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# Environmental Sensitivity

## Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines



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1994

Direction générale  
de la protection de  
l'environnement  
région de l'Ontario

# Legend

- ESI\* Ranking**
- Shoreline Habitats**
- Bedrock or Impermeable Shores**
- 1a(1a) Exposed Bedrock Bluff less than 1 metre elevation
  - 1b(1a) Exposed Bedrock Bluff 1-5 metre elevation
  - 1c(1a) Exposed Bedrock Bluff greater than 5 metre elevation
  - 2(1b) Retaining Wall/Harbour Structure/Breakwaters
  - 3(2) Shelving Bedrock
- Unconsolidated Sediment Shores**
- 4(3) Exposed Sediment Bluff
  - 5a(4) Sand Beach: Depositional
  - 5b(4) Sand Beach: Erosional or Transitory
  - 6(4) Sand Barrier With Lagoon
  - 7a(6a) Pebble Beach
  - 7b(6a) Pebble/Cobble Beach
  - 7c(6a) Cobble Beach
  - 8(6b) Rip Rap
  - 9(6a) Boulder Beach
  - 10(5) Mixed Beach (% by sediment in DOE Database)
- Vegetated Shores**
- 11(9a) Low Vegetated Bank (Grass or Trees)
  - 12(9b) Delta Mud Flat
  - 13a(10a) Fringing Wetland
  - 13b(10b) Broad Wetland
- \* ESI - Canadian Environmental Sensitivity Index (USA ESI Ranking follows in brackets) Higher numbers indicate greater sensitivity.
- Biological Resources**
- Fish**
- Area of Seasonal Fish Spawning
  - Location of Seasonal Fish Migration
- Birds**
- Migratory Waterfowl
  - Colonial Nesting Birds (total nests - all species)
  - Wading Birds (total nests - all species)
  - Shore Birds
  - Raptors
- Shore Associated Mammals**
- Furbearers (such as Muskrat, Mink, and Beaver)
- Human-Use Resources**
- High Recreational Usage**
- Marinas and Small Craft Harbours
  - Anchorage Sites
  - Residential, Recreational or Cottage Use
  - High-Use Recreational Beach
  - Recreational Dive Site
- Resource Extraction**
- Water Intakes - Industrial
  - Water Intakes - Municipal
  - Outfall
  - Commercial Fisheries Activity
- Special Status Areas**
- Highly Sensitive Classified Feature (within 2km)
  - First Nation/Native American Reservation
  - National Park/National Forest
  - Provincial/State Park, Wilderness Area or Nature Reserve/State Forest
  - Conservation Area or Municipal Park
  - Environmentally Sensitive Area\*
  - Area of Natural and Scientific Interest\*
  - Area of Ecological Significance (e.g. Wetland)
  - Dune Formations
- \* As identified by Ontario Ministry of Natural Resources or Conservation Authorities
- Countermeasures**
- Access Site (for land vehicles)
  - Approach Concerns
  - Exposed Rock
  - Coast Guard Light Station
  - Boat Launch: Excellent
  - Boat Launch: Good
  - Boat Launch: Poor
  - Helicopter Landing Site
  - Staging Area: Excellent
  - Staging Area: Good
  - Staging Area: Poor
  - Automated Weather Stations

## Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines

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## Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines

### Prepared by:

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Environmental Protection Branch  
Ontario Region  
Canadian Coast Guard  
1994

United States Coast Guard -  
District 9  
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**These maps are not to be used for navigational purposes.**

While every effort has been made to ensure the accuracy, quality and completeness of the data contained in the Environmental Sensitivity Atlas (and Supplement) for the St. Clair River, Lake St. Clair and Detroit River Shorelines, no responsibility will be accepted by Environment Canada, United States Coast Guard, National Oceanic and Atmospheric Administration or the Canadian Coast Guard for any consequential loss or damage arising from its use.

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## 1.0 Introduction

The "Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines" is a publication designed for use in response to marine spills of oil and other hazardous materials. This Atlas will allow responders to work from a common basis to rapidly identify the resources at risk during a spill. Information in the Atlas will assist decision makers to quickly assign priorities for protection measures.

The Atlas focuses on both the Canadian and United States shorelines of the St. Clair River, Lake St. Clair and Detroit River. This Atlas begins near Sarnia, Ontario and follows the Canadian shoreline past Amherstburg, Ontario to the south end of the Detroit River. The American shoreline is covered from Port Huron, Michigan to Point Mouillee State Game Area in Millville Beach, Michigan at the south end of the Detroit River. The Canadian shoreline north of Sarnia is covered in the "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline" (DOE 1994) and the Canadian shoreline east of Amherstburg is covered in the "Environmental Sensitivity Atlas for Lake Erie (including the Welland Canal) and the Niagara River Shorelines" (DOE 1994). The United States shorelines of the adjacent Great Lakes have also been addressed in "Lake Erie Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI 1985) and "Lake Huron Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI 1994).

**This project is a collaboration of Environment Canada's (DOE) Ontario Region office of the Environmental Protection Branch (EPB-OR), Transport Canada's Canadian Coast Guard (CCG) Central Region office, United States Coast Guard (USCG) District 9 and the United States National Oceanic and Atmospheric Administration (NOAA).**

Two versions of this information have been produced; a softbound (paper) Atlas, and a hardbound (vinyl) Supplement to the Great Lakes Annex of the Canada-United States Joint Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances. A limited number of copies of the hardbound Supplements have been produced. This version is designed for the day to day operational use by several agencies and organizations which have major spill related jurisdictional responsibilities, or deal with environmental emergencies on the Great Lakes on numerous occasions.

The Supplement is designed to complement the Joint Marine Pollution Contingency Plan, which contains additional spill response information such as spill response personnel and procedures. The Supplement differs from the Atlas only in its requirement for field durability, and the addition of several types of spill response countermeasures and highly classified sensitivity information that are critical to spill response decision makers.

The softbound version of the Atlas was prepared for broad distribution to assist agencies and companies in spill preparedness and response. While it will be useful for resource management in general, this Atlas has been designed primarily to assist spill responders.

Numerous references are made in this publication to the Atlas, and to the Supplement. These references indicate the two versions described above. Both versions have been generated from Environment Canada's master database, which is the major product of the project. All data which has been collected and represented on the maps reside digitally in an electronic desktop environmental sensitivity mapping system, similar to a Geographic Information System (GIS). This system will readily allow additions or changes to the database so that updated versions of the Atlas can be released periodically. More importantly, the system will allow for enhanced spill response management at the time of a spill.

Work is underway to create a 'user friendly' Graphical User Interface for the system. Simultaneous viewing of shoreline video and the corresponding GIS screen is also under development.

The electronic desktop environmental sensitivity mapping system is a continually evolving system. EPB-OR welcomes additional information and updates that could enhance the master database. For questions, suggestions or concerns about this publication or the master database, please contact:

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## 2.0 Project Background

In April 1994, EPB-OR asked many agencies to assist in the development of the Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River shorelines. EPB-OR received an excellent response, with many agencies and communities expressing interest or cooperating to provide data and expertise. American agencies agreed that this project was an excellent opportunity to pool resources and create an international product.

The St. Clair River/Lake St. Clair/Detroit River project consisted of six major phases; digital base map preparation, data collection, data digitizing, legend definition, data overlay layer creation, and finally, Atlas layout design.

During the data collection phase in 1994, videotaped helicopter shoreline surveys were made of the study area, which facilitated the completion of shoreline classification, and identification of many countermeasure features. Biological and human-use resources data were assembled from reviews of existing information provided by partner agencies, as well as from site visits and reviews of video tapes. Copies of the video tapes are available by contacting the Ontario Region Environmental Emergencies Section at (416) 739-4994.

Environment Canada was given access to various agencies' resource information. Appendix A has a list of these agencies and the data they contributed. This resource information was subsequently transcribed and digitized to suit the electronic requirements of the production process.

A great deal of care was directed to the selection of legend features and symbols which would serve the immediate needs of spill responders on the Great Lakes and the Connecting Channels. Specific electronic layers were created to present geomorphological, cultural, biological and human-use information.

With input from many response experts, the project team designed the Atlas to convey critical information to a spill responder in a concise, straightforward manner, with a minimum of extraneous detail. Before final publication, these map pages for the St. Clair River, Lake St. Clair and Detroit River were reviewed extensively (for both accuracy and utility) by the key response and resource agencies instrumental in its development and future use.

### 2.1 Regional Approach within a National and International Framework

Every effort has been made to ensure that the Ontario Region master database will be compatible with the recommendations of DOE's National Sensitivity Mapping Program, which is currently being developed.

Close coordination with national and international sensitivity mapping programs was essential for this project because shorelines and sensitive resources for both the American and Canadian sides of the Connecting Channels were mapped. Environment Canada was responsible for the ranking classification of both United States and Canadian shorelines. Since somewhat different shoreline sensitivity ranking and colour schemes are used in the United States, the Atlas legend includes both Environmental Sensitivity Index (ESI) rankings.

The United States Coast Guard (USCG) and National Oceanic and Atmospheric Administration (NOAA) provided all of the sensitive biological and human-use resource information for the United States. This information was obtained through a combination of reviewing existing ESI atlases (produced in 1984 and 1985) and the new sensitive resource annexes from the Area Contingency Plans covering each Connecting Channel's U.S. side (produced in 1993). All of this international information now resides digitally within Environment Canada's master database used to create this atlas (see Section 3.0).

All of the sensitive resource data have been presented using Canadian Great Lakes map symbology methods. However, joint development work with NOAA and USCG has ensured that data and sensitivity representation is similar to Atlas production underway for the American shorelines of the Great Lakes. Close cooperation with Canadian Coast Guard and United States Coast Guard operational officers dictated many of the design layout features of the Atlas and Supplement. For all Connecting Channels atlas work, Environment Canada, NOAA and USCG have all collaborated closely to ensure the international utility of the atlases.

## 3.0 Environment Canada's Desktop Environmental Sensitivity Mapping System

The maps in this publication have been generated from Environment Canada's electronic desktop environmental sensitivity mapping system. The system currently employs MapInfo™ software and MapBasic™ programming language to overlay sensitivity and countermeasure data on electronic base maps.

To show all data at once on paper maps would impact on the clarity and utility of the publication. The specific resource agency information supplied to Environment Canada in the data collection phase of this project has been entered into a comprehensive master database. Some of the data provided are more appropriate as background information, and will remain in the master database but will not be present on paper maps. Information in this database will be readily available to responders (EPB-OR Environmental Emergency Duty Officer at 416-346-1971 in Canada or NOAA Scientific Support Coordinator at 206-526-6317 in the United States) during a spill. This database will also form an appendix to the Supplement version.

For base maps, National Topographic System (NTS) digital map sheets at a scale of 1:50,000 have been used to create the digital Canadian shorelines for the St. Clair River, Lake St. Clair and Detroit River. The digital U.S. shoreline of the St. Clair River, Lake St. Clair and Detroit River was created from United States Geological Survey (USGS) Quad Maps (scale of 1:24,000). On each map page of the publication, reference is made to the relevant NTS or USGS Quad map sheet(s) covering that portion of shoreline displayed. Elements of Canadian base topographic maps showing on each atlas page have been reproduced with Natural Resources Canada's permission. Once data overlays (or 'layers') are added to the base maps, the assembled Atlas information is printed at a scale of 1:25,000, covering the entire 726 kilometres (454 miles) of St. Clair River, Lake St. Clair and Detroit River shoreline (340 km Canadian; 386 km or 241 miles American) on a total of 51 map pages. The more detailed scale of 1:25,000 has been used in this Atlas (compared with others at 1:50,000) due to the narrow nature of the rivers in the study area and the high concentration of urban and industrial development.

The system displays a latitude/longitude graticule superimposed over each map, with hatch marks for every minute of latitude or longitude, and darker hatch marks for every five minutes. A full degree is denoted by the thickest mark. Arrows in the corners of each map page point to the exact location of the displayed coordinates. This system has created maps employing an unprojected latitude and longitude coordinate system.

## 4.0 Nature of Data

### 4.1 Data Collection and Levels of Confidence

EPB-OR staff contacted or made visits to all contributing partner agencies between April and August 1994. Existing and new data sets were gathered or surveyed for the project. For collection of existing data, relevant maps, publications and databases were reviewed, and pertinent information transcribed then digitized by Environment Canada. A new shoreline classification scheme, most suitable for spill response on the Great Lakes and Connecting Channels, defines nineteen (19) different shoreline habitats and their U.S. equivalents. This was the major component of new information specifically surveyed for this project.

Data in digital form existed for only a few Legend features for the St. Clair River, Lake St. Clair and Detroit River. To some degree, data availability on the Great Lakes and Connecting Channels has dictated definition of Legend features and the manner they are displayed on the maps. To use a crosshatched or coloured polygon to represent an area implies a level of certainty regarding the boundaries of that area. Such detailed boundary accuracy was not always available at the time of the data collection phase of the project.

For example, since fish spawning activity information was often supplied for general areas rather than for specific areas or points, a decision was made to use a point symbol, but one defined as an area, hence the Legend feature 'Area of Seasonal Fish Spawning'. This works well considering that the source information does not allow for the rigorous definition of exact boundaries of all fish activity; it more customarily identifies general areas of observed activity, or of suitable habitat. For spill response, it can be assumed that activity occurs in the general vicinity of each fish spawning symbol, with more specific information often being found in the 'Notes' column when available.

Fish spawning and migration data for the study area were often based more on suitable habitat identification than recent specific activity observations. Consultations with local resource experts can assist in defining boundaries more specifically at the time of a spill.

The majority of the Canadian bird information is based on recent, thorough surveys by the Canadian Wildlife Service, Royal Ontario Museum, and the Ontario Ministry of Natural Resources, and is quite accurate and up to date. 'Shore Associated Mammal' information is based on observations, or identification of suitable habitats. 'High Recreational Usage', and 'Resource Extraction' features are based on documented surveys. Prior to publication, these locations were thoroughly reviewed and modified by local individuals familiar with the different shoreline regions of the study area.

For 'Special Status Areas', polygon boundaries have been digitized as provided by various agencies and are considered accurate and up to date. 'Countermeasures' symbols were placed following joint CCG - USCG - NOAA - EPB-OR video review sessions and helicopter and ground surveys during July 1994. These symbols were then reviewed for accuracy and modified where necessary by local experts familiar with the areas involved.

The geomorphology of 100 percent of the St. Clair River, Lake St. Clair and Detroit River shorelines was newly classified by the Project Geomorphologist during the 1994 helicopter survey which was undertaken specifically for this project. Videotapes were filmed during these surveys and then reviewed to confirm the shore classifications that comprise the 'Shoreline Habitat' layer of information. The confidence level for these data is excellent.

These 'Shoreline Habitat' classifications are an excellent guide for responders at the time of a spill. Onsite examination (or 'ground truthing') will ensure that any minor discrepancies are identified during spill response.

## 5.0 Atlas Design and Function

### 5.1 Symbolology and Use of Colour

Each Legend 'feature' represents a different 'layer' of information. These features have been defined by three types of symbols: point symbols, line symbols, and areas, or polygons. A municipal water intake is an example of a point symbol, a Shoreline Habitat classification is a line symbol, and a National Park is an example of an area or polygon, with defined boundaries.

Colour has been used to provide a richness in display and to denote differences among similar symbols, such as an excellent and a poor boat launch. It also distinguishes different shoreline classifications. To assist users in discerning one shoreline colour from another, a removable Legend guide has been included with the Atlas in a pocket attached to the back cover. If required, users may line up this card over the shoreline habitat in question to determine the exact colour code for any given habitat.

During spill response, photocopying and facsimile transmission form a large part of information transfer. Each of the symbols chosen are unique (with only a few exceptions) so that black and white reproductions of the Atlas pages will result in minimal information loss.

For Shoreline Habitats, colours are the best manner to convey this key information without obscuring other valuable data on the maps. In situations where colour cannot be conveyed, the electronic system can produce maps showing Shoreline Habitats by Environmental Sensitivity Index (ESI) number, rather than colour, to meet those needs.

### 5.2 Sensitivity Ranking

Much international work has gone into determining environmental sensitivity ranking schemes. It is a very complex undertaking. Shoreline habitats, biological, cultural and human resources all form an intricate system with many different potential impacts at the time of an oil spill. Some ranking schemes endeavour to weigh many factors and values to come up with a single numerical ranking indicating relative sensitivities of all resources in question. From this ranking, protection and clean up priorities are assigned when deploying limited response equipment and available resources. Alternatively, some atlases limit information to identifying the location of resources at risk without ranking them.

Some sensitivities are readily identified and ranked, such as shoreline habitats. Other resources' relative sensitivities can be completely dependent on circumstances surrounding the spill itself. During any significant spill, a consultation among spill response experts will consider those spill-specific circumstances before coming up with the set of protection and clean up priorities appropriate for that particular incident.

Taking this into consideration, the Environmental Sensitivity Atlas (and Supplement) for the St. Clair River, Lake St. Clair and Detroit River Shorelines ranks 'Shoreline Habitats' in order of increasing sensitivity based on factors such as oil residence time, cleaning potential and exposure to natural removal processes. A full description of the 'Shoreline Habitats' used in this Atlas is contained in Section 9.0.

Environment Canada's newly revised Ontario Region classification scheme for shoreline habitats differs somewhat from that used on Environmental Sensitivity Index (ESI) maps of other United States Great Lakes shores. For this and other newly completed Great Lakes Connecting Channel atlases, the American equivalent to Canadian shoreline habitat rankings is noted (see Section 9.1). The United States shoreline habitat rankings are listed below:

United States ESI Ranking	Shoreline Habitat Description
1A	Exposed Rocky Cliffs
1B	Exposed, Solid Man-made Structures
2	Shelving Bedrock Shores
3	Eroding Scarps in Unconsolidated Sediments
4	Sand Beaches
5	Mixed Sand and Gravel Beaches
6A	Gravel Beaches
6B	Riprap Revetments
7	Exposed Flats
8A	Sheltered Scarps in Bedrock
8B	Sheltered, Solid Man-made Structures
9A	Sheltered, Vegetated Low Banks
9B	Sheltered Sand/Mud Flats
10A	Fringing Wetlands
10B	Extensive Wetlands

Features such as 'Biological Resources' and 'Human-Use Resources' are identified on the maps, but are not specifically ranked in relation to one another. Broad terms such as low, moderate or high priority are used in the 'Notes' column on many map pages to give an indication of relative sensitivity, and relative sensitivities are broadly discussed in the text of Section 7.0, but the final prioritizing decisions will be made by qualified response experts at the time of the spill.

## 6.0 Description of Atlas Legend Features

Figure 1 identifies standard features appearing on the base maps in the Atlas and Supplement. A colour example of the Environmental Sensitivity Atlas legend is shown in Figure 2. A definition of each Environmental Sensitivity Atlas legend feature follows in Sections 6.1 through 6.4. Section 9.0 defines the Shoreline Habitats found in the Atlas.

The size of the symbols in the legend do not represent the exact size shown on the individual maps, due to space constraints.

Standard Base Map Features	
	Dual Highway
	Hard surface, all weather, more than 2 lanes
	Hard surface, all weather, 2 lanes
	Hard surface, all weather, less than 2 lanes
	Loose or stabilized surface, all weather, 2 lanes or more
	Loose or stabilized surface, all weather, less than 2 lanes
Note: U.S. roads are not classified for this atlas and are all represented by a single red line, except as noted above	
	Unclassified streets
	Trail or cut line
	Railway
	Railway tunnel
	Pipeline (underground)
	Ferry
	Vehicle Tunnel

Figure 1: Standard Cartographic Legend for Base Maps

### Legend

**ESI\* Ranking**

**Shoreline Habitats**

**Bedrock or Impermeable Shores**

- 1a(1a) Exposed Bedrock Bluff less than 1 metre elevation
- 1b(1a) Exposed Bedrock Bluff 1-5 metre elevation
- 1c(1a) Exposed Bedrock Bluff greater than 5 metre elevation
- 2(1b) Retaining Wall/Harbour Structure/Breakwaters
- 3(2) Shelving Bedrock

**Unconsolidated Sediment Shores**

- 4(3) Exposed Sediment Bluff
- 5a(4) Sand Beach: Depositional
- 5b(4) Sand Beach: Erosional or Transitory
- 6(4) Sand Barrier With Lagoon
- 7a(6a) Pebble Beach
- 7b(6a) Pebble/Cobble Beach
- 7c(6a) Cobble Beach
- 8(6b) Rip Rap
- 9(6a) Boulder Beach
- 10(5) Mixed Beach (% by sediment in DOE Database)

**Vegetated Shores**

- 11(9a) Low Vegetated Bank (Grass or Trees)
- 12(9b) Delta Mud Flat
- 13a(10a) Fringing Wetland
- 13b(10b) Broad Wetland

\* ESI - Canadian Environmental Sensitivity Index (USA ESI Ranking follows in brackets) Higher numbers indicate greater sensitivity.

**Biological Resources**

**Fish**

- Area of Seasonal Fish Spawning
- Location of Seasonal Fish Migration

**Birds**

- Migratory Waterfowl
- Colonial Nesting Birds (total nests - all species)
- Wading Birds (total nests - all species)
- Shore Birds
- Raptors

**Shore Associated Mammals**

- Furbearers (such as Muskrat, Mink, and Beaver)

**Human-Use Resources**

**High Recreational Usage**

- Marinas and Small Craft Harbours
- Anchorage Sites
- Residential, Recreational or Cottage Use
- High-Use Recreational Beach
- Recreational Dive Site

**Resource Extraction**

- Water Intakes - Industrial
- Water Intakes - Municipal
- Outfall
- Commercial Fisheries Activity

**Special Status Areas**

- Highly Sensitive Classified Feature (within 2km)
- First Nation/Native American Reservation
- National Park/National Forest
- Provincial/State Park, Wilderness Area or Nature Reserve/State Forest
- Conservation Area or Municipal Park
- Environmentally Sensitive Area\*
- Area of Natural and Scientific Interest\*
- Area of Ecological Significance (e.g. Wetland)
- Dune Formations

\* As identified by Ontario Ministry of Natural Resources or Conservation Authorities

**Countermeasures**

- Access Site (for land vehicles)
- Approach Concerns
- Exposed Rock
- Coast Guard Light Station
- Boat Launch: Excellent
- Boat Launch: Good
- Boat Launch: Poor
- Helicopter Landing Site
- Staging Area: Excellent
- Staging Area: Good
- Staging Area: Poor
- Automated Weather Stations

Figure 2: Environmental Sensitivity Atlas Legend

## 6.1 'Notes'

One current constraint of the electronic desktop mapping system is that it does not allow the use of symbology to identify both species and their seasonality in a clear, easily understood manner. The central objective of the Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines is to present mapped sensitivity information that may be readily understood at a glance by spill responders.

To achieve this objective, the 'Notes' column on the side of each map page was used to display species and seasonality information, when available. The symbol on the maps for 'Notes' is a red exclamation point with a white number inside it. Each numbered 'Note' symbol on a map corresponds to the same number in the 'Notes' column for that page. These 'Notes' also highlight important site-specific facts or concerns for the responder including approach concern descriptions (foreshore flats, rocky reefs or submerged vegetation). The 'Notes' are anecdotal. They can be expanded in future Atlas updates as more sensitivity information becomes available.

## 6.2 Biological Resources

Biological Resources include broad groupings entitled Fish, Birds and Shore Associated Mammals. While specific species information is valuable to the responder, the 'top layer' of an Atlas should provide a straightforward initial indication of the general biological activity in an area. The responder can quickly get a sense of local sensitivities without deciphering complex symbology, or cross-referenced tables of data. This latter detail will be required, but it can reside in the 'hidden layers' of the master database, for use by responders in consultation with local resource experts at the time of a spill.

Comprehensive data was available for rare plants along the St. Clair River, Lake St. Clair and Detroit River shorelines. Rare plants are highly sensitive to human activity, and to some degree, to oiling. Reported locations have been described in the 'Notes' column. Consult with local offices of the Ontario Ministry of Natural Resources or Michigan State Department of Natural Resources for additional information.

### 6.2.1 Fish

#### 'Area of Seasonal Fish Spawning' and 'Location of Seasonal Fish Migration'

In the St. Clair River, Lake St. Clair and Detroit River Atlas, the available data collected focused mainly on known areas of spawning and migration activity for fish species having commercial or recreational value. Site-specific information on non-commercial or non-sport fish species was not readily available during data collection for the St. Clair River, Lake St. Clair and Detroit River. As more information becomes available, it will be incorporated into the master database, and in Atlas updates.

As explained in Section 4.1, to use a polygon to represent an area implies a level of certainty regarding the boundaries of that area. Since fish spawning activity information was supplied for general areas, a point symbol defined as an area is used. The symbol for 'Area of Seasonal Fish Spawning' is used to denote habitats such as fish spawning streams, reefs and beaches, and also locations where sensitive life stages (egg, larvae and juvenile) are concentrated. For 'Location of Seasonal Fish Migration', the symbol is typically placed at the mouth of a river or stream known to be used for migration.

For spill response, it can be assumed that activity occurs in the general vicinity of each fish symbol, with more specific information often being found in the 'Notes' column when available. Consultations with local resource experts can assist in defining boundaries more specifically at the time of a spill. In times of an environmental emergency, the Atlas symbols will provide critical initial information regarding fish spawning and fish migration.

The following species and seasonality information for the St. Clair River, Lake St. Clair and Detroit River is derived from information supplied by the various District Offices of the Ontario Ministry of Natural Resources (OMNR) and "Freshwater Fishes of Canada" (Scott and Crossman 1973). This general information will complement details found on the individual maps.

Up to seventy different species have been identified in these water bodies. Sport fishing species in the study area include: smallmouth, largemouth, rock and white bass; yellow and white perch; northern pike, muskellunge and walleye. There are limited commercial catches in Lake St. Clair, for instance, of bluegill and pumpkinseed.

Carp, freshwater drum, black and white crappie, sturgeon, channel catfish, quillback carpsucker, gizzard shad, brown bullhead and redhorse and white sucker are also present in the study area in various locations.

The St. Clair delta is used by twenty-eight natives species for spawning. Rainbow smelt and sea lamprey spawn in the tributaries and alewives, carp and gizzard shad spawn in bays, marshes or other shallow areas (UGLCCS, 1988).

The sea lamprey migrate up streams with a sand, gravel and rubble substrate in spring and early summer to spawn. Significant populations have been found in the Great Lakes. The sea lamprey population in the St. Clair River, Lake St. Clair and Detroit River is lower than other Great Lakes due to a warmer average water temperature and fewer suitable spawning rivers (Scott and Crossman 1973).

Spawning activity for walleye occurs in the St. Clair delta area and most tributaries of the Connecting Channels during the spring, often over boulder or coarse gravel shoals of the lake.

Bass spawn along most of the shoreline in late spring.

Muskellunge and northern pike are spring spawners in heavily vegetated flooded areas.

### 6.2.2 Birds

Areas requiring protection in the event of an oil spill include staging areas for migrating birds, breeding colony sites, foraging areas of breeding birds, important wetlands along the shore, and endangered species habitats. Through a combination of Notes and symbols, these areas have been identified, or the information is available in the master database whenever such data were supplied for the study area.

#### 'Migratory Waterfowl'

This category is comprised of both migrants and breeders which are present in the study area for at least part of the year. Species include those found on shoreline wetlands and sheltered waters such as Canada geese and various dabbling ducks (including mallard, wood duck, northern pintail, black duck, American widgeon, gadwall and teal), plus those species of more open water such as loons, grebes and diving ducks (including common goldeneye, scaup, old squaw, bufflehead, ring-necked duck, redhead and canvasback). Often the 'Notes' column will identify critical staging areas, feeding areas or wetlands for these migratory waterfowl.

An estimated 700,000 diving ducks, 500,000 dabbling ducks and 250,000 Canadian geese migrate across Michigan each fall stopping over on the shorelines of the St. Clair River, Lake St. Clair, and Detroit River (Edwards et al., 1989). It appears that due to increased population of zebra mussels in the eastern wetland area of Lake St. Clair, an increase in the population of diving ducks (lesser scaup, canvasbacks and redheads) has been observed (Dennis and North, 1994).

#### 'Colonial Nesting Birds (total nests - all species)', and 'Wading Birds (total nests all species)'

Regarding colonial waterbirds, the information presented in this Atlas was obtained as part of a program to census all gulls, terns, cormorants, herons and egrets nesting on the Great Lakes during 1989 to 1991. This program was carried out simultaneously in Canada and the U.S. In Canada the program was coordinated and supervised by Environment Canada's Canadian Wildlife Service (CWS).

CWS is preparing a number of Technical Reports, which together will constitute the "Atlas of Colonial Waterbirds Nesting on the Canadian Great Lakes". The CWS Technical Reports will provide detailed information, compare present (1989-91) breeding distribution and abundance data with data for earlier years, and discuss the census findings in a biological context.

The Technical Reports will also deal with the relative scarcity of different species and habitats, and their needs for conservation. For more information on the "Atlas of Colonial Waterbirds Nesting on the Great Lakes", please contact Dr. Hans Blokpoel, Canadian Wildlife Service (see Appendix A under 'Bird Information').

There are numerous species of colonial waterbirds that nest regularly on the Great Lakes with several of these species nesting in the study area: herring gulls, double-crested cormorants (rare), great blue herons, black-crowned night herons (rare), ring-billed gulls, and common terns, Caspian terns (rare) and Forster's terns.

Cormorants are large, dark-plumaged birds with long necks and long bills with a sharp hook at the tip. Terns are small to medium sized, light coloured birds with forked tails and long narrow wings. Gulls are medium sized birds with long wings and rounded tails. Wading birds such as the Great Blue Heron are easily recognized by their distinctive long legs, neck, and bill.

All nesting locations in Canada were acquired from the 1989 to 1991 CWS census, and the Royal Ontario Museum's (ROM) ongoing "Ontario Nest Records Scheme" established prior to 1900. Nesting locations in the U.S. were obtained from the original "Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines" compiled in 1983, in which information from the U.S. Fish and Wildlife Service was used.

Two symbols are used to indicate nesting colonies of waterbirds. One symbol, a gull in flight ('Colonial Nesting Birds'), represents nesting locations for gulls, terns and cormorants. The other symbol, a standing heron ('Wading Birds'), represents nesting or breeding and feeding areas used by herons and egrets.

Where they occur on the individual map pages, these two symbols are followed by a number representing the total number of nests for all species at that location. The species-specific nest numbers are available in the master database. The total nests number was used for a quick reference to give responders an order of magnitude idea of site-specific occurrence of the category; for instance, less than 10 nests is a lower priority; 10 to 100 is of higher priority; and over 100 nests is a high priority concentration.

Of course, number of nests is not the only consideration in setting spill response priorities, but this information will assist responders in initial assessments. Responders will typically be interested in protecting the most vulnerable resources, rather than focussing strictly on the greatest numbers. The numbers are provided only as a guideline for deploying limited resources; in the event of a spill, the appropriate experts will be consulted for specific species information that may change priorities. When a 'Wading Bird' or 'Colonial Nesting Bird' symbol occurs without a number in brackets, it either represents a feeding or foraging location, or a site for which the number of nests was not available.

#### **'Shore Birds'**

This category includes species such as sandpipers and plovers which are small, active birds with short to medium length legs and bills. They can be found nesting or feeding on sand and gravel beaches along the St. Clair River, Lake St. Clair and Detroit River during the ice free season.

#### **'Raptors'**

The two most important raptor species found along the St. Clair River, Lake St. Clair and Detroit River shorelines are osprey and bald eagles. The maps show general locations of nest sites. The bald eagle is an endangered species (CWS) in Ontario, and a threatened species in the U.S. Exact nesting locations of bald eagles remain classified in the master database for use by responders during an environmental emergency. The peregrine falcon is a very rare migrant in the study area.

### **6.2.3 Shore Associated Mammals**

#### **'Furbearers (such as Muskrat, Mink and Beaver)'**

This biological grouping includes mammals such as otters, muskrats, or beavers that are known to occur along the shorelines of the Great Lakes and Connecting Channels and their tributary rivers. Wetlands are the most important habitat for these species. Several species, such as muskrat, beaver and mink have local economic importance.

The 'Notes' column will also periodically make reference to shore associated mammals. Larger mammals, such as moose and bears, occasionally come to the shore but their locations cannot be pinpointed on the maps. Rather, a general comment can be made to alert responders to be prepared for possible encounters with these mammals during shore clean up activities. Oiled carcasses should be removed from shores whenever practical to prevent their ingestion by mammals or raptors such as bears, wolves or eagles.

Note that no symbol was used to denote reptiles and amphibians. Relatively few species of reptiles and amphibians are associated with the shorelines of the Great Lakes and Connecting Channels. Water snakes and several species of turtles that use wetlands are likely to be found in various shoreline habitats (Owens et al., 1992). There was a limited amount of information available for reptiles and amphibian distribution (specific information can be obtained from Environment Canada's Environmental Conservation Branch at 905-336-4843). Where specific information was provided, the 'Notes' column includes a reference to a specific reptile or amphibian species. Both reptiles and amphibians are at risk during an oil spill, but mapping their distribution would not be practical because of their mobility and widespread occurrence. As they are dependent

on water, especially wetlands (Owens et al., 1992), the Atlas identifies these wetland habitats. By protecting these areas against oiling, reptile and amphibian populations will be taken into account, along with birds, fish, and mammals.

## **6.3 Human-Use Resources**

Human-Use Resources are features that have a heightened sensitivity or value because of their use or importance to humans. Locations with these symbols will typically have higher protection and clean up priorities associated with them. These features include areas of high recreational usage, economic benefit or special status (cultural, scientific or ecological importance).

### **6.3.1 High Recreational Usage**

#### **'Marinas and Small Craft Harbours'**

In order for a facility to receive the 'marina' symbol, it must have fuel, docking, parking and telephone facilities. Small Craft Harbours, under the jurisdiction of the Department of Fisheries and Oceans, are also included.

#### **'Anchorage Sites'**

These sites offer suitable and secure anchorage for small watercraft. They are often located in sheltered bays or inlets.

#### **'Residential, Recreational or Cottage Use'**

This symbol indicates the presence of cottages, seasonal or permanent dwellings, resorts, campgrounds, picnic areas, or trailer parks. Residential 'clusters' were often grouped together and denoted as a single symbol.

#### **'High-Use Recreational Beach'**

These areas have a heightened sensitivity during the summer months.

#### **'Recreational Dive Site'**

These locations have been identified using the guidebook "Dive Ontario!" which draws heavily on information from the Ontario Underwater Council, and from U.S. and Canadian diving clubs.

### **6.3.2 Resource Extraction**

#### **'Water Intakes - Industrial'**

This symbol denotes locations where water is extracted from the St. Clair River, Lake St. Clair or Detroit River for industrial, non-food related uses. Contact numbers when available for these industries are provided in the 'Notes' column and should be used to advise that water intakes should be shut down or monitored if threatened by a spill. Any telephone numbers noted in the Atlas are subject to change and should be verified regularly.

#### **'Water Intakes - Municipal'**

This symbol denotes locations where water is extracted from the St. Clair River, Lake St. Clair or Detroit River for community use for drinking water or food processing. Contact numbers for these intakes are provided in the 'Notes' column and should be used to advise that water intakes should be shut down or monitored if threatened by a spill. Any telephone numbers noted in the Atlas are subject to change and should be verified regularly.

#### **'Outfall'**

This symbol denotes locations of municipal and industrial water outfalls discharging into the St. Clair River, Lake St. Clair or Detroit River. Though outfalls are not water resource extraction elements, they are associated

with water-use operations. Contact numbers when available for these industries are provided in the 'Notes' column. For mystery spills, water outfalls should be checked as a possible source of the discharge or release.

### **'Commercial Fisheries Activity'**

Limited commercial fisheries activities were identified in the St. Clair River, Lake St. Clair and Detroit River Connecting Channels. The Detroit River once supported a large commercial fishery for lake whitefish, lake herring, walleye, lake sturgeon, black bass, northern pike, muskellunge and carp. However, due to overfishing, pollution and dredging such a significant commercial fishery in the river no longer exists (UGLCCS, 1988). There is some commercial fishing at Point Edward and Stag Island near Sarnia, and on Lake St. Clair. There is commercial bait fishing activity at Sombra, Peche Island near Windsor and at Edgewater Beach and by the Ambassador Bridge on the Detroit River. Channel catfish are commercially fished at the mouth of the Thames River on Lake St. Clair. There were no fish farms identified in the study area.

The 'Commercial Fisheries Activity' symbol is used whenever such activity was specifically identified in source data either for shore activity such as a primary fish processing facility, or areas along the shores where commercial fishing activity takes place, including harvesting and stocking. Individual map pages in those cases identify specific commercial and recreational fishing areas. More specific Commercial Fisheries Activity data may be added to the database as they become available.

### **6.3.3 Special Status Areas**

These are areas where implementation of protection measures and/or assessment of the effects of oil spills are considered a high priority, especially for those locations within Special Status Areas that are vulnerable to oiling or responder activities.

### **'Highly Sensitive Classified Feature (within 2 km)'**

Certain information sets of a restricted nature due to the high biological, cultural or physical sensitivity of the features described are given this symbol. Endangered species information and archaeological sites are two examples. Exact locations and details are maintained in Environment Canada's master database, but agencies providing the source data did so only with the understanding that this information would not be made readily available, except to responders.

In the event of a spill, responders will report all occurrences of this symbol in an affected area. By reporting the number inside the symbol, they will receive the appropriate information and response advice from EPB's Environmental Emergencies Duty Officer (416-346-1971) and the agency that provided the source data, so that they can effectively implement proper protection and clean up measures.

### **'First Nation/Native American Reservation'**

In Canada, Aboriginal people living on a reserve are referred to as a First Nation. In the U.S., the reserve is known as a Native American Reservation. There are two First Nations along the shorelines of the study area; one located on Walpole Island at the south end of the St. Clair River and the other, Chippewas of Sarnia First Nation, located south of the city of Sarnia. Responders should contact the Chief of Walpole Island First Nation at 519-627-1481 and the Chief of Chippewas of Sarnia First Nation at 519-336-8410 and advise him/her when responding to a spill in their local area or when a spill threatens to impact their shorelines or water intakes. References are made on the appropriate maps in the Notes column. There are no Native American Reservations along the United States shoreline in the study area.

### **'National Park/National Forest'**

National Parks (including National Heritage Sites) are managed by Heritage Canada's Canadian Parks Service in Canada. National Forests and Parks in the United States are managed by the Department of the Interior. In both countries, these areas are identified by a polygon symbol on the map pages. This category may include underwater parks, although none are present in the study area.

### **'Provincial/State Park, Wilderness Area or Nature Reserve/State Forest'**

Provincial Parks, Nature Reserves or Wilderness Areas are areas representing different classes of Provincial Parks under the jurisdiction of the Ontario Ministry of Natural Resources in Canada. In the U.S., State Parks and State Forests are under the jurisdiction of the Michigan Department of Natural Resources.

Whenever possible, the 'Notes' column addresses sensitive features specific to the identified area with appropriate contact numbers. In several cases, this polygon is used on the Great Lakes to represent National Wildlife Areas (NWA) administered by the Canadian Wildlife Service. The NWA on the east side of Lake St. Clair is an example.

### **'Conservation Area or Municipal Park'**

These are areas along the shoreline managed either by Conservation Authorities or local municipalities, and may include urban recreation areas. Orange polygons marked on the maps without an associated name represent municipal parks in most cases.

### **'Environmentally Sensitive Area'**

These are areas designated by various Conservation Authorities, or sensitive areas identified by the Ontario Ministry of Natural Resources in series such as their Sensitive Area Reports (SAR). They have especially sensitive features which are identified in the 'Notes' column.

### **'Area of Natural and Scientific Interest'**

An Area of Natural and Scientific Interest (ANSI) is designated by the Ontario Ministry of Natural Resources in Canada. An ANSI as defined in Canada is an "area of land and water containing natural landscapes or features which have been identified as having values related to protection, natural heritage appreciation, scientific study or education."

"Where ANSIs occur on public lands managed by the Ministry, it will ensure that the land uses and activities which occur, provide for the protection of the identified values."

"On private lands, the Ministry will, through cooperation with others, attempt to ensure that landowners are aware of significant features on their properties and seek the owner's cooperation in protecting such features." (OMNR, 1983)

Site-specific information for ANSIs is detailed in the 'Notes' column. There are no equivalent officially designated areas of this type in the United States.

### **'Area of Ecological Significance (e.g. Wetland)'**

Significant wetland areas along the shores of the St. Clair River, Lake St. Clair and Detroit River have been identified by several agencies providing source data. Their particular sensitivities are represented by a combination of Biological Resources symbols and entries in the 'Notes' column. These areas defined by polygons are in addition to the broad and fringing wetland habitats that have been identified along the shore as part of the shoreline geomorphological classification (Shoreline Habitats). The polygons are used to show the extent of the most significant wetland areas.

"Wetlands support many species of water-associated terrestrial animals. Waterfowl (ducks, geese and swans) and herons are dependent on wetlands, primarily during migration and nesting periods. Many species of amphibians are especially dependent on wetlands throughout their annual cycles. Several species of mammals use wetlands during parts of their annual cycles, but a few, such as muskrats, beaver and mink, are essentially year-round inhabitants. Lakeshore and connecting channel marshes in particular, provide critical feeding, nesting, rearing and moulting habitats for a wide variety of waterbirds and waterfowl." (Owens et al., 1992).

In Ontario, wetlands can be distinguished by Class or Type. In 1985 the Ontario Ministry of Natural Resources and the Canadian Wildlife Service introduced an evaluation system to classify Ontario wetlands (Southern Ontario Wetland Evaluation System 1985) which was updated in 1992 (OMNR 1992). The system identifies four main components: biological, social, hydrological and special features. Each component is assessed and assigned a total value up to 250 points, making the highest possible score 1000 points. The biological component studies the productivity, diversity and overall size of the wetland. The social component includes an assessment of the valued resource products, recreational activity, aesthetics, educational value, proximity to urban areas, ownership and size with regard to the social aspects. The hydrological component examines the connection to a large waterbody, flow stabilization, potential for water quality improvement and erosion control. The fourth component identified as special features includes presence of rare, threatened or endangered flora and fauna, fish habitat, waterfowl nesting, migratory bird staging and also ecological age (succession stage).

The value for each of the four components is summed and a total score is assigned. Based on this score, the Wetland Class is designated according to the following:

- Class 1** - 700 or more total points (or 3 of the 4 components score higher than 200)
- Class 2** - 650 - 700 (or 2 of the 4 components score higher than 200)
- Class 3** - 600 - 650 (or 1 of the 4 components score higher than 200)
- Class 4** - 550 - 600 (or all 4 components score higher than 100)
- Class 5** - 500 - 550 (or 3 of the 4 components score higher than 100)
- Class 6** - 450 - 500 (or 2 of the 4 components score higher than 100)
- Class 7** - all others not included above

Provincially significant wetlands include Classes 1, 2 and 3. The objective of this Atlas is to identify all available data on wetland boundaries. The 'Notes' column will also identify wetland class, when that information is available. For further information on wetland classes, contact OMNR.

For a discussion of the different Types of wetlands present on the Great Lakes, see Appendix D of Environment Canada's "Oil Spill Shoreline Clean Up Assessment Team (SCAT) Manual for the Ontario Great Lakes and St. Lawrence River Shorelines", or consult the local office of the Ontario Ministry of Natural Resources. In the United States, contact the Michigan Department of Natural Resources.

Areas with unique or regionally or seasonally significant habitats (e.g. migratory stopovers) are also considered to be Areas of Ecological Significance.

### **'Dune Formations'**

This line symbol denotes areas along the shore where vegetated or unvegetated sand dunes exist. Their sensitivity is outlined in the 'Notes' column for responders. Damage to vegetation on dunes can lead to further dune erosion.

## **6.4 Countermeasures**

### **'Access Site (for land vehicles)'**

This symbol identifies locations where a good road is close enough to the shore, and an existing trail is adequate to walk to the water and drag boom and light equipment for response purposes. Note that any access over private property will require permission from the landowner before response activities commence at that location. The same applies to the use of private boat launches. Comments regarding private property are noted on the Supplement version and in the master database.

### **'Approach Concerns: Foreshore Flats/Rocky Reefs/Submerged Vegetation'**

Approach concerns may indicate the presence of foreshore flats, rocky reefs or submerged vegetation (seasonal variation). These markings denote some of the features that will be of concern to responders when approaching a shore from the water. These markings are meant to reinforce existing navigational aids and charts, not replace them. Most of the north and east shoreline of Lake St. Clair is protected by seasonal growth of submerged vegetation extending far into the lake (OMNR, Aylmer District Office, Personal Communication, 1994).

The submergent vegetation beds located in the Detroit River and St. Clair River represent more than an approach concern. Responders should make efforts to protect the submergent vegetation beds as they are critical habitats for numerous aquatic species and important feeding areas for fish populations (OMNR, 1994).

### **'Exposed Rock'**

This marking denotes a feature that will be of concern to responders during response activity. These markings are meant to reinforce existing navigational aids and charts, not replace them.

### **'Coast Guard Light Station'**

This symbol shows the approximate location of manned or unmanned Canadian or United States Coast Guard light station installations. Equipment and facility details vary by location; full information is maintained in the master database. Often, facilities such as helicopter pads and buildings will also be identified by their own

corresponding symbol. Contact CCG Operations Centre at 800-265-0237 (519-337-6360) or USCG District 9 at 216-522-4404 for further information regarding available facilities.

