SP			83.647	7.511	8.842	
4	Fighting Island: Site 6	4	4	1	42.191	-83.116	1.8	5791	H+1 SP			88.198	0.363	11.44	
4	Fighting Island: Site 6	4	4	2	42.191	-83.116	1.6	5792	S+H	1.715	88.216	9.933	0.137		
4	Fighting Island: Site 6	4	4	3	42.190	-83.117	1.6	5793	S	0	96.594				3.406
4	Fighting Island: Site 6	4	5	1	42.190	-83.115	1.7	5794	H+1 SP			93.969	3.824	2.207	
4	Fighting Island: Site 6	4	5	3	42.190	-83.116	1.8	5795	S+H	0	29.454	69.865	0.681		
5	Fighting Island: Site 4	9	1	1	42.208	-83.122	1.4	5796	S	0.8	90.144				9.056
5	Fighting Island: Site 4	9	1	2	42.208	-83.123	2.0	5797	S+H	0	19.607	79.626	0.767		
5	Fighting Island: Site 4	9	2	2	42.210	-83.123	2.1	5798	S+H	0	21.416	77.113	1.471		
5	Fighting Island: Site 4	9	3	2	42.211	-83.123	2.2	5800	S+H	0.473	13.282	83.565	2.68		
5	Fighting Island: Site 4	9	4	1	42.213	-83.123	1.4	5801	S	0.153	95.059				4.788
5	Fighting Island: Site 4	9	4	2	42.213	-83.124	2.2	5802	S+H	0	28.941	69.497	1.562		
5	Fighting Island: Site 4	9	4	3	42.213	-83.124	2.2	5803	S+H	0.927	11.872	86.863	0.338		
5	Fighting Island: Site 4	9	5	1	42.215	-83.124	1.3	5804	S	0.128	91.786				8.086
5	Fighting Island: Site 4	9	5	2	42.215	-83.124	2	5805	S+H	0	68.115	30.378	1.506		

		Large Gravel Calculation					Adjusted for large gravel					
Site	Initial Sample weight (g)	Total wt. excluded from analysis (gravel and shells) (g)	Percent of sample by weight	% of sample of fine analysis	**% gravel**	**% sand**	**% silt**	**% clay**	**% gravel + sand**	**% silt+clay (=mud)**	TOTAL	Analysis Comments
Fighting Island: Site 6				100.00			87.92	2.72	9.36		100.00	
Fighting Island: Site 6	200.1	45.4	22.69	77.31	29.06	65.46				5.48	100.00	pre-screened for gravel & shells
Fighting Island: Site 6				100.00			93.96	1.77	4.27		100.00	
Fighting Island: Site 6				100.00	6.21	87.04				6.75	100.00	
Fighting Island: Site 6				100.00							0.00	
Fighting Island: Site 6				100.00	0.00	15.75	74.43	9.82			100.00	
Fighting Island: Site 6				100.00			89.48	1.38	9.14		100.00	
Fighting Island: Site 6				100.00	0.00	91.49				8.51	100.00	
Fighting Island: Site 6				100.00			83.65	7.51	8.84		100.00	
Fighting Island: Site 6				100.00			88.20	0.36	11.44		100.00	
Fighting Island: Site 6	169.6	24.9	14.68	85.32	16.14	75.26	8.47	0.12			100.00	pre-screened for gravel & shells, see other notes
Fighting Island: Site 6				100.00	0.00	96.59				3.41	100.00	
Fighting Island: Site 6				100.00			93.97	3.82	2.21		100.00	
Fighting Island: Site 6				100.00	0.00	29.45	69.87	0.68			100.00	
Fighting Island: Site 4				100.00	0.80	90.14				9.06	100.00	
Fighting Island: Site 4				100.00	0.00	19.61	79.63	0.77			100.00	
Fighting Island: Site 4				100.00	0.00	21.42	77.11	1.47			100.00	
Fighting Island: Site 4				100.00	0.47	13.28	83.57	2.68			100.00	
Fighting Island: Site 4				100.00	0.15	95.06				4.79	100.00	
Fighting Island: Site 4				100.00	0.00	28.94	69.50	1.56			100.00	
Fighting Island: Site 4				100.00	0.93	11.87	86.86	0.34			100.00	
Fighting Island: Site 4				100.00	0.13	91.79				8.09	100.00	
Fighting Island: Site 4				100.00	0.00	68.12	30.38	1.51			100.00	