### **'Boat Launch: Excellent'**

A boat launch is rated "excellent" if it has a large, firm surface ramp into deep water, is protected from waves, has good road access, and has sufficient space for manoeuvring large trailers. Docks to accommodate large boats must also be present.

### **'Boat Launch: Good'**

A "good" boat launch has a solid ramp for small vessels leading into deep water.

### **'Boat Launch: Poor'**

A "poor" boat launch symbol marks a site where a ramp of gravel exists, or merely a trail over the beach. Such sites may need additional work before being useable for response efforts. Certain additional locations have been described in the 'Notes' column as suitable sites for dragging small craft over the sand or cobble beach, but these have not received boat launch symbols.

### **'Helicopter Landing Site'**

Only designated sites with proper pads for helicopters up to the 'B212' (or equivalent) size are noted. Pilots will advise on other acceptable landing sites, as required, during response to a spill.

### **'Staging Area: Excellent'**

Staging areas are locations for setting up and deploying response equipment and for establishing command centres or outposts. Before a staging area is rated "excellent", it must have large parking and storage space, a building suitable for operational headquarters, adequate power and telephone, road and water access, and docking facilities.

### **'Staging Area: Good'**

A "good" staging area has road and water access, telephone, power, parking space, and facilities adequate enough to establish a small or secondary command post/headquarters.

### **'Staging Area: Poor'**

A "poor" staging area is in a more remote location, and is probably the only site available. It will have road and water access, as well as space for a command post trailer.

### **'Automated Weather Stations'**

These locations have been identified in Canada by DOE's Atmospheric Issues Division or by NOAA in the United States to give an indication of the nearest station to a given spill. Portable emergency equipment is available for site specific weather reporting in case of an environmental emergency. Contact DOE's Ontario Region Environmental Emergencies Duty Officer (416-346-1971) or NOAA's Scientific Support Coordinator (206-526-6317) to make the appropriate arrangements.

### **Additional Countermeasures Note:**

The Supplement version of this Atlas includes additional layers of information for use by spill response experts, as outlined below:

#### **'Equipment Depot' and 'Boom Storage Site (Marine Emergency Response Trailer)'**

Great Lakes Response Corporation (PIMEC, Inc.), Canadian Coast Guard and United States Coast Guard response equipment depots and boom storage sites (Marine Emergency Response Trailers) are identified on the appropriate map page in the 'Notes' column of the atlas, and as symbols in the Supplement. Contact CCG Operations Centre at 800-265-0237 (519-337-6360) or USCG District 9 at 216-522-4404 for further information regarding available equipment.

### 'Location of Collection and Recovery Site'

These locations mark areas where oil will likely collect naturally, and where clean up and recovery operations could be carried out, for instance on sand beaches or platform rock. In some cases, booms could be used to direct oil to these locations to facilitate clean up and recovery and protect more sensitive adjacent shores.

### 'Suggested Boom Deployment'

These markings show only suggested positioning of boom. They do not give boom length requirements. Estimated boom length requirements, however, are listed in the master database. The master database will describe the use for the boom, i.e., whether deflection, exclusion or containment booming should be used, or suggest the sealing of a culvert in a causeway.

These boom deployments are only suggestions for countermeasures. The actual deployment of boom during an environmental emergency will be guided by spill response experts, following a prompt review of the circumstances related to the actual spill.

## 7.0 Sensitivities of Biological Resources; Vulnerability to Spilled Oil on the Great Lakes and Connecting Channels

This section includes direct quotes or summaries of information from the Canadian Wildlife Service and the Natural Resource Response Guide Series produced for the U.S. National Oceanic and Atmospheric Administration (NOAA) by Research Planning, Inc. (RPI). Such guides, along with local resource experts, may be consulted to obtain specific information regarding life history, habitat preferences, behaviour, and other ecological factors that influence sensitivity to spilled pollutants.

A short description of the sensitivity to spilled oil or hazardous materials will follow for the biological groupings of fish, birds and shore associated mammals. Prior to discussing individual biological groupings, a few definitions will assist responders in determining the expected impact of spills.

**Aromatic hydrocarbons** are a major group of cyclic petroleum hydrocarbons such as benzene and toluene that are moderately soluble in water and are generally highly toxic to aquatic organisms. **Refined oil** is the product of distillation of crude oil into light or heavy components. Light refined oils include gasoline, kerosene, diesel oil, and individual components such as benzene or toluene. Heavy refined oils include fuel oil Numbers 4 (Heating Oil), 5, and 6 (Bunker C). The **water-soluble fraction (WSF)** is that portion of an oil that is soluble in water under equilibrium conditions. The water-soluble fraction of petroleum hydrocarbons is composed mostly of aromatic hydrocarbons, such as benzene or toluene (NOAA, 1987).

### 7.1 Fish

Regarding fish, the adverse impacts associated with spills of crude and refined oils are primarily caused by the chemical toxicity of the water-soluble fraction.

"The WSF is the portion of oil that marine fish are most likely to be exposed to during an oil spill. Oils that are relatively soluble in water will be more likely to cause toxic effects to fish. For this reason, refined petroleum products (especially gasoline) present a much more severe threat to openwater marine fish than do crude oils.

"A review of experimental and accidental oil spills shows that...the average concentrations of oil likely to be encountered by open-water fish are about 100 to 10,000 times lower than the acute toxicity values of most petroleum hydrocarbons. Therefore, an oil slick floating on the water surface is unlikely to affect adult fish, but there is some potential for toxic effects to...eggs and larvae" (RPI, 1987).

Toxic effects may also occur as a result of direct contamination of the shallow habitats used by fish and it is therefore important to identify critical fish habitats.

"Such contamination may result in acute short term toxic effects from the oil or long term effects from residual hydrocarbons that are persistent in sediments. Heavy refined oils (including Heating Oil and Bunker C) contain a high proportion of these hydrocarbons known to cause chronic contamination of shorelines. This type of contamination can cause toxic effects to fish species that spawn in shallow areas, and these effects may occur long after the spawning sites were initially exposed to oil" (RPI, 1987).

According to the Ontario Ministry of Natural Resources, all wetlands along the shores of the St. Clair River, Lake St. Clair and Detroit River are considered critical fish habitat which should be given high priority for protection (pers. comm., OMNR, 1992). Other areas of critical fish habitat such as spawning beds and migration routes are identified throughout the St. Clair River, Lake St. Clair and Detroit River on the individual maps.

Much of the data represented in the Atlas refers to anadromous fish. These are fish species that live in brackish (slightly salty) or salt water as adults and ascend freshwater coastal rivers to spawning and nursery grounds. Many freshwater fish such as lake sturgeon, walleye, trout and salmon are considered to be anadromous fish in the Great Lakes where they ascend tributary rivers during spawning.

"All anadromous species are considered to be at moderate to high risk from oil and hazardous materials spills occurring in navigable waters due to their dependence on certain nearshore and shallow water habitats for critical stages of their life cycle" (RPI, 1987).

Adult fish are at moderate risk during spawning runs since they must pass through nearshore areas where spills are likely to pose a significant threat of toxic exposure.

"Eggs and larvae are at a high risk of exposure at spawning areas. These life stages are unable to avoid waterborne pollutants due to poor swimming ability or dependence on certain habitats such as gravel streambeds. Spills that result in contamination of bottom sediments pose the most serious threat to anadromous fish populations because eggs of many species adhere to or are buried in sediments. Salmonids are probably the most sensitive to contamination of spawning areas because their eggs are spawned in shallow waters, and they remain in the sediments for many months prior to hatching and downstream migration" (RPI, 1987).

Juvenile fish are dependent on shallow, nearshore nursery areas. This places them at a moderate to high risk of exposure to toxic concentration of pollutants during spills.

### 7.2 Birds

"Most of the negative effects of oil spills on marine birds are the result of the birds coming into direct contact with floating oil. Exposure of birds to oil has the primary effect of fouling the plumage. Oil causes disruption of the fine structure of the small strands that form the feathers, causing loss of their water-repellent characteristics. The plumage of oiled birds also becomes matted, allowing water to penetrate to the body surface, which results in chilling and hypothermia as well as a loss of buoyancy" (RPI, 1988).

Some bird species are more vulnerable to oil spills than others.

"Presumably, those species that are able to leave the water and thereby reduce or avoid hypothermia (such as gulls, wading birds, and some waterfowl) are more tolerant to oil" (RPI, 1988).

"Oiled birds can also readily ingest oil during preening. The effects of ingested oil include anemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, and decreased production and viability of eggs" (RPI, 1988).

Direct exposure of eggs to oil has the greatest potential for reproductive damage. Exposure to very small quantities of oil during the early stages of incubation are most toxic. Oiled adult birds can easily transfer toxic doses to eggs.

Certain behavioral characteristics of birds can increase their vulnerability to impacts of oil spills. "Feeding, flocking and roosting behaviours of many species result in repeated or prolonged diving into or sitting on the water surface where contact with floating oil is possible" (RPI, 1988).

There have been various indices developed to determine relative sensitivities of birds to oil. These typically consider factors such as range, population, habits, mortality, and annual exposure in a given region (RPI, 1988). As discussed in Section 5.2, such factors will be taken into account by local resource experts at the time of a spill. For the purposes of this Atlas, some considerations have been listed to give a general idea of relative sensitivities.

The following paragraphs summarize the vulnerability of the various bird categories symbolized in the Atlas legend. Again, the Canadian Wildlife Service and NOAA's Natural Resource Response Guide for Marine Birds (by RPI) are the main sources for this information.

## 7.2.1 Migratory Waterfowl

The vulnerability of waterfowl to spilled oil is highly variable, depending primarily on habitat preference. Geese and many diving ducks are highly vulnerable because they tend to concentrate in large flocks on relatively exposed offshore and nearshore waters during migration. Dabbling ducks are less vulnerable due to their preference for more protected coastal wetlands. Loons and grebes (water birds) are highly adapted to an aquatic existence and rarely leave the open water where they are present during much of the year. This increases their vulnerability to an oil spill, but they do not form large flocks. They tend to occur in small groups or as scattered individual birds.

## 7.2.2 Colonial Nesting Birds

“The most significant offshore terrestrial animal resources at risk from an oil spill are nesting colonies of gulls, terns, and cormorants. Although colonies on the Great Lakes are widely scattered, an oil spill could have a significant effect if large colonies are within the spill zone” (Owens et al., 1992).

For the “Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines”, as noted in Section 6.2.2, the Colonial Nesting Birds category includes gulls, terns and cormorants. Only one species of cormorant nests on the Great Lakes and Connecting Channels. Terns and cormorants are highly vulnerable in that they feed on fish and are therefore forced to use waterbodies for foraging. Cormorants are true divers (i.e. they dive from the surface of the water and swim underwater pursuing their prey), whereas terns plunge dive from the air. The feeding behaviour of diving birds such as cormorants results in regular entry into the water, increasing their vulnerability to spilled oil. On the other hand, terns and cormorants tend to roost on islands, structures, etc., rather than on the water itself.

“These birds do not form large flocks or roost on the water, so mass mortalities are not likely” (RPI, 1988).

Gulls (ringbills and herring) often feed on sources such as dumps or farm fields, but they also forage along the shores of the Great Lakes, catching fish by plunge diving, as terns do. Surface feeding birds such as gulls...

“...often form large flocks that regularly roost on the open water. This behaviour can result in large kills from spilled oil, but based on numerous case histories, impacts to these birds are usually not severe. This is due in large part to their highly adaptable nature. Gulls are well known for their ability to exploit a wide range of habitats and food sources and they also are relatively prolific breeders. They are readily able to avoid oil spills, and their populations can recover from mortalities if they occur” (RPI, 1988).

The breeding season varies for colonial waterbird species. Gulls usually return to the colonies before snow and ice has melted, but terns normally return several weeks later (feeding exclusively on fish, they need to be assured of open water). In the St. Clair River, Lake St. Clair and Detroit River, most activities at the nesting colonies will take place during May through August.

## 7.2.3 Wading Birds

Hérons, egrets and cranes have much lower vulnerability to floating oil because they are rarely immersed in the water and do not flock or roost on the water. For this reason they are identified separately on the maps, even though herons and egrets are also considered to be colonial waterbirds. Herons and egrets stalk shallow pools, immersing only their heads to catch prey. These types of birds tend to avoid oiled areas, but responders must be aware of the possibility of contamination or loss of their food sources in the water column of shallow, sheltered waters (RPI, 1988). On the St. Clair River, Lake St. Clair and Detroit River, most activities at the nesting colonies will take place during May through August.

## 7.2.4 Shore Birds

Most shorebirds have low to moderate vulnerability to spilled oil. They are rarely immersed in water and are unlikely to encounter spilled oil. They do not form large staging flocks along the St. Clair River, Lake St. Clair and Detroit River shoreline. At certain times in other areas (for instance, on Lake Ontario), their habit of flocking by the thousands to a limited number of specific locations (very shallow, productive waters) increases their vulnerability, due to the impact that oil spills could have on their highly localized food source (on which they are heavily reliant).

## 7.2.5 Raptors

Bald eagles are considered to be highly vulnerable in the event of an oil spill. Although they rarely enter the water and are unlikely to be oiled, they have a small population and a very long recovery rate. “Osprey are much more marine oriented and will capture fish directly from the water. They are ranked as moderately vulnerable (lower than bald eagles) because they are more common and more widely distributed than bald eagles” (RPI, 1988). For both of these species, consumption of oiled prey is a concern.

## 7.2.6 Bird Seasonality

When such information is available, the ‘Notes’ column on individual map pages gives site specific descriptions of seasonality. In the following table, a general description is provided for species occurring on the St. Clair River, Lake St. Clair and Detroit River shorelines.

**Table 1A: St. Clair River, Lake St. Clair and Detroit River Bird Seasonality: Colonial Waterbirds**

Species	Period present on St. Clair River	Breeding Season <sup>Δ</sup>	Nest Location	Category			Abundance		
				Migrant	Summer Resident	Winter Visitor	Common	Uncommon	Rare
Double-crested Cormorant	April to October	Don't breed	On ground and in trees (islands and peninsulas).	√					√
Great Blue Heron	March to December	April to August	In trees (islands and on mainland)	√	√	√		√	
Black-crown Night Heron	April to September	April to July	In trees and bushes (islands)	√	√				√
Herring Gull	All year	April to July	On ground. (islands)	√	√	√		√	
Ring-billed Gull	March to December	April to July	On ground (islands)	√				√	
Common Tern	April to October	May to July	On ground (islands)	√	√			√	
Caspian Tern	April to May and July to August			√					√
Forster's Tern	April to August	May to July	In marshes	√	√			√	

<sup>Δ</sup> From establishing nesting territories through fledgling chicks.

(Canadian Wildlife Service, 1994)

**Table 1B: St. Clair River, Lake St. Clair and Detroit River Bird Seasonality: Waterfowl, Shorebirds, Raptors**

Species	Status	Period Present on St. Clair River
Common Loon	Common migrant and occasional breeder	Very common throughout migration (March to May, August to November)
Grebe species	Common migrants; no breeding	Year round
Canada Goose	Common migrant; some local breeding	Migration (March, April, October and November) Resident “giant” Canada Geese present year round
Dabbling Ducks (including northern pintails, american wigeon, black duck, teal, gadwalls)	Common migrants, black ducks are common winter residents; some local breeding	Migration (March, April, September to November)
Dabbling Ducks (including mallard and wood duck)	Common migrants; some local breeding	Migration (March, April, September to November) Mallards - year round
Diving Ducks (including scaups, oldsquaw, common goldeneye, buffleheads, ring-necked ducks, redheads, canvasbacks)	Common migrants and winter residents; very rare breeders	September to May
Shorebirds (including sandpipers and plovers)	Very common migrants; uncommon breeders	Migration (March to May, September to November)
Bald Eagles	Rare migrant; common resident; rare breeder	Year round
Osprey	Common migrant and rare breeder	Year round
Peregrine Falcon	Very rare migrant	Migration (April, May, October and November)

(Canadian Wildlife Service, 1994)

## 7.3 Shore Associated Mammals

A shore associated mammal's exposure to spilled oil can result in a significant reduction in the insulative property of its fur. Once exposed to oil, a mammal's grooming activity may lead to ingestion of oil. (RPI, 1989).

## 8.0 Sensitivities of Human-Use Resources; Vulnerability to Spilled Oil on the Great Lakes and Connecting Channels

Factors to consider when establishing sensitivities of Human-Use Resources include economic value, resource 'replaceability', risk to public health, and cultural/archaeological value.

No rigorous ranking scheme has been employed for these features, as discussed in Section 5.2. Broad terms such as "highly valued" have been used in the 'Notes' column to give an indication of the level of priority likely to be assigned to a Human-Use Resource during spill response.

## 9.0 Shoreline Habitats and Associated Countermeasures

### 9.1 St. Clair River, Lake St. Clair and Detroit River Shoreline Habitat Classification Scheme

The shorelines of the St. Clair River, Lake St. Clair and Detroit River have been classified as shown below. The Canadian Environmental Sensitivity Index (ESI) number for each shoreline type indicates the sensitivity ranking of that type. The equivalent United States ESI is also listed to aid U.S. agencies and responders familiar with the "Sensitivity of Coastal Environments and Wildlife to Spilled Oil" Atlas series prepared by Research Planning, Inc. In both classification schemes the higher numbers indicate greater relative sensitivity to the impacts of an oil spill. Colours range from "coldest" (blue) for Exposed Bedrock Bluff, shore type 1a to "hottest" (red) for 'Broad Wetland', shore type 13b.

Response priorities will be finalized at the time of a spill. The fact that a Broad Wetland is denoted in red does not necessarily mean that it would be boomed ahead of all other areas. Spill-specific circumstances will dictate actual protection measures.

U.S. ESI Ranking	Can ESI Ranking	
		<b>Bedrock or Impermeable Shores</b>
1a	1a	Exposed Bedrock Bluff less than 1 metre elevation
1a	1b	Exposed Bedrock Bluff 1-5 metre elevation
1a	1c	Exposed Bedrock Bluff greater than 5 metre elevation
1b	2	Retaining Wall/Harbour Structure/Breakwaters (Anthropogenically modified shore)
2	3	Shelving Bedrock
		<b>Unconsolidated Sediment Shores</b>
3	4	Exposed Sediment Bluff
4	5a	Sand Beach: Depositional
4	5b	Sand Beach: Erosional or Transitory
4	6	Sand Barrier with Lagoon
6a	7a	Pebble Beach
6a	7b	Pebble/Cobble Beach
6a	7c	Cobble Beach
6b	8	Rip Rap (Anthropogenically modified shore)
6a	9	Boulder Beach
5	10	Mixed Beach (% by sediment in DOE Database)

U.S. ESI Ranking	Can ESI Ranking	
9a	11	<b>Vegetated Shores</b> Low Vegetated Bank (Grass or Trees) Delta Mud Flat Fringing Wetland Broad Wetland
9b	12	
10a	13a	
10b	13b	

## 9.2 Shoreline Habitat Characteristics and Appropriate Countermeasures

In this section, the major physical characteristics of each Shoreline Habitat will be discussed. A photograph is provided for each shoreline type present in the study area, depicting a typical example on the St. Clair River, Lake St. Clair or Detroit River. Expected oil behaviour and residence time for each Shoreline Habitat will be described. Suggestions for appropriate clean up methods for each shore type will be made.

The following shoreline characteristics will be addressed:

- i) **Shoreline Morphology** - includes a description of shoreline width, slope and characteristic topography, component sediment type(s), and the wave/littoral drift environment. Littoral drift is sedimentary material that is transported in the littoral (coastal) zone under the influence of waves and currents.
- ii) **Shoreline Sensitivity** - includes oil residence time, natural oil removal processes/rate, and the impact to immediate flora and terrestrial fauna.
- iii) **Clean Up Operations** - involves identifying effective clean up methods for each shoreline type, as well as indicating potential environmental hazards that the clean up operation may pose.

In general, in the Great Lakes the water volume and distances between shores are insufficient to "absorb" large quantities of oil. Oil moved off one shoreline will likely reappear on an adjacent shore. Environment Canada recommends cleaning any oil deposits which can be removed safely and without causing further habitat damage.

All of the clean up methods outlined are suggestions only. Each has certain implications or drawbacks that must be weighed on a site by site basis by spill response experts at the scene of a spill. **All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.**

Additional information on shoreline protection and clean up is addressed in the Environment Canada video "Great Lakes Shoreline Protection and Clean Up." Contact Chromavision International Inc. (613-748-5335) for ordering details.

## 9.2.1 Bedrock or Impermeable Shores

### 1a. Exposed Bedrock Bluff less than 1 metre elevation

### 1b. Exposed Bedrock Bluff 1-5 metre elevation

### 1c. Exposed Bedrock Bluff greater than 5 metre elevation

### ESI 1a, 1b, and 1c. Exposed Bedrock Bluff (U.S. ESI 1a)

No photograph available.

The combination of resistant bedrock surfaces, little sediment, steep slopes, and a constant, high wave energy environment make exposed bedrock bluffs the least sensitive shoreline to oiling. This shoreline type was not observed in the study area, but a description is included for general Great Lakes preparedness.

If the stranded oil is below the normal limit of wave action, it would persist for only a few days to weeks. If shoreline oiling occurred during a storm event then the material would be stranded and unaffected by normal wave action, until the recurrence of a subsequent storm event of similar magnitude. Lower bluffs (< 1 m elevation) are generally more sensitive since they usually have rough surfaces, containing many fractures and depressed pockets. Oil may collect within these surfaces and persist for up to several seasons.

Bedrock bluff shorelines are not especially biologically sensitive due to scant flora and terrestrial fauna.

Bedrock bluff shorelines with a heightened Human-Use value or bluffs which were oiled during storm events, will likely require remedial clean up measures. Low-pressure hosing and manual oil scraping are the preferred clean up methods. Steam cleaning and/or high-pressure hosing may be considered for the most resistant rock surfaces.

Access to these shores is often poor by land and hazardous by water. Bedrock bluff shorelines in locations without heightened Human-Use value may be permitted to self-clean through natural abrasion processes, if manual removal is unsafe or logistically impossible. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

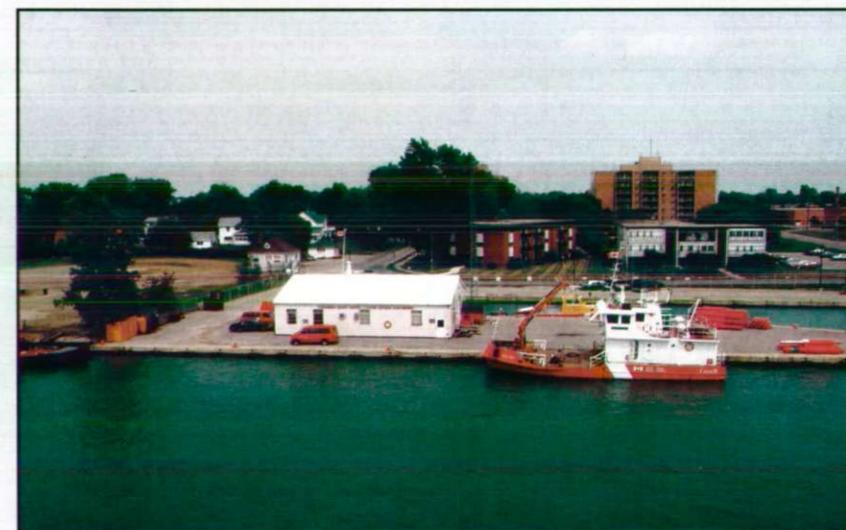
### ESI 2. Retaining Wall/Harbour Structure/Breakwaters (U.S. ESI 1b)

When artificial shorelines are created through construction, the shoreline is designated as Retaining Wall/Harbour Structure/Breakwaters. Retaining walls are usually small isolated features used to protect private property from bank erosion. They are composed of wood pilings, structural steel, asphalt, or concrete. When concentrated in near continuous stretches (such as along large ports) they are termed harbour structures. Rip rap material encased within wire netting can be used to front shorelines, resulting in a vertical shore classified as harbour structure.

Retaining wall/harbour structure shores are not particularly sensitive to oil, or clean up operations. This shoreline type commonly supports very little plant or animal life, except for bird use along the structure's upper

portions. There is minimal oil persistence along sections exposed to regular waves, but long term oil persistence is possible along sheltered sections.

Hard, durable harbour structure surfaces permit the use of high-pressure hosing or steam cleaning for clean up. Recently spilled oil can be effectively cleaned by means of low-pressure hosing. Ships docked along harbour facilities will similarly require all traces of oil residue removed from their hulls before leaving the port. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.



### ESI 3. Shelving Bedrock (U.S. ESI 2)

No photograph available.

Shelving bedrock shores are wide, flat expanses of bedrock, at or immediately below normal water levels. This shoreline type was not observed in the study area, but a description is included for general Great Lakes preparedness.

Generally, shelving bedrock shores are lower energy wave environments than bedrock bluff shores. Waves could carry oil across the full width of the shelf.

Continued wave exposure would likely readily cleanse oil from the lower reaches of the shelf. Oil deposited during a storm would be stranded above normal water levels and would be naturally cleansed only during storms of similar magnitude.

Inaccessible shelving bedrock shores may naturally self-clean (perhaps within two seasons). Other shores, including those with high aesthetic or recreational value, will likely require remedial clean up measures. Oil which collects within depressed regions of the shelf may be cleaned manually or by sump/pump removal. Stranded deposits could be removed by low or high-pressure hosing or steam cleaning for the most resistant rock surfaces. Shelving bedrock shores which support high populations of birds, especially nesting sites, should be cleaned manually to minimize disturbance. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

## 9.2.2 Unconsolidated Sediment Shores

Unconsolidated sediment shores differ from bedrock shores in that the material is loose and non-cemented.

### ESI 4. Exposed Sediment Bluff (U.S. ESI 3)

These bluffs are predominantly erosional forms, carved by wind, wave and surface water erosion. They form where accumulations of glacial material border the shoreline and are exposed to direct wave action. Fox Island and Sugar Island at the southern end of the Detroit River are two sites containing sections of exposed sediment bluff, but this type is rare in the study area. There is little biological activity along these bluffs.

Shoreline sections are commonly steep and relatively narrow (< 4 metres).

Spilled oil would be deposited along the lowest portion of the bluff, where wave energy is high, and the oil would be self-cleaned within days or weeks through wave abrasion. Oil deposited during storms may be stranded above this level and may persist until manually removed or subsequent storm surges self-clean the area.

The clean up of stranded oil along unconsolidated sediment bluffs is made difficult by the lack of a shore zone beach, steep bluff slopes, and the ease of bluff erosion. Heavy machinery would be unable to access high or extensive sediment bluff sections. The removal of material at the base of the bluff could promote slumping or landsliding; a serious hazard to clean up crews, and land owners residing on the crest of the bluff. Similarly the use of low/high-pressure hosing or steam cleaning could remove sufficient sediment to induce slope failure.

In the case of small sediment bluffs where shore zone access is available, manual clean up is recommended. Very steep or high sediment bluff sections are generally not accessible; in these instances it is recommended that the oil deposit naturally self-clean. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.



### ESI 5a. Sand Beach: Depositional (U.S. ESI 4)

Depositional sand beaches occur in this area where wave deposited sand has accumulated, often in coves or other sheltered environments. On a depositional beach, the gross annual amount of sediment entering the system exceeds the gross annual amount of sediment leaving the system (positive net annual sediment budget). Offshore regions in this area tend to be shallow and uniformly sloping. The depositional sand beaches tend to be quite narrow and are rarely backed by sand dunes. Only a few depositional sand beaches exist along the St. Clair River, Lake St. Clair and Detroit River shorelines and almost all are thin and narrow.

Biological activity typically includes the presence of shorebirds, and sand beaches are often of high recreational value.

Spilled oil would be deposited along the upper limit of wave action. Heavy or viscous oil rarely penetrates more than 2 centimetres, though with higher temperatures or lighter oil, penetration depth will likely increase.

If water levels were normal the stranded oil deposit may be buried by subsequent storm beach deposits. It is important to locate and remove oil before subsequent burial, when possible. When buried, stranded oil can

persist for decades, requiring regular clean up for several years, as the deposits resurface.

In times of elevated water levels, oil may be stranded above the normal swash zone if not removed by clean up teams, where it could weather to form an "asphalt pavement". Eroded asphalt pavement material is often deposited over a wide area as small "tar balls".

Sand beaches, due to their shallow slopes, load bearing capacity, lack of vegetation, and many access roads often permit the use of heavy machinery such as graders/scrapers. Note that sediment removal must be minimized; if too much sand is removed, the beach may be destabilized, causing accelerated beach erosion.

Beach cleaning machines may be used to remove stray tar ball deposits from affected beaches. On very narrow beaches, or those without road access, manual raking is a slow but effective method.

All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

### ESI 5b. Sand Beach: Erosional or Transitory (U.S. ESI 4)

Both erosional and transitory sand beaches are present along the St. Clair River, Lake St. Clair and Detroit River shorelines, although most are erosional. On an erosional beach the gross annual amount of sediment leaving the system exceeds the gross annual amount of sediment entering the system (negative net annual sediment budget). For the purposes of spill response, an erosional beach at any given point in time behaves in the same manner as a depositional beach, except that buried oil will likely resurface more often.

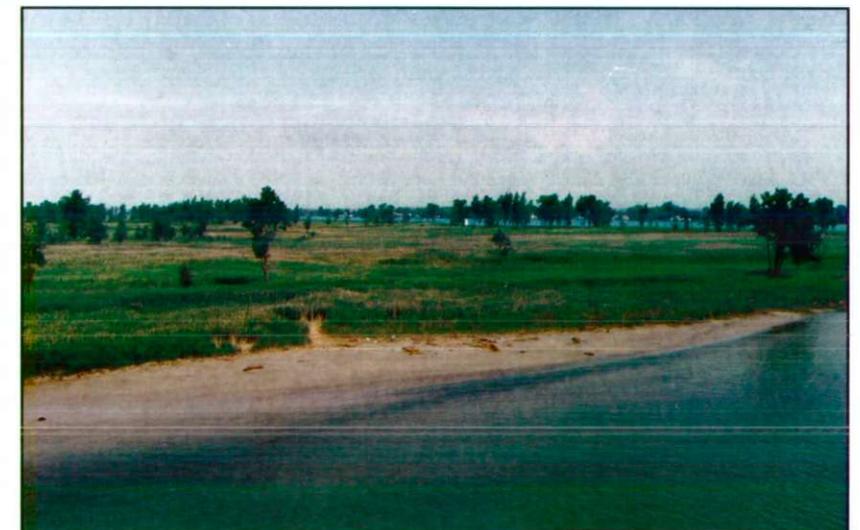
Transitory beaches tend to form in areas with a neutral or near zero net annual sediment budget. During times of normal water levels, sediment may collect in small coves or wave-cut notches to form a poorly defined beach. Such deposits are transient and are regularly removed during storms.

Transitory sand beaches are extremely narrow and often quite steep. Offshore regions are often very deep, permitting waves to break very close to the shoreline.

Oil deposited on a transitory sand beach during times of normal water level is apt to be quickly eroded during the next major storm surge, and transported down drift (likely within one season) to strand elsewhere, likely as sediment-laden "tar balls".

Clean up operations along transitory sand beaches are complicated by the lack of access roads, and the mobility of the beach material. Where clean up can be very quickly undertaken, manual raking of the beach is recommended.

Clean up should not be attempted along transitory beaches which occupy wave-cut notches in unconsolidated sediment bluffs. The danger of bluff slumping to clean up crews, as well as the risk to property owners at the crest of the bluff, is too great. In this environment natural self-cleaning should be allowed, though down drift locations are likely to be affected by tar balls which wash ashore.



### ESI 6. Sand Barrier with Lagoon (U.S. ESI 4)

No photograph available.

This shore type occurs where littoral drift causes a smooth barrier of sand to form and effectively seal a cove. Coves containing a stream typically have a very small opening (the "outlet") in the sand barrier. The backwater cove which forms is termed a lagoon. This shoreline type was not observed in the study area, but a description is included for general Great Lakes preparedness.

The thin, low sand barrier protects the lagoon from wave action, and a wetland often develops. Such wetlands are especially sensitive to disturbances of the protective sand barrier.

The impact of an oil spill on the sand barrier would be similar to that for a depositional sand beach. It is unlikely that oil could cross the barrier through wave washover or beach erosion. Oil could, however, enter the lagoon if waves cross the outlet, which is likely in storm events.

In the event of a spill, boom should be deployed to seal the barrier outlet, and diversion booms used to deflect oil from the sand barrier. Small outlets could be closed with a sediment dyke or sand bags. Heavy machinery should not be employed for clean up. The removal of sand during clean up, compaction of sand by machinery, plus the potential of vegetation disturbance along the barrier crest could result in extensive barrier erosion and the inundation of the lagoon environment. In this instance manual raking of affected shorelines is the only acceptable clean up method, except in those cases where close supervision ensures minimal sediment removal or compaction. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

### ESI 7a. Pebble Beach (U.S. ESI 6a)

Pebble beaches are shore accumulations of coarse sediment (0.2-4 cm diameter) that form in a higher energy wave environment compared to sand beaches. Pebble beaches are characteristically narrower and steeper than sand beaches; widths of 2-5 metres are common in the Great Lakes, however, there are no pebble beaches along the St. Clair River, Lake St. Clair and Detroit River shorelines. The photograph shows an example on Lake Huron at the mouth of the St. Clair River.

Oil will penetrate a pebble beach to occupy the spaces between pebbles; penetration depths of 0.5 metres have been observed. Very light oil, though able to penetrate the sediment, would be washed through the beach sediment and into the lake by wave action. Heavy oil may remain on the surface and, after weathering, cement pebble grains to form asphalt pavement.

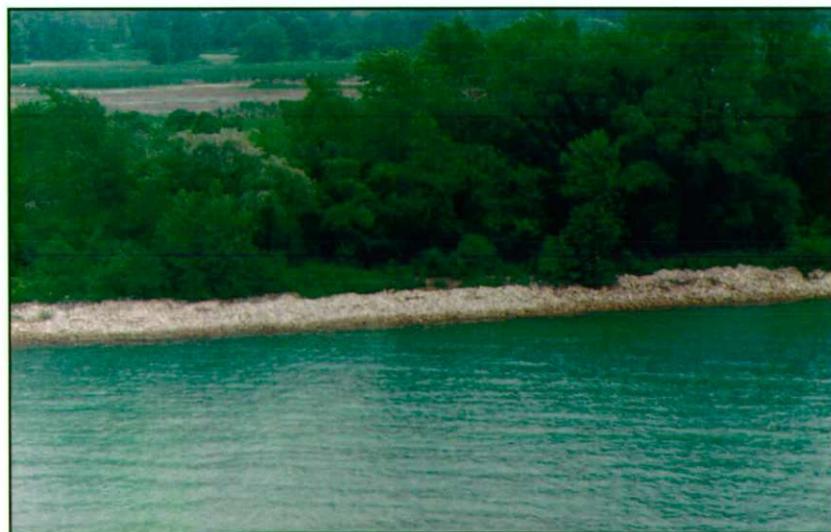
On a pebble beach, where the sediment moves more readily with wave action, subsequent storms tend to bury oil stranded high on the beach. Oil buried at a depth of 0.5 metres or more could persist for years before natural abrasion by wave action removed the deposit.

Sensitive flora and fauna may be adversely affected by oil on shore and in the water column, for instance when certain fish species are spawning along these shores, or if organisms ingest oil or become coated in oil.

Most pebble beaches are thin, relatively steep and lack easy road access, so use of heavy machinery is restricted. The load bearing capacity of pebble beaches can often support light equipment such as bobcats. Physical breaking or tilling using long tynes dragged through the pebble can be effective in bringing oil nearer to the surface for self-cleaning and weathering.

Low-pressure flushing with a header deluge may assist in moving light oil through the sediment to the water's edge for collection. The use of steam cleaning and low or high-pressure hosing should be avoided on pebble beaches, since they temporarily reduce the viscosity of the oil and could drive oil deeper through the pebble material, making removal more difficult. Pebble beaches must be water flushed (header deluge) quickly, while the spilled oil is still fresh. Otherwise, the oil will be present in the substrate for a much longer time.

Manual cleaning can be an effective clean up option. Responders must be careful to minimize sediment removal. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.



### ESI 7b. Pebble/Cobble Beach (U.S. ESI 6a)

Pebble/cobble beaches are rare along the St. Clair River, Lake St. Clair and Detroit River shorelines. They consist of a mixture of pebbles (0.2-4 cm diameter) and larger cobble material (4.5-25 cm). Generally pebble/cobble beaches are narrower and steeper than pebble beaches; widths of 2-3 metres are common.

Oil may rapidly penetrate into the spaces between pebble/cobble sediment. Even heavy oil may penetrate to a depth of 1 m or more, where it can persist for years before natural abrasion by wave action would remove the deposit.

Very light oil, though able to penetrate the sediment, would be washed through the beach sediment and into the lake by wave action. Heavy or viscous oil may remain on the surface and, after weathering, cement pebble/cobble material to form an asphalt pavement.

Sensitive flora and fauna may be adversely affected by oil on shore and in the water column, for instance when certain fish species are spawning along these shores, or if organisms ingest oil or become coated in oil.

Most pebble/cobble beaches are very thin, relatively steep, and do not have easy road access, so use of heavy machinery is restricted. The load bearing capacity of pebble/cobble beaches may support light equipment such as bobcats. If the cobbles are not too large, physical breaking or tilling using long tynes dragged through the sediment can be effective in bringing oil nearer to the surface for self-cleaning and weathering.

Low-pressure flushing with a header deluge may assist in moving light oil through the sediment to the water's edge for collection. The use of steam cleaning and low or high-pressure hosing should be avoided on pebble/cobble beaches, since they temporarily reduce the viscosity of the oil and could drive oil deeper through the shore material, making removal more difficult. Pebble/cobble beaches must be water flushed (header deluge) quickly, while the spilled oil is still fresh. Otherwise, the oil will be present in the substrate for a much longer time.

Manual cleaning can be an effective clean up option. Responders must be careful to minimize sediment removal. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

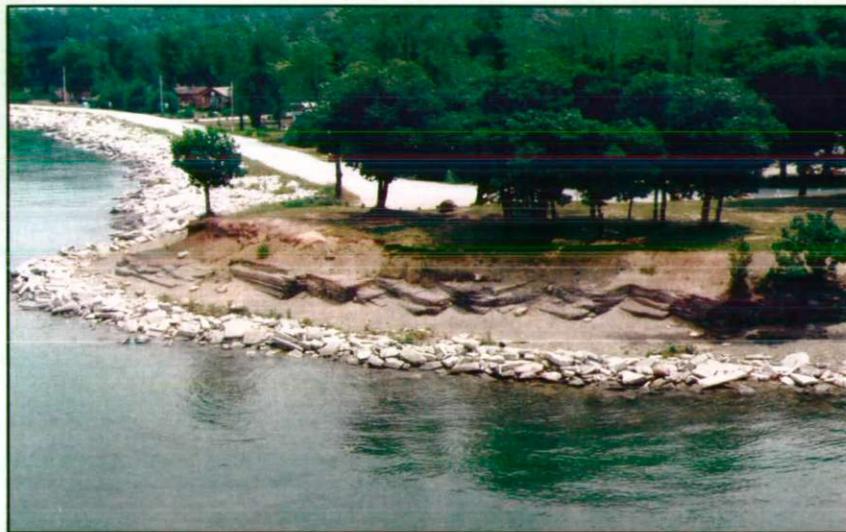
### ESI 7c. Cobble Beach (U.S. ESI 6a)

Cobble beaches are rare along the St. Clair River, Lake St. Clair and Detroit River shorelines. Cobble beaches contain well sorted sediment clasts, 4.5-25 cm in diameter.

Cobble beaches are generally narrower and steeper than pebble/cobble beaches; widths of 2 metres or less are common. Cobble-sized material cannot pack tightly, permitting oil to rapidly infiltrate cobble sediment.

Large amounts of stranded heavy oil are likely to penetrate to a depth of 1 metre or more, where it can persist for years before natural abrasion by wave action would remove the deposit. Very light oil, though able to penetrate the sediment, would be washed through the beach sediment and into the lake by wave action. Heavy or very viscous oil may remain on the surface, and, after weathering, cement cobble clasts to form an asphalt pavement.

Sensitive flora and fauna may be adversely affected by oil on shore and in the water column, for instance when certain fish species are spawning along these shores, or if organisms ingest oil or become coated in oil.



Most cobble beaches are extremely thin, steep, and rarely have easy road access, so use of heavy machinery is very restricted. The load bearing capacity of cobble beaches may support light equipment such as bobcats. If the cobbles are not too large, physical breaking or tilling using long tynes dragged through the sediment can be effective in bringing oil nearer to the surface for self-cleaning and weathering.

Low-pressure flushing with a header deluge may assist in moving light oil through the sediment to the water's edge for collection. The use of steam cleaning, and low or high-pressure hosing should be avoided on cobble beaches, since they temporarily reduce the viscosity of the oil and could drive oil deeper through the shore material, making removal more difficult. Cobble beaches must be water flushed (header deluge) quickly, while the spilled oil is still fresh. Otherwise, the oil will be present in the substrate for a much longer time.

Manual cleaning can be an effective clean up option. Responders must be careful to minimize sediment removal. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

### ESI 8. Rip Rap (Anthropogenically Modified Shore) (U.S. ESI 6b)

When natural shorelines are mantled with debris to protect the shore from wave-induced bank erosion, the resulting shoreline is termed rip rap. Rip rap usually takes the form of large, coarse material which is inexpensive and locally available. This may include roughly quarried stone, scrap wood, damaged concrete castings, or clay pipe refuse.

Most rip rap shores are narrow and fairly steep. Wave energy within these locales tends to be high (hence the need for rip rap).

Rip rap can be an important substrate for some bird and fish activity.

The large blocks often used in rip rap behave as a boulder beach in terms of oil penetration, having large interstitial pockets between blocks that can retain oil if not thoroughly cleaned. For these reasons, certain rip rap shores may be a priority for protection measures.



### ESI 9. Boulder Beach (U.S. ESI 6a)

No photograph available.

There are no boulder beaches along the St. Clair River, Lake St. Clair and Detroit River shorelines. A description is contained here due to the similarity (from an oil residence perspective) of some rip rap and boulder beaches. Boulder beaches are accumulations of large boulders (25+ centimetres diameter), the smaller sediments having been washed away by wave action in the high energy environment.

Boulder beaches are extremely narrow and often quite steep; beach widths of 2 metres or less are common.

Boulder beach sediment, due to its large size, cannot pack densely. Light oil, when washed onshore, will rapidly penetrate boulder sediment and be washed through the beach sediment and returned to the lake by wave action. Abrasion by breaking waves and a very permeable sediment combine to remove trapped light oil relatively quickly.

Large amounts of oil are likely to penetrate to a depth of 1 metre or more, and oil could remain trapped between boulders from where it will seep out over time if not cleaned. Very viscous oil may remain on the surface,

and adhere to boulders where it will eventually weather and form an asphalt pavement.

Sensitive flora and fauna may be adversely affected by oil on shore and in the water column.

Since boulder beaches are extremely thin, steep, and rarely have easy road access, the use of heavy machinery for clean up operations is severely limited. Where possible, steam cleaning or low/high-pressure hosing may be effective in speeding the removal of recently stranded oil. Due to the permeable nature of boulder beaches, oil buried to a great depth (+0.5 metres) can be effectively removed by these methods.

If these methods are not feasible, isolated boulder beaches may be considered for self-cleaning through wave abrasion, as long as adjacent sensitive shores are protected. Boulder beaches with sensitive features or high Human-Use value may be cleaned manually, using aids such as sorbent pads and scrapers. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

In most cases, good road access permits the use of several forms of heavy equipment. In some cases, the large, blocky nature of rip rap permits the use of high-pressure hosing or steam cleaning without significantly endangering (through erosion) the underlying protected shoreline.

Recently spilled oil can often be effectively cleaned by low-pressure hosing. Small spills can be cleaned by employing manual labour and scraping the rip rap, or through the use of sorbent material to remove pooled oil. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

### ESI 10. Mixed Beach (% by sediment in DOE Database) (U.S. ESI 5)

No photograph available.

There are no mixed beaches along the St. Clair River, Lake St. Clair and Detroit River shorelines.

They occur elsewhere in the Great Lakes and are accumulations of very poorly sorted sediment including large amounts of coarse sediment (boulders and cobbles), and some finer materials (e.g. sand). The percentage of component sediment types in each shore's case is expressed in descending order (e.g. boulders - 70%; cobbles - 30%) in Environment Canada's master database.

Mixed beaches are typically shallow sloped, very small (less than 100 metres in length), fairly wide, and restricted to pockets/coves between headlands, in well-sheltered, low energy wave environments. The sheltered wave environment permits the finer sediment to remain and fill the spaces between larger cobble/boulder sized material.

Oil washed ashore along mixed beaches with finer sediment is unlikely to penetrate much; this sediment limits the downward movement of oil. Only very light oils could penetrate this material. Since the sheltered wave environment limits the oil's removal by wave abrasion, deposits of oil are likely to persist for a long time on the surface of mixed beaches. Heavier oils could slowly weather to form asphalt pavements.

Sensitive flora and fauna may be adversely affected by oil on shore and in the water column, for instance if organisms ingest oil or become coated in oil.

Heavy machinery can be quite destructive to the beach surface; the sheltered wave environment ensures beach damage will not quickly be repaired by natural deposition and reworking of shoreline sediments.