Analysis Priority	Site	Sam	Transect	Quadrat	Latitude	Longitude	Depth	Run #	Analysis Method	% gravel	% sand	% silt	% clay	% gravel + sand	% silt+clay (=mud)
5	Fighting Island: Site 5	21	1	1	42.197	-83.122	2.4	5806	H+1 SP			97.12	1.993	0.886	
5	Fighting Island: Site 5	21	1	2	42.197	-83.123	1.71	5807	H+1 SP			86.93	2.431	10.64	
5	Fighting Island: Site 5	21	2	1	42.199	-83.123	2.46	5808	H+1 SP			96.737	1.844	1.42	
5	Fighting Island: Site 5	21	2	2	42.199	-83.123	1.86	5809	S+H	0	27.331	48.118	24.552		
5	Fighting Island: Site 5	21	2	3	42.199	-83.124	1.91								
5	Fighting Island: Site 5	21	3	2	42.200	-83.123	1.96	5810	S+H	0	25.796	54.856	19.348		
5	Fighting Island: Site 5	21	3	3	42.200	-83.124	1.95	5811	S+H	0	10.066	88.702	1.233		
5	Fighting Island: Site 5	21	4	1	42.202	-83.122	3.18	5812	H+1 SP			96.905	2.176	0.92	
5	Fighting Island: Site 5	21	4	3	42.202	-83.124	1.87	5813	S+H	0	23.689	76.152	0.159		
5	Fighting Island: Site 5	21	5	1	42.204	-83.123	1.88	5814	S+H	0	14.86	84.234	0.906		
5	Fighting Island: Site 5	21	5	2	42.204	-83.123	1.78	5815	H+1 SP			86.954	1.393	11.653	
6	Old Boblo Dock	1	2	1	42.086	-83.113	1.5	5816	S	27.423	72.558				0.019
6	Old Boblo Dock	1	2	2	42.086	-83.113	1.8	5817	S+H	0	47.802	51.356	0.842		
6	Old Boblo Dock	1	2	3	42.086	-83.113	1.74	5818	S	3.579	92.885			3.536	
6	Old Boblo Dock	1	2	4	42.086	-83.113	2.54	5819	H+1 SP			86.588	2.93	10.481	

Large Gravel Calculation | **Adjusted for large gravel**

Site	Initial Sample weight (g)	Total wt. excluded from analysis (gravel and shells) (g)	Percent of sample by weight	% of sample of fine analysis	**% gravel**	**% sand**	**% silt**	**% clay**	**% gravel + sand**	**% silt+clay (=mud)**	TOTAL	Analysis Comments
Fighting Island: Site 5				100.00			97.12	1.99	0.89		100.00	
Fighting Island: Site 5				100.00			86.93	2.43	10.64		100.00	
Fighting Island: Site 5				100.00			96.74	1.84	1.42		100.00	
Fighting Island: Site 5				100.00	0.00	27.33	48.12	24.55			100.00	wood in sample
Fighting Island: Site 5				100.00							0.00	
Fighting Island: Site 5				100.00	0.00	25.80	54.86	19.35			100.00	wood in sample
Fighting Island: Site 5				100.00	0.00	10.07	88.70	1.23			100.00	wood in sample
Fighting Island: Site 5				100.00			96.91	2.18	0.92		100.00	
Fighting Island: Site 5				100.00	0.00	23.69	76.15	0.16			100.00	wood in sample
Fighting Island: Site 5				100.00	0.00	14.86	84.23	0.91			100.00	wood in sample
Fighting Island: Site 5				100.00			86.95	1.39	11.65		100.00	
Old Boblo Dock	213.5	95.4	44.68	55.32	59.85	40.14				0.01	100.00	pre-screened for gravels
Old Boblo Dock	178.9	59.7	33.37	66.63	33.37	31.85	34.22	0.56			100.00	pre-screened for gravels
Old Boblo Dock	210.6	95.3	45.25	54.75	47.21	50.85			1.94		100.00	pre-screened for gravels
Old Boblo Dock				100.00			86.59	2.93	10.48		100.00	