On newly deposited oil, low-pressure hosing and flushing, and manual clean up with shovels, pitchforks, and sorbent pads can be effective. Sump/pump operations can be effective on thick accumulations of oil on the beach surface. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

## 9.2.3 Vegetated Shores

Shorelines dominated by vegetation are common features in sheltered environments along the St. Clair River, Lake St. Clair and Detroit River shorelines. Coves protected by peninsulas, or the leeward edges of major islands often are dominated by vegetated shores.

### ESI 11. Low Vegetated Bank (Grass or Trees) (U.S. ESI 9a)

Low vegetated banks are sheltered environments nearly covered in vegetation, with no erosive bluffs or exposed sediment immediately above the waterline; vegetation covers all land surfaces along the shore. Low vegetated bank shorelines are distinguished from broad and fringing wetland shores by the absence of aquatic vegetation.

Most low vegetated shorelines exist in low wave energy environments.

Generally gentle in slope, these shores include environments such as forests, meadows, fields and lawns.

Due to the very low energy environment, stranded oil is unlikely to be removed naturally. The impact of spilled oil can be effectively reduced if there is time to manually spread sorbent material along the shore prior to oiling.

Great care must be taken not to harm the vegetation during clean up, since it serves to stabilize the banks. Low-pressure flushing and hosing may be used to remove recently stranded oil as long as smaller vegetation species are not apt to be damaged, and if topsoil will not be removed by the process. Runoff water must be collected and removed. This method may drive residual oil into soil, complicating clean up operations.

An on-site expert is recommended for supervision during clean up. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.



### ESI 12. Delta Mud Flat (U.S. ESI 9b)

No photograph available.

There are normally no exposed deltaic mud flats along the St. Clair River, Lake St. Clair and Detroit River shorelines. However, at times of low water levels, the Lake St. Clair delta may have extensive flats exposed or present just beneath the water surface. Deltaic mud flats form when flowing river water slows abruptly upon reaching the lake, allowing suspended sediment to be deposited at the mouth of the river.

Delta mud flats have very gentle slopes and scant vegetation. Commonly, large portions of the mud flat are submerged. Delta flat sediments range from sand to clay-sized particles.

Fringing wetlands commonly bound the margins of delta mud flats.

Due to the shallow slope, oil spills could potentially affect a wide band of shoreline, sometimes as much as ten metres or more. The low wave energy environment ensures that spilled oil will persist. Oil deposited during normal water levels will typically form a "bath-tub ring" at the

water line. Oil could mix with new incoming delta sediment and be buried. Oil deposited during a storm would persist above the normal swash zone, and weathering could form an asphalt pavement.

These areas often support relatively rich concentrations of burrowing organisms and are key foraging sites for birds.

Oil on the surface of mud flats would be very difficult to clean. Deltaic sediments have a very low bearing capacity, prohibiting the use of heavy machinery (except during winter months, when delta sediments are frozen). Manual clean up is recommended, but great care will be required to minimize the mixing of oil deeper into the substrate in areas of foot traffic. The removal of delta sediment is unlikely to destabilize the delta flat since fluvial deposition is ongoing.

Further complications include ensuring safe access to the oiled portions of the mud flat; extreme care is required due to the low weight bearing capacity of the sediment. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

### ESI 13a. Fringing Wetland (U.S. ESI 10a)

Fringing wetlands are a type of vegetated shoreline containing an abundance of aquatic vegetation. They are usually much smaller than broad wetlands. Along the St. Clair River, Lake St. Clair and Detroit River shorelines, marsh communities are the most common form of fringing wetland.

Characteristically, they are restricted to shallow water coves protected from wind or waves. They closely border the shore to form a narrow belt of aquatic vegetation offshore. The shores of the east side of Walpole Island and the east side of Lake St. Clair contain excellent examples.

Oil spills pose a serious threat to fringing wetlands, which are highly valued for their importance as significant fauna habitats (nesting and spawning sites of various, often endangered species), or for the sensitive flora they contain.

Oil spilled in fringing wetlands could persist for years since wave abrasion processes are absent. The use of floating barrier booms at the mouth of coves, or deflection booms updrift of fringing wetlands could reduce oil damage to these sensitive environments.

All wetland environments are extremely sensitive to destructive clean up practices, especially when vegetation or sediment is removed, since wetland regeneration happens very slowly. The use of heavy equipment

is potentially more hazardous to the wetland community than the spill itself due to the risk of vegetation destruction, compaction of organic matter, grinding of oil into marsh soil, and the spreading of oil adhered to equipment surfaces to uncontaminated wetland regions.

Low-pressure flushing and hosing, and manual use of sorbents are the safest clean up methods. Usually road access does not exist; clean up crews would likely have to be transported to and from the site by small flat-bottomed boats. The use of low-pressure hosing to herd thin sheens of oil away from vegetation and towards deeper water (where it may be collected by skimming) is one method that has been effective.

Cutting oiled vegetation should only be considered as a last resort where large amounts of persistent oil are stranded in areas sheltered from natural removal processes, and where sensitive biological resources are at risk of being affected by the residual oil. Cutting does not improve vegetative recovery in most cases. Great care must be taken not to damage or trample roots.

An on-site expert is recommended for supervision during clean up. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.



### ESI 13b. Broad Wetland (U.S. ESI 10b)

Broad wetlands are vegetated shorelines which contain an unusual abundance of diverse aquatic vegetation. Along the St. Clair River, Lake St. Clair and Detroit River shorelines, marsh communities are the most common form of broad wetland.

Broad wetlands are usually quite large (1 to 2 km long), and occupy shallow water coves (often containing creek outlets) protected from wind or wave action in very low energy environments. They may extend into bay waters for hundreds of metres. The Lake St. Clair delta is a good example of an extensive broad wetland.

Oil spills pose a serious threat to broad wetlands, which are highly valued for their importance as significant fauna habitats (nesting and spawning sites of various, often endangered species), or for the sensitive flora they contain.

Oil spilled in broad wetlands could persist for years since wave abrasion processes are absent. The use of floating barrier booms at the mouth of coves, or deflection booms updrift of broad wetlands could reduce oil damage to these sensitive environments. In very dense wetlands, oil is unlikely to penetrate past the outer edge of the vegetation.

All wetland environments are extremely sensitive to destructive clean up methods, especially when vegetation or sediment is removed or damaged, since wetland

regeneration happens very slowly. The use of heavy equipment is potentially more hazardous to the wetland community than the spill itself due to the risk of vegetation destruction, compaction of organic matter, grinding of oil into marsh soil, and the spreading of oil adhered to equipment surfaces to uncontaminated wetland regions.

Low-pressure flushing and hosing, and manual use of sorbents are the safest clean up methods. Usually road access does not exist; clean up crews would likely have to be transported to and from the site by small flat-bottomed boats. The use of low-pressure hosing to herd thin sheens of oil away from vegetation and towards deeper water (where it may be collected by skimming) is one method that has been effective.

Cutting oiled vegetation should only be considered as a last resort where large amounts of persistent oil are stranded in areas sheltered from natural removal processes, and where sensitive biological resources are at risk of being affected by the residual oil. Cutting does not improve vegetative recovery in most cases. Great care must be taken not to damage or trample roots.

An on-site expert is recommended for supervision during clean up. All clean up methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

## 10.0 St. Clair River, Lake St. Clair and Detroit River: Physical Overview

The total shoreline length of both sides of the St. Clair River, Lake St. Clair and Detroit River Connecting Channels (including islands) is 726 kilometres (454 miles); 340 kilometres along the Canadian shore and 386 kilometres (241 miles) along the U.S. side. Flow rates and water levels are not controlled by manmade structures in any manner. Ice jams occur frequently along the St. Clair River in winter affecting its flow rate and therefore reducing water levels in Lake St. Clair. Fast currents in the St. Clair River and Detroit River complicate on-water spill response activities. The St. Clair River and Detroit River shorelines are often characterized by heavy urban and industrial development and activity, especially at Sarnia and Detroit. In fact, the majority of the Michigan shoreline of both rivers and the lake is primarily private property consisting of homes, yacht clubs/marinas and industry; there are very few municipal parks (DFO 1986). The Ontario shoreline is also heavily developed with homes and industry with the exception of the St. Clair delta, which has extensive wetland areas inhabited by a wide variety of species of plants and animals.

In fact, the Walpole Island First Nation and surrounding areas is internationally known for its excellent cattail marsh, as well as endangered prairie and oak savannah habitats. These extensive, high quality habitats contain about 100 nationally and provincially rare or endangered plant species, some of which are not known elsewhere in Canada. There are many provincially/nationally significant species of birds, herptiles, mammals and butterflies. The wetlands are immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding (OMNR, 1994).

The Canadian portion of the entire study area covered in this atlas falls within what is defined as a Primary Area of Response (PAR) under the Canada Shipping Act amendments of 1995. The Sarnia PAR encompasses the Canadian shores of the St. Clair River, Lake St. Clair and the Detroit River. These areas are highlighted for enhanced preparedness against spills due to the higher risk of incidents associated with these areas. Contact Canadian Coast Guard - Central Region for more information on PARs.

**St. Clair River:** The St. Clair River is approximately 64 kilometres (40 miles) long with a maximum width of 1.2 kilometres (0.75 miles) and a maximum depth of 21 metres (70 feet). The river has a water elevation drop of 1.7 metres (Owens 1979) as it flows from Lake Huron to Lake St. Clair with an average flow of 5200 cubic metres per second (Limno-Tech 1985) and an average flushing rate of 21 hours (UGLCCS, 1988). While currents are strong, energy levels along the river's shoreline are very low. The channel is narrow throughout the length of the section, making wave generation by ships an important factor in energy levels at the shoreline. The shoreline is characterized by low vegetated cliffs or artificial structures (rip rap, retaining wall or harbour structures) (Owens 1979).

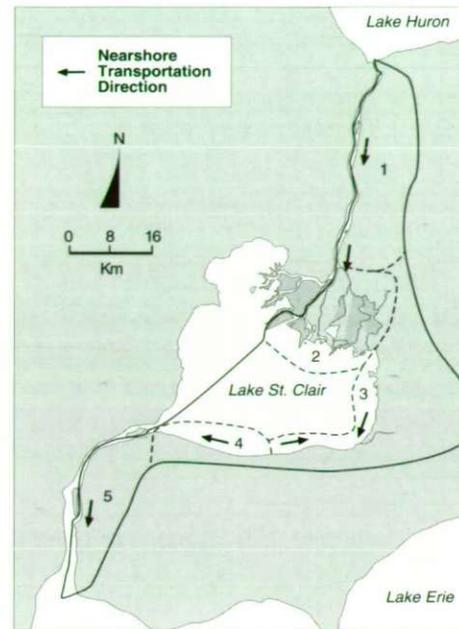
**Lake St. Clair:** Lake St. Clair is a relatively shallow lake with an average depth of 5 metres (16 feet) and a width of only 40 kilometres (25 miles), a surface area of 1115 cubic kilometres (Limno-Tech 1985) and an average flushing rate of 6 days (UGLCCS, 1988). A navigation channel has been dredged to a depth of 8.3 metres (27 feet) to accommodate commercial vessel traffic. Lake St. Clair is a very low energy environment with a maximum fetch of 40 kilometres (Owens 1979).

The delta which developed at the base of the St. Clair River was created by the accumulation of material that was fed into the system from Lake Huron and deposited at the river mouth. The wetlands of both the delta in the north and those along the east shore of the lake have developed in shallow, low wave energy environments. Most of this coastline is very irregular, unprotected and highly sensitive, therefore this area is extremely vulnerable to spills. There are no significant industries or major urban centres located on the lake itself (UGLCCS, 1988), but there are many private residential and recreational properties along the lakeshore. The south coast of the lake is composed of low cliffs, narrow beaches and artificial structures (rip rap, retaining walls or harbour structures), and the nearshore zone is extremely shallow (Owens 1979). Much of the shoreline of Lake St. Clair has been modified (landfill, walls and dykes).

**Detroit River:** The Detroit River is approximately 52 kilometres (32 miles) long with a maximum width of three kilometres (1.9 miles). The river flows from Lake St. Clair to Lake Erie and has an average flow of 5300 cubic metres per second. The change in water elevation is 1 metre (Limno-Tech, 1985) and the average flushing rate is 20 hours (UGLCCS, 1988). While currents are strong, energy levels along the river's shoreline are very low (Owens 1979). As in the St. Clair River, ship wakes represent a significant shore-zone process (Owens 1979). Extensive shallow shoals have formed on either side of the Detroit River in the southern portion due to bedrock outcrops underneath the river (Sly and Lewis 1972). The Detroit River is the busiest connecting channel of the upper Great Lakes involving shipments of iron ore, coal, limestone, gypsum, oil and wheat (UGLCCS, 1988).

## 10.1 Water Circulation and Shoreline Transport

In the event of a spill, currents, wind and wave conditions must be monitored to assist in predicting the trajectory of a contaminant. When the trajectory and destination of a spill have been defined, the target shoreline should be assessed for shoreline transport. While overviews of circulation are not necessarily reliable measures of transport, the following information will assist response decision makers in assessing spill impact.



(Owens, 1979)

Longshore sediment transport is the mechanism by which sediment material is moved parallel to the coast (by wave-induced processes). Figure 3 shows the coastal environments and primary shorezone transport directions for the St. Clair River, Lake St. Clair and Detroit River shorelines. Table 2 summarizes the main features of each of the five subdivisions in Figure 3.

Another important consideration on the Great Lakes and Connecting Channels is the historical, annual and storm variation in water levels. This will partially dictate which part of the shore will be oiled during a spill event. A Great Lakes Water Level Bulletin is published each month by the Canadian Hydrographic Service. It includes a six month forecast of water levels. Exact water levels during a response to a spill can be obtained from Environment Canada by phoning 905-336-4581.

**Figure 3: Coastal Environments and Primary Shore-Zone Transport Directions of St. Clair River, Lake St. Clair and Detroit River Shorelines**

**Table 2: Coastal Environments of St. Clair River, Lake St. Clair and Detroit River Shorelines**

Subdivision	Relief and Geology	Coastal Zone			Sediment Availability And Transport
		Shore-Zone Character	Beach Character	Fetch, Wave Exposure and Ice	
1. St. Clair River	Low relief with unconsolidated sediments: cliffs less than 5 m: no exposed bedrock	Straight river channel with vegetated cliffs, narrow beaches or artificial structures: marshes on Stag Island and in sheltered sites	Beaches are narrow and predominantly poorly-sorted coarse sediments	Very sheltered, narrow channel: ship generated waves significant: strong river currents: shorezone ice up to 4 months/year, ice jams form in channel	Sediments generally scarce: material fed in from Lake Huron transported through river into Lake St. Clair
2. St. Clair Delta	Very low relief, generally < 3m: deltaic environment	Complex shoreline: "bird foot" shaped delta with many channels and shallow bays: predominately a marsh environment with dykes and reclamation in northern sections	Beaches narrow or absent, predominantly fine-grained sediments: some channel margin erosion adjacent to shipping lanes	Very low wave-energy levels: maximum fetch 40 Km: shore-zone ice up to 4 months/year	Area of sediment accumulation
3. East and South-east Lake St. Clair	Very low relief, <5m: no exposed bedrock	Dyked and undyked marshes in east: low cliffs in the southeast with some narrow beaches west of Belle River	Where present, beaches are narrow and composed of sand-pebble sediments	Low wave-energy environment: maximum fetch 40 Km and shallow nearshore zone: shore-zone ice up to 4 months/year	Fine-grained sediments in east trapped in marshes: sediments generally scarce in southeast and transported to the west
4. Southwest Lake St. Clair	Very low relief, <5m: no exposed bedrock	Low, eroding cliffs protected by seawalls, beaches narrow or absent: considerable artificial protection	Beaches are low and narrow: predominantly sand-pebble sediments	Low wave-energy environment: maximum fetch 40 Km and shallow nearshore zone: shore-zone ice up to 4 months/year	Sediments scarce: transported westward into the Detroit River
5. Detroit River	Low relief (<10m) with unconsolidated sediments: bedrock outcrops in sections of the river bed, but not in the shore zone	Straight river channel, eroding cliffs largely protected by seawalls: beaches narrow or absent: marshes in sheltered sites	Beaches are low and narrow: sediments in sand to cobble size range, generally poorly-sorted	Very sheltered, narrow channel: ship-generated waves significant: strong river currents: shore-zone ice up to 4 months/year, ice jams form in channel	Sediments generally scarce: material from Lake St. Clair transported through river into Lake Erie

(Owens, 1979)

The general pattern of the surface water circulation in the rivers is from north to south and surface water circulation in Lake St. Clair is affected by the flow of water exiting the St. Clair River and entering the Detroit River (see Figure 4). Maximum water surface temperatures on the St. Clair River, Lake St. Clair and Detroit River will typically reach 25C (Saulesleja, 1986).

Figure 4 also gives general information such as the location of communities with their populations.

**Figure 4a: St. Clair River Surface Currents and Shoreline Overview**

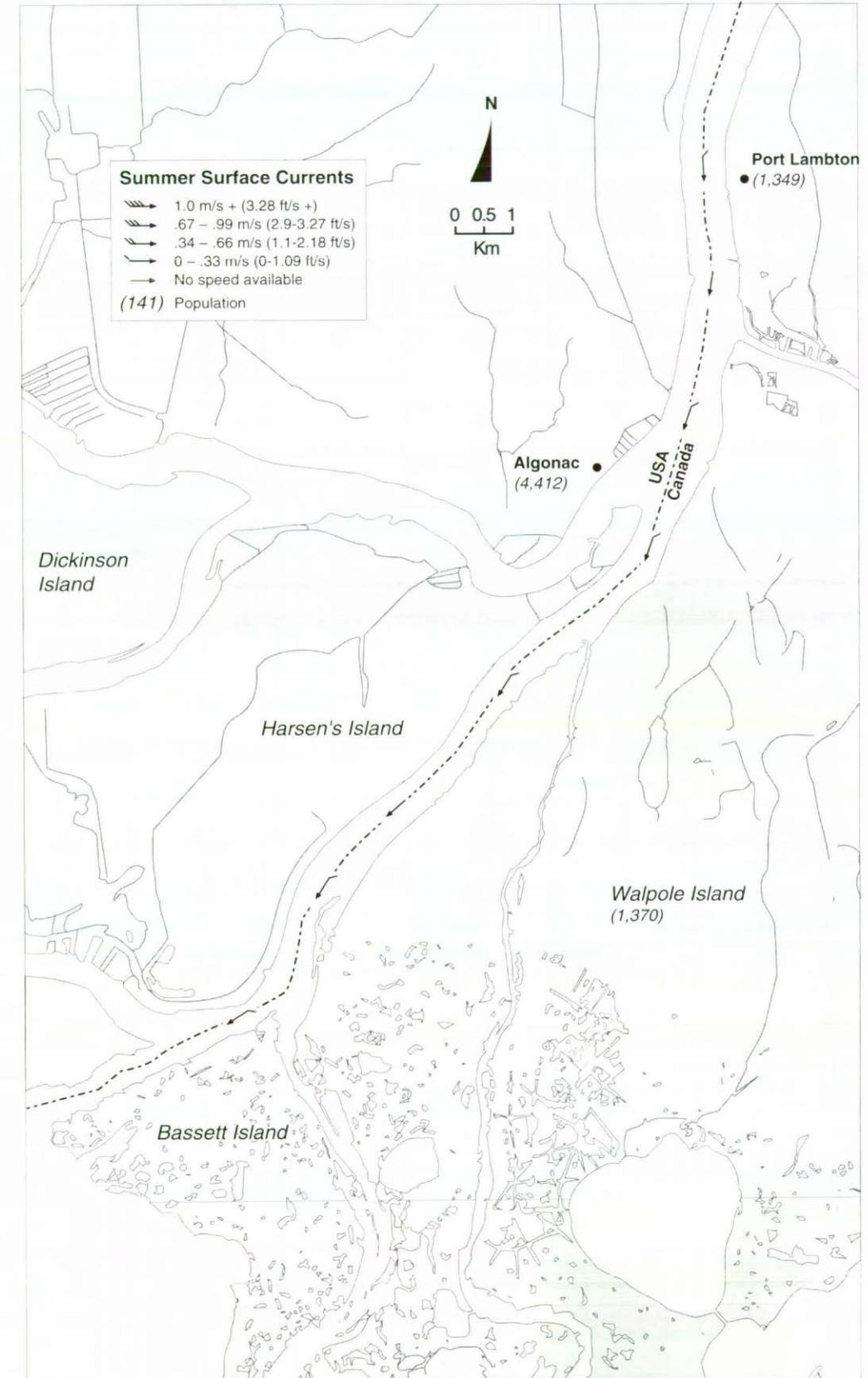
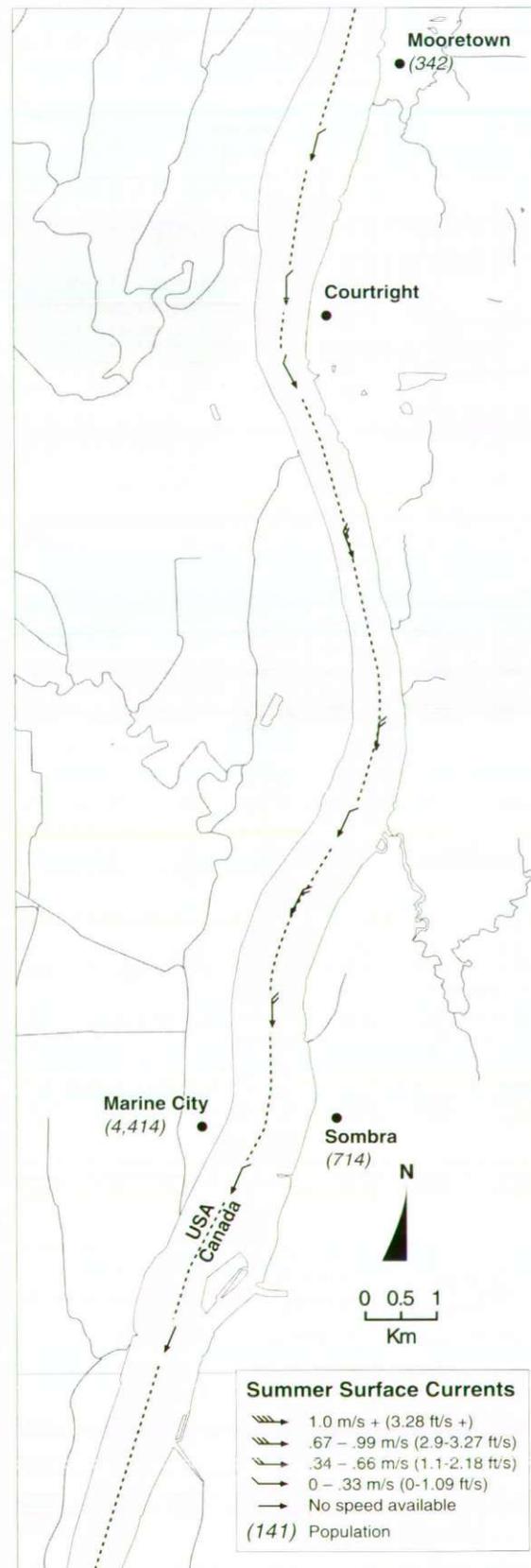
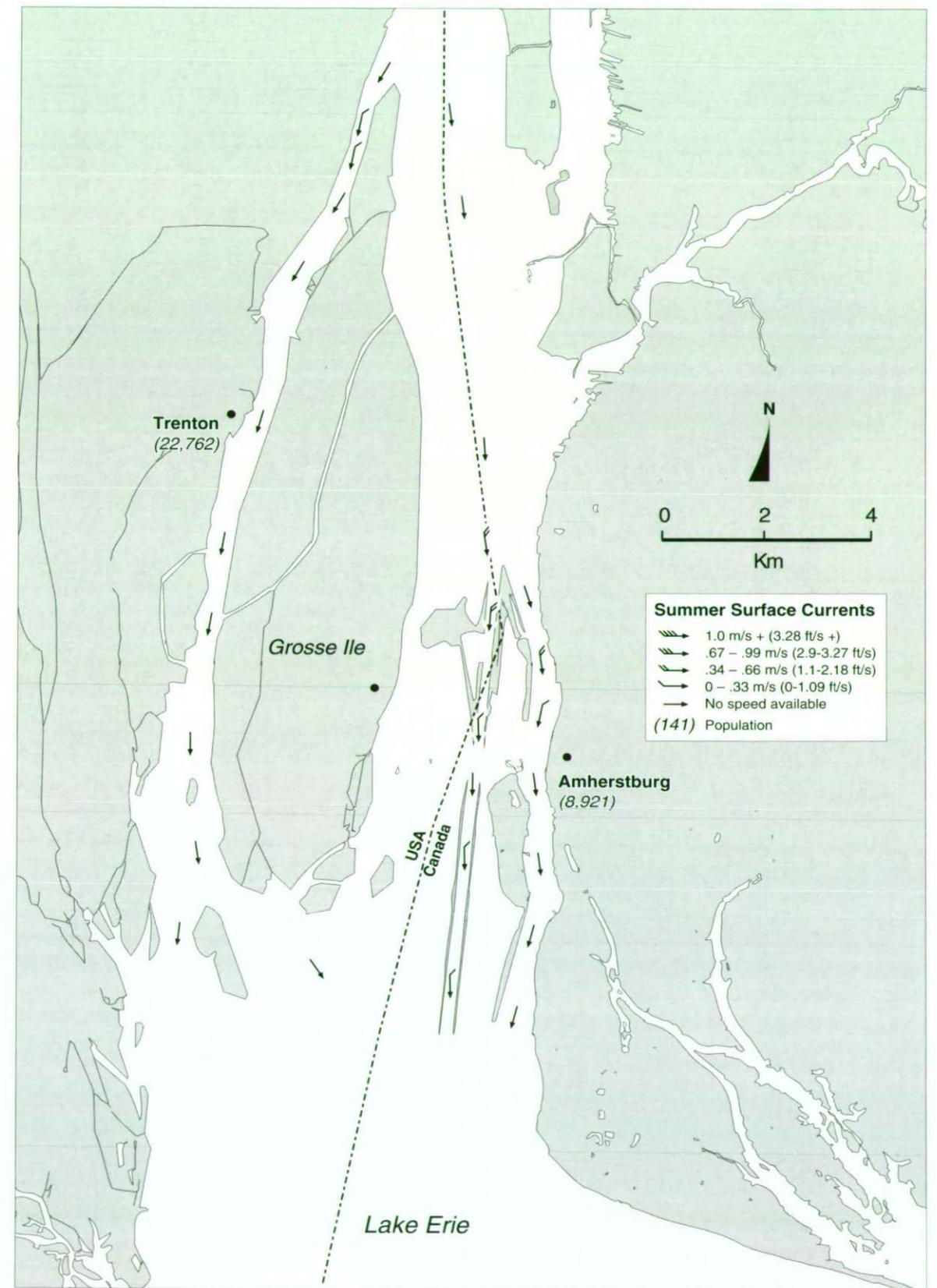
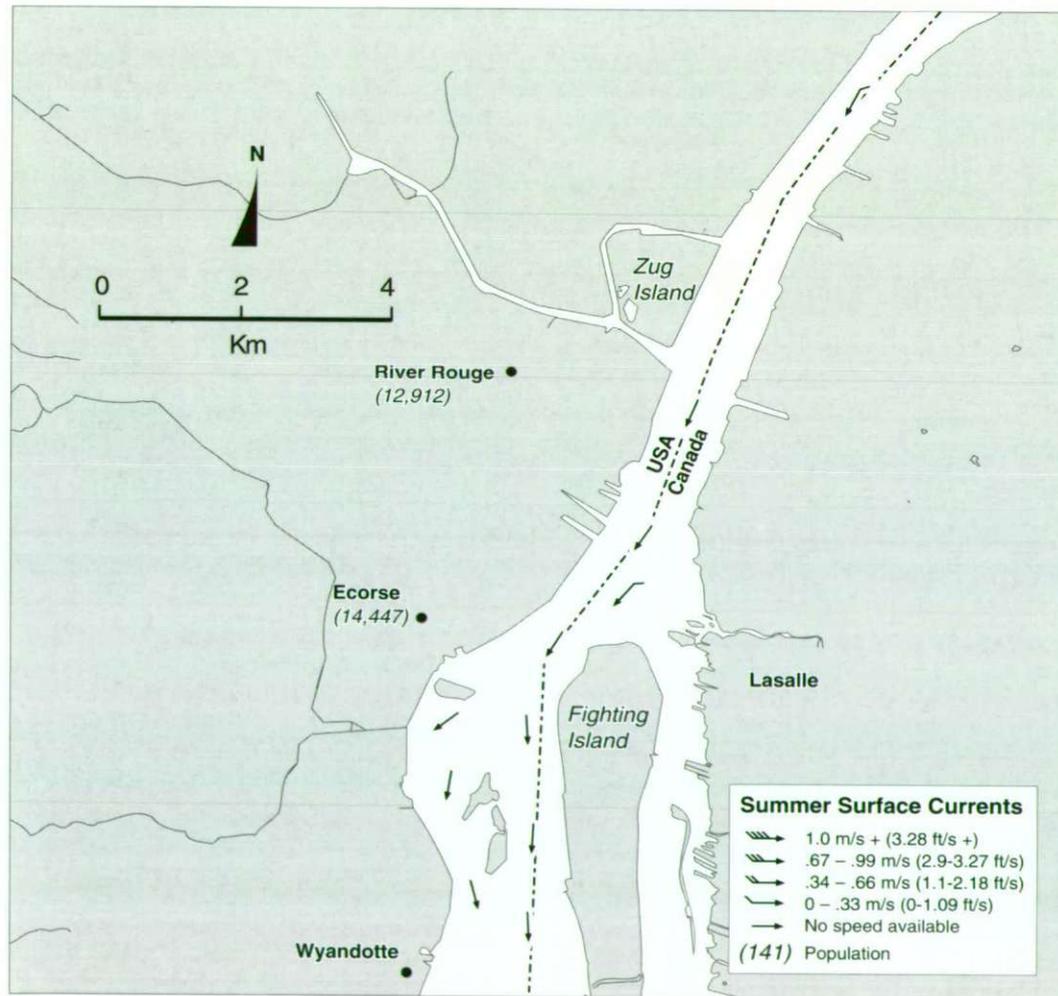
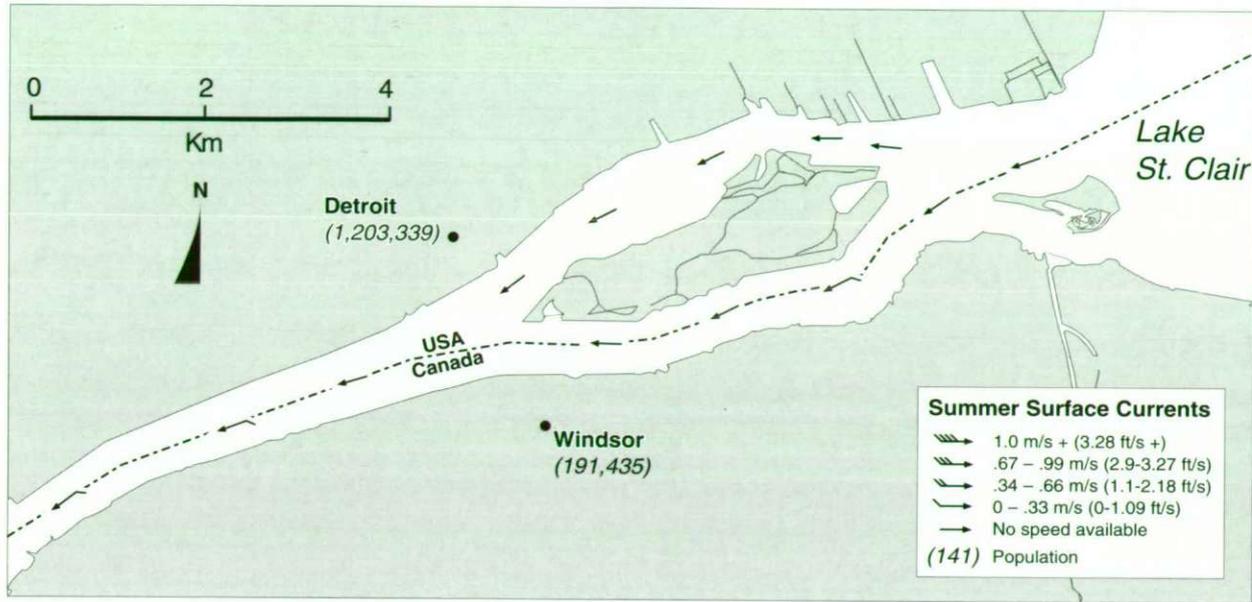
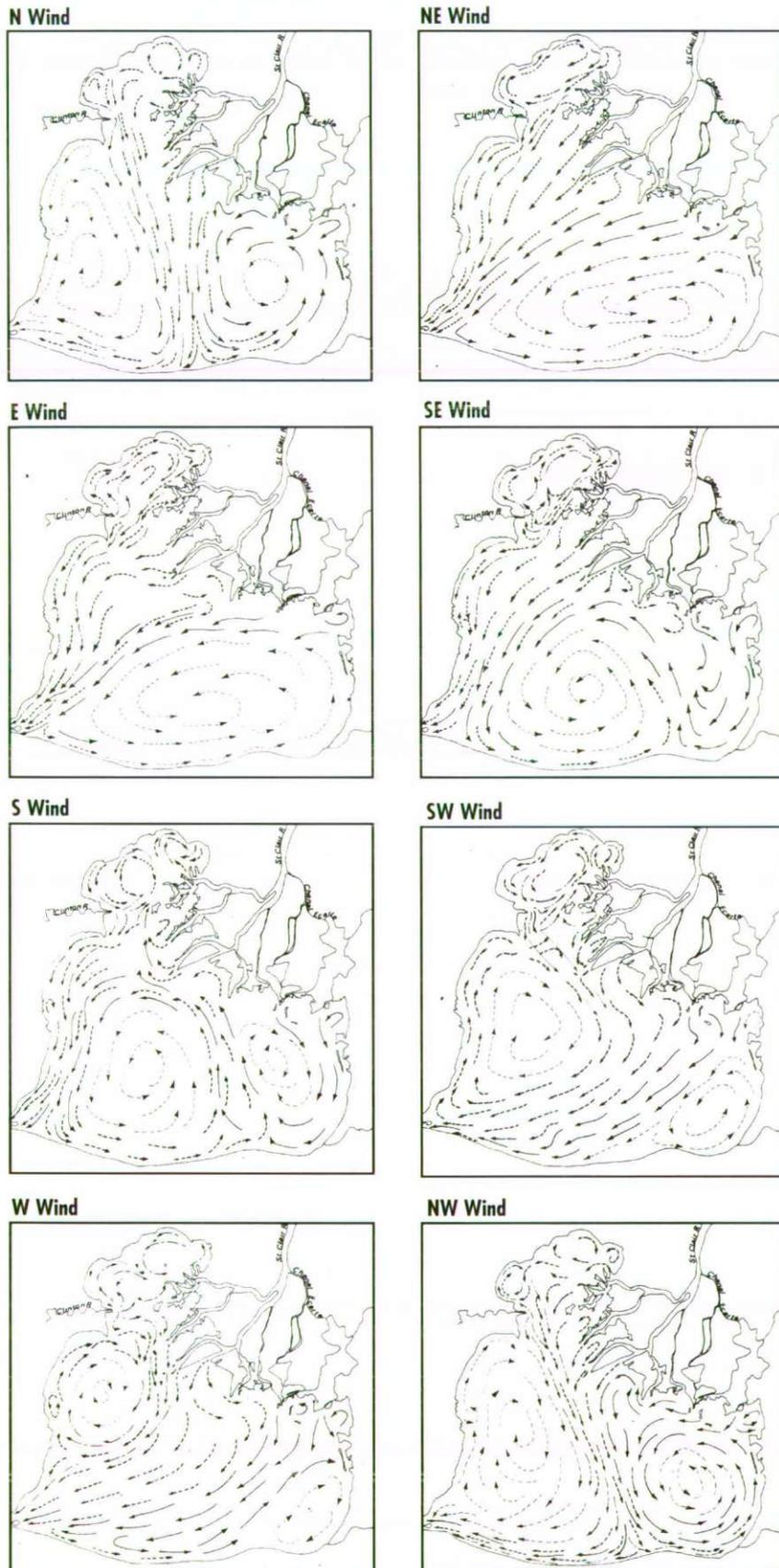


Figure 4b: Detroit River Surface Currents and Shoreline Overview



(Canadian Coast Guard, 1979)  
 (Population Data Source: Statistics Canada Census, 1991)

**Figure 4c Lake St. Clair Surface Currents**



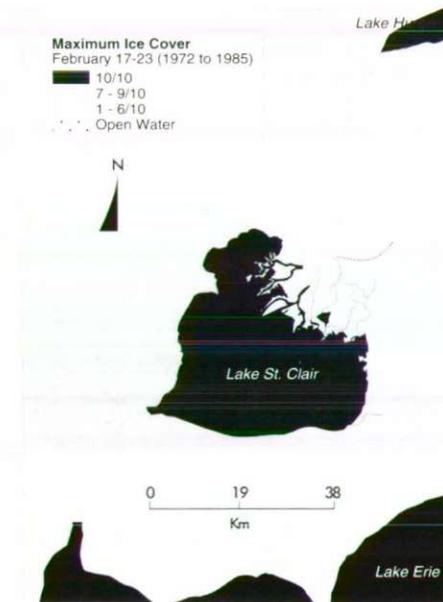
(Canadian Coast Guard, 1979)

## 10.2 Ice Cover

“The formation of shore ice in Lake St. Clair begins in the sheltered bays of the north and northeast coast during late December. In the eastern part of the lake, freeze-up is earlier and the ice persists longer due to the westerly winds that drive the floes into this part of the lake. The ice cover reaches 100% in most years; the maximum coverage is usually in late February, but may be as early as late January. Breakup commences in early March and most of the lake is ice-free by April.” (Owens 1979).

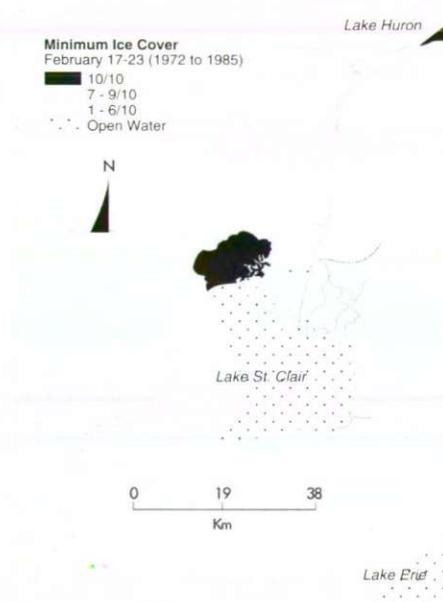
In the St. Clair River and Detroit River channels the strong currents (up to 2 metres per second) prevent ice formation in many sections, but in slack reaches, delta channels or bays, the period of ice cover is similar to that of Lake St. Clair. Ice jams frequently form in the rivers due to floating drift ice at the entrances, or at areas where the rivers are narrower or constricted, or where ice is prevented from leaving the channel at the downstream end by lake ice (Great Lakes Basin Commission 1975). In the St. Clair River, ice jams may reduce flow by as much as ten percent causing upstream flooding and reducing the water level in Lake St. Clair. The effect of ice jams in the Detroit River are not as noticeable because the river is wider and the current is slower.

(Saulsleja, 1986)



**Figure 5a: St. Clair River, Lake St. Clair and Detroit River Maximum Ice Cover**

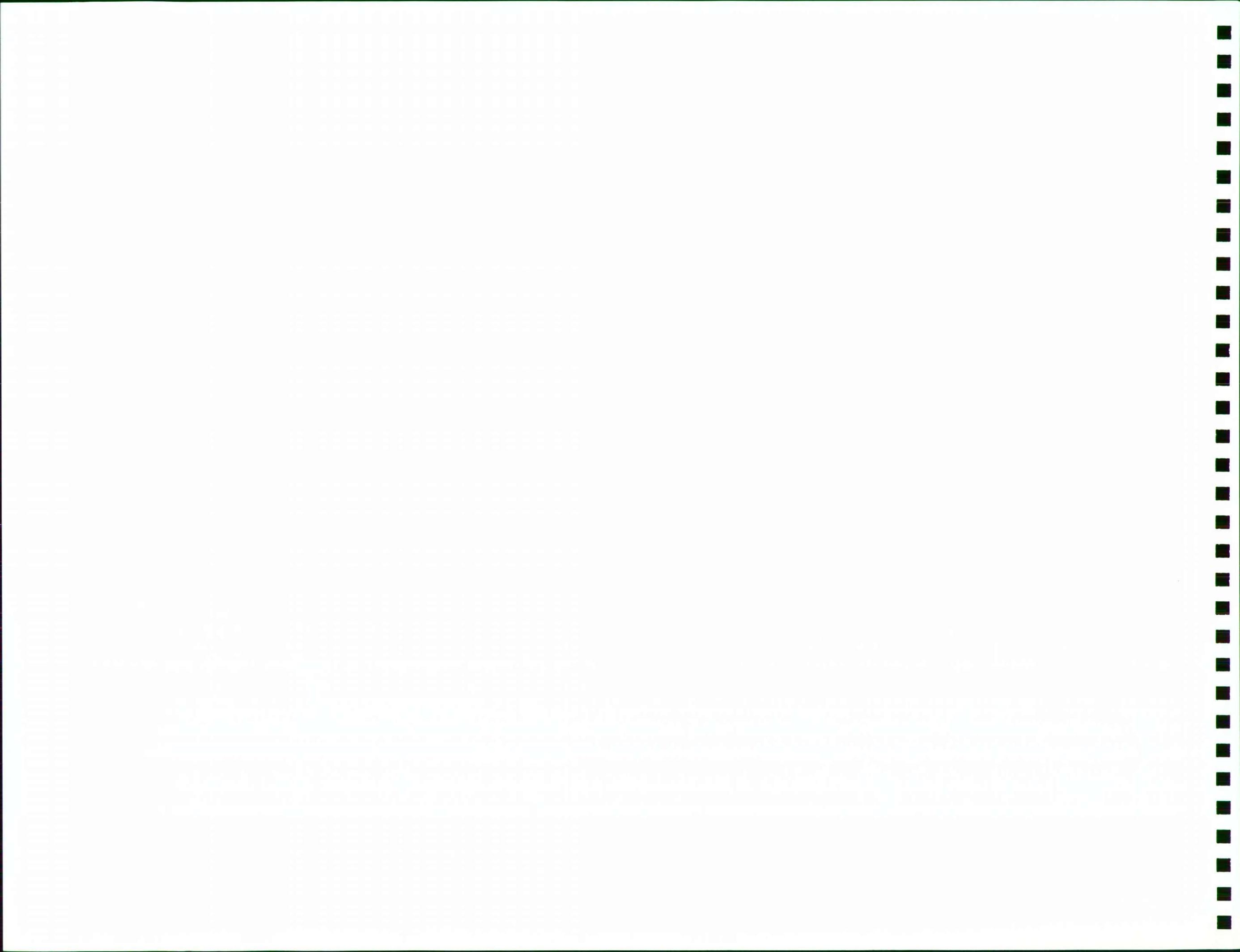
(Saulsleja, 1986)



**Figure 5b: St. Clair River, Lake St. Clair and Detroit River Minimum Ice Cover**

## 10.3 Wind and Waves on the St. Clair River, Lake St. Clair and Detroit River

The primary wind direction for Lake St. Clair is from the southwest, with a secondary prevailing frequency out of the northwest. The relatively short fetch of Lake St. Clair of 40 kilometres (25 miles) limits maximum wave height to 1 metre (3.3 feet). On rare occurrences, this height may be exceeded. A seasonal variation in wave heights is expected due to the variation in wind velocity between summer and winter months. (Owens 1979). On the Connecting Channels, responders should note that ship wakes have a greater effect on the shoreline than wind generated waves.