Habitat Data Worksheet - Turbidity Information

Sam	Site	Transect	Quadrat	Northing	Easting	Depth	Turbidity Tube	Turbidimeter	SAV	SAV photo	Method	other SAV in Area (Y/N)	Comments
17	Peche Island: Site 2	1	1	4690186	340962.2	1.24	<5	0.57	80	NO	RAKE	N	
17	Peche Island: Site 2	1	2	4690263	340932.6	1.76	<5	0.62	0	NO	VIS	N	
17	Peche Island: Site 2	1	3	4690361	340884.6	2.21	<5	0.84	unk	NO	RAKE	N	too deep to see bottom and determine SAV coverage
17	Peche Island: Site 2	2	1	4690230	341160.1	1.3	<5	0.55	25	NO	RAKE	Y	wild celery in area (very stunted in growth)
17	Peche Island: Site 2	2	2	4690302	341121.4	1.77	<5	0.69	10	NO	RAKE	Y	slender naiad and wild celery in area (stunted)
17	Peche Island: Site 2	2	3	4690390	341065.7	2.44	<5	0.63	40	NO	RAKE	N	rocky substrate in area
17	Peche Island: Site 2	3	1	4690320	341334.4	1.37	<5	0.67	50	NO	RAKE	Y	slender naiad in area
17	Peche Island: Site 2	3	2	4690378	341298.7	1.78	<5	0.78	50	NO	RAKE	Y	short leaf pondweed in area
17	Peche Island: Site 2	3	3	4690438	341263.7	2.67	<5	0.63	unk	NO	GRAPPLE TOSS	N	SAV coverage too difficult to estimate due to depth, trace amount of veg came up in grapple
13	Peche Island: Site 4	1A	1	4689742	341553.8	1.25	<5	0.88	100	YES	RAKE	Y	wild celery, and white water lillies in area/ transect and quad on electro transect
13	Peche Island: Site 4	1A	2	4692184	259220.8	0.91	<5	1.21	100	NO	RAKE	Y	lots of filamentous algae (underwater sp) in area and white water lilies in area as well/transect and quad on electro transect
13	Peche Island: Site 4	2	1	4689869	341647.3	0.55	<5	1.05	0	NO	VIS	N	transect and quad NOT on electro transect/ sed contains 35% quagga mussel shells/ water snake in area/ no SAV present, 35% other ponar sample is dreissenid shells
13	Peche Island: Site 4	1B	1	4689902	341521.1	0.75	<5	0.8	10	NO	RAKE	Y	white waterlily in area
13	Peche Island: Site 4	1B	2	4689960	341445.8	0.71	<5	1.38	80	YES	RAKE	Y	SAV cover best estimate, turbidity from outboard made assessment difficult, detritus made sediment like black soil, water very briney, water star-grass in area
13	Peche Island: Site 4	1C	1	4689869	341384.4	0.78	<5	1.11	10	YES	RAKE	N	detritus makes sediment like black soil
13	Peche Island: Site 4	1C	2	4689879	341283.2	0.94	<5	0.72	90	NO	RAKE	N	
9	Fighting Island: Site 4	1	1	4675036	324820.2	1.4	<5	1.62	100	NO	RAKE	Y	richardson's pondweed in the area
9	Fighting Island: Site 4	1	2	4675034	324770.6	2	<5	1.27	100	NO	RAKE	N	
9	Fighting Island: Site 4	2	1	4675243	324813.8	1.4	<5	1.72	75	NO	RAKE	N	
9	Fighting Island: Site 4	2	2	4675226	324775.4	2.1	<5	1.43	100	NO	RAKE	N	
9	Fighting Island: Site 4	2	3	4675215	324728.9	2.1	<5	1.64	100	NO	RAKE	N	
9	Fighting Island: Site 4	3	1	4675430	324792.9	1.4	<5	1.48	80	NO	RAKE	Y	wild celery in the area
9	Fighting Island: Site 4	3	2	4675428	324751.5	2.2	<5	1.44	100	NO	RAKE	N	
9	Fighting Island: Site 4	3	3	4675416	324693.4	2.2	<5	2.17	100	NO	RAKE	N	
9	Fighting Island: Site 4	4	1	4675636	324746.0	1.4	<5	1.46	100	NO	RAKE	N	
9	Fighting Island: Site 4	4	2	4675626	324703.6	2.2	<5	2.59	100	YES	RAKE	N	