# Environmental Sensitivity

## Maps for the St. Clair River, Lake St. Clair and Detroit River Shorelines

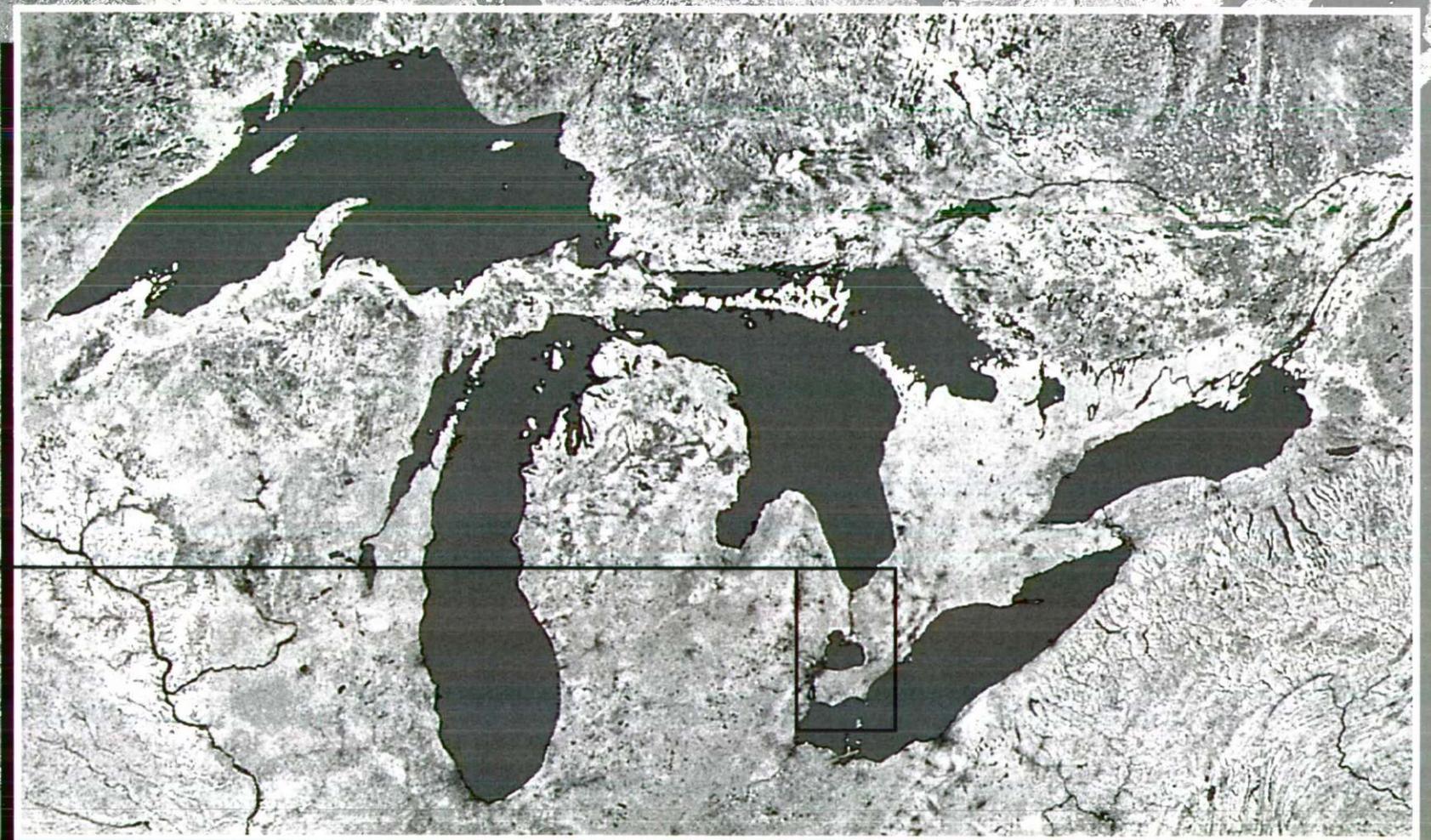


Environment  
Canada

Environmental  
Protection Branch  
Ontario Region

Environnement  
Canada

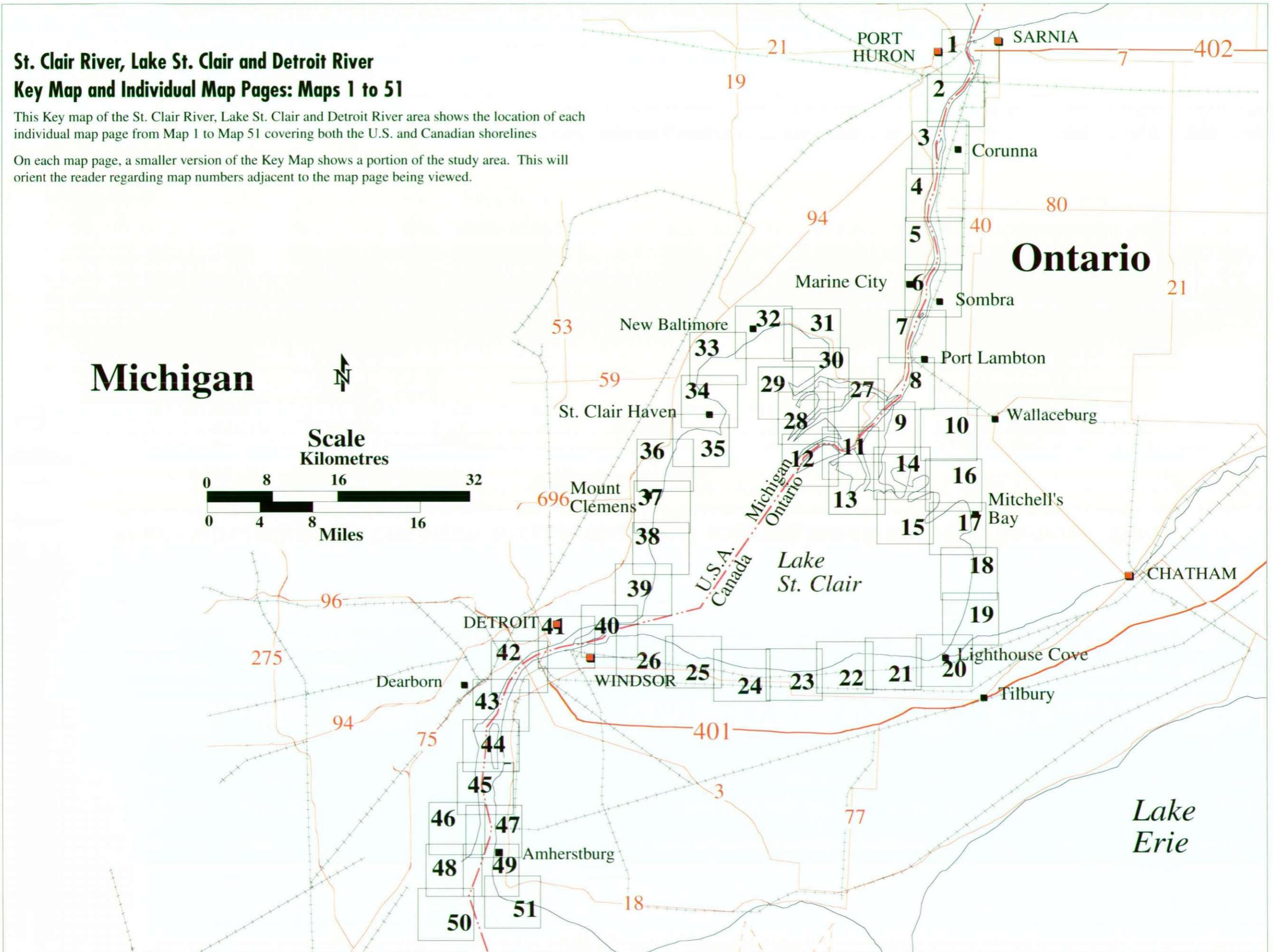
Direction générale  
de la protection de  
l'environnement  
région de l'Ontario



## St. Clair River, Lake St. Clair and Detroit River Key Map and Individual Map Pages: Maps 1 to 51

This Key map of the St. Clair River, Lake St. Clair and Detroit River area shows the location of each individual map page from Map 1 to Map 51 covering both the U.S. and Canadian shorelines

On each map page, a smaller version of the Key Map shows a portion of the study area. This will orient the reader regarding map numbers adjacent to the map page being viewed.



**NOTES**

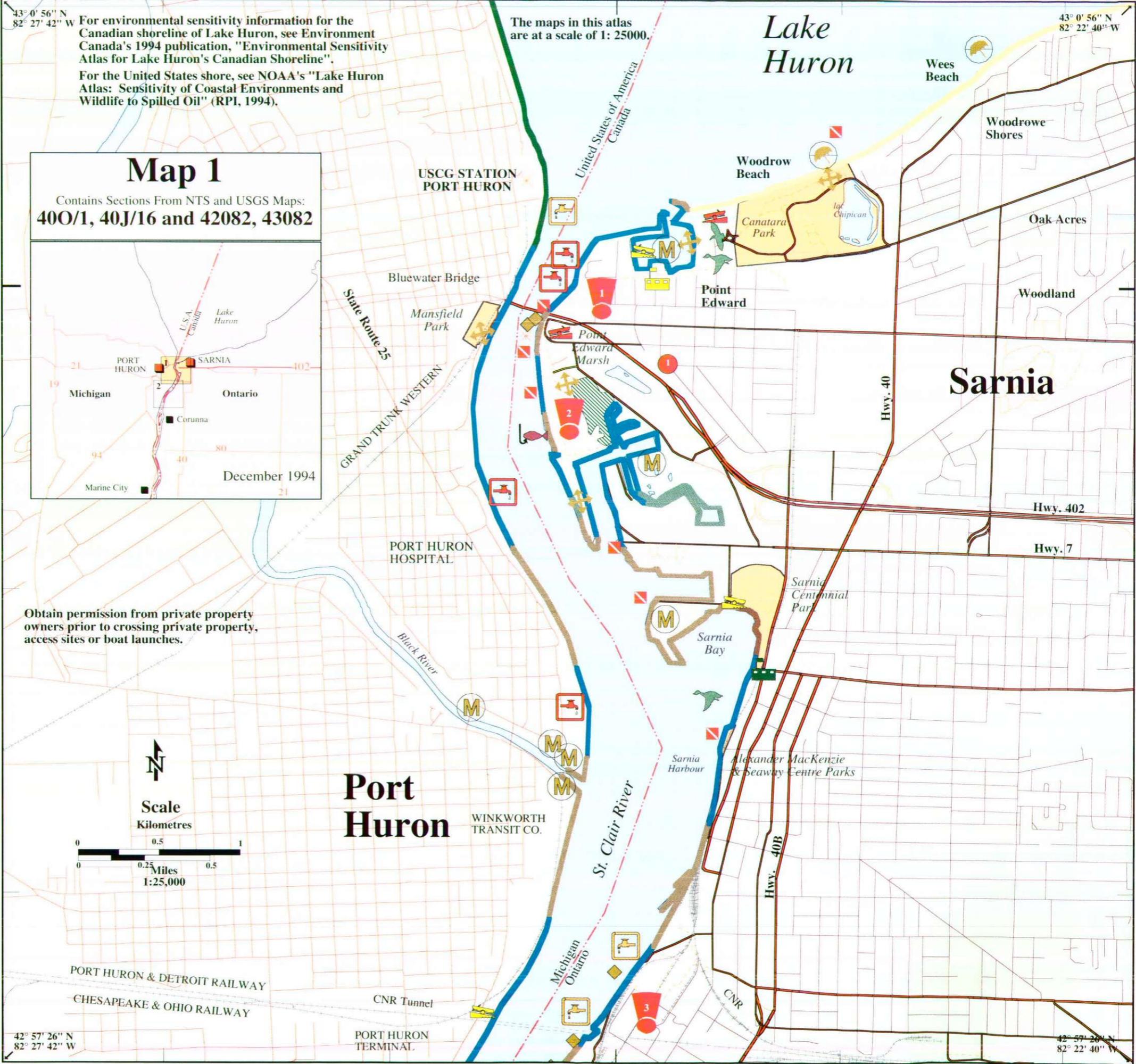
A red exclamation point symbol is used on the maps to catch the responder's attention.

- 1 Lambton County and Sarnia City Water Service System Water Intakes - Call (519) 344-7429.  
Point Edward Water Pollution Control Plant Water Outfalls - Call (519) 339-7273.  
Canada Customs, Highway 402 border crossing - For trans-border spill response activity - Call (519) 336-3097.  
For U.S. Customs - Call (810) 985-9541.  
Dunn Paper Company Industrial Water Intake - Call (810) 984-5521.

- 2 Point Edward Marsh is a Class 3 wetland located on mineral soils. Available open water and interspersed vegetation communities create a productive waterfowl habitat. This wetland is surrounded by urban development. Provincially significant species found within the wetland include the Pied-billed Grebe, Marsh Wren, Black-crowned Night Heron and Butler's Garter Snake. Colonial waterbirds such as the Great Blue Heron actively use this site as a feeding location. The area has been identified as locally significant with respect to waterfowl staging and production. Commercial fishing activities have seasonal significance in Lake Huron near Point Edward.

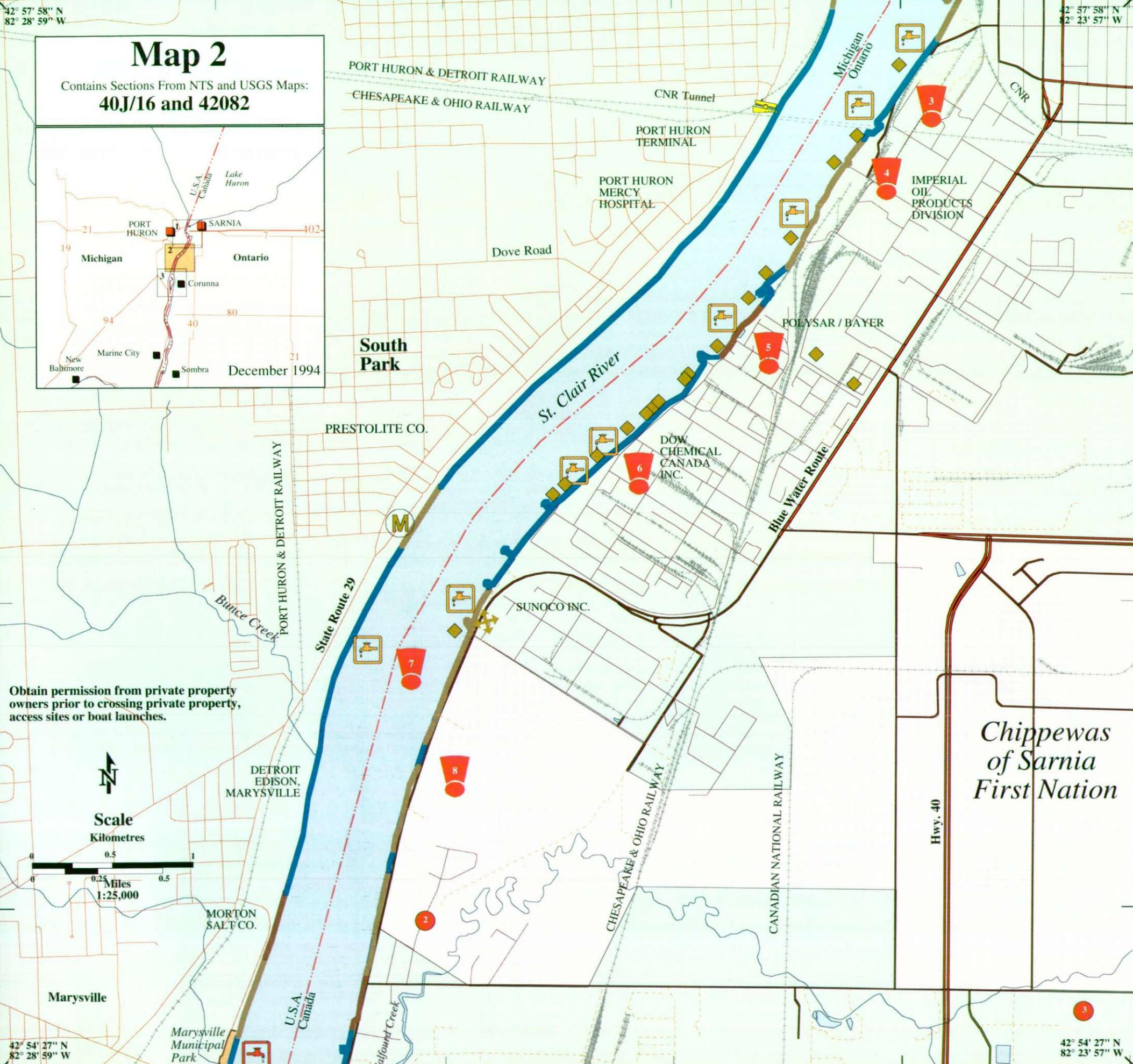
City of Port Huron, U.S.A. Municipal Water Intake - Call (810) 984-9780 or (810) 984-4141 (24 hrs.).

- 3 Imperial Oil Products Division Water Intakes and Outfalls - Call (519) 339-5666.



**Map 1**  
Contains Sections From NTS and USGS Maps:  
**400/1, 40J/16 and 42082, 43082**

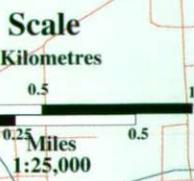
Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



**Map 2**  
 Contains Sections From NTS and USGS Maps:  
**40J/16 and 42082**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 3 Imperial Oil Products Division Water Intakes and Outfalls - Call (519) 339-5666.
- 4 Sarnia City Water Pollution Control Plant Outfall - Call (519) 344-8507.
- 5 Polysar/Bayer Water Intakes and Outfalls - Call (519) 337-8251.
- 6 DOW Chemical Canada Inc. Water Intakes and Outfalls - Call (519) 339-3957 or (519) 339-3545.
- 7 Sunoco Inc. Water Intakes and Outfalls - Call (519) 383-3627. Marysville, Edison Power Plant Intake - Call (810) 364-2235.
- 8 Chippewas of Sarnia First Nation Territory is designated as an Environmentally Sensitive Area. It is a large natural wilderness area surrounded by industrial development. The area is composed of Oak Hickory savannahs and swamp forest with some areas cleared for agriculture. Swamps store and discharge water into Talfourd Creek. This area is a refuge for wildlife intolerant of the massive disturbances which surround it. Rare plants include Pignut Hickory, Panicked Tick Trefoil, Yam Root, Winged Loosestrife, Cardinal Flower, Seedbox, Native Flowering Crab, Wild Plum, Swamp White Oak, Black Oak, Water Dock and Summer Grape. Rare birds include the Red Bellied Woodpecker. Responders should contact the Chief of the Chippewas of Sarnia First Nation before commencing any response activity - Call (519) 366-8410 (9am - 5pm).

# NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 9 Carp spawn in June/July at the mouth of Talfourd Creek.  
Shell Canada Ltd. Water Intakes and Outfalls - Call (519) 481-1245.  
Ethyl Canada Inc. Water Outfall - Call (519) 862-1411.  
Novacor Chemicals Water Intakes and Outfalls - Call (519) 481-3237.  
City of Marysville, U.S.A. Municipal Drinking Water Intake - Call (810) 364-8460 or (810) 364-8844 (Sheriff's Dept.).

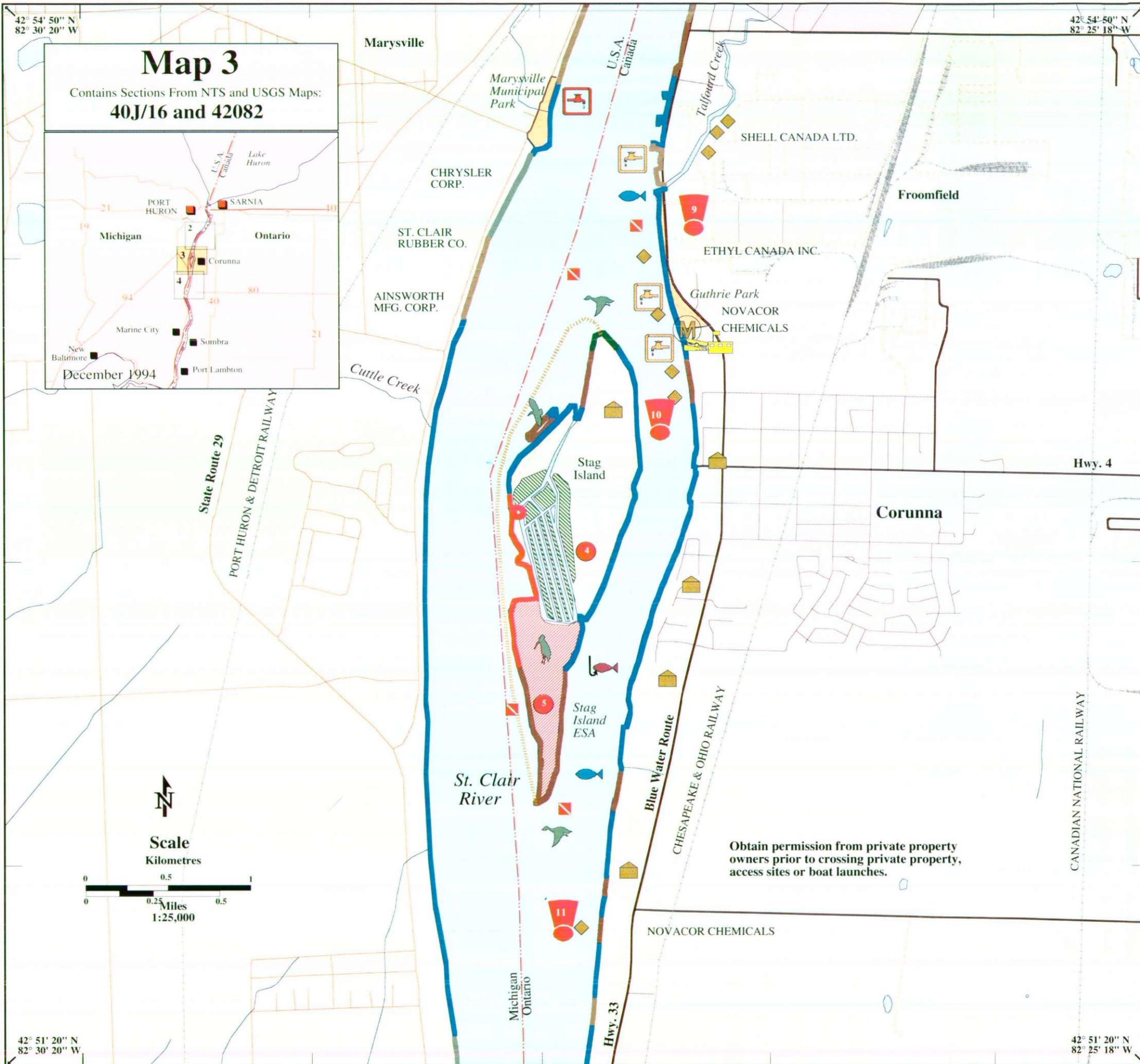
10 The Environmentally Sensitive Area on Stag Island is a Class 3 wetland that contains a number of resources with potential economic value including fish, Snapping Turtles and furbearers (Muskrat). Recreational fishing is intensive, while hunting and boating activities are moderate. Provincially significant species include the Great Egret and Forrester's Tern as well as the regionally significant Fringed Gentian. Stag Island wetland has been identified as regionally significant for waterfowl staging and locally significant for waterfowl production. This site has also been documented as a significant habitat for fish spawning and rearing.

The submergent vegetation beds along Stag Island represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Corunna Water Pollution Control Plant Water Outfall - Call (519) 862-1060.

The Great Lakes Response Corporation's equipment depot is located at Corunna.

- 11 Novacor Chemicals Water Outfall - Call (519) 862-2961.



42° 51' 43" N  
82° 30' 49" W

42° 51' 43" N  
82° 25' 48" W

# Map 4

Contains Sections From NTS and USGS Maps:  
**40J/16 and 42082**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

42° 48' 12" N  
82° 30' 49" W

42° 48' 12" N  
82° 25' 48" W

## NOTES

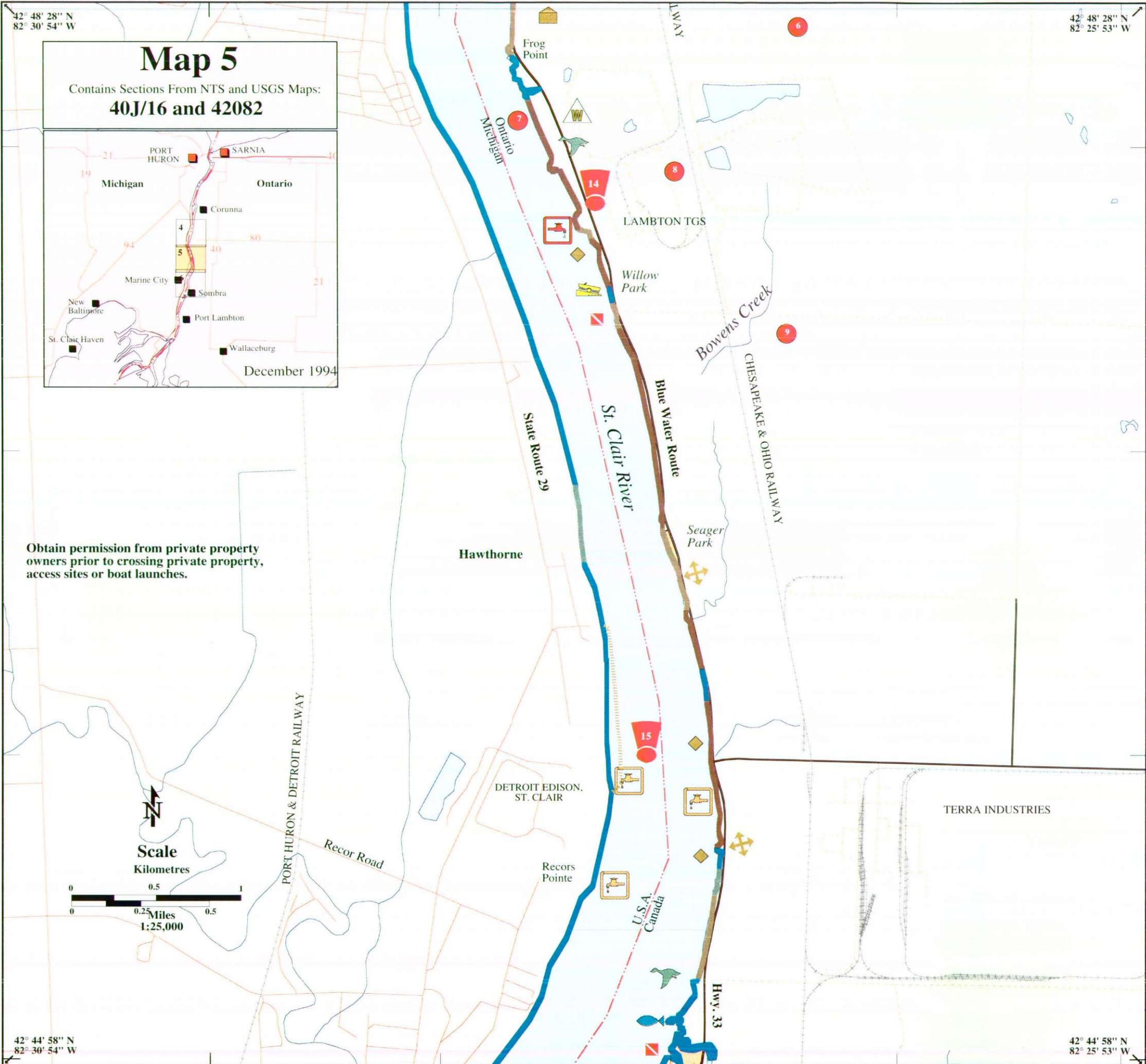
A red exclamation point symbol is used on the maps to catch the responder's attention.

- 12** Seasonal fish spawning of White Sucker and Largemouth Bass occurs in Baby Creek.  
Mooretown Centennial Park Golf Course Water Intake. Call St. Clair Parkway Commission at (519) 862-2291 or after hours at (519) 677-5268.
- 13** Courtright City Water Pollution Control Plant Water Outfall - Call Sarnia MOEE at (519) 336-4030.  
City of St. Clair, U.S.A. Municipal Water Intake - Call (810) 329-2811.  
Diamond Crystal Salt Company Industrial Intake - Call (810) 329-2214.

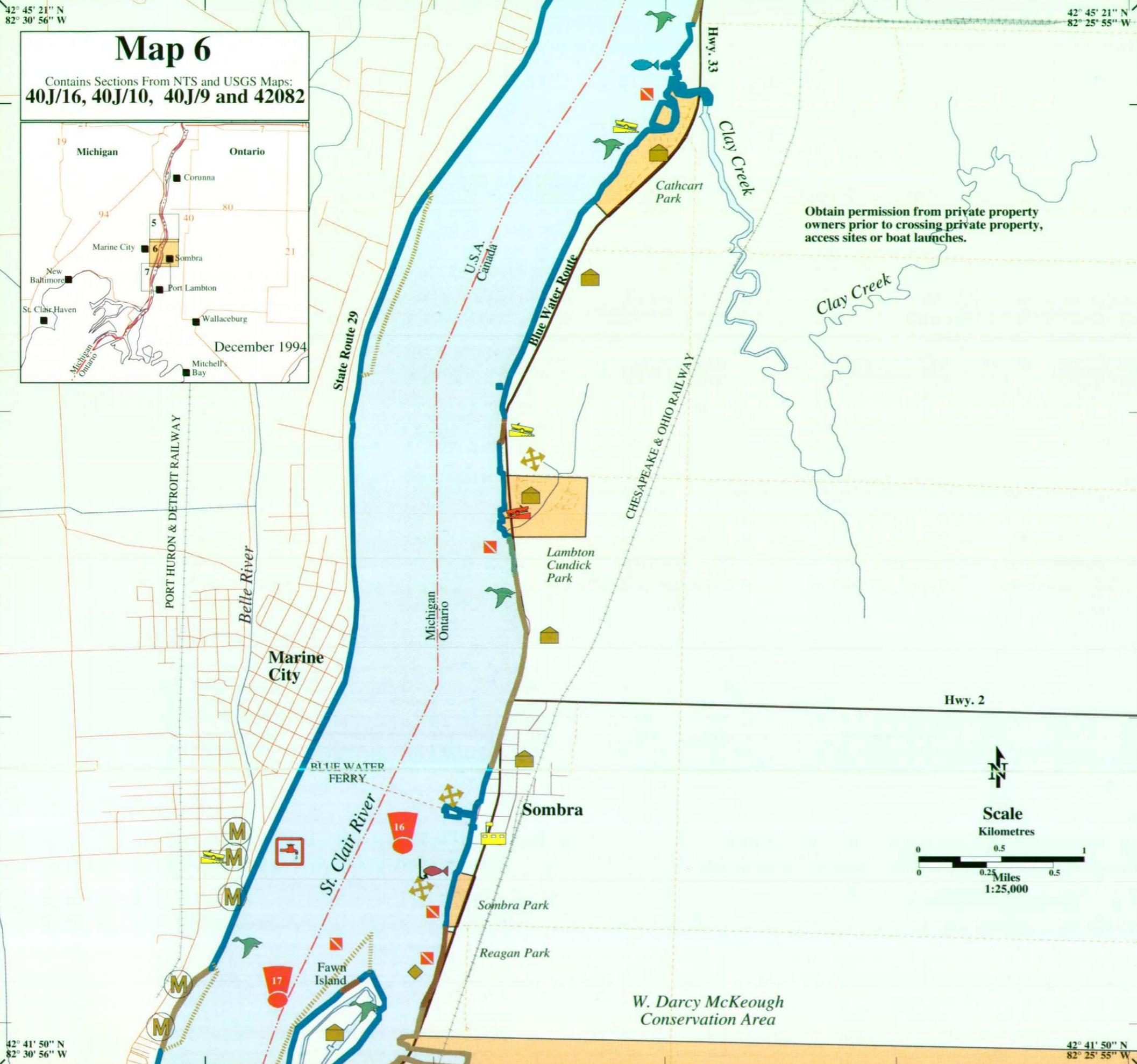
**NOTES** !

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 14 Ontario Hydro Lambton Generating Station Water Intakes and Outfalls - Call (519) 431-1126.
- 15 Terra Industries Ltd., Canada Water Intakes and Outfalls - Call (519) 867-2739.  
Canadian Liquid Air CO2 plant outfalls (not operational in 1994) - Call (519) 867-2824 (24 hrs.).  
Detroit Edison Company, St. Clair, U.S.A. Industrial Intake - Call (810) 329-0410, or (810) 329-2235 (State Police - working hours).  
St. Clair County #2, U.S.A. Industrial Intake (near Recors Pointe) - Call (810) 364-5720 ext. 201.



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

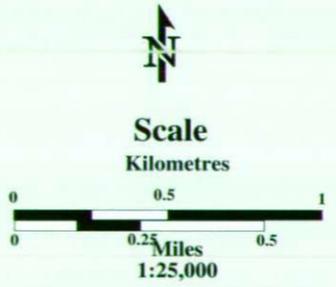


**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 16** Toll ferry service exists between Sombra, Ontario and Marine City, Michigan.  
 Marine City, U.S.A. Municipal Water Intake - Call (810) 765-8087.  
 Commercial bait fishing activities have seasonal significance near Sombra.  
 The Canadian Coast Guard maintains an equipment depot and boom storage site at Sombra.
- 17** Fawn Island provides feeding grounds for migratory waterfowl. Several shipwrecks exist offshore.  
 Responders must be aware of submergent vegetation when approaching the west shore. The submergent vegetation beds located around Fawn Island represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.  
 Sombra City Water Pollution Control Plant Water Outfall - Call Sarnia MOEE at (519) 336-4030.

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



# NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**17** Fawn Island provides feeding grounds for migratory waterfowl. Several shipwrecks exist offshore.

Responders must be aware of submergent vegetation when approaching the west shore. The submergent vegetation beds located around Fawn Island represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Sombra City Water Pollution Control Plant Water Outfall - Call Sarnia MOEE at (519) 336-4030.

**18** Chinook Chemical Co. Water Intake and Outfall - Call (519) 392-3411.

W. Darcy McKeough Conservation Authority - Call St. Clair Region Conservation Authority - (519) 245-3710 or (519) 871-0639.

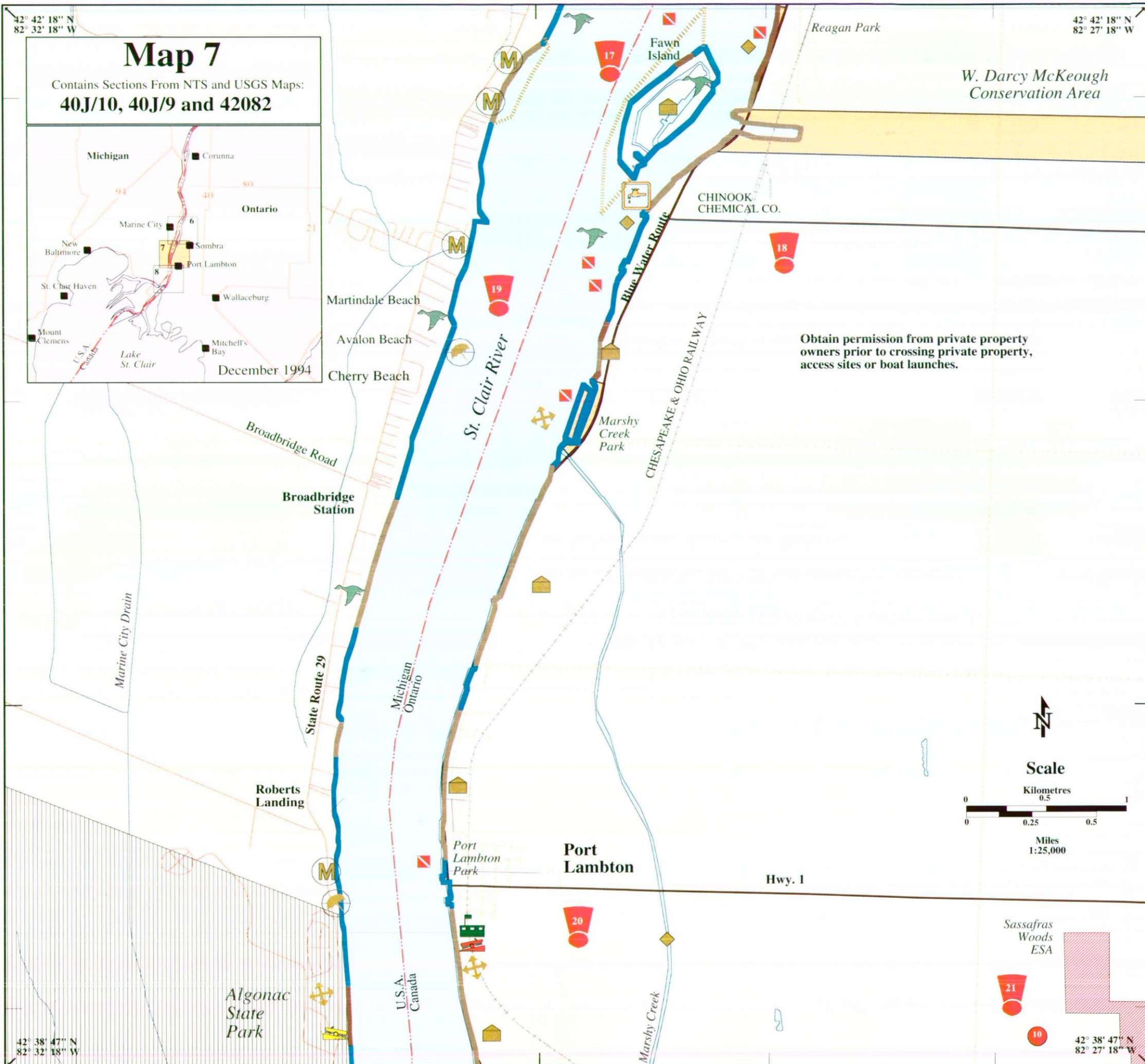
**19** Martindale, Avalon and Cherry Beaches area hosts wintering waterfowl, especially Redheads and Canvasbacks. The area extends from Algonac north to Marine City.

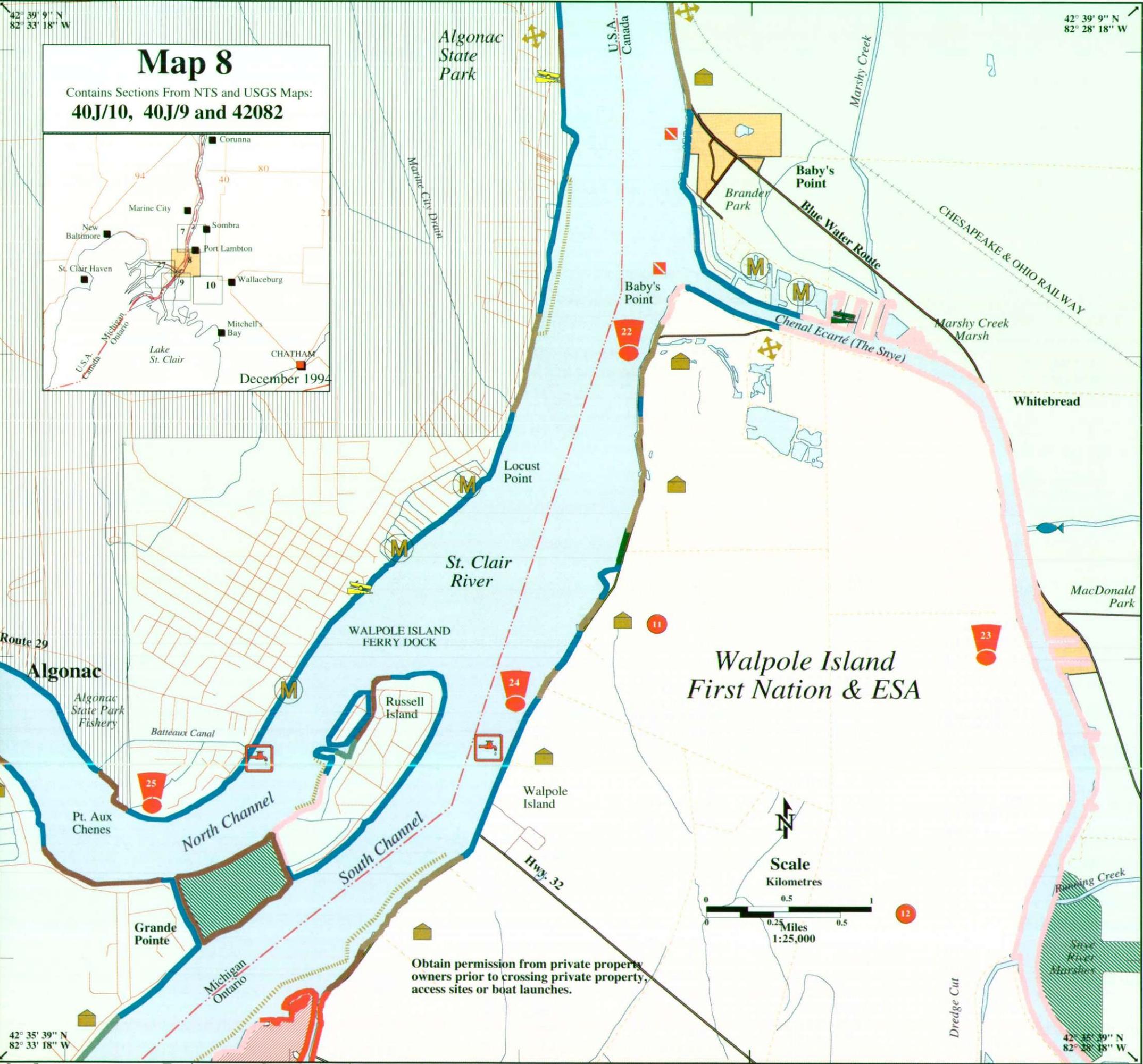
**20** Port Lambton Water Pollution Control Plant Water Outfall - Call Sarnia MOEE at (519) 336-4030.

Toll ferry service exists between Port Lambton, Ontario and Roberts Landing, Michigan.

A Canadian Coast Guard boom storage site is located at Port Lambton.

**21** Sassafras Woods Environmentally Sensitive Area supports a large number of provincially and nationally significant Carolinian tree species. Rare plants include Short-styled Snake Root, Black Walnut, Tulip Tree, Sycamore, Chinquapin Oak, Black Oak, and Sassafras.





### NOTES

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**22** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, fur-bearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several clearings are rich in prairie vegetation elements.

Drainage diking and channel improvements are extensive. The Chenal Ecarté leads into an extensive marshy area within Walpole Island. The northern section of the river is diked; however, the southern section leads directly into the Marsh. The First Nation draws its drinking water from the Chenal Ecarté.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

**23** Extensive fish habitat rehabilitation work is underway at MacDonald Park.

**24** Toll ferry service exists between Walpole, Ontario on Walpole Island and Algonac, Michigan - Call (519) 677-5679.

The Water Treatment Plant is in the town of Walpole Island. For the Walpole Island Drinking Water Intake - Call Walpole Heritage Centre - (519) 527-1475, or Sarnia MOEE at (519) 336-4030.

**25** This portion of Algonac State Park bordering the St. Clair River is used as a recreational fishery. The City of Algonac #2 Municipal Water Intake is located near Batteaux Canal - Call (810) 794-3261.

United States Coast Guard has a boom storage site in Algonac, Michigan.

## NOTES !

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**26** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, fur-bearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret, Black-crowned Night Heron and Tern colonies are present here.