Sam	Site	Transect	Quadrat	Northing	Easting	Depth	Turbidity Tube	Turbidimeter	SAV	SAV photo	Method	other SAV in Area (Y/N)	Comments
9	Fighting Island: Site 4	4	3	4675607	324663.5	2.2	<5	2.59	100	NO	RAKE	N	
9	Fighting Island: Site 4	5	1	4675828	324682.2	1.3	<5	1.75	100	NO	RAKE	N	
9	Fighting Island: Site 4	5	2	4675812	324643.8	2	<5	1.41	100	NO	RAKE	N	
21	Fighting Island: Site 5	1	1	4673812	324761.7	2.4	<5	1.68	100	NO	GRAPPLE TOSS	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	1	2	4673812	324717.1	1.71	<5	1.86	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	2	1	4674012	324763.4	2.46	<5	1.65	100	NO	GRAPPLE TOSS	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	2	2	4674009	324703.8	1.86	<5	2.07	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	2	3	4674016	324626.3	1.91	<5	2.8	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	3	1	4674206	324770.7	2.31	<5	1.48	100	NO	GRAPPLE TOSS	Y	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom, richardson's pondweed in area, wild celery and coontail equally comprise most of quadrat sample
21	Fighting Island: Site 5	3	2	4674203	324705.3	1.96	<5	2.36	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	3	3	4674190	324624.0	1.95	<5	2.57	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom, sediment sample is soil like
21	Fighting Island: Site 5	4	1	4674409	324774.0	3.18	<5	1.54	100	NO	GRAPPLE TOSS	Y	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom, richardson's pondweed in the area
21	Fighting Island: Site 5	4	2	4674408	324712.9	1.84	<5	2.5	100	NO	RAKE	Y	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom, wild celery and milfoil in the area
21	Fighting Island: Site 5	4	3	4674409	324641.9	1.87	<5	2.31	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
21	Fighting Island: Site 5	5	1	4674602	675227.7	1.88	<5	1.4	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in rake as was too deep and turbid to see bottom
21	Fighting Island: Site 5	5	2	4674594	324705.1	1.78	<5	2.52	100	NO	RAKE	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom

Sam	Site	Transect	Quadrat	Northing	Easting	Depth	Turbidity Tube	Turbidimeter	SAV	SAV photo	Method	other SAV in Area (Y/N)	Comments
4	Fighting Island: Site 6	1	1	4673397	324848.0	2.3	<5	2.32	100	YES	RAKE	N	
4	Fighting Island: Site 6	1	2	4673369	324831.6	1.7	<5	3.05	100	NO	RAKE	N	
4	Fighting Island: Site 6	1	3	4673323	324824.7	1.8	<5	3.64	100	NO	RAKE	N	
4	Fighting Island: Site 6	2	1	4673367	324932.4	2.2	<5	2.63	100	YES	RAKE	N	
4	Fighting Island: Site 6	2	2	4673397	324848.0	2.3	<5	2.53	100	NO	RAKE	N	ponar pic says Quad1
4	Fighting Island: Site 6	2	3	4673253	324921.3	2	<5	2.48	100	NO	RAKE	Y	Wild celery in area
4	Fighting Island: Site 6	2	4	4673195	324909.9	1.9	<5	2.3	100	NO	RAKE	N	
4	Fighting Island: Site 6	3	1	4673284	325120.4	1.8	<5	2.3	100	YES	RAKE	N	site is in between two patches of bulrushes on shoreline, shoreline dominated by phrag
4	Fighting Island: Site 6	3	2	4673244	325074.7	1.6	<5	2.95	100	NO	RAKE	N	
4	Fighting Island: Site 6	3	3	4673245	325040.1	1.9	<5	1.98	100	NO	RAKE	N	
4	Fighting Island: Site 6	3	4	4673138	324988.6	1.9	<5	2.47	100	NO	RAKE	N	
4	Fighting Island: Site 6	4	1	4673155	325291.5	1.8	<5	2.44	100	NO	RAKE	N	
4	Fighting Island: Site 6	4	2	4673127	325261.0	1.6	<5	2.19	100	NO	RAKE	N	
4	Fighting Island: Site 6	4	3	4673088	325227.0	1.6	<5	2.26	100	NO	RAKE	N	
4	Fighting Island: Site 6	4	4	4673031	325168.6	1.5	<5	2.45	50	YES	RAKE	N	turbidity slightly to high to see SAV coverage in quadrat clearly, not enough contrast between veg and chara, estimate based on visual and by feel
4	Fighting Island: Site 6	5	1	4673088	325384.8	1.7	<5	2.28	100	NO	RAKE	N	
4	Fighting Island: Site 6	5	2	4673032	325337.2	1.6	<5	3.02	100	YES	RAKE	N	cobble observed on bottom in area
4	Fighting Island: Site 6	5	3	4672985	325287.3	1.8	<5	2.43	100	NO	RAKE	N	
19	Boblo Island: Site 3	7	1	4662750	324873.8	0.475	<5	2.25	0	NO	VIS	Y	wild celery, water star-grass and milfoil in area
19	Boblo Island: Site 3	8	1	4662806	324881.0	1.02	<5	2.14	90	NO	RAKE	Y	filamentous algae in area
19	Boblo Island: Site 3	9	1	4662856	324886.4	1.147	<5	1.95	100	NO	RAKE	N	
19	Boblo Island: Site 3	1	1	4661830	324851.9	1.15	<5	1.53	40	NO	RAKE	N	
19	Boblo Island: Site 3	1	2	4661832	324885.0	1.792	<5	2.09	0	NO	RAKE	Y	wild celery, water star-grass, slender naiad, and floating leaf pondweed in area, video of freighter prop wash effect on bay taken from this quadrat
19	Boblo Island: Site 3	2	1	4661935	324842.9	1.503	<5	2.24	100	NO	RAKE	N	
19	Boblo Island: Site 3	2	2	4661935	324875.2	2.528	<5	1.95	100	NO	GRAPPLE TOSS	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
19	Boblo Island: Site 3	3	1	4662034	324826.3	1.409	<5	1.69	100	NO	RAKE	N	
19	Boblo Island: Site 3	3	2	4662034	324858.6	2.543	<5	2.03	100	NO	GRAPPLE TOSS	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
19	Boblo Island: Site 3	4	1	4662131	324817.9	1.434	<5	1.44	100	NO	RAKE	N	
19	Boblo Island: Site 3	4	2	4662133	324847.8	2.558	<5	2.02	100	NO	GRAPPLE TOSS	Y	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom, milfoil in area

Sam	Site	Transect	Quadrat	Northing	Easting	Depth	Turbidity Tube	Turbidimeter	SAV	SAV photo	Method	other SAV in Area (Y/N)	Comments
19	Boblo Island: Site 3	5	1	4662234	324808.1	1.277	<5	1.36	0	NO	VIS	N	photo taken of bottom through water, boulders made ponar difficult
19	Boblo Island: Site 3	5	2	4662237	324840.4	1.893	<5	1.98	100	NO	RAKE	N	
19	Boblo Island: Site 3	6	1	4662336	324811.4	1.782	<5	1.87	0	NO	RAKE	N	
19	Boblo Island: Site 3	6	2	4662333	324846.9	2.768	<5	1.72	100	NO	GRAPPLE TOSS	N	SAV coverage is estimate based on feel and quantity of veg retrieved in grapple as was too deep to see bottom
1	Old Boblo Dock	1	1	4661397	325212.7	1.49	<5	-99	100	YES	RAKE	N	did not have turbidimeter equipment yet, wild celery and slender (?) pondweed equally make up most of the sample
1	Old Boblo Dock	1	2	4661411	325193.2	1.95	<5	-99	100	YES	VIS	N	SAV too deep for rake, didn't have grapple, relied on vis for assessment, two species equally make up sample
1	Old Boblo Dock	1	3	4661429	325178.8	2.03	<5	-99	100	YES	RAKE	N	
1	Old Boblo Dock	2	1	4661461	325262.3	1.5	<5	-99	20	NO	RAKE	N	
1	Old Boblo Dock	2	2	4661487	325240.6	1.8	<5	-99	100	YES	VIS	Y	Richardon's Pondweed in area
1	Old Boblo Dock	2	3	4661509	325224.6	1.74	<5	-99	100	YES	VIS	Y	unknown Sav sp. in area
1	Old Boblo Dock	2	4	4661528	325202.7	2.54	<5	-99	100	YES	PONAR	N	SAV coverage an estimate based on feel, too deep to see
1	Old Boblo Dock	3	1	4661533	325329.5	1.3	<5	-99	10	NO	RAKE	N	rocky subtrate
1	Old Boblo Dock	3	2	4661545	325296.7	1.6	<5	-99	100	YES	VIS	Y	milfoil and unknown broad-leaf in area
1	Old Boblo Dock	3	3	4661557	325263.0	1.7	<5	-99	100	YES	VIS	N	