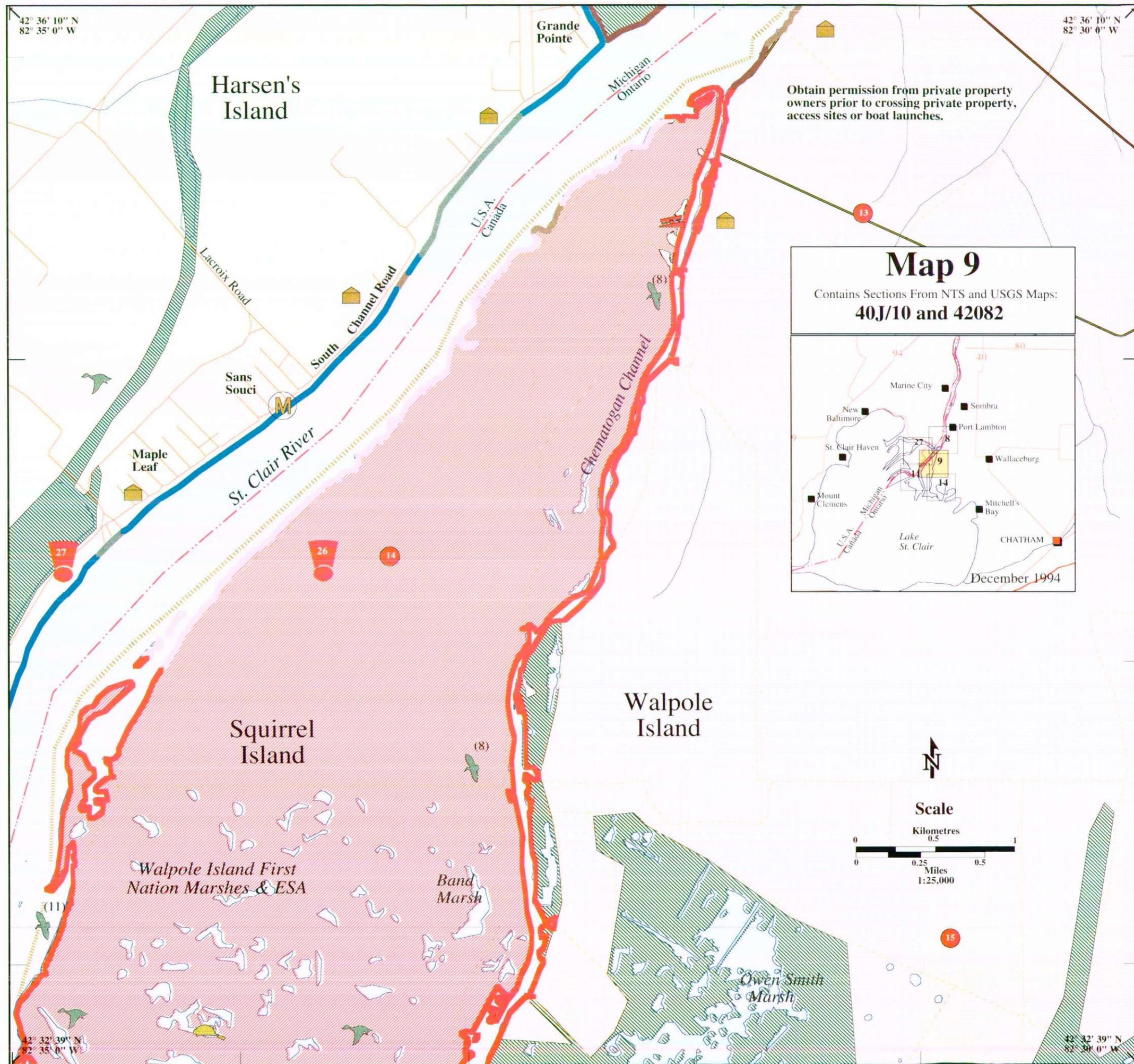
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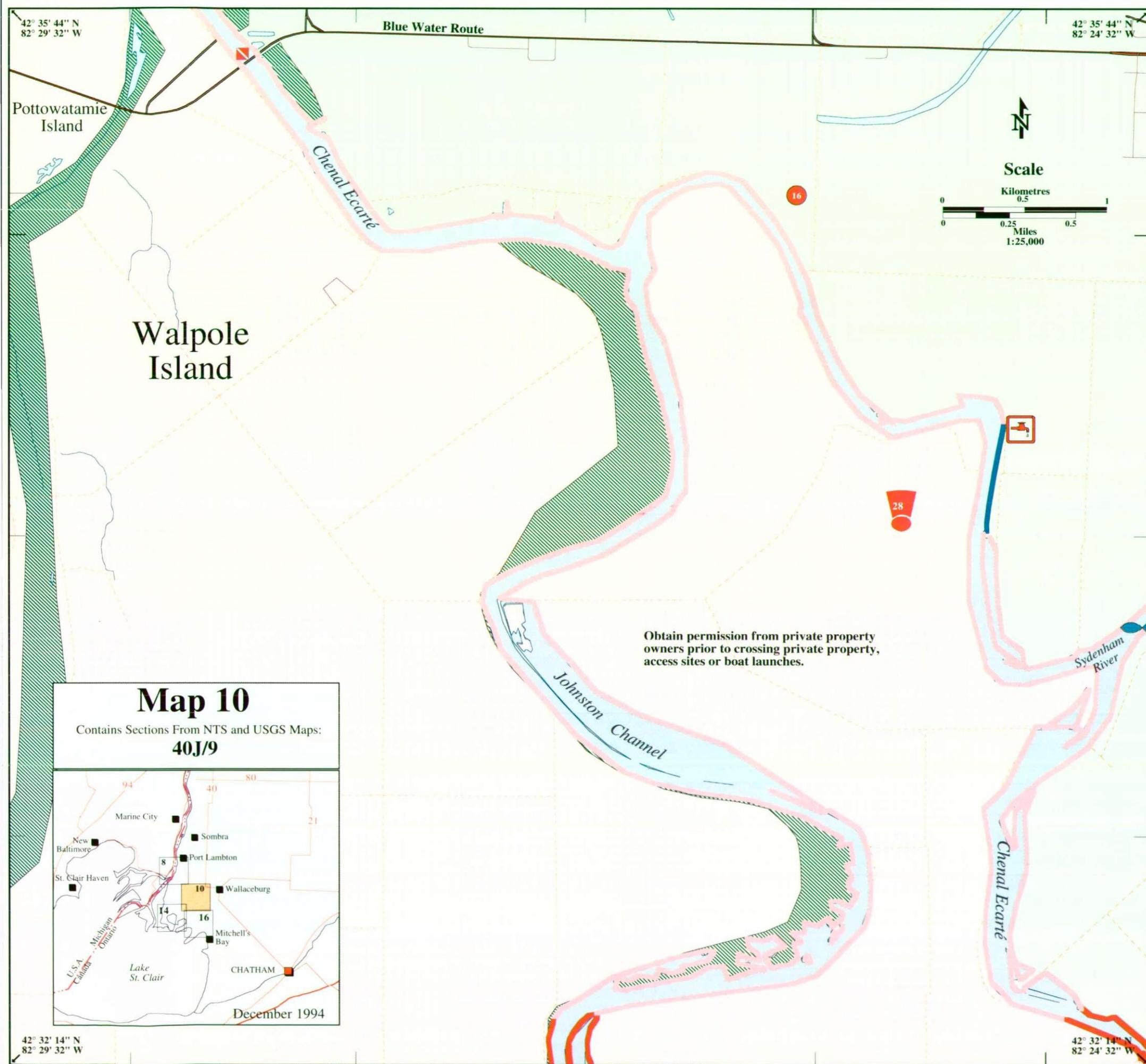
Drainage diking and channel improvements are extensive.

The submergent vegetation beds (an approach concern) throughout the First Nation territory should be protected. They are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

**27** The marshy areas throughout Harsen's Island are used extensively by migrating birds in the fall migration. There are a number of endangered species of birds, plants and reptiles located on and around the Island.





## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**28** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret, Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

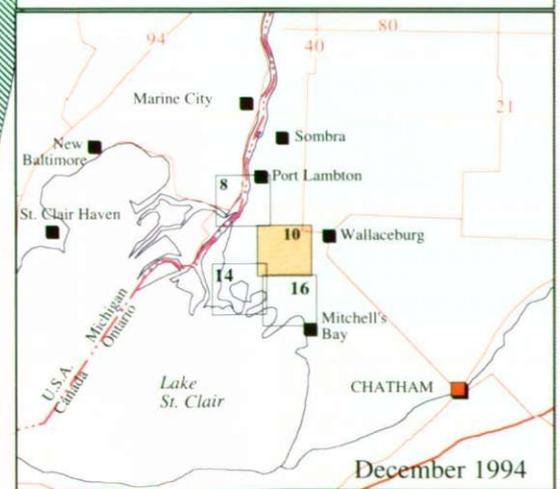
Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

For the town of Wallaceburg Waterworks Municipal Water Intake - Call (519) 627-4191, or Sarnia MOEE at (519) 336-4030.

The Sydenham River, which runs through Wallaceburg and joins the Chenal Ecarté (The Snye) south of the Wallaceburg Intake, is a Walleye spawning river.

## Map 10

Contains Sections From NTS and USGS Maps:  
**40J/9**



**NOTES**

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**26** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, fur-bearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

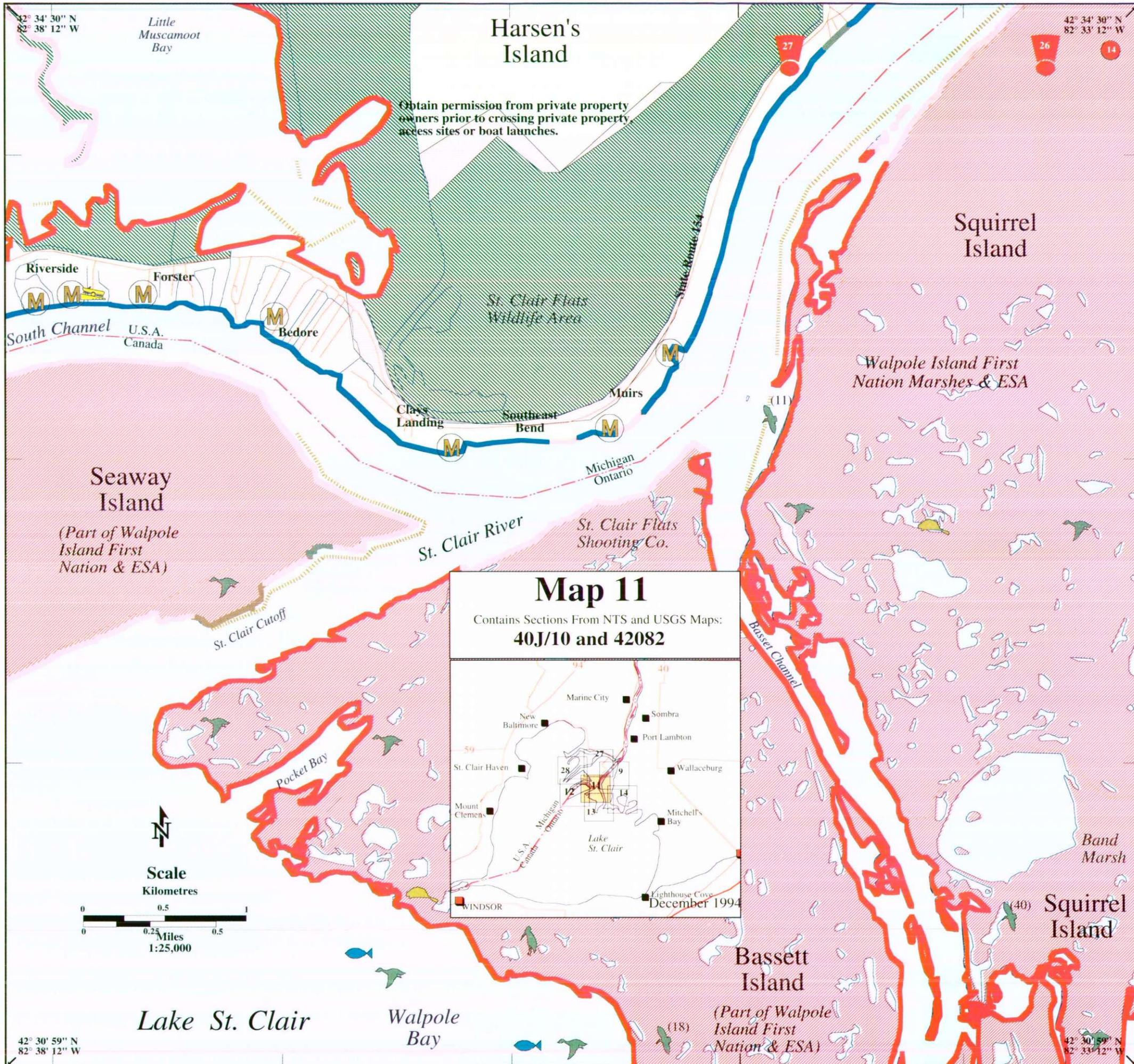
The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species. Several clearings are rich in prairie vegetation.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds (an approach concern) throughout the First Nation territory should be protected. They are critical habitat for numerous aquatic species and important feeding areas for fish populations.

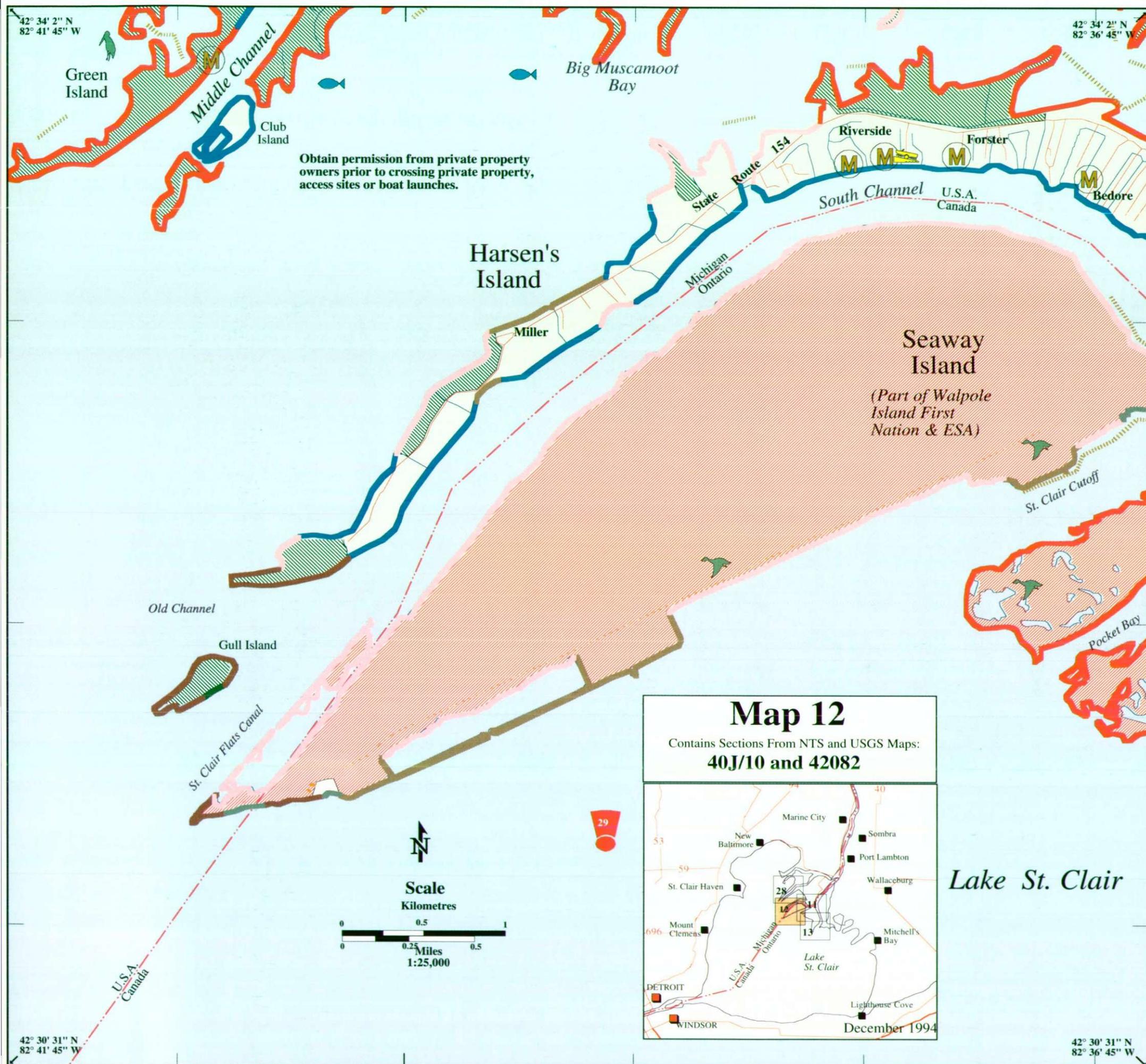
Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

**27** The marshy areas throughout Harsen's Island are used extensively by migrating birds in the fall migration. There are a number of endangered species of birds, plants and reptiles located on and around the Island.



**Map 11**  
 Contains Sections From NTS and USGS Maps:  
**40J/10 and 42082**

The inset map shows the following locations: New Baltimore, Marine City, Sombra, Port Lambton, Wallaceburg, Mitchell's Bay, Lighthouse Cove December 1994, WINDSOR, St. Clair Haven, Mount Clemens, Lake St. Clair, Michigan, U.S.A. Canada, and Detroit.



**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**29** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

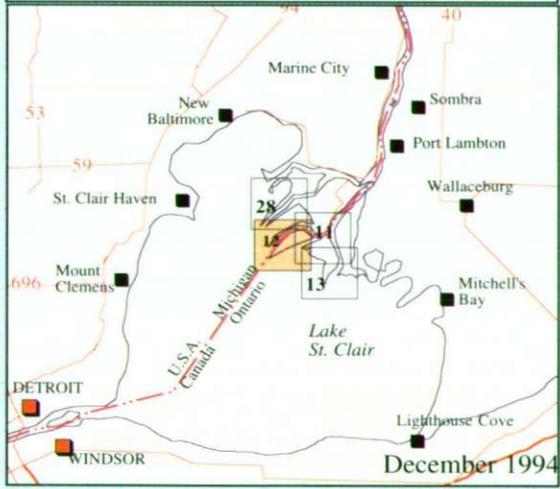
Drainage diking and channel improvements are extensive.

The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

**Map 12**

Contains Sections From NTS and USGS Maps:  
**40J/10 and 42082**



**NOTES !**

A red exclamation point symbol is used on the maps to catch the responder's attention.

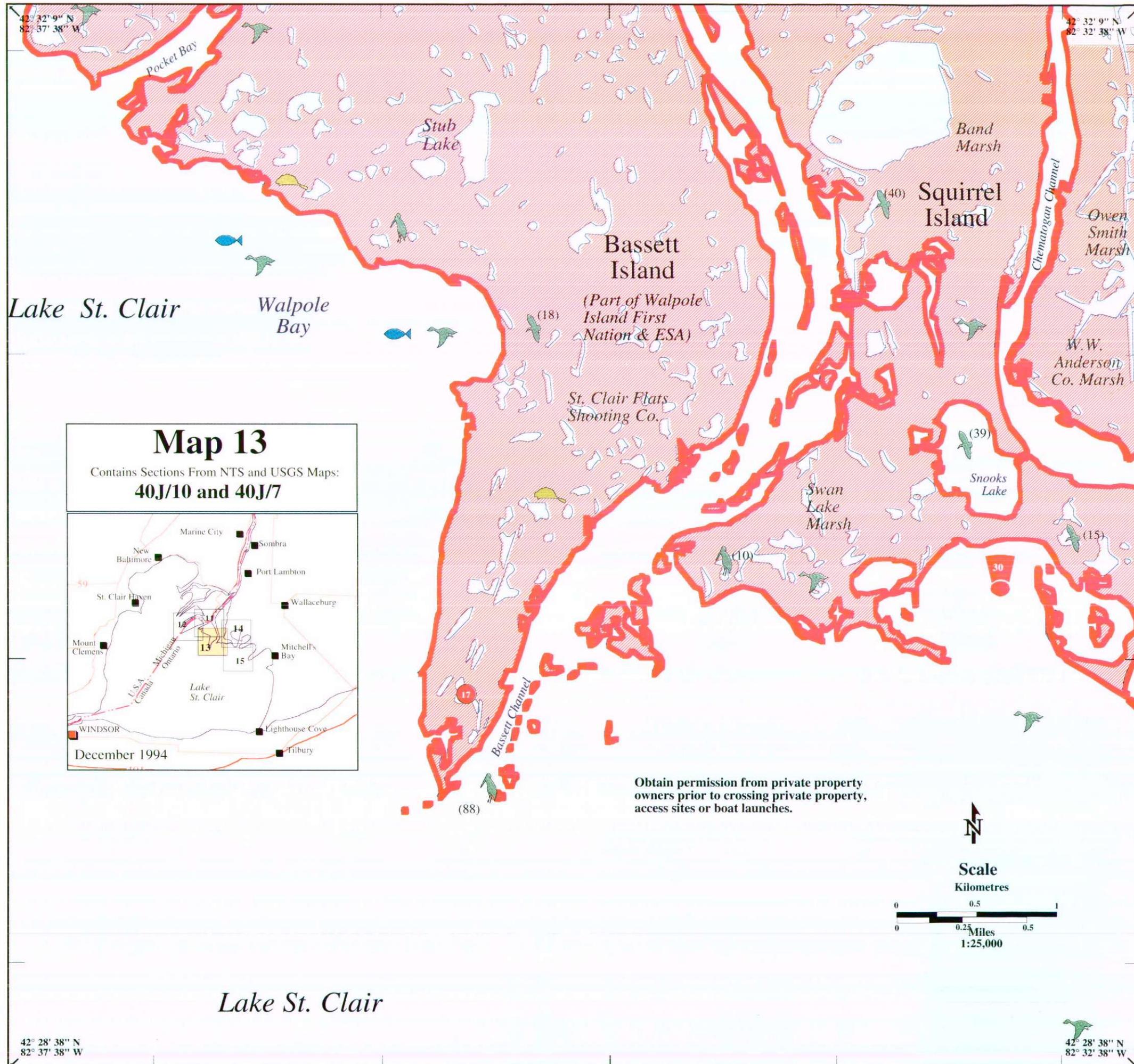
**30** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class I wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

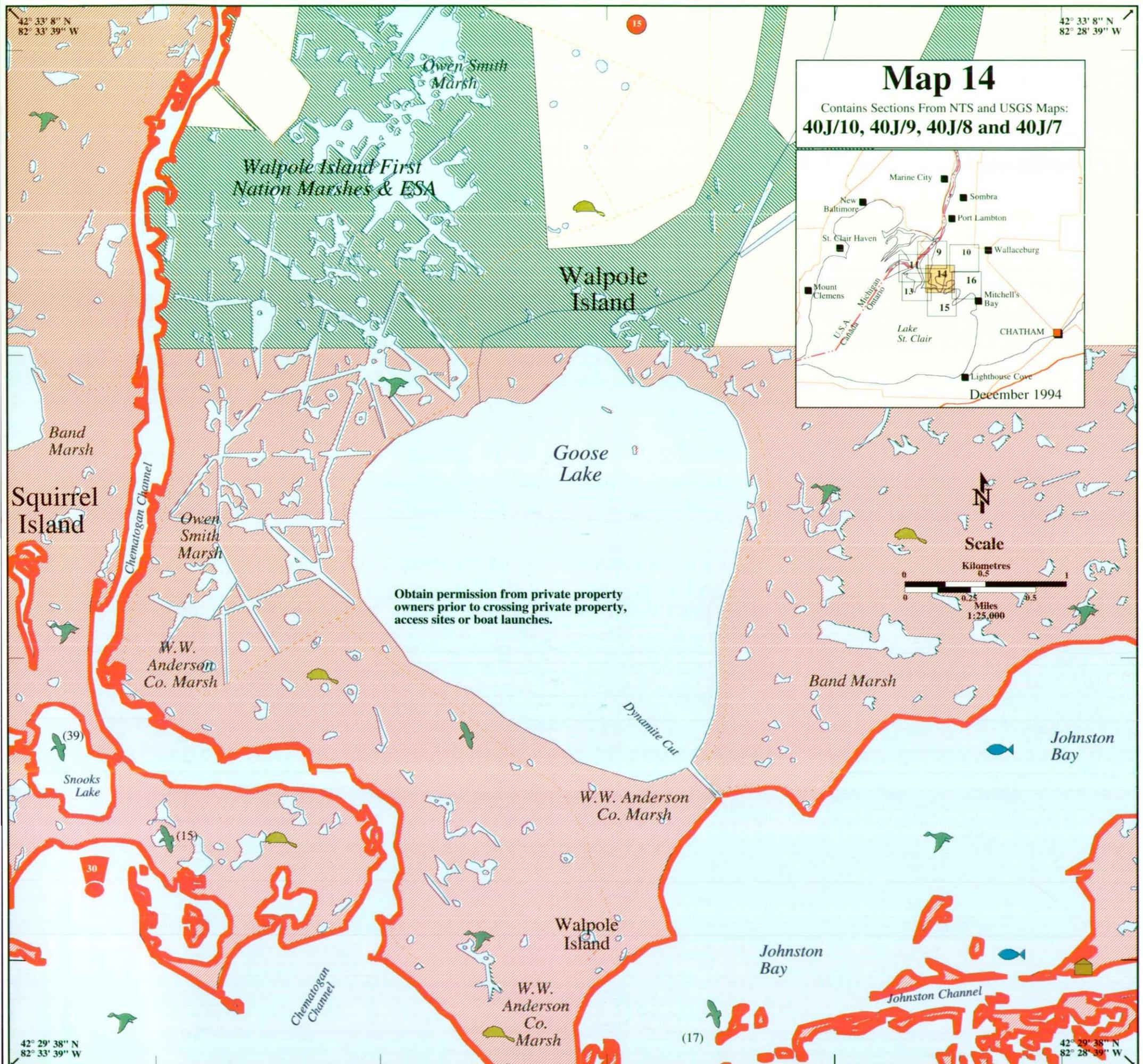
The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

Drainage diking and channel improvements are extensive.

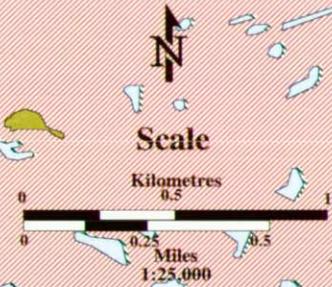
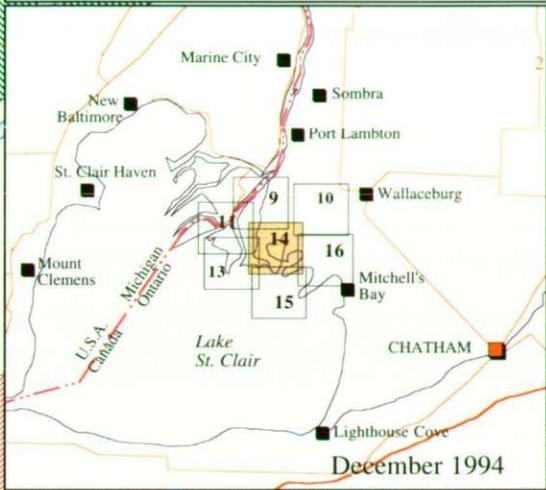
The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.





**Map 14**  
 Contains Sections From NTS and USGS Maps:  
**40J/10, 40J/9, 40J/8 and 40J/7**



**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**30** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret, Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

## NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**31** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

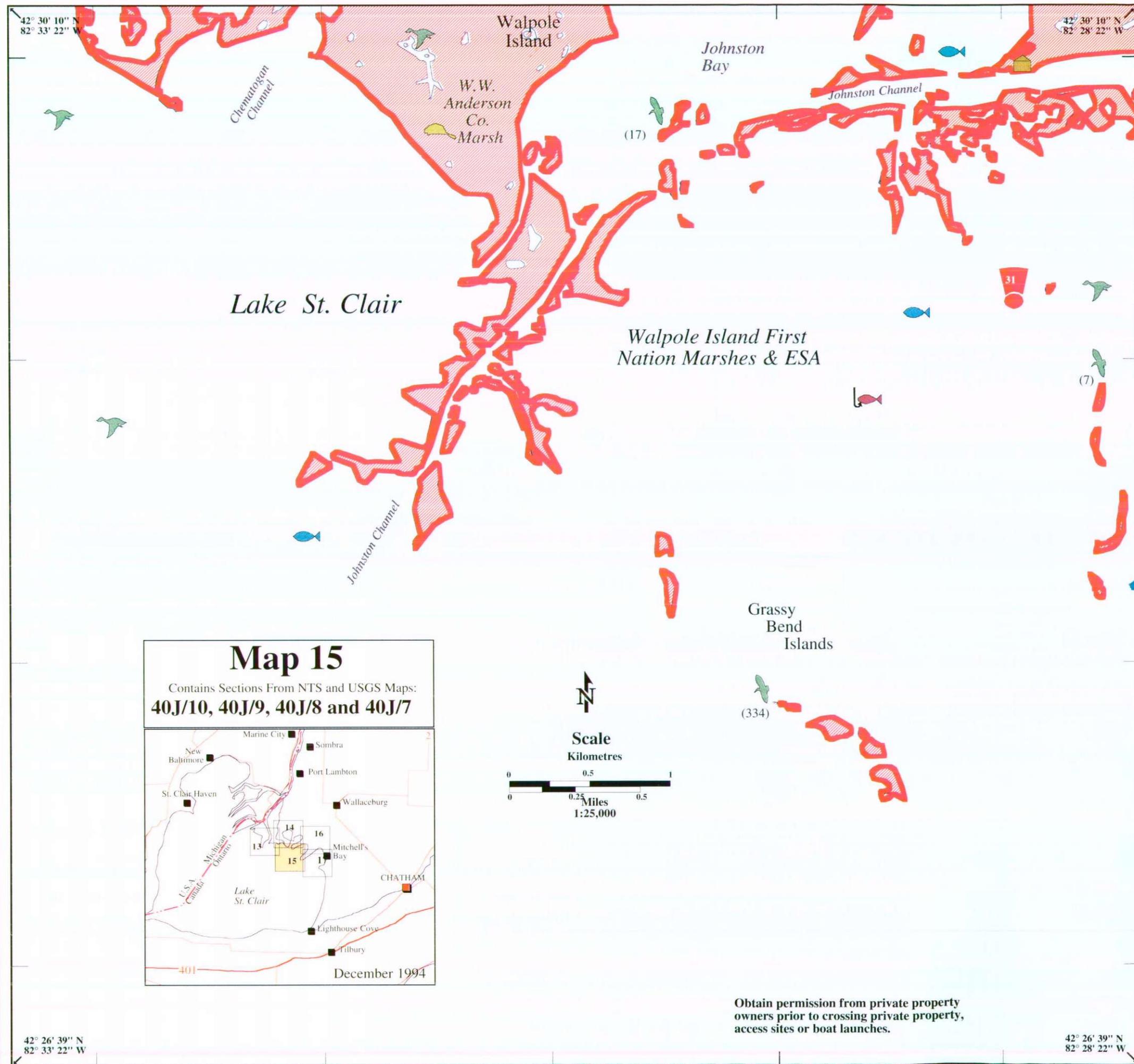
The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

These waters are a spawning area for Yellow Perch, Catfish and other species of fish. There is an abundance of preferred waterfowl food.

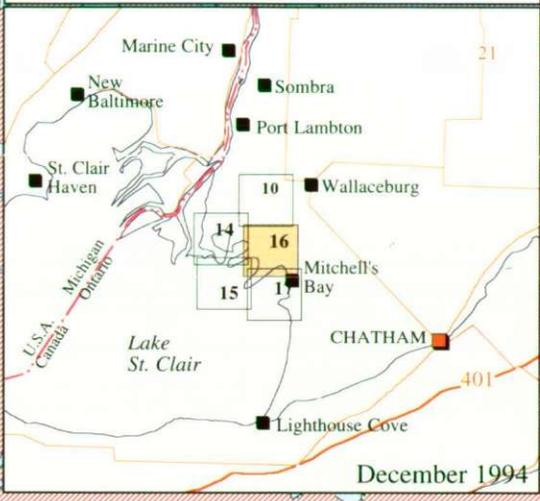


42° 32' 21" N  
82° 29' 6" W

42° 32' 21" N  
82° 24' 7" W

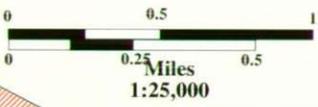
# Map 16

Contains Sections From NTS and USGS Maps:  
**40J/9 and 40J/8**



### Scale

Kilometres



Johnston Bay

Band Marsh

Walpole Island

Walpole Island First Nation Marshes & ESA

St. Anne Shooting Co.

St. Anne Island

St. Anne Shooting Co.

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

Keowiash Marsh

Joseph Davidson Marsh

Mud Creek Club Marsh

Rankin / Sloan Marsh

Rankin Creek

Pintail Marsh

Cul de Sac

Rex / Cadotte Marsh

Rankin Sloan Marsh

42° 28' 51" N  
82° 29' 6" W

42° 28' 51" N  
82° 24' 7" W

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**31** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, furbearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret, Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats, which form a series of the best examples left in Ontario. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species, some of which are not known elsewhere in Canada. Several uncultivated clearings are rich in prairie vegetation elements. Good sized agricultural fields are also present in this area, which after harvest, provide excellent feeding areas.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds located throughout the First Nation territory represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

These waters are a spawning area for Yellow Perch, Catfish and other species of fish. There is an abundance of preferred waterfowl food.

**32** The Bear Creek Wetland straddles Bear Creek (just off the map). This wetland is the Bear Creek Unit of the St. Clair National Wildlife Area and it is planned for expansion in 1995.

## NOTES !

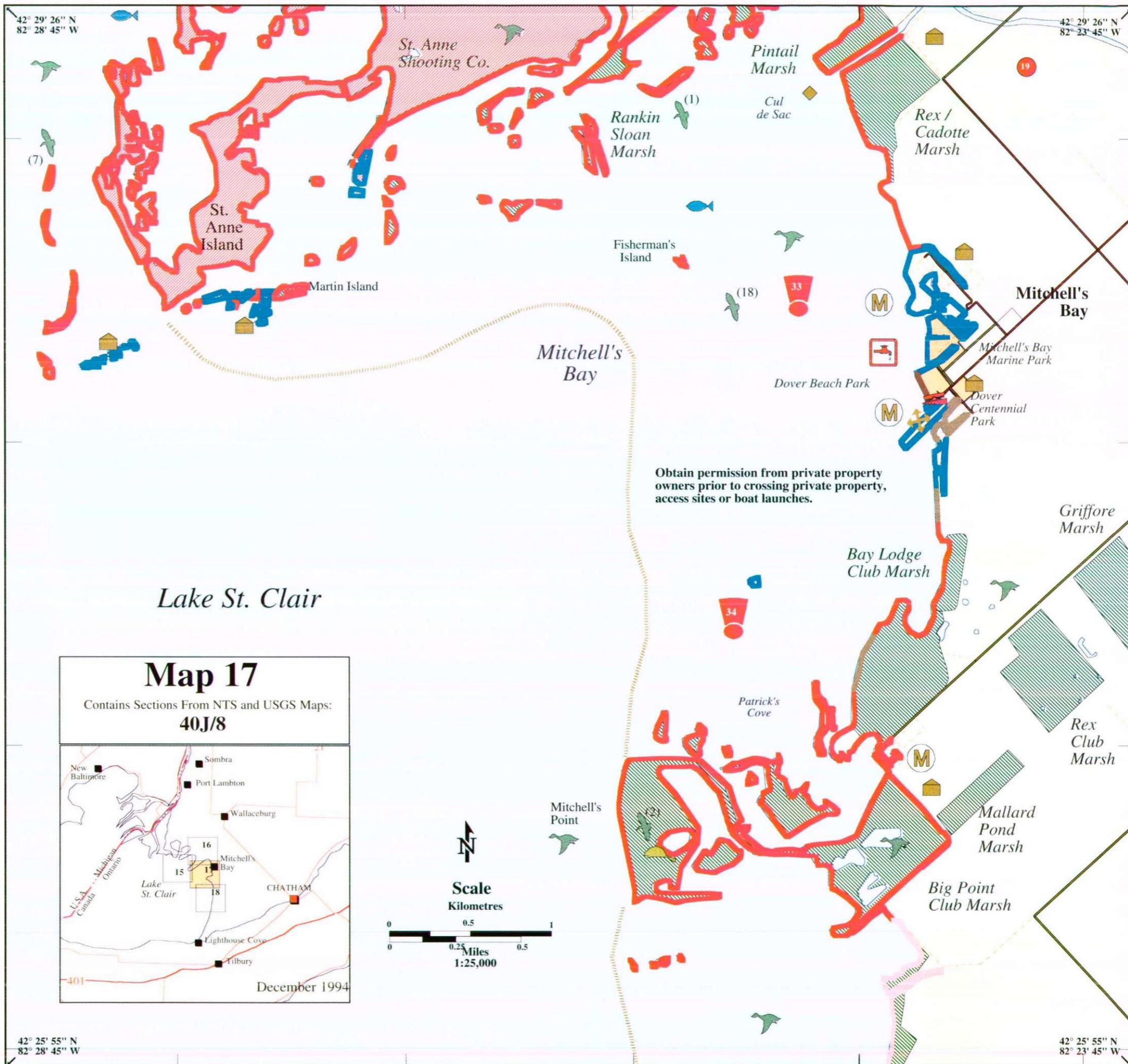
A red exclamation point symbol is used on the maps to catch the responder's attention.

**33** Mitchell's Bay Water Treatment Plant Water Intake and Outfall - Call (519) 627-1211 (8am to 4pm), or (519) 436-8748 (pager).

Mitchell's Bay is an important spawning area for Smallmouth and Largemouth Bass, Sunfish, Black Crappies and Yellow Perch. Many waterfowl are located offshore.

**34** The St. Clair Marshes extend along the east shore of Lake St. Clair from Mud Creek Club Marsh south to the Thames River. The marshes are remnants of a habitat type that was once more abundant in Kent and Essex Counties. Situated on the Bothwell Sand Plain, these areas are considered Class 1 wetlands and consist of cattail, reed and meadow marsh, submergent aquatic vegetation communities, wooded swamp and barrier beach communities interspersed with open water. The marshes are important migratory bird stopover points in spring and fall, waterfowl staging and breeding grounds, fish spawning sites, and cover for fur bearing mammals. They are an important habitat for many threatened, endangered and rare species including: American Lotus, Culver's Root, Yellow Stargrass, Eastern Fox Snake, Spotted Turtle, Eastern Spiny Softshell Turtle as well as migrating Tundra Swan populations. The area is disturbed by diking, draining, hunting, fishing and boating activities. The area around Mitchell's Point and Big Point Club Marsh is a low, shallow area heavily utilized by waterfowl. Access by boat is sometimes difficult.

The submergent vegetation beds along Mitchell's Bay represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.



42° 26' 25" N  
82° 27' 45" W

42° 26' 25" N  
82° 22' 46" W

Lake St. Clair

St. Luke's Bay

Big Point Club Marsh

Lake St. Clair Marshes ANSI

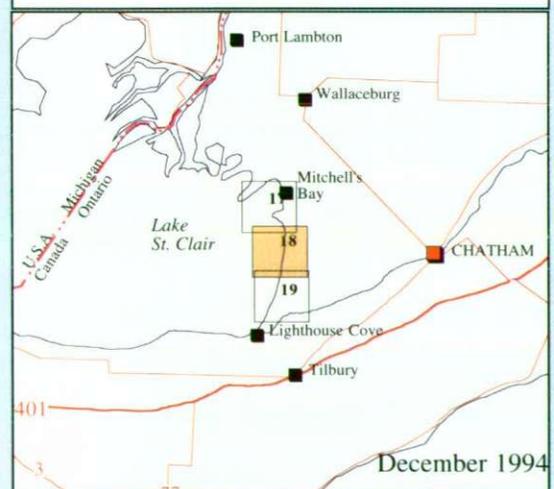
Big Point Club Marsh

St. Luke's Club Marsh II

St. Luke's Club Marsh I

# Map 18

Contains Sections From NTS and USGS Maps:  
**40J/8**



Scale  
Kilometres  
0 0.5 1  
Miles  
0 0.25 0.5  
1:25,000

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**35** The St. Clair Marshes extend along the east shore of Lake St. Clair from Mud Creek Club Marsh south to the Thames River. The marshes are remnants of a habitat type that was once more abundant in Kent and Essex Counties. Situated on the Bothwell Sand Plain, these areas are considered Class 1 wetlands and consist of Cattail, Reed and Meadow Marsh, submergent aquatic vegetation communities, wooded swamp and barrier beach communities interspersed with open water. The marshes are important migratory bird stopover points in spring and fall, waterfowl staging and breeding grounds, fish spawning sites, and cover for fur bearing mammals. They are an important habitat for many threatened, endangered and rare species including: American Lotus, Culver's Root, Yellow Stargrass, Eastern Fox Snake, Spotted Turtle, Eastern Spiny Softshell Turtle as well as migrating tundra swan populations. The area is disturbed by diking, draining, hunting, fishing and boating activities.

The submergent vegetation beds along St. Luke's Bay represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

42° 22' 54" N  
82° 27' 45" W

42° 22' 54" N  
82° 22' 46" W

**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

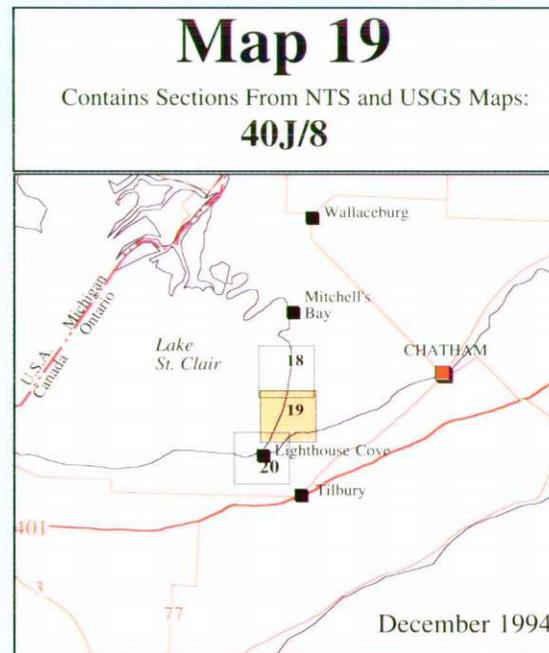
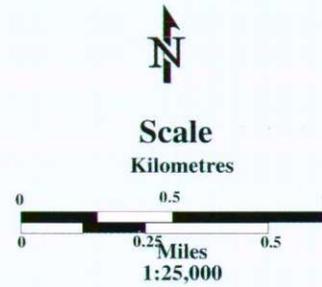
**36** The St. Clair National Wildlife Area is part of the St. Clair Marshes Area of Natural and Scientific Interest (ANSI), along with other marshes which include Bradley's, Balmoral, St. Lukes, etc. The St. Clair National Wildlife Area is an important resting and feeding site for migrating waterfowl. Herons, Egrets, birds of prey, shorebirds, and songbirds all pass through this area. To date, 190 bird species have been observed. The Area contains many marsh dependant wildlife species including several rare or endangered species such as the Eastern Fox Snake and Blanding's Turtle. The area provides winter cover for Muskrat, Mink, Weasel, Skunk and Raccoon, as well as good nesting habitat for more than thirty bird species. Diked marshes here are separated from the lake. Several of the marshes draw some of their water from the Lake. Call (519) 354-1418 to reach Environment Canada's St. Clair National Wildlife Area office.

**37** The St. Clair Marshes extend along the east shore of Lake St. Clair from Mud Creek Club Marsh south to the Thames River. The marshes are remnants of a habitat type that was once more abundant in Kent and Essex Counties. Situated on the Bothwell Sand Plain, these areas are considered Class 1 wetlands and consist of cattail, reed and meadow marsh, submergent aquatic vegetation communities, wooded swamp and barrier beach communities interspersed with open water. The marshes are important migratory bird stopover points in spring and fall, waterfowl staging and breeding grounds, fish spawning sites and cover for fur bearing mammals. They are an important habitat for many threatened, endangered and rare species including: American Lotus, Culver's Root, Yellow Stargrass, Eastern Fox Snake, Spotted Turtle, Eastern Spiny Softshell Turtle as well as migrating Tundra Swan populations.

42° 23' 23" N  
82° 27' 37" W

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

Lake St. Clair



42° 19' 52" N  
82° 27' 37" W

42° 23' 23" N  
82° 22' 38" W

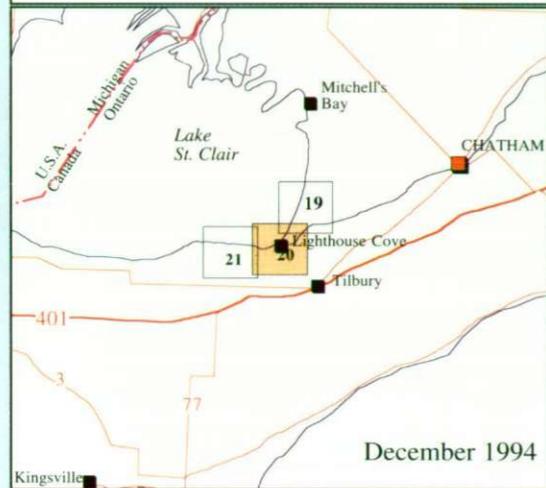
42° 19' 52" N  
82° 22' 38" W

42° 20' 34" N  
82° 29' 55" W

42° 20' 34" N  
82° 24' 57" W

# Map 20

Contains Sections From NTS and USGS Maps:  
**40J/8**



## Lake St. Clair

Bradley's Marsh

Bradley Farms Marshes

Recess Club Marsh

Lighthouse Conservation Area

Lighthouse Cove

Paternoster Club Marsh

Jeannettes Creek

Baptiste Creek

Big Creek

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**37** The St. Clair Marshes extend along the east shore of Lake St. Clair from Mud Creek Club Marsh south to the Thames River. The marshes are remnants of a habitat type that was once more abundant in Kent and Essex Counties. Situated on the Bothwell Sand Plain, these areas are considered Class 1 wetlands and consist of cattail, reed and meadow marsh, submergent aquatic vegetation communities, wooded swamp and barrier beach communities interspersed with open water. The marshes are important migratory bird stopover points in spring and fall, waterfowl staging and breeding grounds, fish spawning sites and cover for fur bearing mammals. They are an important habitat for many threatened, endangered and rare species including: American Lotus, Culver's Root, Yellow Stargrass, Eastern Fox Snake, Spotted Turtle, Eastern Spiny Softshell Turtle as well as migrating Tundra Swan populations.

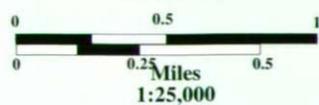
**38** The Tilbury City Water Treatment Plant Water Intake - Call (519) 255-0500 (pager). Commercial fishing of channel Catfish and hook line activities occur near the mouth of the Thames River. The Thames River is an important spawning area for Walleye, White Bass, Common White Sucker and Freshwater Drum. These species are found nearby in Lake St. Clair as well. The area labelled Lighthouse Conservation Area is mostly residential.

**39** Paternoster Club Marsh is a Class 3 wetland of robust emergent vegetation that provides important habitat for commercial fishing activities and wildlife such as Bullfrogs, Snapping Turtles and furbearing mammals. The complex is inundated with water year round and a natural channel flows through it. Four provincially significant bird species feed here: Northern Harrier, Great Egret, Black-crowned Night Heron and Caspian Tern. Colonial waterbirds, Ring-billed Gulls and Great Blue Herons also feed here and the site also provides winter cover for Ring-necked Pheasants.



Scale

Kilometres



42° 17' 3" N  
82° 29' 55" W

42° 17' 3" N  
82° 24' 57" W

# NOTES !

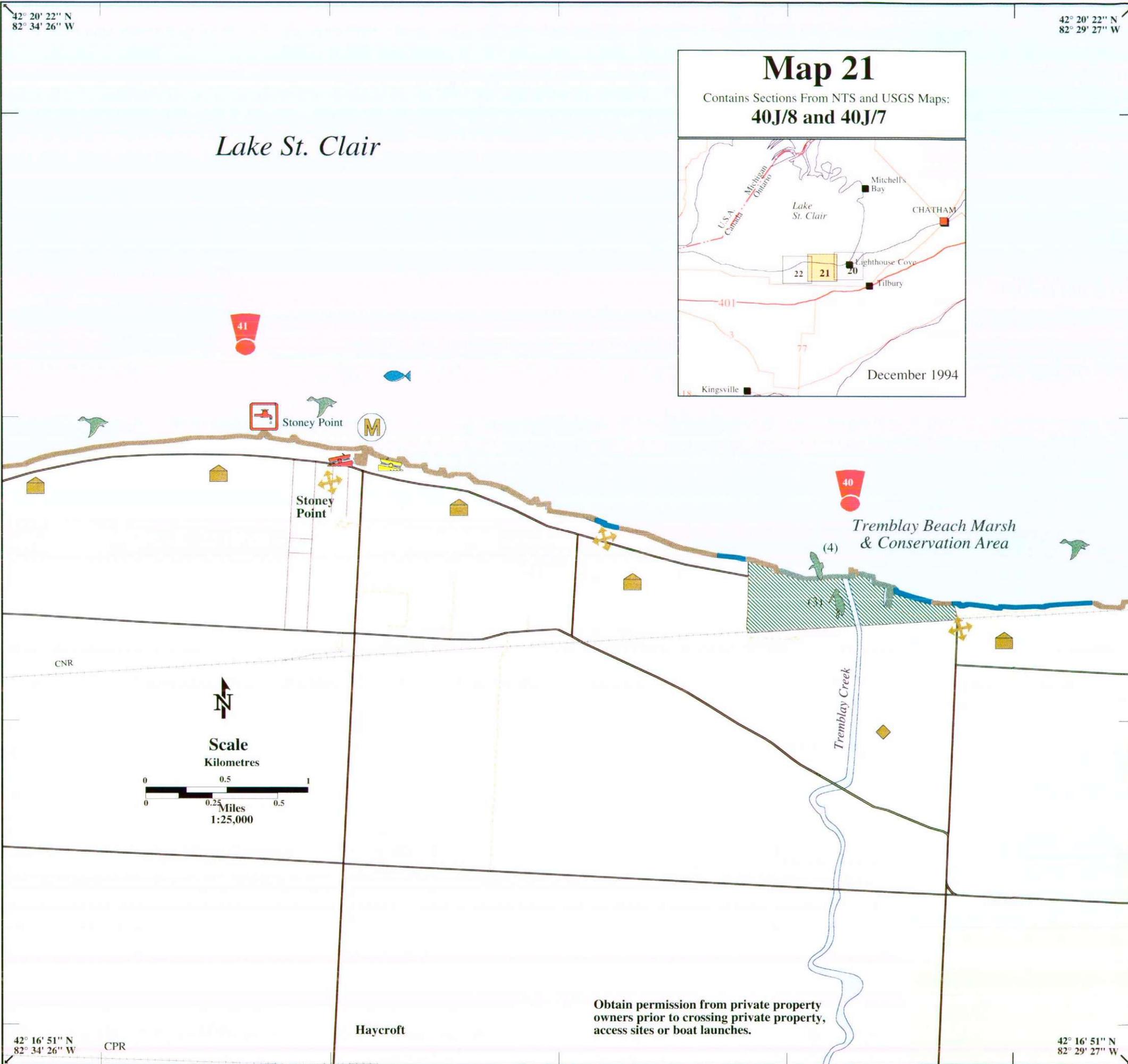
A red exclamation point symbol is used on the maps to catch the responder's attention.

**40** Tremblay Beach Marsh Conservation Area is a Class 3 wetland, consisting mainly of cattail, phragmites and open water. The area is enclosed on all sides by earthen embankments, although high water levels on Lake St. Clair can potentially erode the beach side. The area is considered one of the best marsh bird breeding and nesting sites for Bitterns, Rails, Coots and Black Terns. Provincially significant birds have been observed including King Rail and the Yellow-headed Blackbird. It is owned and managed by the Essex Region Conservation Authority - Call (519) 776-5209.

Stoney Point Water Pollution Control Plant Water Outfall - Call (519) 255-0500 (pager).

**41** Tilbury North Water Supply System Water Intake - Call (519) 255-0500 (pager).

There is Walleye spawning activity along these shores.

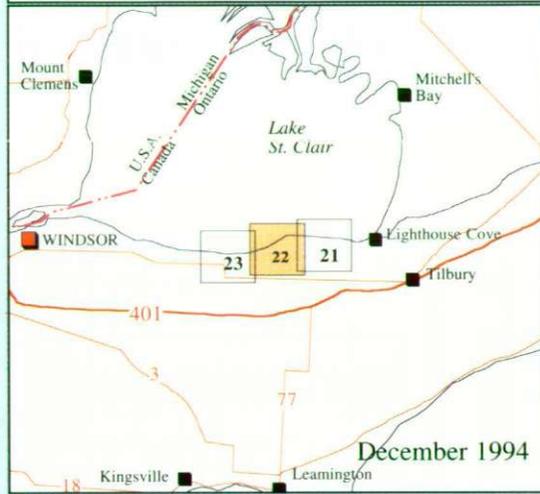


42° 20' 6" N  
82° 38' 41" W

42° 20' 6" N  
82° 33' 42" W

# Map 22

Contains Sections From NTS and USGS Maps:  
**40J/7**



## Lake St. Clair

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

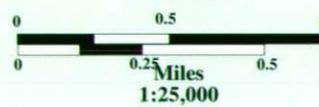
Ruscom Shores Wetland, E.S.A & Conservation Area

Deerbrook

St. Joachim Station



Scale  
Kilometres



CPR

42° 16' 35" N  
82° 38' 41" W

42° 16' 35" N  
82° 33' 42" W

### NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 42 Ruscom Shores Environmentally Sensitive Area and Conservation Area is a Class 3 wetland consisting mainly of shoreline cattail marsh separated from Lake St. Clair by a barrier sand beach. A small shrubby thicket swamp area exists. The area is an active feeding site for Herons and is an important spring migration site for waterfowl. Eight provincially rare and eight regionally rare plant species have been recorded at this site as well as the Spotted Turtle, Great Egret, Black Crowned Night Heron and Marsh Wren. Ruscom Shores ESA is owned and managed by the Essex Region Conservation Authority - Call (519) 776-5209.



# NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**43** Belle River City Water Treatment Plant Water Intakes - Call Calcom Security at (519) 250-5010.

The shores of Lake St. Clair from Stoney Point east of Belle River to Windsor are densely concentrated with private recreational and residential properties.

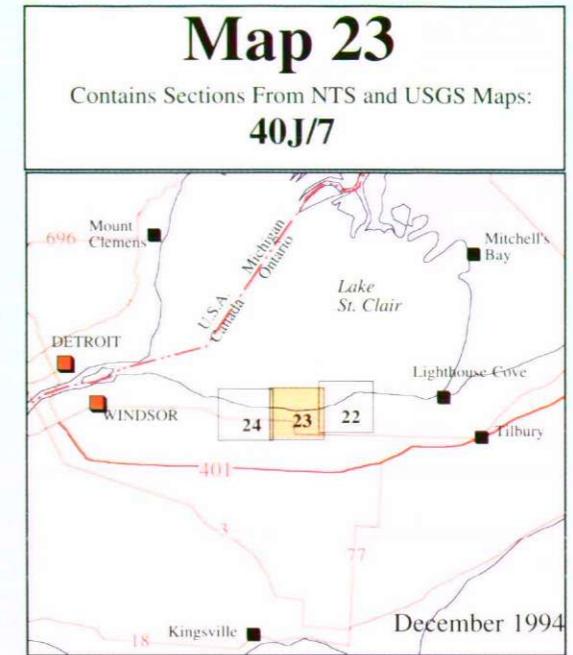
The waters off these shores are an area of concentration for waterfowl in fall.

42° 19' 38" N  
82° 43' 10" W

42° 19' 38" N  
82° 38' 11" W

## Lake St. Clair

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



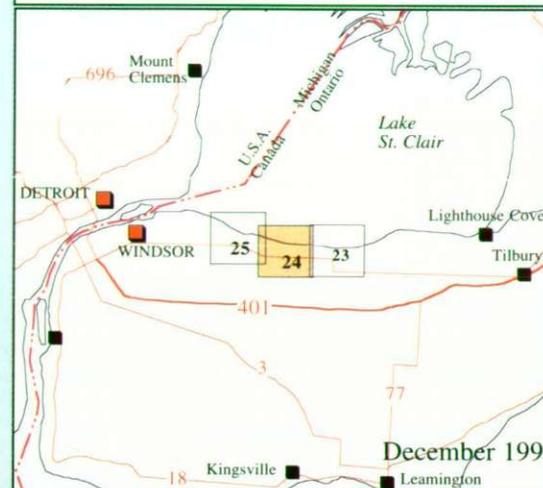
42° 19' 35" N  
82° 47' 47" W

42° 19' 35" N  
82° 42' 48" W

# Lake St. Clair

## Map 24

Contains Sections From NTS and USGS Maps:  
**40J/7**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

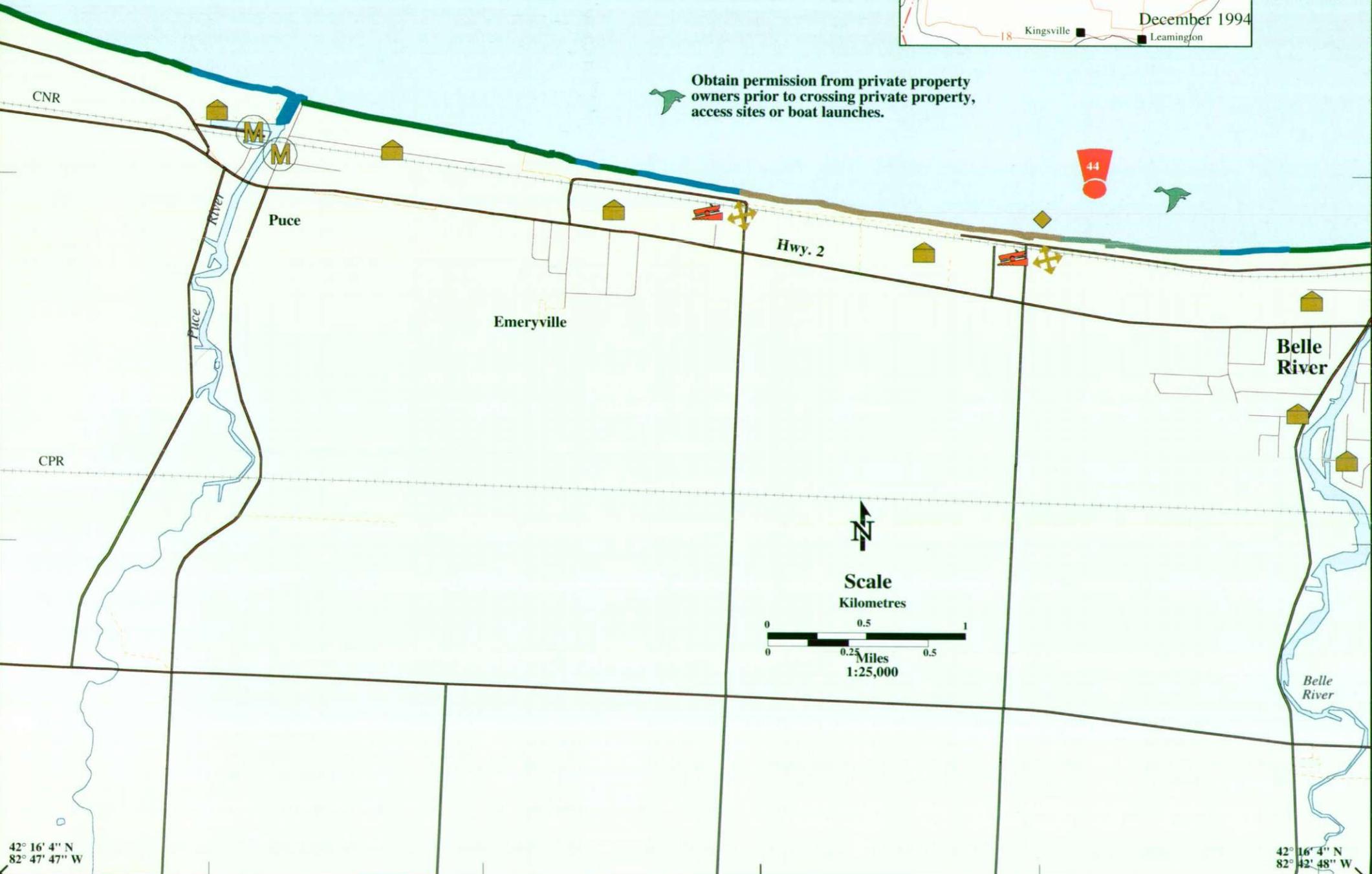
**NOTES** !

A red exclamation point symbol is used on the maps to catch the responder's attention.

44 Belle River City Water Pollution Control Plant Water Outfalls - Call Calcom Security at (519) 250-5010.

The shores of Lake St. Clair from Stoney Point east of Belle River to Windsor are densely concentrated with private recreational and residential properties.

The waters off these shores are an area of concentration for waterfowl in fall.



42° 16' 4" N  
82° 47' 47" W

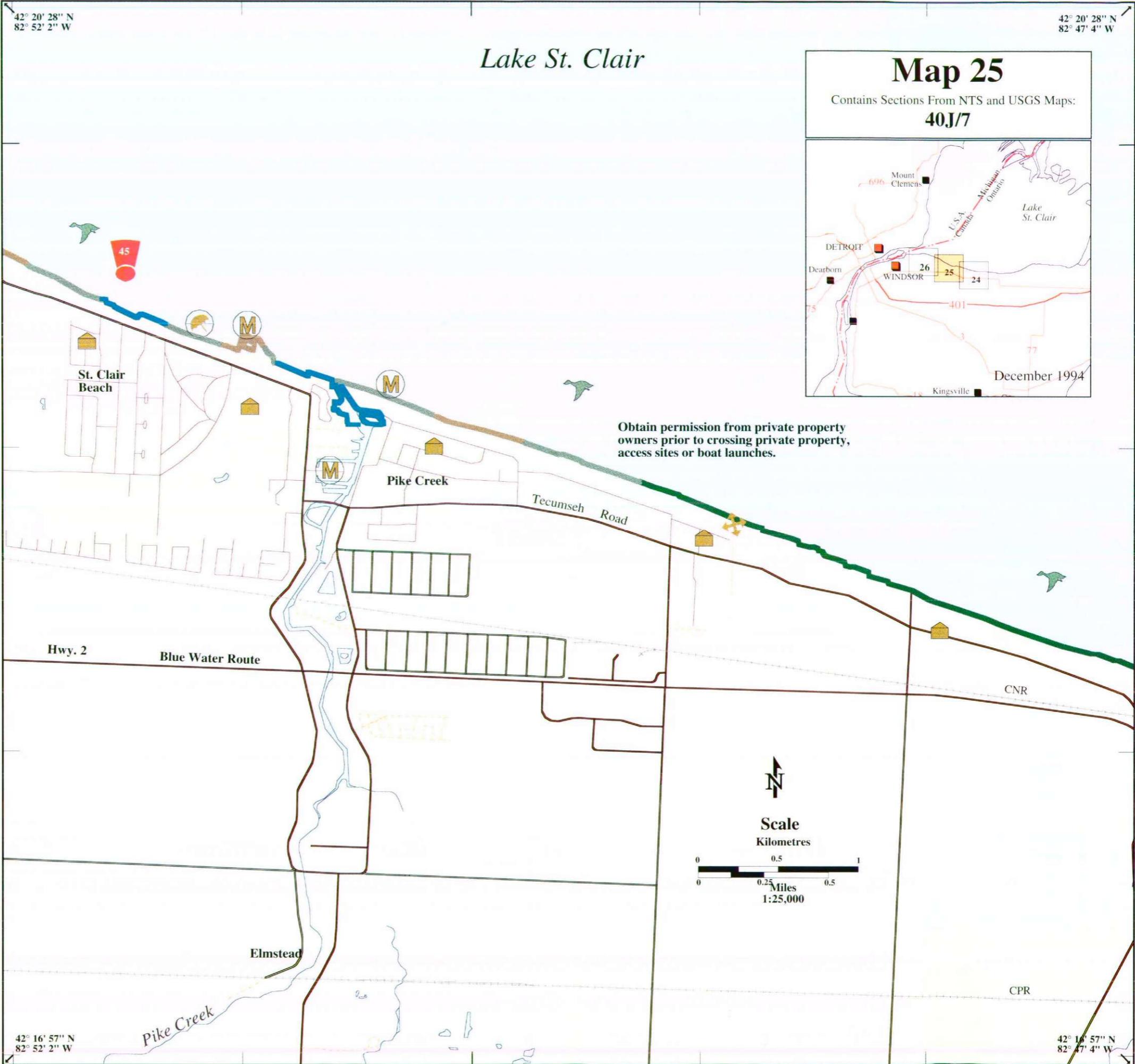
42° 16' 4" N  
82° 42' 48" W

# NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

45 St. Clair Beach is a popular recreation area. The shores of Lake St. Clair from Stoney Point east of Belle River to Windsor are densely concentrated with private recreational and residential properties.

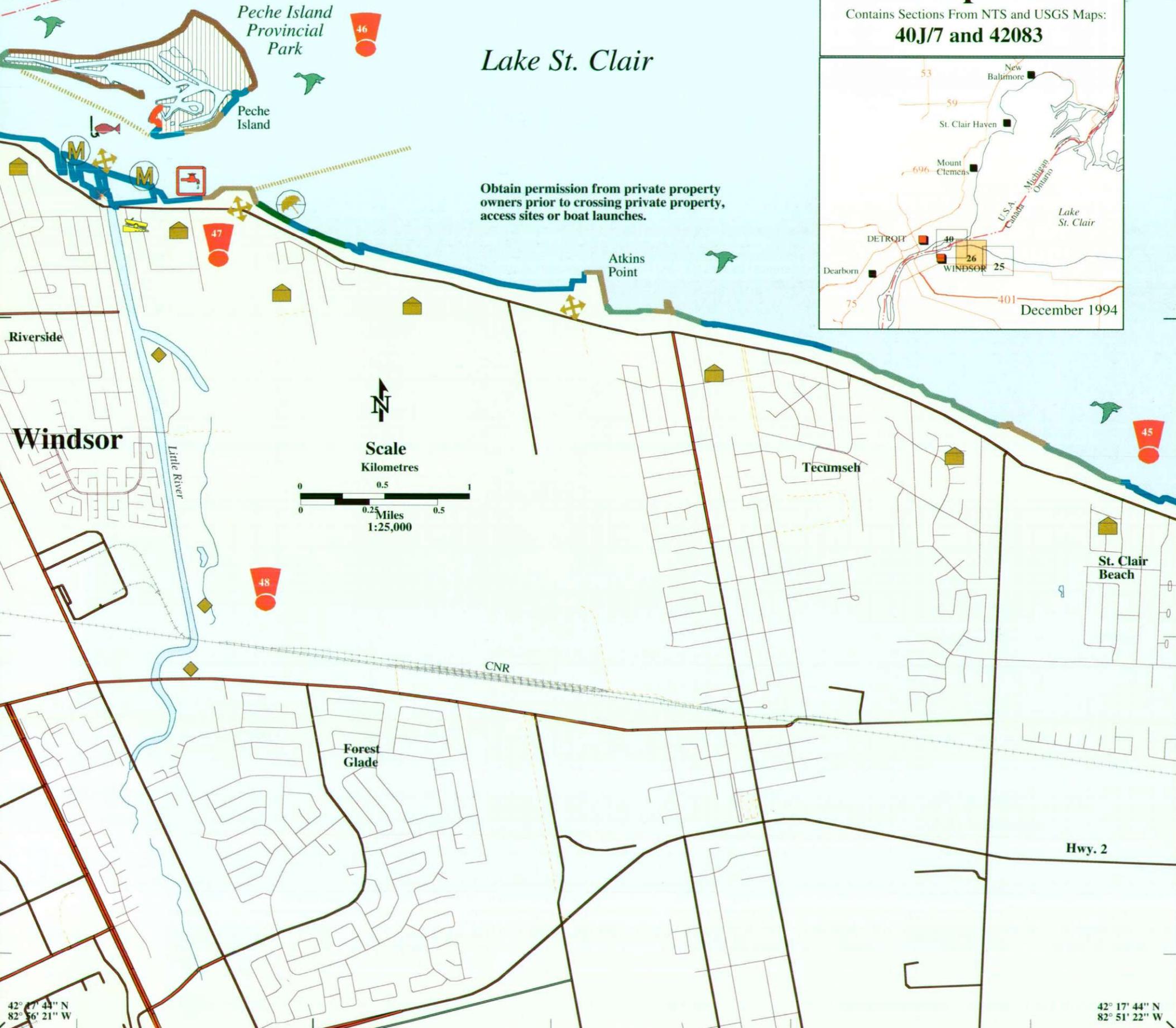
The waters off these shores are an area of concentration for waterfowl in fall. Many bird and fish species are active throughout the southern shore area at various times of the year.



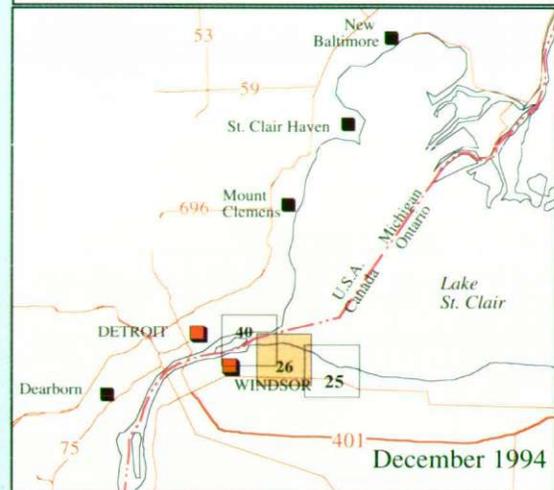
42° 21' 15" N  
82° 56' 21" W

42° 21' 15" N  
82° 51' 22" W

Detroit River Michigan Ontario U.S.A. Canada



**Map 26**  
Contains Sections From NTS and USGS Maps:  
**40J/7 and 42083**



**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 45** St. Clair Beach is a popular recreation area. The shores of Lake St. Clair from Stoney Point east of Belle River to Windsor are densely concentrated with private recreational and residential properties.  
The waters off these shores are an area of concentration for waterfowl in fall. Many bird and fish species are active throughout the southern shore area at various times of the year.
- 46** Peche Island Provincial Park is a locally important migratory waterfowl stop over point. The park is also a very ecologically diverse area; 235 plant species have been observed and 12 are considered rare in Canada.  
Commercial bait fishing activities occur offshore.  
The submergent vegetation beds along Peche Island and the mainland represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species, and important feeding areas for fish populations.
- 47** The Town of Tecumseh Water Treatment Plant Water Intakes - Call (519) 735-3001.  
Little River Water Pollution Control Plant Water Outfall - Call (519) 948-1751.
- 48** General Motors Auto Trim Plant Water Outfall - Call (519) 251-1200.

## NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**26** Walpole Island First Nation Territory is a designated Environmentally Sensitive Area which is principally comprised of three large delta islands (Walpole, Squirrel and St. Anne) at the mouth of the St. Clair River. The island complex provides active feeding and nesting habitats for colonial waterbirds, waterfowl and wading birds. Significant breeding populations of rare birds are also present. The river estuarine marsh system is considered a Class 1 wetland and is immensely valuable for waterfowl production and staging, fish spawning, fur-bearer protection and significant colonial waterbird breeding and feeding. For instance, Great Egret Black-crowned Night Heron and Tern colonies are present here.

The ESA is internationally known for its cattail marsh, as well as its endangered prairie and oak savannah habitats. These extensive, high quality habitats are host to about 100 nationally and provincially rare and endangered plant species. Several clearings are rich in prairie vegetation.

Drainage diking and channel improvements are extensive.

The submergent vegetation beds (an approach concern) throughout the First Nation territory should be protected. They are critical habitat for numerous aquatic species and important feeding areas for fish populations.

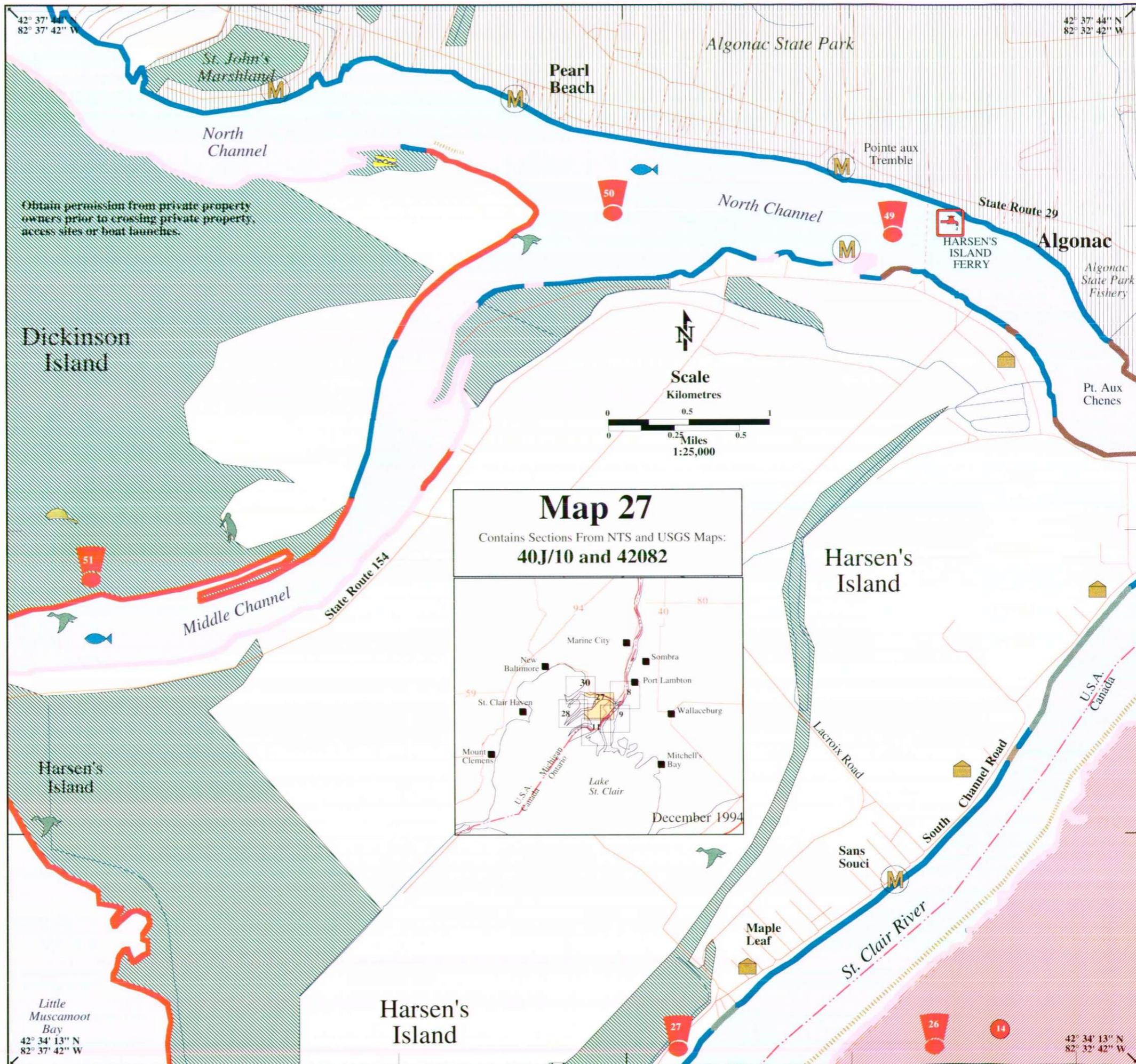
Responders should contact the Chief of Walpole Island First Nation at (519) 627-1476 before commencing any response activities in this area.

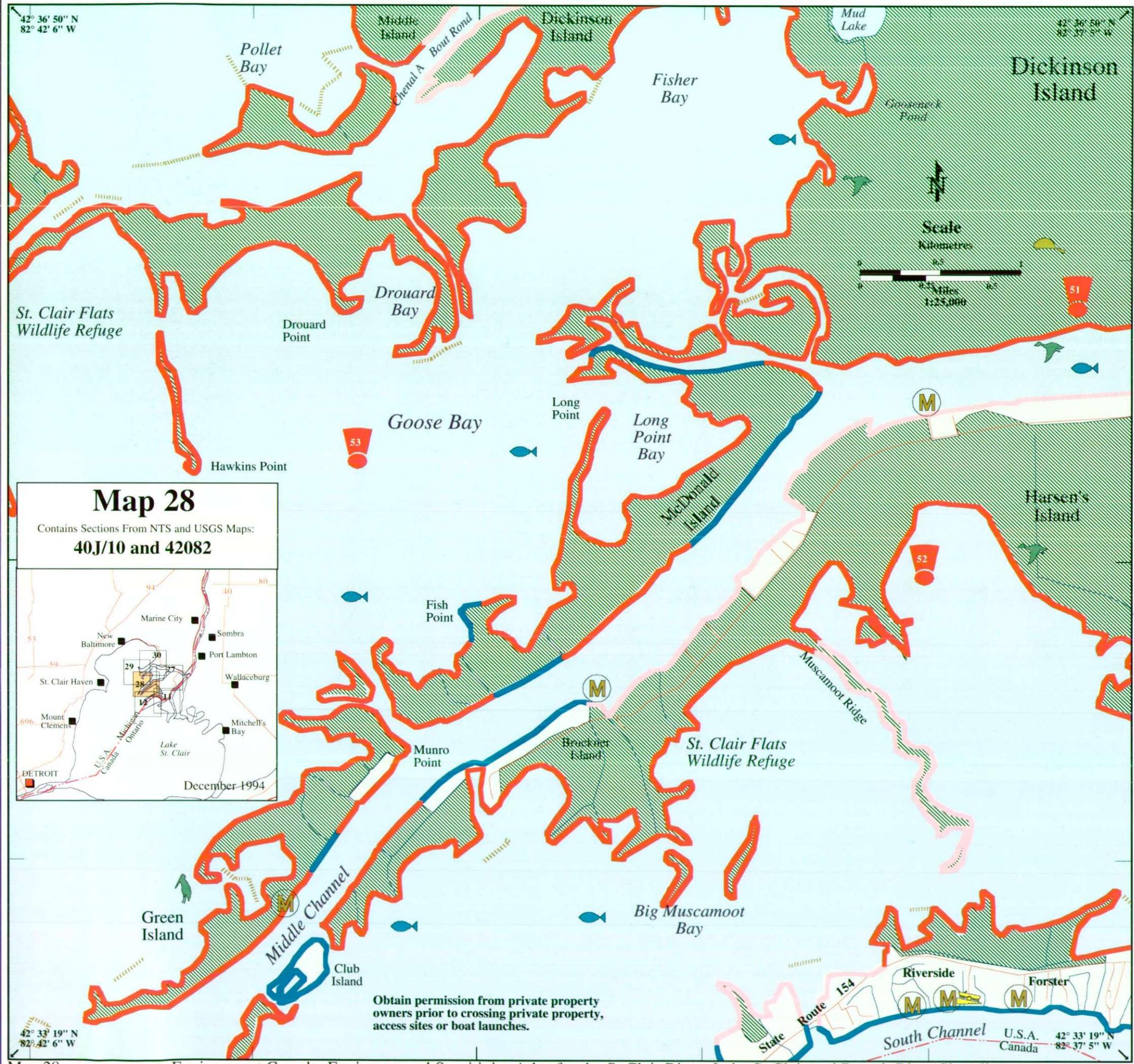
**27** The marshy areas throughout Harsen's Island are used extensively by migrating birds in the fall migration. There are a number of endangered species of birds, plants and reptiles located on and around the Island.

**49** The City of Algonac #1 Municipal Water Intake - Call (810) 794-3281. This portion of Algonac State Park bordering the St. Clair River (east to Batteaux Island) is used as a recreational fishery.

**50** The North Channel is a spawning and fishing area for Sturgeon and Walleye.

**51** The shallow, marshy areas of Dickinson Island are valuable spawning and nursery beds for such species as Lake Sturgeon, Northern Pike, Bass, Yellow Perch, Carp and Suckers. The island is also used by migratory waterfowl in the spring. Other wildlife species include Muskrat, White Deer and Fox.





**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**51** The shallow, marshy areas of Dickinson Island are valuable spawning and nursery beds for such species as Lake Sturgeon, Northern Pike, Bass, Yellow Perch, Carp and Suckers. The island is also used by migratory waterfowl in the spring. Other wildlife species include Muskrat, White Deer and Fox.

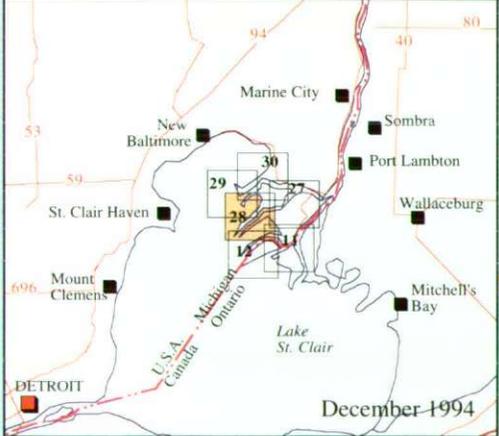
**52** The marshy areas throughout Harsen's Island are used extensively by migratory birds in the fall migration. There are a number of endangered species of birds, plants and reptiles located on and around the Island.

**53** The whole area along the west sides of Dickinson's Island and Harsen's Island is called the St. Clair Flats, which is a very productive and highly utilized area for fish and wildlife.

Goose Bay is a major fish spawning and nursery area for such species as Sturgeon, Walleye, Northern Pike, Yellow Perch, Muskellunge, Largemouth and Small-mouth Bass, Channel Catfish and others.

The submergent vegetation beds throughout the St. Clair Flats represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

**Map 28**  
Contains Sections From NTS and USGS Maps:  
**40J/10 and 42082**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

## NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**53** The whole area along the west sides of Dickinson's Island and Harsen's Island is called the St. Clair Flats, which is a very productive and highly utilized area for fish and wildlife.

Goose Bay is a major fish spawning and nursery area for such species as Sturgeon, Walleye, Northern Pike, Yellow Perch, Muskellunge, Largemouth and Smallmouth Bass, Channel Catfish and others.

The submergent vegetation beds throughout the St. Clair Flats represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

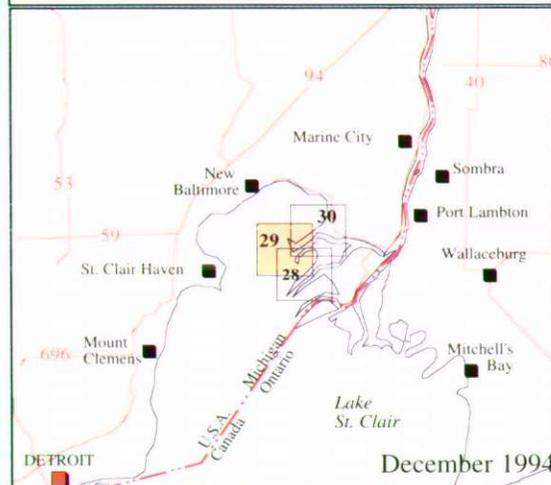
42° 38' 30" N  
82° 43' 51" W

42° 38' 30" N  
82° 38' 51" W

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

## Map 29

Contains Sections From NTS and USGS Maps:  
42082



Scale  
Kilometres  
0 0.5 1  
Miles  
0 0.25 0.5  
1:25,000

42° 34' 59" N  
82° 43' 51" W

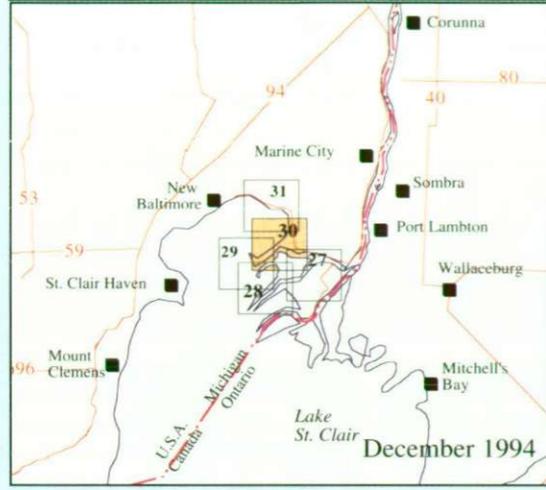
42° 34' 59" N  
82° 38' 51" W

42° 39' 48" N  
82° 40' 50" W

42° 39' 48" N  
82° 35' 50" W

# Map 30

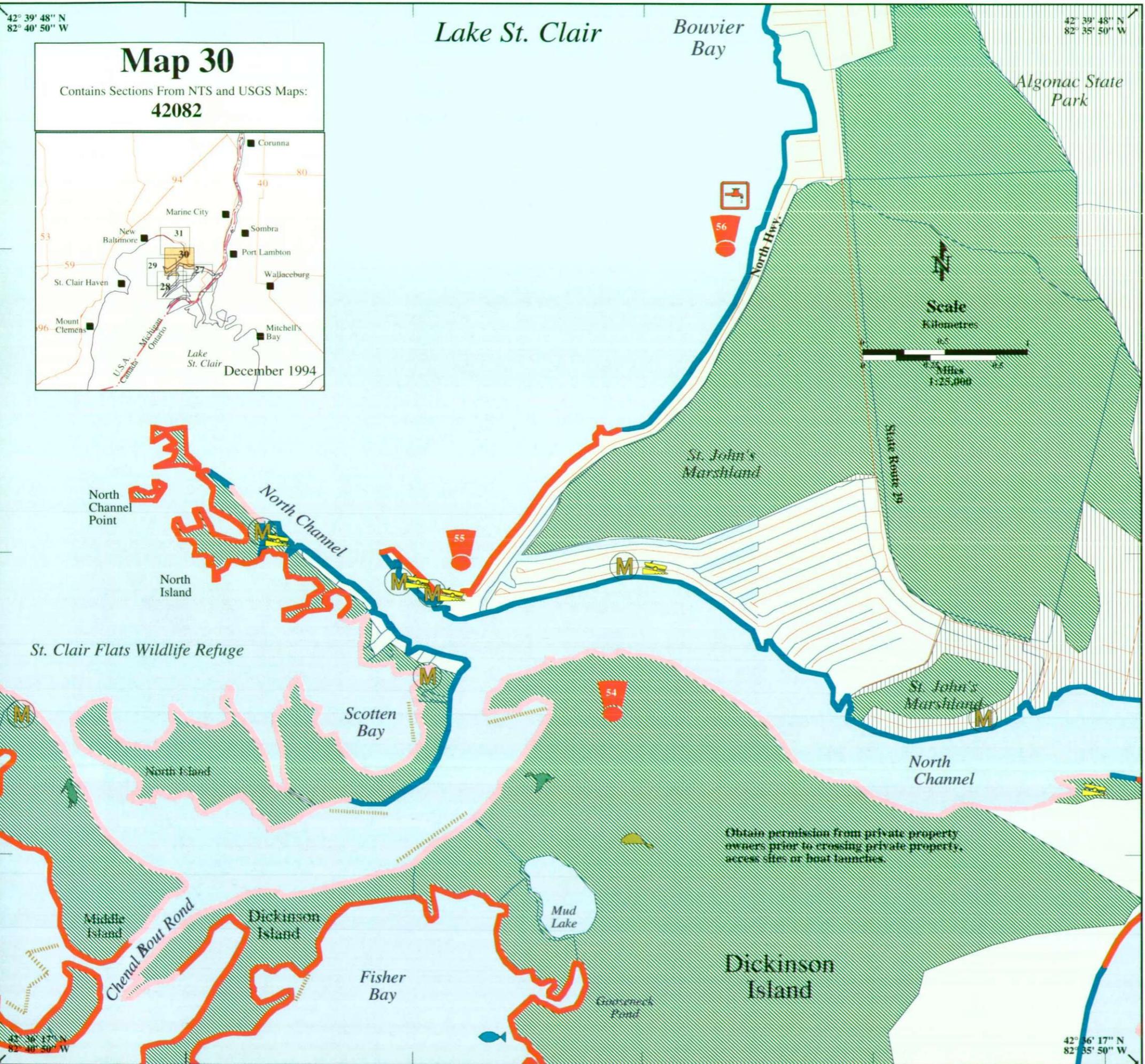
Contains Sections From NTS and USGS Maps:  
**42082**



## Lake St. Clair

### Bouvier Bay

### Algonac State Park



### NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**54** The shallow, marshy area of Dickinson Island are valuable spawning and nursery beds for such species as Lake Sturgeon, Northern Pike, Bass, Yellow Perch, Carp and Suckers. The island is also used by migratory waterfowl in the spring. Other wildlife species include Muskrat, White Deer and Fox.

**55** The St. John's Marshland Recreation Area lies inland, however, a bridge opening allows access from Bouvier Bay and the North Channel.

**56** Macomb County, U.S.A. Drinking Water Intake - Contact the Michigan Department of Natural Resources' 24 hour answering service at (517) 373-7660.

42° 36' 17" N  
82° 35' 50" W

**NOTES** !

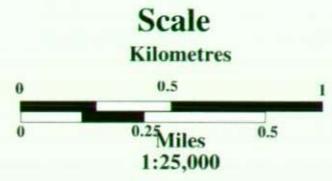
A red exclamation point symbol is used on the maps to catch the responder's attention.

- ! 56 Macomb County, U.S.A. Drinking Water Intake - Contact the Michigan Department of Natural Resources' 24 hour answering service at (517) 373-7660.
- ! 57 Ira Township (Fairhaven) Municipal Drinking Water Plant Intake - Call (810) 725-7231.
- ! 58 Anchor Bay is heavily used by migrant diving ducks and is a spawning and fishing area for such species as Yellow Perch, Smallmouth and Largemouth bass and Sunfish.



42° 42' 35" N  
82° 45' 52" W

42° 42' 35" N  
82° 40' 52" W

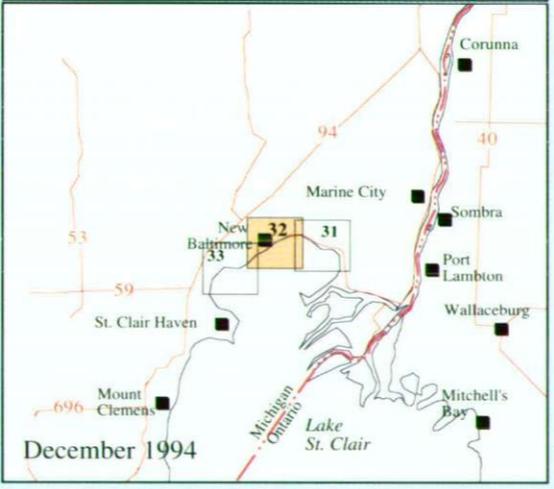


Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



# Map 32

Contains Sections From NTS and USGS Maps:  
**42082**



## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**58** Anchor Bay is heavily used by migrant diving ducks and is a spawning and fishing area for such species as Yellow Perch, Smallmouth and Largemouth bass and Sunfish.

**59** Town of New Baltimore, U.S.A. Municipal Drinking Water Plant Intake - Call (810) 725-7300.

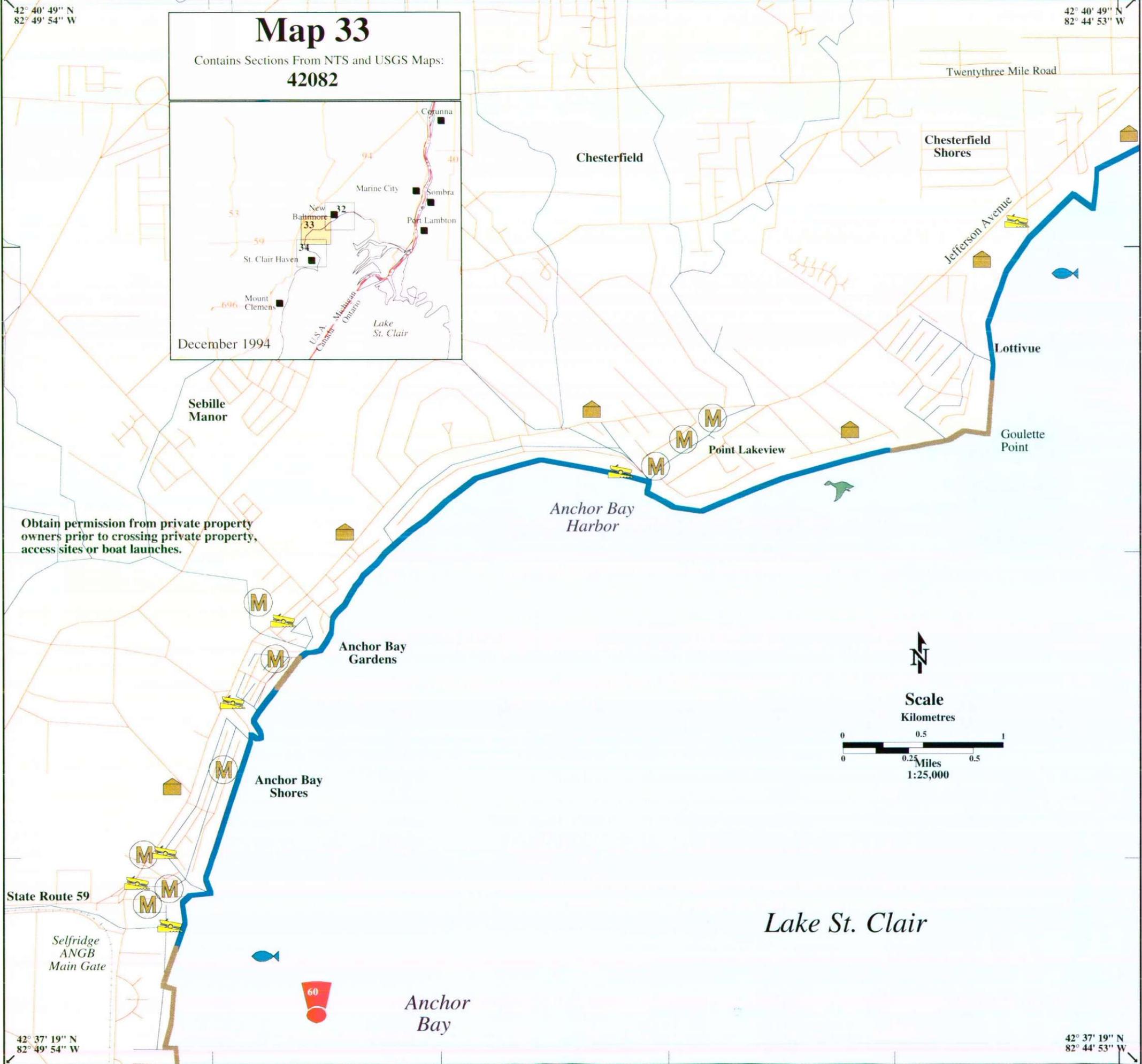
42° 39' 4" N  
82° 45' 52" W

42° 39' 4" N  
82° 40' 52" W

# NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**60** Anchor Bay is heavily used by migrant diving ducks and is a spawning and fishing area for such species as Yellow Perch, Smallmouth and Largemouth Bass and Sunfish.





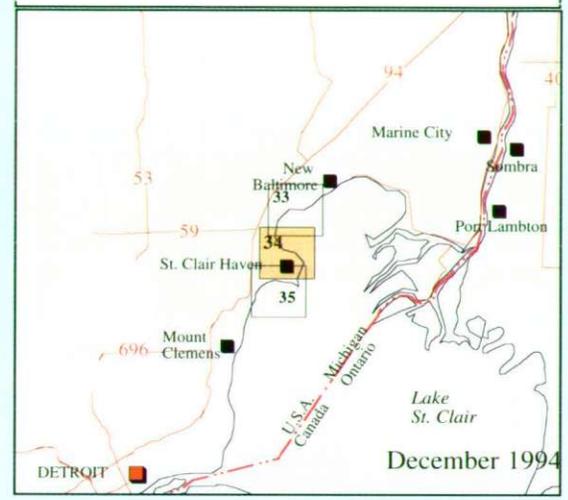
**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**60** Anchor Bay is heavily used by migrant diving ducks and is a spawning and fishing area for such species as Yellow Perch, Smallmouth and Largemouth Bass and Sunfish.

**Map 34**

Contains Sections From NTS and USGS Maps:  
**42082**



**NOTES** !

A red exclamation point symbol is used on the maps to catch the responder's attention.

- ! 61 Metropolitan Beach is the most heavily used public beach in the region.  
L'Anse Creuse Bay is used by migrant diving ducks such as Redheads, Canvasbacks, Mallards and Blue-winged Teals. The Bay is also an important fish spawning area.
- ! 62 St. Clair County #1 Municipal Drinking Water Intake - Call (810) 364-5720 (ext. 6201).





**NOTES** !

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 62 St. Clair County #1 Municipal Drinking Water Intake - Call (810) 364-5720 (ext. 6201).

# NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 63 The United States Coast Guard, St. Clair Shores base, does not have an equipment depot or boom storage site on location. The outfall immediately north of the Coast Guard base is St. Clair Shores' combined sewer outfall.



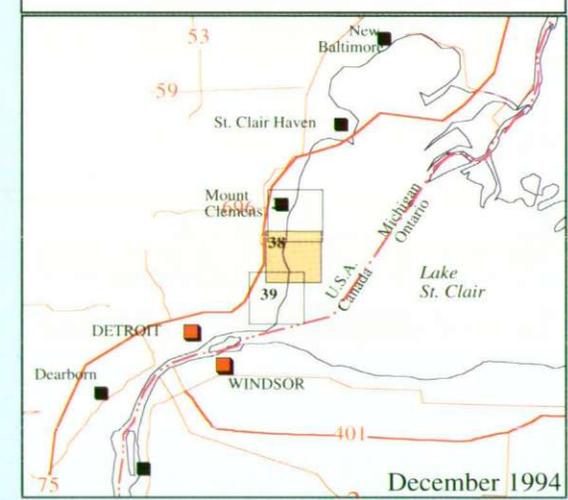


**NOTES** 

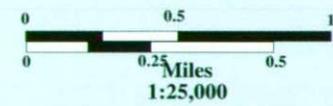
A red exclamation point symbol is used on the maps to catch the responder's attention.

**Map 38**

Contains Sections From NTS and USGS Maps:  
**40J/7 and 42082**



Scale  
Kilometres



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

*Lake St. Clair*

# NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

 City of Grosse Pointe Farms  
Municipal Drinking Water Intake -  
Call (313) 343-2328.





**NOTES** !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**46** Peche Island Provincial Park is a locally important migratory waterfowl stop over point. The park is also a very ecologically diverse area; 235 plant species have been observed and 12 are considered rare in Canada.  
 Commercial bait fishing activities occur offshore.  
 The submergent vegetation beds along Peche Island and the mainland represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species, and important feeding areas for fish populations.

**47** The Town of Tecumseh Water Treatment Plant Water Intakes - Call (519) 735-3001.  
 Little River Water Pollution Control Plant Water Outfall - Call (519) 948-1751.

**48** General Motors Auto Trim Plant Water Outfall - Call (519) 251-1200.

**65** City of Detroit, Michigan Municipal Drinking Water Intake - Call System Control Centre at (313) 961-6132 (24 hrs.).  
 The Detroit Edison Conners Creek Industrial Intake is currently not in operation.  
 Blue Heron Lagoon and the north shore of Belle Isle are important fish spawning and nursery areas, and Belle Isle is a waterfowl concentration area for migrant and wintering ducks (along the south and west sections of the Island).

42° 22' 33" N  
82° 59' 27" W

42° 22' 33" N  
82° 54' 28" W

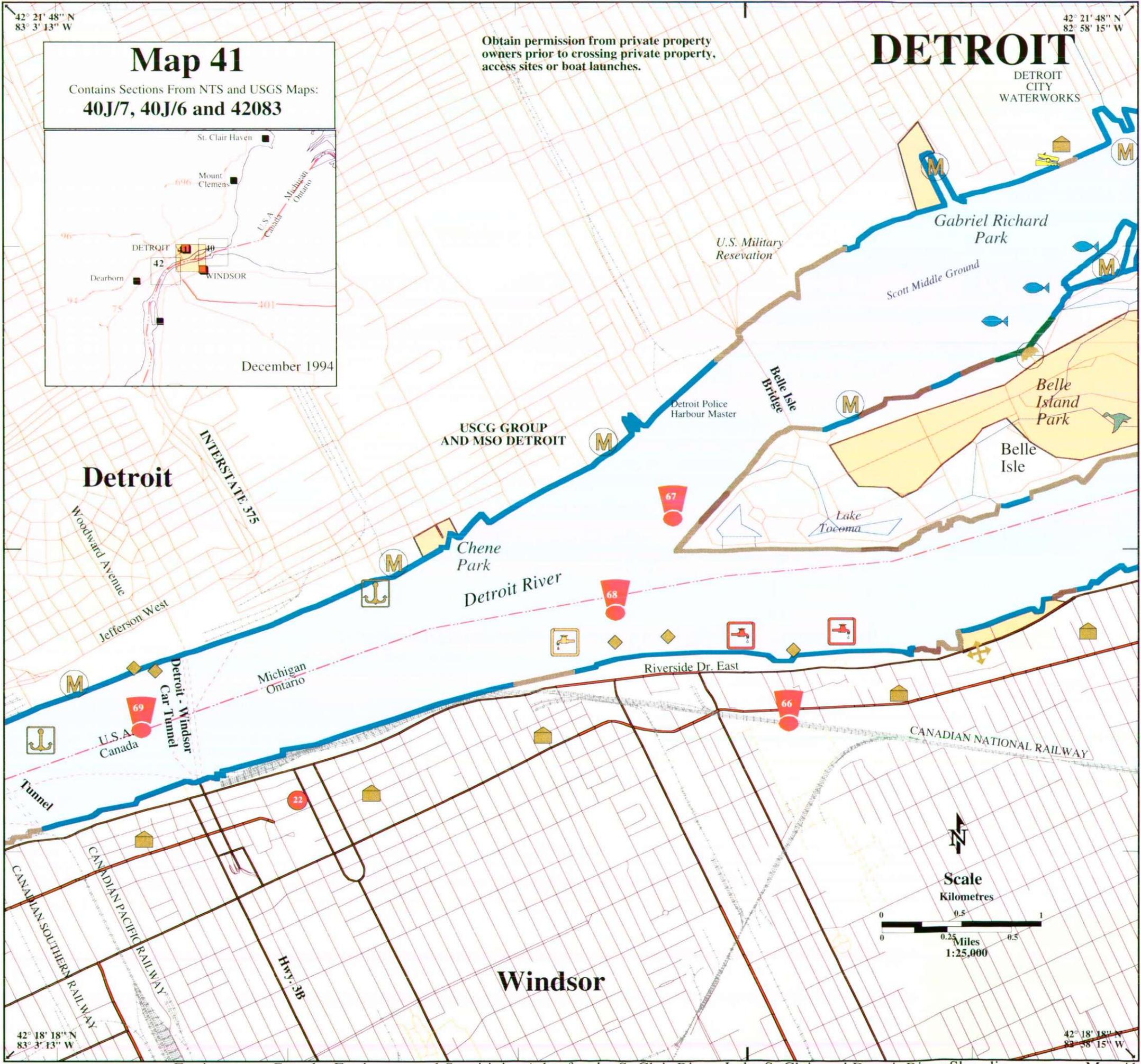
42° 19' 2" N  
82° 59' 27" W

42° 19' 2" N  
82° 54' 28" W

**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 66 The Windsor Public Utilities Commission Water Treatment Plant Water Intakes and Water Pollution Control Plant Water Outfall - Call (519) 255-2786.
- 67 The south and west sections of Belle Isle is a waterfowl concentration area for migrant and wintering ducks, and the Island's north shore is an important fish spawning and nursery area.
- 68 Ford Motor Company Ltd. Water Outfall - Call (519) 257-2020.  
Hiram Walker & Sons Ltd. Water Intakes and Water Outfall - Call (519) 254-5171 (ext. 333).  
U.S. Coast Guard maintains response equipment at their Detroit Marine Safety Office.
- 69 For Canada Customs at the Detroit-Windsor Car Tunnel, call (519) 257-6469. For U.S. Customs, call (313) 226-3161.  
For spills to the Windsor Harbour, contact the Windsor Harbour Commission at (519) 528-5741.  
There are several rail car ferries operating between Windsor and Detroit on this portion of the Detroit River.

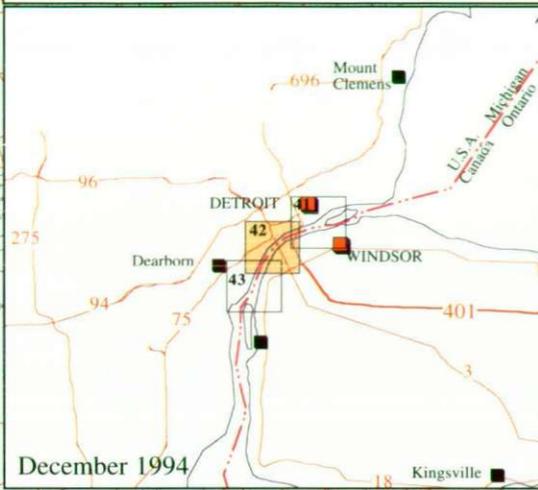


42° 20' 8" N  
83° 7' 23" W

42° 20' 8" N  
83° 2' 24" W

# Map 42

Contains Sections From NTS and USGS Maps:  
**40J/6 and 42083**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**69** For Canada Customs at the Detroit-Windsor Car Tunnel, call (519) 257-6469. For U.S. Customs, call (313) 226-3161.  
For spills to the Windsor Harbour, contact the Windsor Harbour Commission at (519) 528-5741.  
There are several rail car ferries operating between Windsor and Detroit on this portion of the Detroit River.

**70** For Canada Customs at the Ambassador Bridge, call (519) 257-6514. For U.S. Customs, call (313) 226-3134.  
Commercial bait fishing activity occurs near the Ambassador Bridge. Various fish species are found throughout this River.  
For Mistersky Electric Company's cooling water intake - Call (313) 842-3350.

**71** Canadian Salt Company Fine salt plant Water Intakes and Water Outfall - Call (519) 256-3105.

**72** The Windsor Public Utility Commission Water Pollution Control Plant Water Outfall - Call (519) 253-7217.  
Ontario Hydro - J.C. Keath Generating Station Water Intake and Water Outfall - the plant has not been in operation since 1983.  
The response contractor, Marine Pollution Control, maintains response equipment on the U.S. side near Zug Island.  
Great Lakes Steel Industrial Intake - Call (313) 297-3005.

# DETROIT

N & W NORFOLK AND WESTERN

INTERSTATE 75

Riverside Park

DETROIT MARINE TERMINAL

MISTERSKY ELECTRIC

U.S. Military Reservation

ALLIED CHEMICAL

GREAT LAKES STEEL

MARINE POLLUTION CONTROL

DMT

42° 16' 37" N  
83° 7' 23" W

J.W. WESCOTT

Ambassador Bridge

Windsor Harbour Commission Dock

Hwy. 18

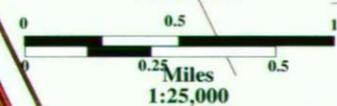
Hwy. 3

ESSEX TERMINAL RAILWAY



Scale

Kilometres

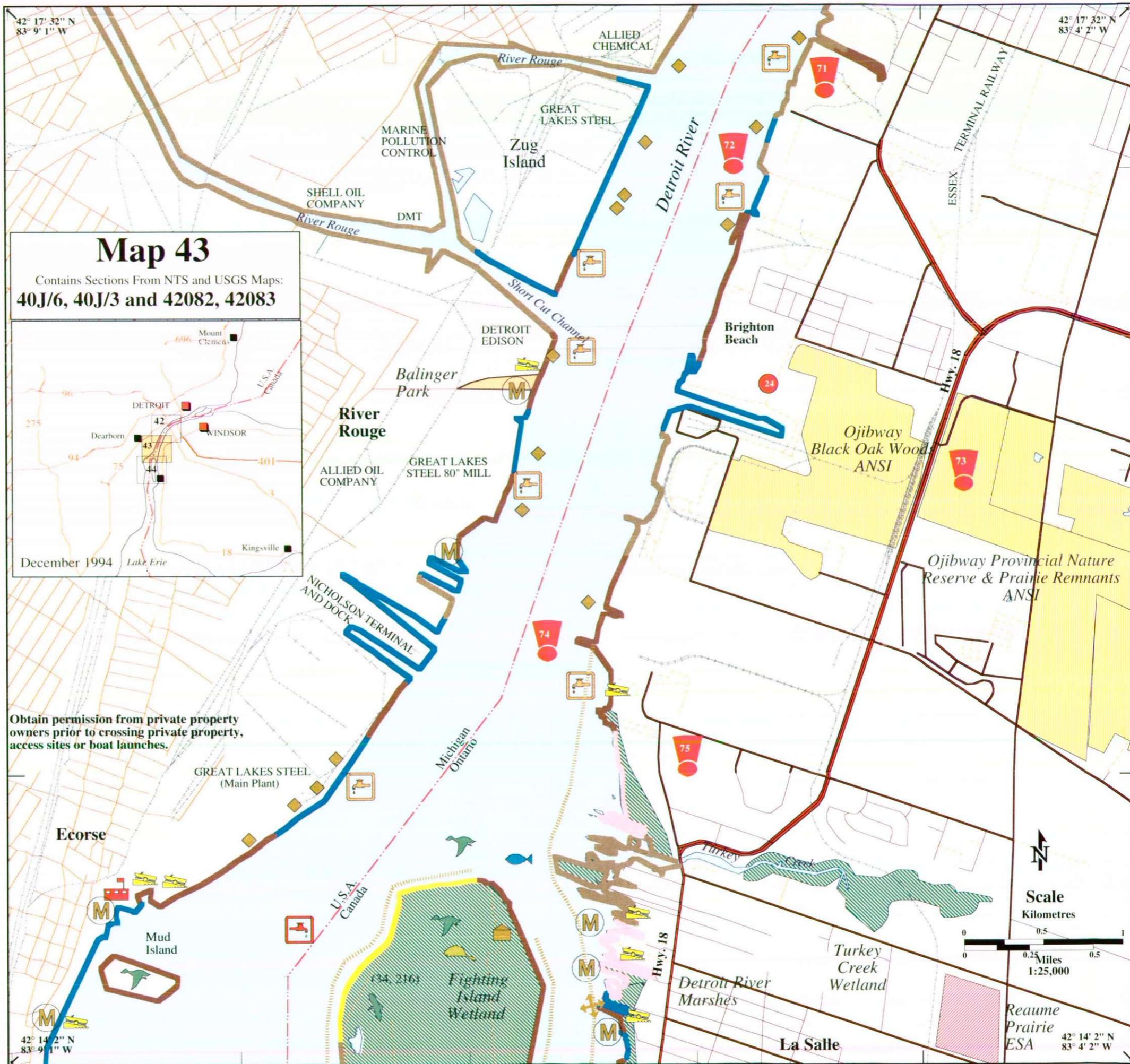


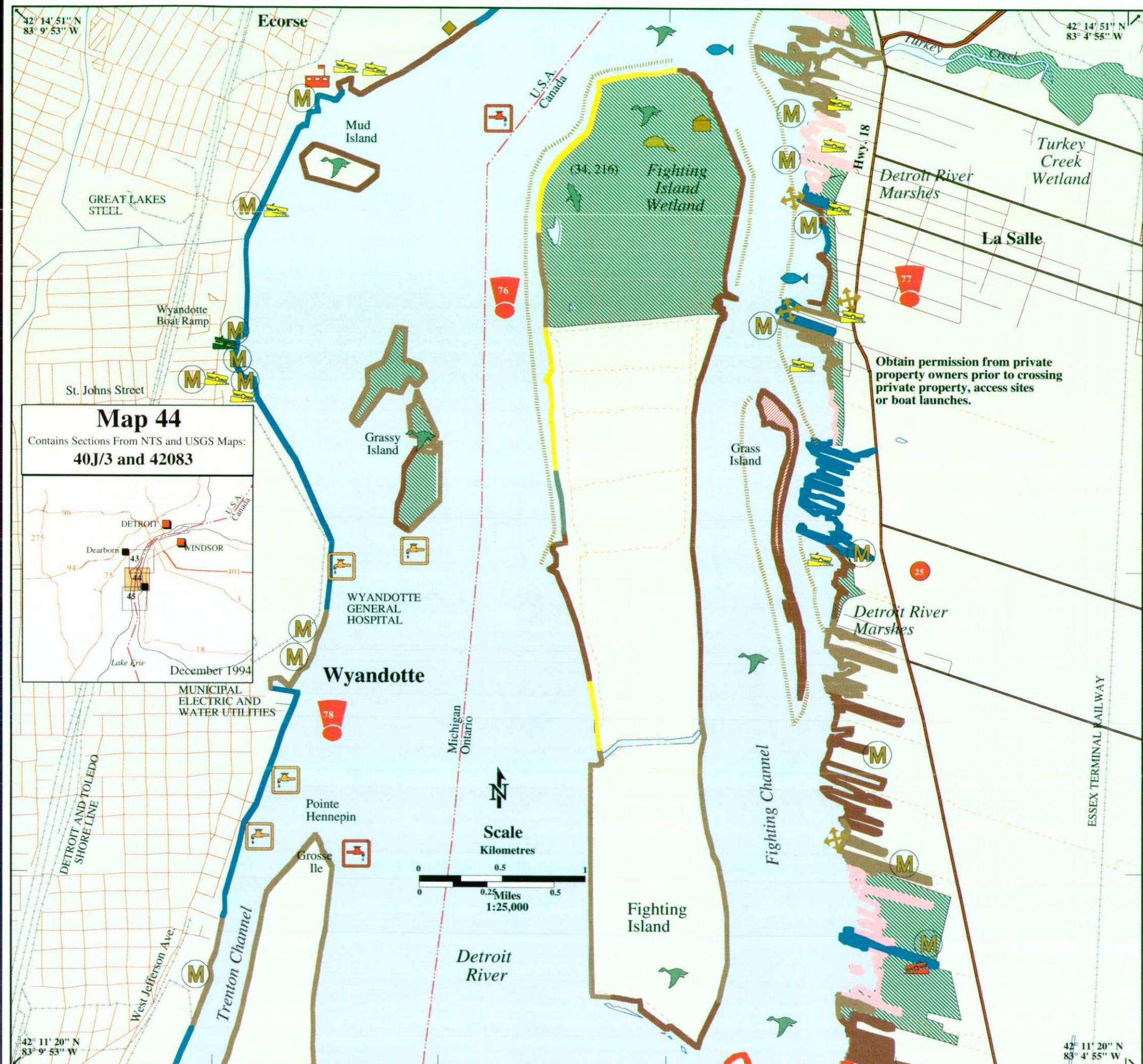
42° 16' 37" N  
83° 2' 24" W

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 71 Canadian Salt Company Fine salt plant Water Intakes and Water Outfall - Call (519) 256-3105.
- 72 The Windsor Public Utility Commission Water Pollution Control Plant Water Outfall - Call (519) 253-7217.  
Ontario Hydro - J.C. Keath Generating Station Water Intake and Water Outfall - the plant has not been in operation since 1983.  
The response contractor, Marine Pollution Control, maintains response equipment on the U.S. side near Zug Island.
- 73 The Ojibway Prairie Complex includes areas that are designated as Nature Reserve Class Provincial Park, as well as municipal parkland and the Springarden Road ANSI. These remnants are internationally significant, representing some of the best tallgrass prairie, oak savannah, and oak forest habitats in Canada. More than one-half of the known Ontario prairie plant species occur in this area.
- 74 Canadian Salt Company Rock Salt Plant Water Intakes and Water Outfall - Call (519) 256-3105.  
U.S. Process Water Intakes - Detroit Edison - Call (313) 297-8320.  
Great Lakes Steel - 80" Mill and Main Plant - Call (313) 297-3005.
- 75 Reaume Prairie ESA is for its size (about 1 hectare), an exceptionally rich, undisturbed prairie remnant. Of the approximately 200 plant species, at least 35 are provincially rare and another 6 are regionally rare.  
Turkey Creek ESA is a riverine Class 3 wetland that consists primarily of robust emergents and small sections of wooded swamp. Some of the wetland is an embayment of open water with scattered shoreline vegetation - mainly Cattails. Water levels correspond directly to that of the Detroit River. This site attracts an unusual amount of wildlife. Many provincially significant species utilize the wetland for feeding or breeding habitat. Marsh Wrens, Black-crowned Night Herons, Eastern Fox Snakes and Massasaugua Rattlesnakes can all be found at Turkey Creek. Provincially significant plant species including Ohio Spiderwort and Ironweed are found at this site.





**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**76** Fighting Island is a Class 3 wetland that was historically used as a chemical waste settling area. The existing marsh primarily consists of Cattail Marsh, however a significant Oak Hickory forest exists. Sweet Pignut Hickory, a provincially rare species, is dominant. There are an additional 203 plant species occurring of which 10 are rare in Canada and Ontario. The Island is completely diked, effectively separating the wetland from the Detroit River. The wetland provides habitat for many provincially significant animal species. The abundance and diversity of nesting and feeding marsh birds is regionally significant. Ducks have been recorded as using Fighting Island as a migratory stopover point. The wetland supports colonies of Herring Gulls, Common Terns and Ring-billed Gulls. Rare breeding birds include - Great Blue Heron, Black-crowned Night Heron, Least Bittern and the Eastern Bluebird which utilizes the wetland for feeding. The Island also provides habitat for Red Fox, Coyote and Muskrat. Seasonal fish spawning occurs, especially Yellow Perch. Grassy Island is utilized by migrating and overwintering waterfowl.

The Fighting Island Municipal Water Intake located in the channel off the northwest side of Fighting Island supplies drinking water for the City of Detroit - Call (313) 224-4775.

**77** The Detroit River marshes (Class 2 wetland), are comprised of six individual units located between Fighting Island and the east shore of the Detroit River. These marshes are used extensively for fishing, canoeing and boating. Many privately owned areas along the shoreline are used for hunting. Biologically this wetland is very diverse in flora and fauna, providing excellent wildlife habitat. Species inhabiting this area include: Pied-billed Grebe, Great Egrets, Black-crowned Night Herons, Common Terns, Butler's Garter Snake, Massasaugua Rattlesnake and Eastern Fox Snake. Provincially significant plant species include: Swamp Rose Mallow, Ohio Spiderwort and Yellow Pond Lilly. In addition, this wetland is used by fish as a spawning and rearing habitat.

**78** Point Hennepin Municipal Water Intake - Call (313) 224-4775.  
 BASF Wyandotte, North Intake - Call (313) 282-3300.  
 Municipal Electric and Water Co. Intakes - Call (313) 282-7100.

**Map 44**  
 Contains Sections From NTS and USGS Maps:  
**40J/3 and 42083**

December 1994

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**79** BASF Wyandotte, South Plant Industrial Intake - Call (313) 282-3300. For the McLouth Steel Corp. Trenton #1 and #2 Industrial Intakes south of the Grosse Ile Toll Bridge - Call (313) 285-1200 (ext. 270).

Trenton Channel is used by diving ducks in winter. It is a migration staging area for numerous other waterfowl.

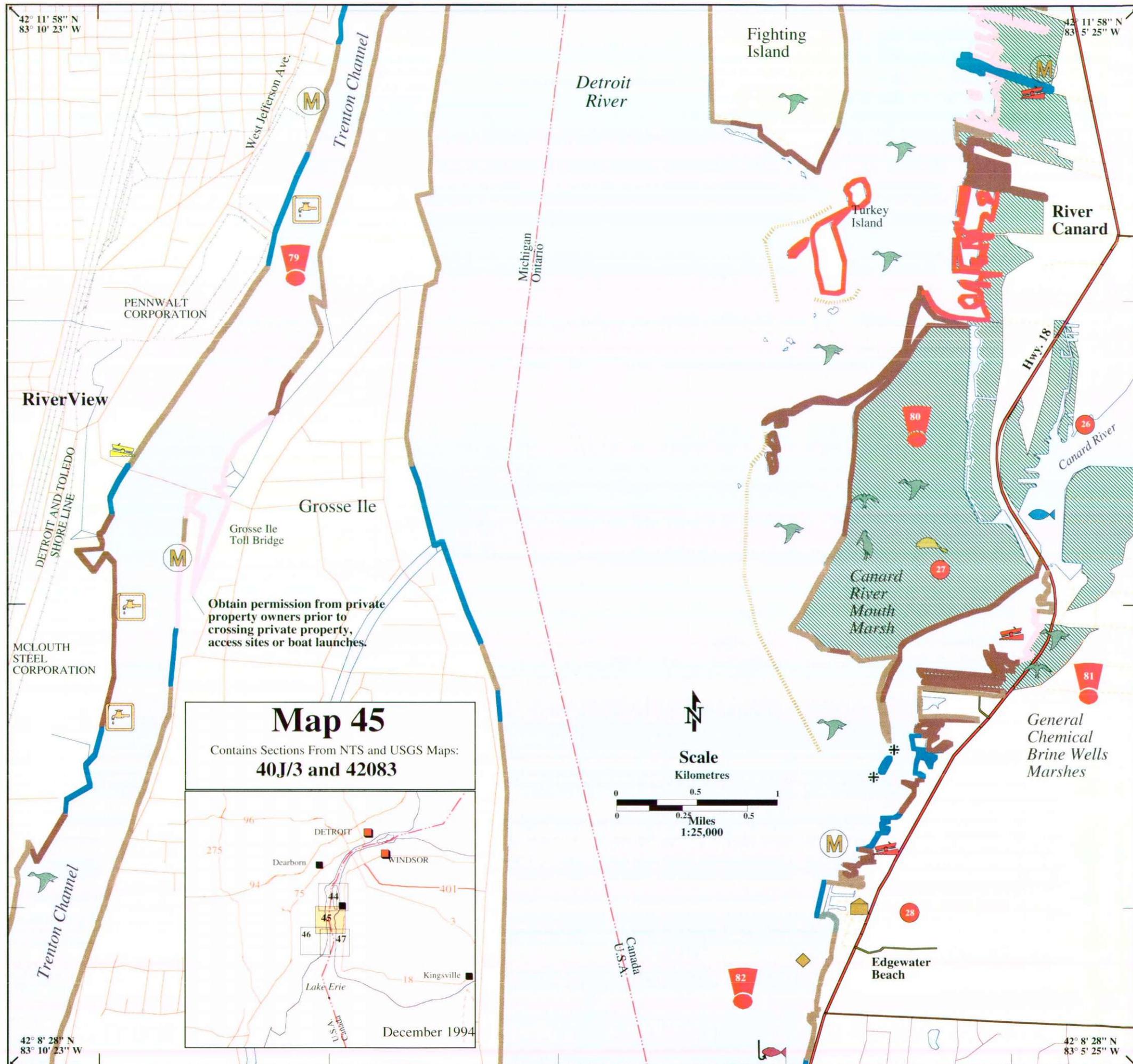
**80** Canard River Mouth Marsh is a Class I wetland that is ecologically important due to the abundance and assortment of natural vegetation. The area provides wildlife habitat especially for those species which require a mixture of upland and wetland habitats. Canard River contains a number of biological resources including fish, Bullfrogs, Snapping Turtles and furbearers. Provincially significant bird and plant species including Pied-billed Grebe, Great Egret, Least Bittern, American Lotus and Spatterdock are present. Gadwall, Northern Shoveller and American Coot are regionally significant species. Several colonial waterbirds utilize the marsh as feeding habitat including the Black Tern, Great Blue Heron, Great Egret and Black-crowned Heron. Hunting, fishing and boating activity occurs in this area. Although little winter cover is available for wildlife it is an important site for waterfowl (especially Redhead, Canvasback) and shorebird migration during spring and fall.

There are extensive beds of submergent vegetation in this area of the Detroit River, including species such as Wild Celery. These beds represent more than an approach concern. Responders should protect these beds as they are critical habitat for numerous aquatic species and important feeding areas for fish populations.

**81** General Chemical Brine Wells Environmentally Sensitive Area serves as a migratory stopover for shorebirds. Some migrating waterfowl can be found using larger pools. The brine fields contains one of the best assemblages of halophytic (plants that grow in salty soil) plants in Southern Ontario. Six rare species have been found, however further inventory is required.

**82** Edgewater Beach Water Pollution Control Plant Water Outfall - Call (519) 736-5447.

Commercial bait fishing activities occur near Edgewater Beach.

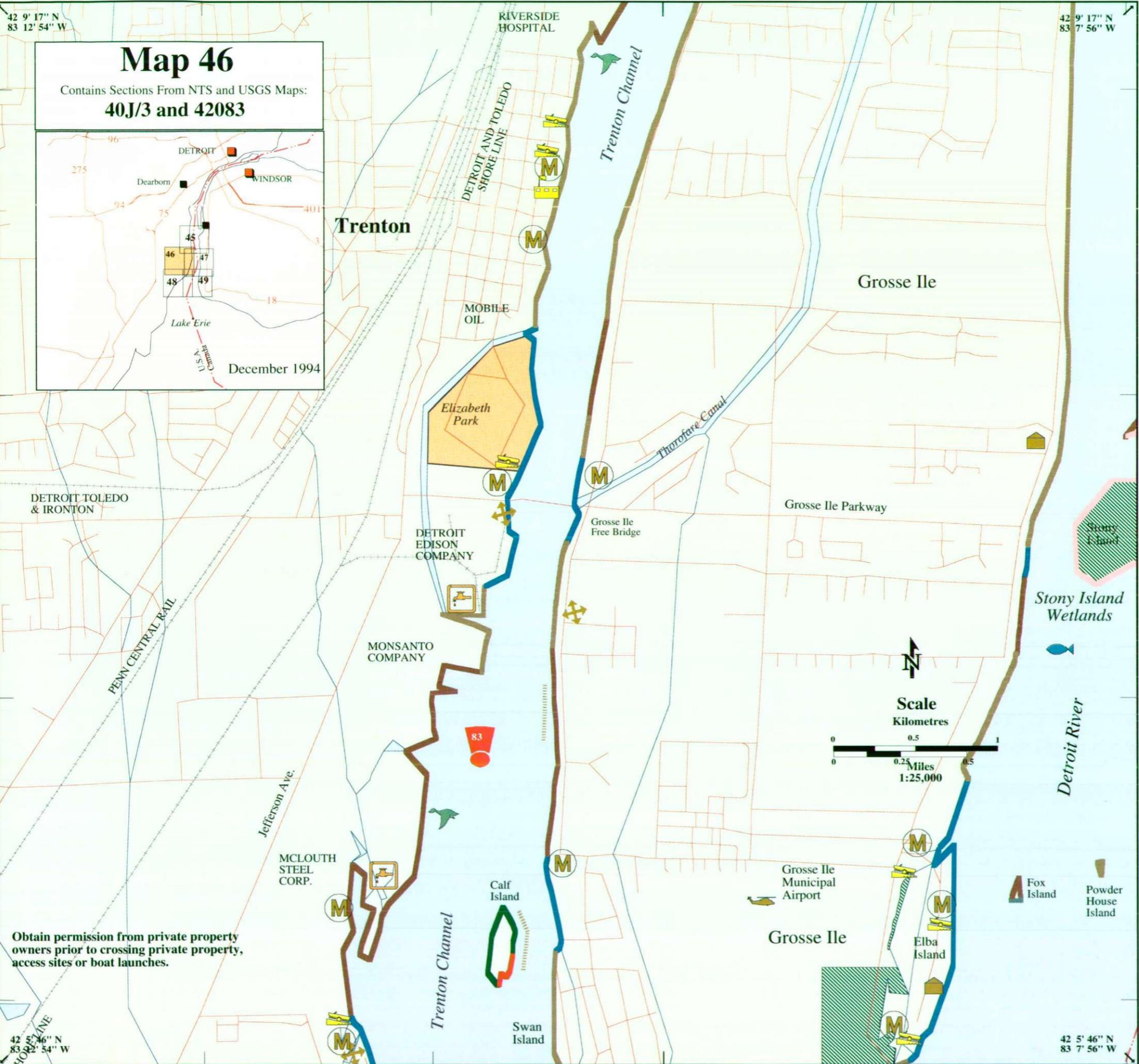
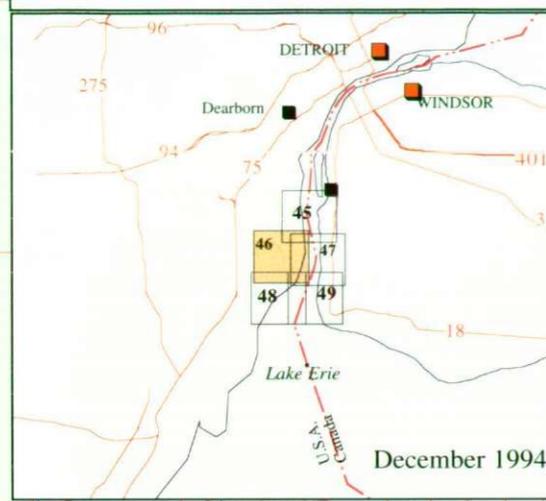


42° 9' 17" N  
83° 12' 54" W

42° 9' 17" N  
83° 7' 56" W

# Map 46

Contains Sections From NTS and USGS Maps:  
**40J/3 and 42083**



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

42° 5' 46" N  
83° 12' 54" W

42° 5' 46" N  
83° 7' 56" W

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

**83** Detroit Edison Co., Trenton Industrial Intake - Call (313) 676-9307.

McLouth Steel Corp. Industrial Intake - Call (313) 285-1200.

Trenton Canal is used by diving ducks in winter. It is a migration staging area for numerous other waterfowl.

# NOTES !

A red exclamation point symbol is used on the maps to catch the responder's attention.

**82** Edgewater Beach Water Pollution Control Plant Water Outfall - Call (519) 736-5447.

Commercial bait fishing activities occur near Edgewater Beach.

**84** Trout spawning and fishing activities occur in Crystal Lake, a local deep hole on the Island north of Crystal Bay.

Amherstburg Drinking Water Supply System Water Intake - Call (519) 736-5447.

In spring and summer, there is wading bird nesting activity in the Stony Island Wetlands. This area of the Detroit River is a waterfowl concentration area. The portion of the River south of Stony Island is an important fish spawning and nursery area for various species.

**85** General Chemical Ltd. Water Intake - Call (519) 736-2111.

The Seagram Company Ltd. Water Intake and Water Outfall - Call (519) 736-2161.

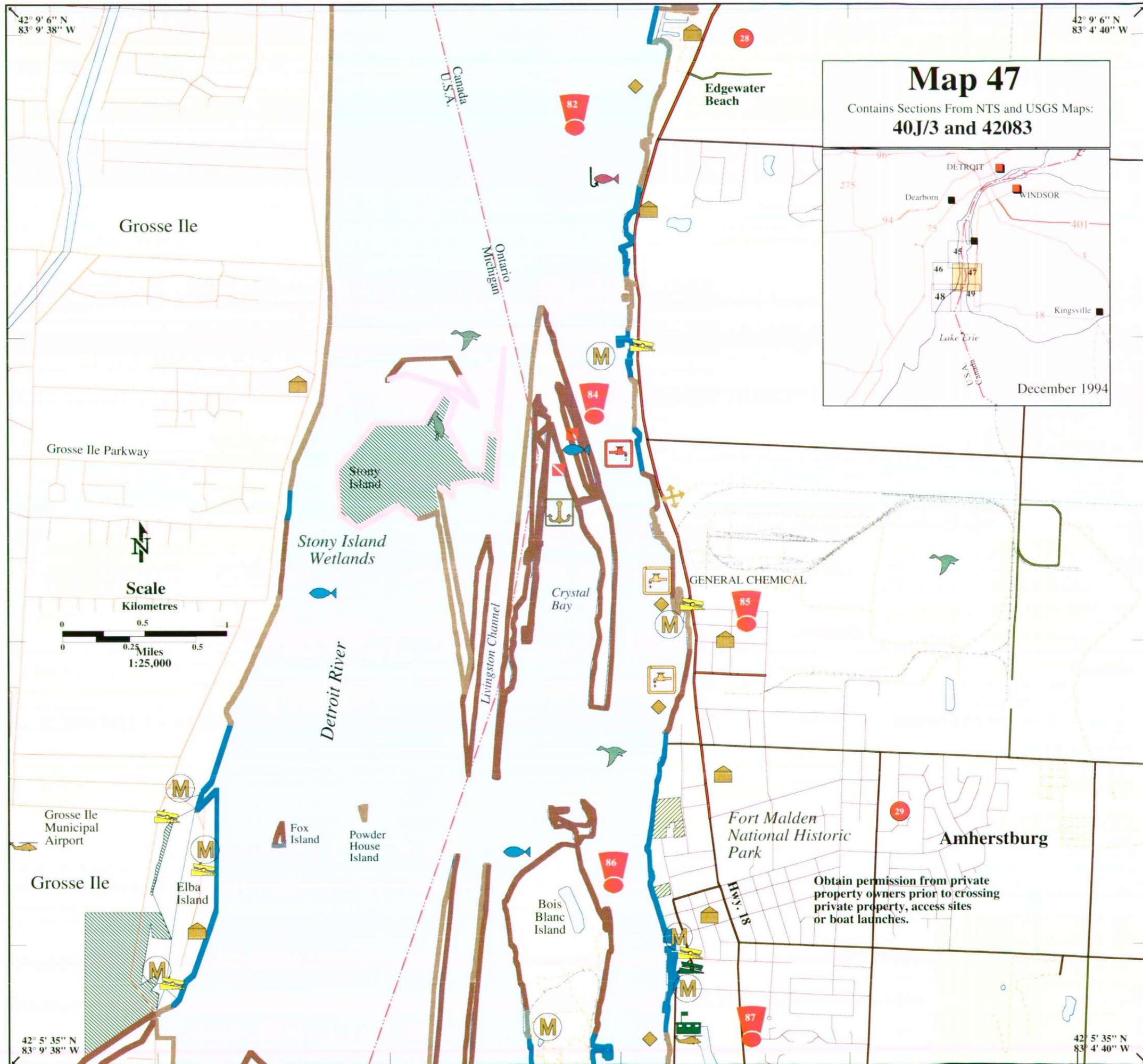
**86** Fort Malden National Historic Park covers three sites: sites one and two can be found on the mainland in Amherstburg. Site three is located on the southwest end of Bois Blanc Island.

- Call (519) 736-5416. Bois Blanc Island is also a well known spawning area for White Bass. Most of the White Bass fishery is concentrated in this area.

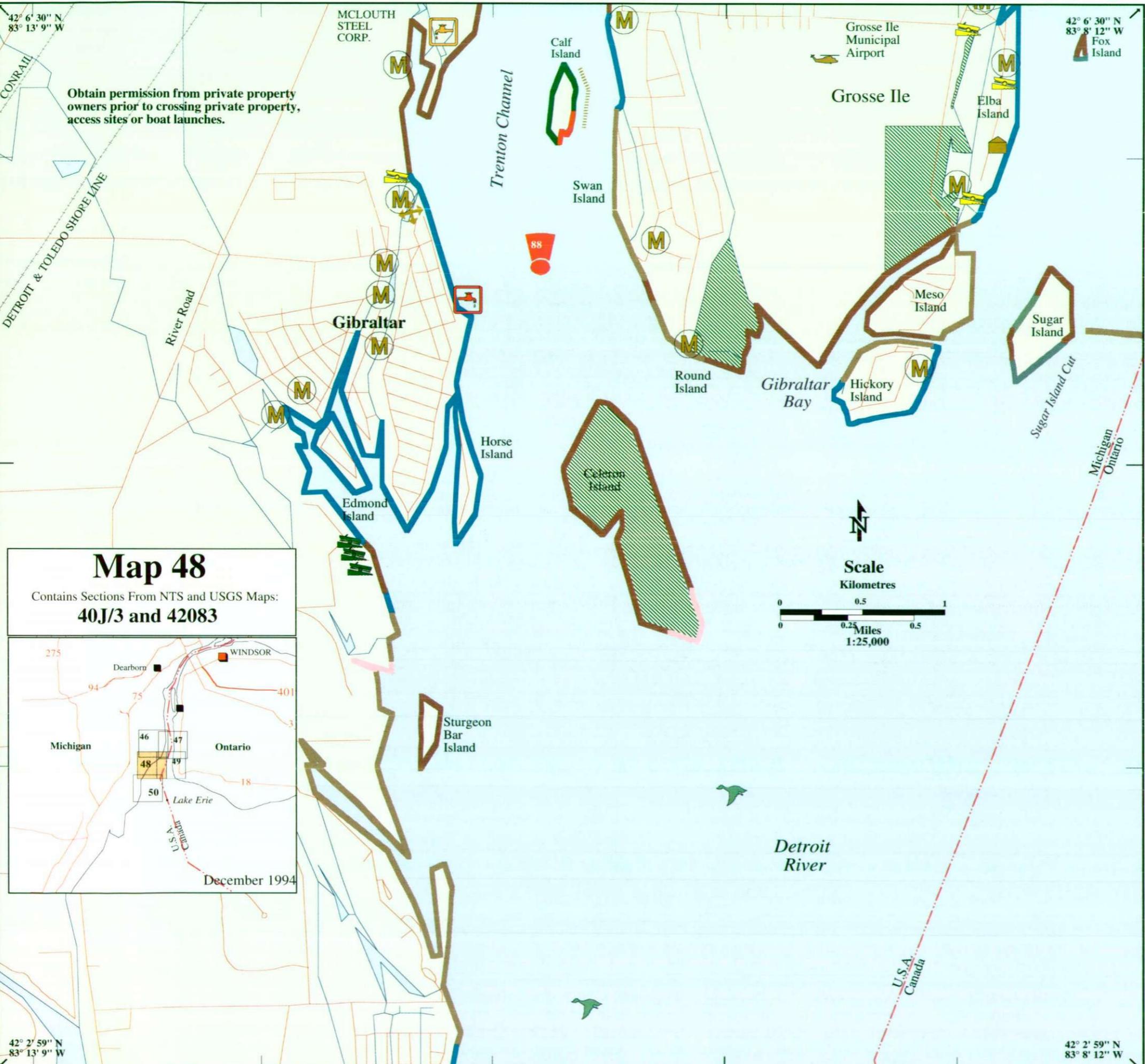
**87** Amherstburg Water Pollution Control Plant Water Outfall - Call (519) 736-5447.

Amherstburg Canadian Coast Guard Base - Call (519)-736-5449 (day) or 1-800-265-0237 (24 hrs.).

Response equipment is maintained at this base.



Obtain permission from private property owners prior to crossing private property, access sites or boat launches.



### NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

- 88 McLouth Steel Corp. Industrial Intake - Call (313) 285-1200.
- Trenton Canal is used by diving ducks in winter. It is a migration staging area for numerous other waterfowl.
- Town of Gibraltar Municipal Water Intake - Call (313) 676-3952 or Gibraltar Police Dept. after hours at (313) 676 1022.
- Celeron Island's marshes are used by some dabbling duck species. The waters around the Island are utilized by Scaup, particularly during migration. Waterfowl use is extremely high in the waters south of Celeron Island.

## NOTES

A red exclamation point symbol is used on the maps to catch the responder's attention.

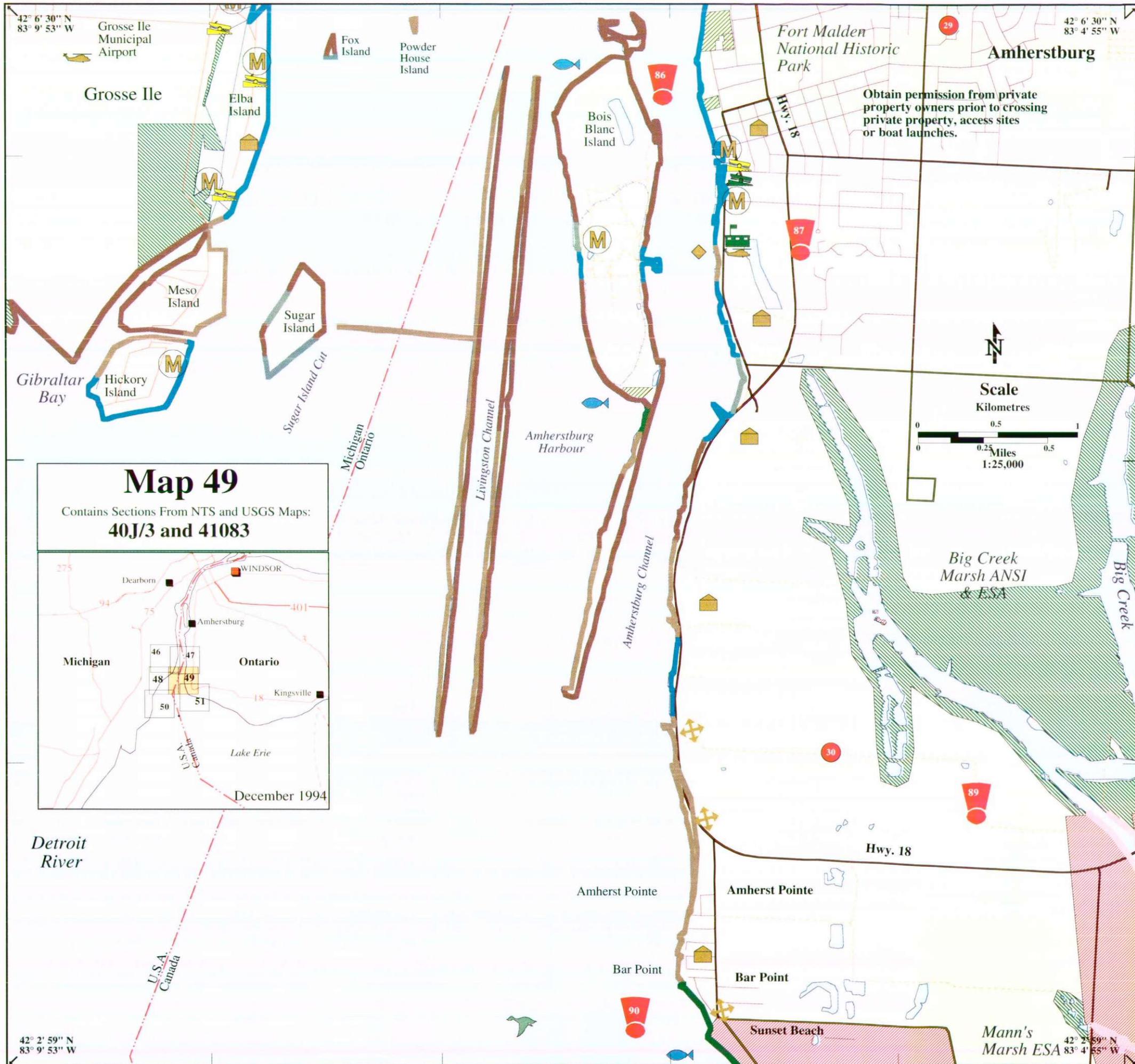
- 86** Fort Malden National Historic Park covers three sites; sites one and two can be found on the mainland in Amherstburg. Site three is located on the southwest end of Bois Blanc Island. - Call (519) 736-5416.

Bois Blanc Island is also a well known spawning area for White Bass. Most of the White Bass fishery is concentrated in this area.
- 87** Amherstburg Water Pollution Control Plant Water Outfall - Call (519) 736-5447.

Amherstburg Canadian Coast Guard Base - Call (519)-736-5449 (day) or 1-800-265-0237 (24 hrs.).

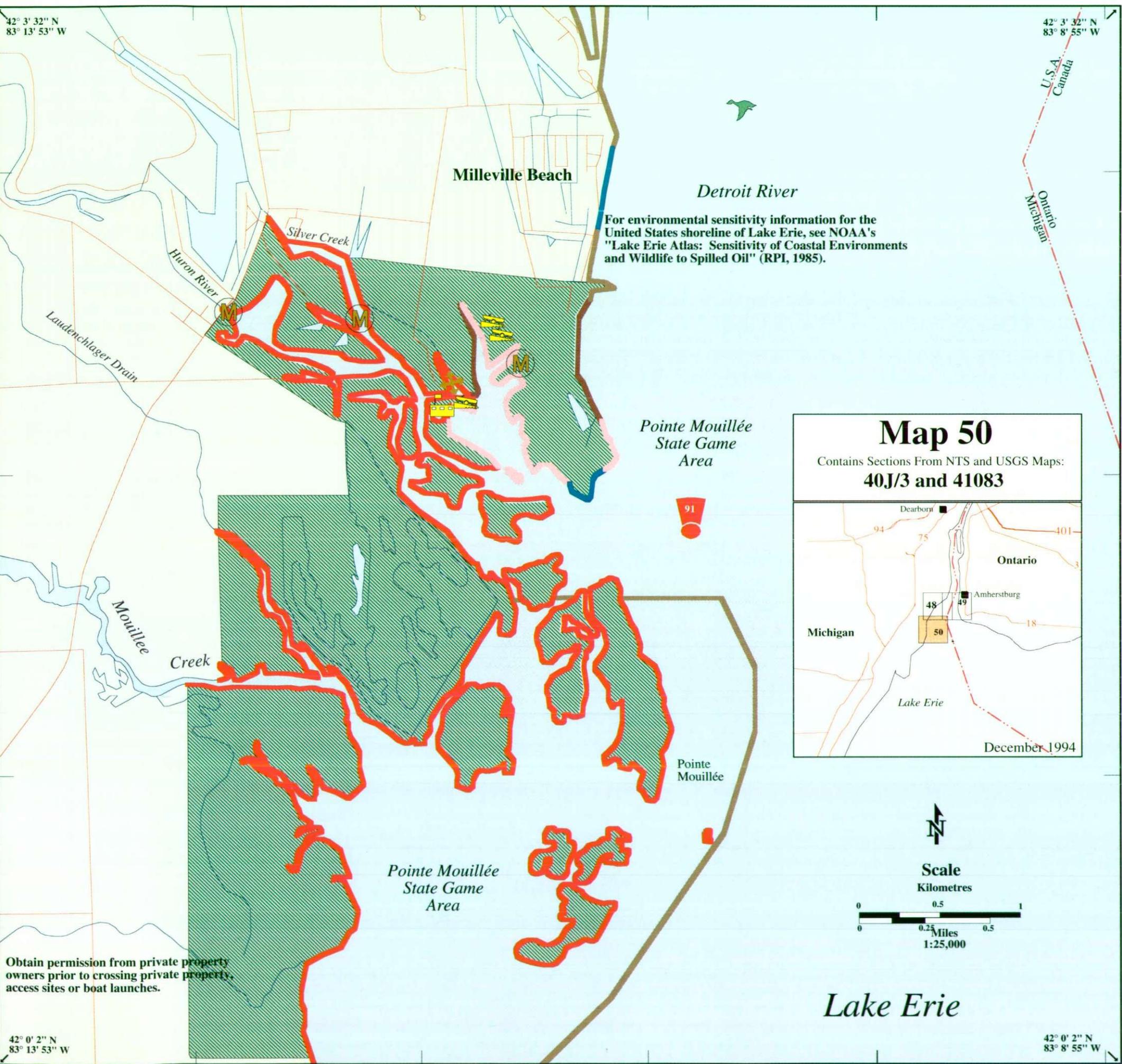
Response equipment is maintained at this base.
- 89** Big Creek Marsh is an Environmentally Sensitive Area, with parts designated as Areas of Natural and Scientific Interest. It supports a major concentration of dabbling ducks (Mallard, Wood Duck, Black Duck) during the fall migration in late September through to winter freeze up, peaking in late October to early November. Observed numbers are up to 10,000. The marsh is also a spring staging area.

Big Creek Marsh is the largest in Essex County and is considered a Class 2 wetland. Since the Big Creek watershed is predominantly agricultural, with little forest cover, run-off of topsoil and pollutants is a major problem. Significant tracts of relatively undisturbed lowland and upland forest are associated with Big Creek Marsh. White Tailed Deer inhabit the forest. Many examples of rare plants and wildlife are present; most notably the Small-Flowered Hemicarpha, a small sedge which grows on moist sand and is not found elsewhere in Ontario. Portions of the Big Creek Wetland are owned by the Ontario Ministry of Natural Resources and the Essex Region Conservation Authority (Big Creek Conservation Area) - Call (519) 776-5209.
- 90** This is an open lake staging area for diving ducks (Scaup, Mergansers), during the peak migration period of mid-October to late November. Concentrations during these periods and in late March may be in the thousands.



42° 3' 32" N  
83° 13' 53" W

42° 3' 32" N  
83° 8' 55" W



For environmental sensitivity information for the United States shoreline of Lake Erie, see NOAA's "Lake Erie Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI, 1985).

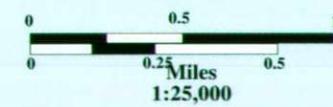
**Map 50**  
Contains Sections From NTS and USGS Maps:  
**40J/3 and 41083**



December 1994



Scale  
Kilometres



*Lake Erie*

42° 0' 2" N  
83° 13' 53" W

42° 0' 2" N  
83° 8' 55" W

**NOTES**

A red exclamation point symbol is used on the maps to catch the responder's attention.

**91** Pointe Mouillée State Game Area is considered a highly sensitive habitat for a wide variety of fish and wildlife species.

Obtain permission from private property owners prior to crossing private property, access sites or boat launches.

## NOTES !

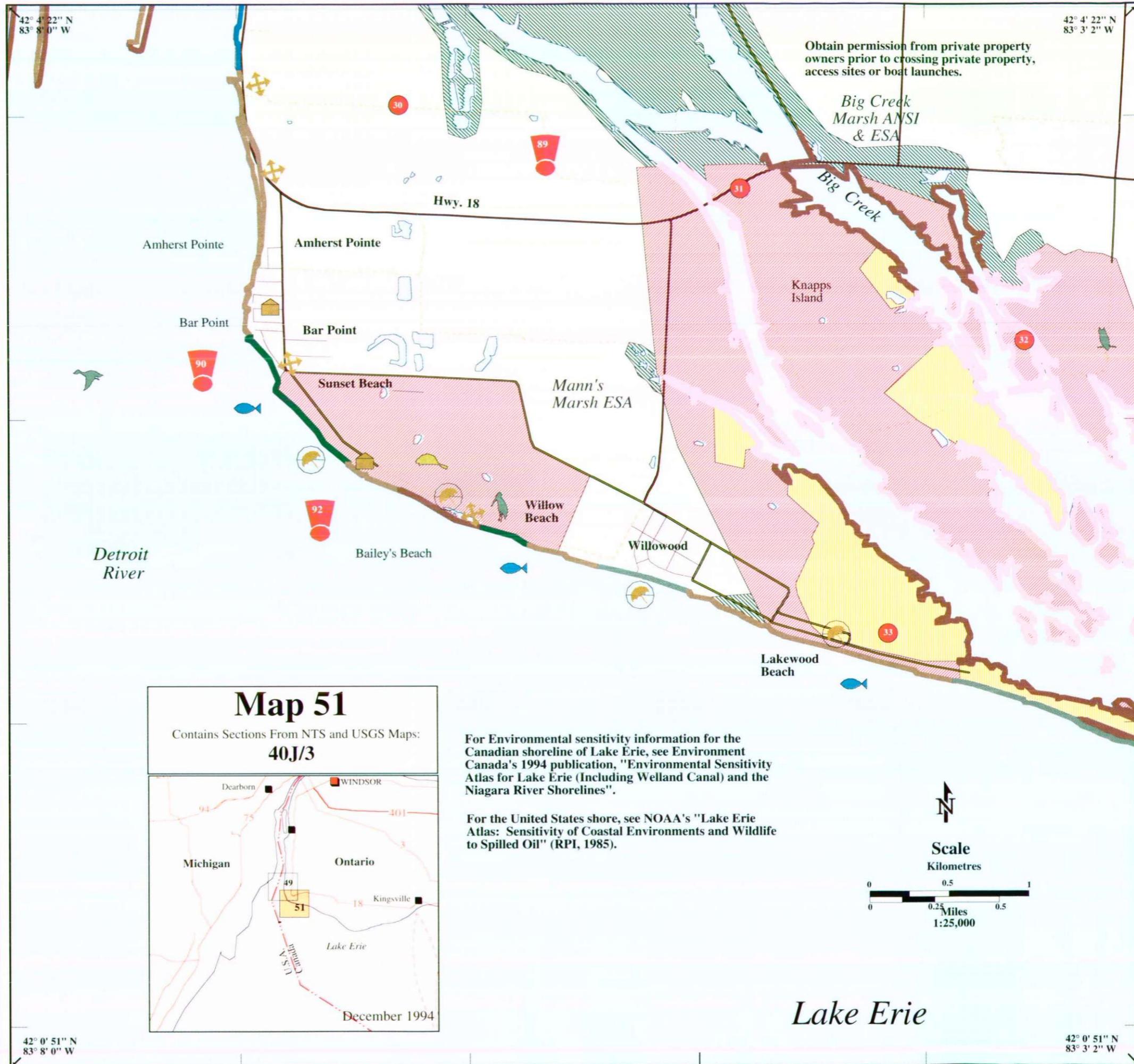
A red exclamation point symbol is used on the maps to catch the responder's attention.

**89** Big Creek Marsh is an Environmentally Sensitive Area, with parts designated as Areas of Natural and Scientific Interest. It supports a major concentration of dabbling ducks (Mallard, Wood Duck, Black Duck) during the fall migration in late September through to winter freeze up, peaking in late October to early November. Observed numbers are up to 10,000. The marsh is also a spring staging area.

Big Creek Marsh is the largest in Essex County and is considered a Class 2 wetland. Since the Big Creek watershed is predominantly agricultural, with little forest cover, run-off of topsoil and pollutants is a major problem. Significant tracts of relatively undisturbed lowland and upland forest are associated with Big Creek Marsh. White Tailed Deer inhabit the forest. Many examples of rare plants and wildlife are present; most notably the Small-Flowered Hemicarpha, a small sedge which grows on moist sand and is not found elsewhere in Ontario. Portions of the Big Creek Wetland are owned by the Ontario Ministry of Natural Resources and the Essex Region Conservation Authority (Big Creek Conservation Area) - Call (519) 776-5209.

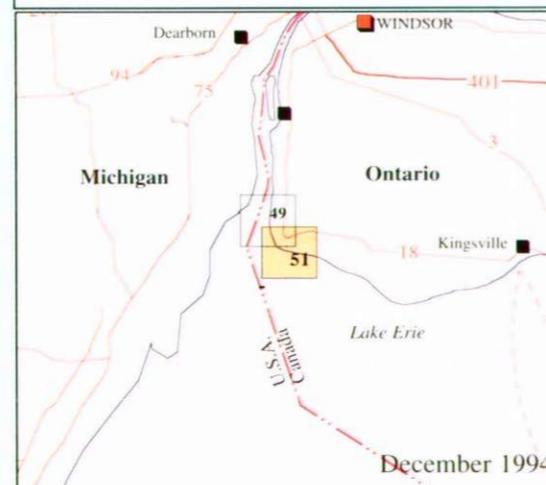
**90** This is an open lake staging area for diving ducks (Scaup, Mergansers), during the peak migration period of mid-October to late November. Concentrations during these periods and in late March may be in the thousands.

**92** Mann's Marsh is a Class 2 wetland that contains an abundance and assortment of natural vegetation. It is surrounded by a variety of land uses which provide excellent wildlife habitat for various species. The site contains harvestable timber, various commercial fish species, Snapping Turtles and furbearers (Muskrat, Raccoon, Mink, Red Fox). Hunting activity is moderate in the fall. The site is adjacent to Lake Erie but separated by a barrier beach. A number of provincially significant animal and plant species can be found in the marsh including the Black-crowned Night Heron, Great Egret, Eastern Fox Snake and Swamp Rose Mallow. The marsh also provides locally significant winter cover for deer. There are several sandy beaches in this area which are both public and provincially owned. There is Smelt spawning all along these beaches in the spring.



## Map 51

Contains Sections From NTS and USGS Maps:  
40J/3



For Environmental sensitivity information for the Canadian shoreline of Lake Erie, see Environment Canada's 1994 publication, "Environmental Sensitivity Atlas for Lake Erie (Including Welland Canal) and the Niagara River Shorelines".

For the United States shore, see NOAA's "Lake Erie Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI, 1985).



Scale  
Kilometres  
0 0.5 1  
0 0.25 0.5  
Miles  
1:25,000

Lake Erie

## Appendix A

### Data Sources

Source agencies for specific data used in the creation of the Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines are listed below.

### A.1 Biological Resources

#### A.1.1 Bird Information

##### Colonial Waterbird Nesting Sites

Environment Canada, Canadian Wildlife Service, 49 Camelot Drive, Nepean, Ontario, K1A 0H3 (613) 952-2410. Contacts Dr. Hans Blokpoel and Gaston Tessier

Environment Canada, Canadian Wildlife Service - Habitat Conservation, 152 Newbold Court, London, Ontario, N6E 1Z7 (519) 681-9486. Contacts - Gary McCullough and Norm North

Royal Ontario Museum Contact Dr. Jim Dick, Department of Ornithology, Ontario Nest Records Scheme

##### Waterfowl, Raptor, and Shorebird Data

Environment Canada, Canadian Wildlife Service, 49 Camelot Drive, Nepean, Ontario, K1A 0H3. (613) 952-0931. Contact Joe Carreiro

Environment Canada - Canadian Wildlife Service, 49 Camelot Drive, Nepean, Ontario, K1A 0H3 (613) 952-2299. Contact Ken Ross, Waterfowl Specialist

Environment Canada, Canadian Wildlife Service - Habitat Conservation, 152 Newbold Court, London, Ontario, N6E 1Z7 (519) 681-9486. Contacts - Gary McCullough and Norm North

Ducks Unlimited 1-800-665-DUCK

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

Ontario Ministry of Environment and Energy - Sarnia (519-336-4030) and Windsor (519-254-2546) offices

National Museum of Canada

Royal Ontario Museum Flora and Fauna (including rare) information, historic data (geological, meteorological)

Royal Ontario Museum Contact Dr. Jim Dick, Department of Ornithology, Ontario Nest Records Scheme

#### A.1.2 Fish Information

Canada Centre for Inland Waters, Fish and Ocean Charts, Burlington, Ontario. (905) 366-4549

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

Ontario Ministry of Environment and Energy - Sarnia (519-336-4030) and Windsor (519-254-2546) offices

#### A.1.3 Shore Associated Mammals

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

### A.2 Countermeasures

Transport Canada, Canadian Coast Guard, Prescott District, Prescott, Ontario. (613) 925-2865 (Ext. 258). Contact Ray Amell

The following USCG - MSO - Detroit (address below) personnel participated in joint Countermeasures determination sessions:

Mark Powers

Ben Smith

United States Coast Guard - Marine Safety Office, 110 Mt. Elliott Avenue, Detroit, Michigan. 48207-4380. Contact: Mark Powers

National Oceanic and Atmospheric Administration, 1240 East 9th Street, Cleveland, Ohio. 44199. (216) 522-7760. Contact: Ken Barton

United States Coast Guard, District 9, 1240 East Ninth Street, Cleveland, Ohio. 44199-2060. 216-522-3994. Contact: Laurie Perry

Great Lakes Response Corporation (PIMEC, Inc.), 291 St. Clair Parkway, Corunna, Ontario, N0N 1G0. (519) 862-2281. Contact Chuck Bailey, Dave Engleson

Ontario Ministry of Environment and Energy - Sarnia (519-336-4030) and Windsor (519-254-2546) offices

Environment Canada, Regional Environmental Emergencies Coordinator, Environmental Protection Branch Ontario Region, 25 St. Clair Avenue East, 7th Floor, Toronto, Ontario. M4T 1M2. (416) 973-1059. Contact Philip Baker

Environment Canada, Environmental Emergencies Officer, Environmental Protection Branch Ontario Region, 25 St. Clair Avenue East, 7th Floor, Toronto, Ontario. M4T 1M2. (416) 973-1061. Contact Steve Clement

### Weather Information

Atmospheric Environment Service Meteorological Station Sites, Meteorological Data (wind, temperature, precipitation etc.) 4905 Dufferin Street, Downsview, Ontario.

### A.3 Human-Use Resources

#### A.3.1 High Recreational Usage

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

Ontario Ministry of Environment and Energy - Sarnia (519-336-4030) and Windsor (519-254-2546) offices

St. Clair Region Conservation Authority, 205 Mill Pond Cres., Strathroy, ON N7G 3P9, phone - 519-245-3710

Essex Region Conservation Authority, 360 Fairview Ave. W., Essex, ON N8M 1Y6, phone - 519-776-5209. Contact: Dan Lebedyk

Lower Thames Valley Conservation Authority, 100 Thames Street, Chatham, ON N7L 2Y8, phone - 519-354-7310. Contact: Valerie Welsh

#### Anchorage Sites

Richardson's Chartbook and Cruising Guide, Richardson's Marine Publishing Inc., Streamwood, Illinois

#### Scuba Sites

"Dive Ontario!" publication. Contact: Cris Kohl, 16 Stanley Avenue, Chatham, Ontario. N7M 3J2 - (519) 351-1966

#### Small Craft Harbours

Department of Fisheries and Oceans, Canadian Centre for Inland Waters, Small Craft Harbours, Burlington, Ontario. (905) 336-4637

#### A.3.2 Resource Extraction

##### Water Intakes/Outfalls

Canadian Great Lakes Basin Intake and Outfall Atlas, Ontario Ministry of the Environment

DOE - Ontario Region Staff Inquiries

##### Commercial Fisheries Activity

Department of Fisheries and Oceans (DFO), Canadian Centre for Inland Waters, Burlington, Ontario. (905) 336-4637

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

### Natural Gas Wells and Pipelines

Ontario Ministry of Natural Resources, Petroleum Resources Section at 519-426-7650 or Pembina Exploration Ltd. at 905-834-4390

### A.3.3 Special Status Areas

#### Archaeological Site Information

The Ontario Ministry of Culture, Tourism and Recreation includes the following statement as a matter of standard policy with data distribution: "While the Ministry of Culture, Tourism and Recreation attempts to maintain a current and reliable database covering all known archaeological occurrences in the province, the Ministry waives responsibility for the quality, accuracy and completeness of this information and any damages which may be incurred through its use."

Heritage Policy Branch, Ontario Ministry of Culture, Tourism and Recreation, Contact Bernice Field, Archaeological Site Database, 77 Bloor St. West, Toronto, Ontario. (416) 314-7161, (416) 314-7790 (Fax)

#### Area of Ecological Significance

Environment Canada, Canadian Wildlife Service, Nepean, Ontario. (613) 952-0931

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

#### Areas of Natural and Scientific Interest (ANSI)

Ontario Ministry of Natural Resources Contact Lands Division, Areas of Natural and Scientific Interest, Ontario.

Ontario Ministry of Natural Resources (OMNR) Offices:

Tilbury OMNR Office, Lake St. Clair Fisheries Assessment Unit, RR #1, Tilbury, ON N0P 2L0, phone - 519-682-1152

Petrolia OMNR Office, 360 Centre St., Box 1379, Petrolia, ON N0N 1R0, phone - 519-882-0502

Chatham OMNR Office, Contact: Don Hector

#### Conservation Area Information

Association of Conservation Authorities of Ontario Contact Jan Street, Suite 127, Times Square, 380 Armour Road, Peterborough, Ontario. K9H 7L7 (705) 749-9131

Ministry of Natural Resources Conservation Authority Information Contact Phyllis Miller, Toronto, Ontario. (416) 314-1978

St. Clair Region Conservation Authority, 205 Mill Pond Cres., Strathroy, ON N7G 3P9, phone - 519-245-3710

Essex Region Conservation Authority, 360 Fairview Ave. W., Essex, ON N8M 1Y6, phone - 519-776-5209. Contact: Dan Lebedyk

Lower Thames Valley Conservation Authority, 100 Thames Street, Chatham, ON N7L 2Y8, phone - 519-354-7310. Contact: Valerie Welsh

#### Dune Formation Information

Natural Resources Canada, Geological Survey of Canada, Ottawa, Ontario. (613) 995-4342

Ontario Ministry of Natural Resources Crown Lands, 77 Wellesley St., MacDonald Block, Toronto, Ontario. M7A 2C1. (416) 314-2001

Ontario Ministry of Natural Resources, Surveys, Mapping and Remote Sensing Branch, Geographic Information Services, Topographic Data Base, 90 Sheppard Ave. East, 4th Floor, North York, Ontario. M2N 3A1. (416) 392-2510

Ministry of Northern Development and Mines, 900 Bay St., Toronto, Ontario (416) 314-3790

Ontario Geological Survey Mines and Minerals Information Centre Library c/o Janet Heitsch, Rm. M217900, Bay Street, MacDonald Block, Toronto, Ontario. M7A 1C3. (416) 314-3803

Ontario Government Book Store, (Publications, road maps, and Provincial Electoral Districts), Toronto, Ontario. (416) 326-5300

#### Environmentally Sensitive Areas

St. Clair Region Conservation Authority, 205 Mill Pond Cres., Strathroy, ON N7G 3P9, phone - 519-245-3710

Essex Region Conservation Authority, 360 Fairview Ave. W., Essex, ON N8M 1Y6, phone - 519-776-5209. Contact: Dan Lebedyk

Lower Thames Valley Conservation Authority, 100 Thames Street, Chatham, ON N7L 2Y8, phone - 519-354-7310. Contact: Valerie Welsh

Association of Conservation Authorities of Ontario, Contact Jan Street, Suite 127, Times Square 380 Armour Road, Peterborough, Ontario. K9H 7L7 (705) 749-9131

Ontario Ministry of Natural Resources Conservation Authority Information Contact Phyllis Miller, Toronto, Ontario. (416) 314-1978

#### First Nation/Native Land Information

Indian and Northern Affairs Canada, 25 St. Clair Ave. E., 5th floor, Toronto, ON M4T 1M2 - (416) 973-6234

Ontario Ministry of Natural Resources, Native Register Population (maps of settlements numbers, locations, resources used)

#### National Parks

Heritage Canada; Canadian Parks Service:

Fort Malden National Historic Park, Amherstburg, ON. Contact: Bob Garcia, Robert Watt

#### Provincial/State Parks, Nature Reserves or Wilderness Areas

Ontario Ministry of Natural Resources Peche Island Provincial Park, Windsor, ON, phone - 519-825-4659

Algonac State Park (810) 465-2160

#### A.4 Shoreline Habitats

##### Shoreline Classifications

Environment Canada, Environmental Emergencies Section, Environmental Protection Branch, Ontario Region, (416) 973-1059

Jeff Ollerhead (Contractor), Geomorphologist. Contact Environment Canada

##### Aerial Photos

Natural Resources Canada, Air Photo Sales, Ottawa, Ontario (613) 995-4560

Ontario Ministry of Natural Resources, Aerial Mapping Service First Floor, Room # M173900 Bay St. (Corner of Bay and Wellesley) Toronto, Ontario (416) 314-2001

Ministry of Natural Resources Air Photos (road, forestry and ground) 77 Wellesley St., MacDonald Block, Toronto, Ontario. M7A 2C1 (416) 314-2001

Ministry of Natural Resources Surveys, Mapping and Remote Sensing Branch, Geographic Information Services, Topographic Data Base, 90 Sheppard Ave., East, 4th Floor, North York, Ontario. M2N 3A1. (416) 392-2510

University of Toronto Mapping Library, Toronto, Ontario

University of Waterloo Map and Design Library, Environmental Studies Building, 1 University of Waterloo, Waterloo, Ontario. (519) 885-1211

#### A.5 Base Maps and Mapping System

##### Digital Layer Creation and System Consulting

Environment Canada staff, Christine Rowe (Contractor - contact DOE) and Digimap Data Services Inc. (Contractor) - 37 Kodiac Crescent, Unit 3, North York, Ontario

##### Municipal Maps

Ontario Base Maps (OBM) 1:20,000 Ontario Ministry of Natural Resources Topographic Mapping Section, 90 Sheppard Ave. East, 4th Floor, North York, Ontario. M2N 3A1 (416) 733-5090

##### Topographical Maps

Natural Resources Canada, Geological Survey of Canada, Ottawa, Ontario. (819) 564-5600

United States Geological Survey, Department of the Interior, Various Dates: "USGS Quad Maps", Washington, D.C.

Ontario Ministry of Natural Resources, Crown Lands (land titles, patents and leases), 77 Wellesley St., MacDonald Block, Toronto, Ontario. M7A 2C1. (416) 314-2001

Ontario Ministry of Natural Resources, Topographical Maps, 77 Wellesley St., MacDonald Block, Toronto, Ontario. M7A 2C1 (416) 314-1666

Ontario Government Book Store Publications, Ontario Road Maps and Provincial Electoral Districts, Toronto, Ontario (416) 326-6500

### A.6 Main United States Data Sources

Primary biological resource information was extracted from NOAA's: "St. Clair River, Lake St. Clair and Detroit River Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI, 1986). Where necessary, updates to that information were received from resource managers from the Michigan Department of Natural Resources.

Human-use, protection strategy, and sensitive area information was compiled from the USCG's "Southeastern Michigan Coastal Zone Area Contingency Plan".

## Appendix B

### Listing of National Topographic System (NTS) and United States Geological Survey (USGS) Map Sheets

The following NTS map sheets (1:50,000 scale) cover the Canadian shoreline of the St. Clair River, Lake St. Clair and Detroit River. Elements of base topographic maps showing on each atlas page have been reproduced with Natural Resources Canada's permission.

Map Sheet	Year
40 O/1	1986
40 J/16	1986
40 J/10	1986
40 J/9	1987
40 J/8	1986
40 J/7	1986
40 J/6	1986
40 J/3	1986

The following USGS Quad map sheets (1:24,000 scale) cover the United States shoreline of the St. Clair River, Lake St. Clair and Detroit River. The USGS map number (e.g. 43082) located in the Key Map Box on each map corresponds to the block (identified in the USGS Index to Topographic and Other Map Coverage publication) which includes the area covered by each map page.

Map Title	Map Number
New Baltimore, Mich.	N4237.5-W8237.5/7.5
Marine City, Mich.-Ont.	N4237.5-W8230/7.5
St. Clair Flats, Mich.-Ont.	42082-E6-TF-024
New Haven, Mich.	N4237.5-W8245/7.5
Mt. Clemens East, Mich.	N4230-W8245/7.5
Mt. Clemens West, Mich.	N4230-W8252.5/7.5
Grosse Pointe, Mich.	N4222.5-W8252.5/7.5
Belle Isle, Mich.-Ont.	N4215-W8252.5/7.5
Detroit, Mich.-Ont.	N4215-W8300/7.5
Dearborn, Mich.	N4215-W8307.5/7.5
Wyandotte, Mich.-Ont.	42083-B2-TF-024
Rockwood, Mich.-Ont.	N4200-W8307.5/7.5
Estral Beach, Mich.-Ohio-Ont.	N4152.5-W8307.5/7.5
Lakeport, Mich.-Ont.	N4300-W8222.5/7.5
Port Huron, Mich.-Ont.	42082-H4-TF-024
St. Clair, Mich.-Ont.	42082-G4-TF-024
Algonac, Mich.-Ont.	N4230-W8230/7.5

## Appendix C

### References and Suggestions for Further Reading

Baker, Philip, 1993: "Development of an Environmental Sensitivity Atlas for Lake Superior's Canadian Shoreline using Electronic Desktop Mapping" in Proceedings of the 16th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar pp. 225-254. Environment Canada, Ottawa, Ontario.

Canadian Coast Guard, Central Region/Environment Canada, Environmental Emergencies Section, 1979, Amended 1987: "Detroit - St. Clair River Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", Toronto, Canada.

Dennis, D.G. and N.R. North, 1994: "Waterfowl Use of Lake St. Clair Prior to and Immediately After Zebra Mussel Invasion", in Proceedings of the 37th International Association for Great Lakes Research and Estuarine Research Federation, University of Windsor, Windsor, Ontario.

Edwards, C.J., P.L. Hudson, W.G. Duffy, S.J. Nepszy, C.D. McNapp, R.C. Hass, C.R. Liston, B. Manny, W.D. Busch, 1987: "Hydrological, Morphometrical and Biological Characteristics of the Connecting Rivers of the International Great Lakes - A Review". Canadian Journal of Aquatic Sciences.

The Environmental Applications Group Ltd., 1987: "Lake Erie Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", prepared for Environmental Protection Ontario Region, Environment Canada, Toronto.

Environment Canada, Canadian Wildlife Service 1974: "Waterfowl Studies in Eastern Canada 1969 - 1973". Edited by Hugh Boyd. Report Series 29.

Environment Canada, Canadian Wildlife Service, 1984: "Waterfowl Studies in Ontario 1973-81". Edited by S. G. Curtis, D. G. Denis and H. Boyd, Occasional paper 54.

Environment Canada/Canadian Coast Guard, 1992: "The Oil Spill Shoreline Clean Up and Assessment Team (SCAT) Manual for the Ontario Great Lakes and St. Lawrence River Shorelines: Procedures for Assessment of Oiled Shorelines and Clean Up Options". Prepared by Owens, E. H., D.I. Little, and J.J. Young of Woodward-Clyde Consultants, Seattle, Washington.

Environment Canada, Environmental Protection Branch - Ontario Region 1993: "Environmental Sensitivity Atlas for Lake Superior's Canadian Shoreline", Minister of Supply and Services Canada, Cat. No. EN40-452/1993/E

Environment Canada, Environmental Protection Branch - Ontario Region 1993: "Environmental Sensitivity Atlas for Lake Ontario's Canadian Shoreline", Minister of Supply and Services Canada, Cat. No. EN40-453/1993/E

Environment Canada, Environmental Protection Branch - Ontario Region 1994: "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline (including Georgian Bay)", Minister of Supply and Services Canada, Cat. No. EN40-455/1994/E

Environment Canada, 1994: "Canadian Coastal Environments, Shoreline Processes and Oil Spill Cleanup" written by E.H. Owens, Owens Coastal Consultants Ltd., Environmental Protection Series Report 3/SP/5 - March 1994, Minister of Supply and Services Canada, Cat. No. En49-14/3-5E, Ottawa, Ontario.

Environment Canada, Environmental Protection Branch - Ontario Region 1994: "Environmental Sensitivity Atlas for Lake Erie (including the Welland Canal) and Niagara River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/9-1994E

Environment Canada, Environmental Protection Branch - Ontario Region 1994: "Environmental Sensitivity Atlas for the St. Marys River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/7-1994E

Environment Canada, Environmental Protection Branch - Ontario Region 1994: "Environmental Sensitivity Atlas for the St. Lawrence River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/5-1994E

Goodyear, C. D., T. A. Edsall, D. M. Ormsby Dempsey, G. D. Moss and P. E. Polansky, 1982: "Atlas of the Spawning and Nursery Areas of Great Lakes Fishes", Volumes 1 to 14, Prepared for the offices of Biological Services, Fish and Wildlife Service, U. S. Department of the Interior, Washington, D. C. 20240.

Great Lakes Basin Commission, 1975a: "Great Lakes Basin Framework Study: Appendix II - Levels and Flows", Great Lakes Basin Commission, Ann Arbor, Michigan.

Gundlach, E. R., Baca, B. J., Coastal Science and Engineering Inc., 1986: "St. Clair River, Lake St. Clair, and Detroit River: A Coastal Resource Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", prepared for Environmental Protection Ontario Region, Environment Canada, Toronto.

Kleinfeldt Consultants Ltd., 1990: "Canadian Great Lakes Basin Intake/Outfall Atlas", Volume 4 (St. Clair River, Lake St. Clair and Detroit River) prepared for the Ontario Ministry of the Environment.

Kohl, Cris, 1990: "Dive Ontario!" pub. Cris Kohl, 16 Stanley Avenue, Chatham, Ontario. N7M 3J2.

Limno-Tech. 1985: "Summary of Existing Status of Upper Great Lakes Connecting Channels Data", unpublished manuscript.

MacLaren Plansearch Limited, 1991: "Wind and Wave Climate Atlas - Volume III - The Great Lakes", prepared by MacLaren Plansearch Ltd., for Transport Canada, Montreal, Quebec. Transport Canada Publication Number TP 10820E.

Ontario Ministry of the Environment and Energy - Ontario Ministry of Natural Resources, 1992: "Guide to Eating Ontario Sport Fish", Queen's Printer for Ontario. ISSN 0826-9653, Toronto, Ontario.

Ontario Ministry of Natural Resources, 1969: Map - "Migratory Fish Location and Species".

Ontario Ministry of Natural Resources - Ontario Ministry of Municipal Affairs, 1992: "Wetlands Policy Statement - Manual of Implementation Guidelines". Queens Printer for Ontario, Toronto, Ontario.

Owens, E. H., 1982: "Canadian Inland Waters Coastal Environments and the Clean Up of Oil Spills", prepared for the Environmental Protection Service, Environment Canada.

Owens, E. H., 1979: "The Canadian Great Lakes: Coastal Environments and the Clean Up of Oil Spills", prepared for the Environmental Protection Service, Environment Canada.

Pembina Exploration Limited, 1994, 953 Elm Street, P.O. Box 98, Port Colborne, Ontario. L3K 5V7: "St. Clair River, Lake St. Clair and Detroit Pipeline Gathering Systems and Gas Well Locations".

Reinders, F. J. and Associates Canada Limited, 1988: "Littoral Cell Definition and Sediment Budget for Ontario's Great Lakes: Final Report", prepared for the Ministry of Natural Resources, Conservation Authorities and Water Management Branch, Toronto, Ontario.

Reinders, F. J. and Associates Canada Limited, 1988: "Littoral Cell Definition and Sediment Budget for Ontario's Great Lakes Appendix II to Final Report: Maps", prepared for the Ministry of Natural Resources, Conservation Authorities and Water Management Branch.

Research Planning, Inc., 1985: "St. Lawrence River Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1985: "Niagara River Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", U.S. shoreline prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1985: "Lake Erie Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", U.S. shoreline prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1993: "Lake Ontario Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", U.S. shoreline prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1985: "Lake Michigan Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1994: "Lake Huron Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil; Supplement to the Joint Canada - United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", U.S. shoreline prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1989: "Natural Resource Response Guide: Marine Mammals". Prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1987: "Natural Resource Response Guide: Marine Fish". Prepared for Office of the Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1989: "Natural Resource Response Guide: Marine Shellfish". Prepared for the Office of

Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Research Planning, Inc., 1988: "Natural Resource Response Guide: Marine Birds". Prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (NOAA).

Richardson's Marine Publishing Inc., 1990: "Richardson's Chartbook and Cruising Guide", Streamwood, IL.

Robichaud, J. I., 1984: "Sailing Directions, Great Lakes", Volume I (Lower Great Lakes), Sixth Edition, Department of Fisheries and Oceans.

Saulesleja, A. (ed.), 1986: "Great Lakes Climatological Atlas", Atmospheric Environment Service, Environment Canada, Ottawa, Ontario.

Scott, W.B. and E.J. Crossman, 1973: "Freshwater Fishes of Canada", Department of Fisheries Research Board of Canada, Bulletin 184, Minister of Supply and Services Canada, Ottawa, Ontario.

Sly, P.G. and C.F.M. Lewis, 1972: "The Great Lakes of Canada - Quaternary Geology and Limnology Guidebook to Field Excursion A43", 24th International Geology Conference, Geology Survey of Canada, Ottawa, Ontario.

United States Coast Guard, Marine Safety Office - Cleveland, 1993: "Area Contingency Plan". USCG - MSO 1055 9th Street, Cleveland, Ohio. 44114.

United States Coast Guard, Marine Safety Office - "Southeastern Michigan Coastal Zone Area Contingency Plan - 1993". USCG - MSO 110 Mt. Elliott Avenue, Detroit, Michigan. 48207-4380.

United States Coast Guard, Marine Safety Office - Western Lake Erie, 1993: "Area Contingency Plan". USCG - MSO 234 Summit Street, Toledo, Ohio. 43604-1590.

United States Geological Survey, Department of the Interior, Various Dates: "USGS Quad Maps", Washington, D.C.

Upper Great Lakes Connecting Channels Study (UGLCCS), 1988: Volume 1 and 2, Final Report, Contributed By: U.S. Fish and Wildlife Service, Ministry of Environment and Energy, NOAA, U.S. Army Corps of Engineers, City of Detroit, U.S. Environmental Protection Agency, Environment Canada.

## Appendix D

### Acronyms and Abbreviations Used in Environmental Sensitivity Atlases

AID	Atmospheric Issues Division
ANSI	Area of Natural and Scientific Interest
CA	Conservation Authority
CCG	Canadian Coast Guard
CWS	Canadian Wildlife Service
DEC	New York State Department of Environmental Conservation
DOE	Department of Environment/Environment Canada
EPA	Environmental Protection Agency
EPB	Environmental Protection Branch
ESA	Environmentally Sensitive Area
ESI	Environmental Sensitivity Index
Ft	Feet
GIS	Geographic Information System
GLRC	Great Lakes Response Corporation
GS	Generating Station
IBP	International Biological Program
Km or km	Kilometre
M or m	Metres
MDNR	Michigan Department of Natural Resources
MSO	Marine Safety Office
NOAA	National Oceanic and Atmospheric Administration
NRC	Natural Resources Canada
NTS	National Topographic Series
OMNR	Ontario Ministry of Natural Resources
OMOEE	Ontario Ministry of Environment and Energy
OR	Ontario Region
RAP	Remedial Action Plan
REEC	Regional Environmental Emergencies Coordinator
RPI	Research Planning, Inc.
SAR	Sensitive Area Reports
Twp	Township
US	United States
USCG	United States Coast Guard
USGS	United States Geologic Survey
WSF	Water Soluble Fraction



To assist users in discerning one shoreline colour from another, a removable Legend insert has been included with the atlas. If required, users may line up this card over the shoreline habitat in question, to determine the exact colour of a given habitat.

## Legend

- ESI\* Ranking**
- 1a(1a) Exposed Bedrock Bluff less than 1 metre elevation
  - 1b(1a) Exposed Bedrock Bluff 1-5 metre elevation
  - 1d(1a) Exposed Bedrock Bluff greater than 5 metre elevation
  - 2(1b) Retaining Wall/Harbour Structure/Breakwaters
  - 3(2) Shelving Bedrock
  - 4(3) Exposed Sediment Bluff
  - 5a(4) Sand Beach: Depositional
  - 5b(4) Sand Beach: Erosional or Transitory
  - 6(4) Sand Barrier With Lagoon
  - 7a(6a) Pebble Beach
  - 7b(6a) Pebble/Cobble Beach
  - 7c(6a) Cobble Beach
  - 8(6b) Rip Rap
  - 9(6a) Boulder Beach
  - 10(5) Mixed Beach (% by sediment in DOE Database)
  - 11(9a) Low Vegetated Bank (Grass or Trees)
  - 12(9b) Delta Mud Flat
  - 13a(10a) Fringing Wetland
  - 13b(10b) Broad Wetland

### Shoreline Habitats

#### Bedrock or Impermeable Shores

- Unconsolidated Sediment Shores**

#### Vegetated Shores

- \* ESI - Canadian Environmental Sensitivity Index (USA ESI Ranking follows in brackets) Higher numbers indicate greater sensitivity.

### Biological Resources

- Fish**
- Area of Seasonal Fish Spawning
  - Location of Seasonal Fish Migration
- Birds**
- Migratory Waterfowl
  - Colonial Nesting Birds (total nests - all species)
  - Wading Birds (total nests - all species)
  - Shore Birds
  - Raptors
- Shore Associated Mammals**
- Furbearers (such as Muskrat, Mink, and Beaver)

### Human-Use Resources

- High Recreational Usage**
- Marinas and Small Craft Harbours
  - Anchorage Sites
  - Residential, Recreational or Cottage Use
  - High-Use Recreational Beach
  - Recreational Dive Site
- Resource Extraction**
- Water Intakes - Industrial
  - Water Intakes - Municipal
  - Outfall
  - Commercial Fisheries Activity
- Special Status Areas**
- Highly Sensitive Classified Feature (within 2km)
  - First Nation/Native American Reservation
  - National Park/National Forest
  - Provincial/State Park, Wilderness Area or Nature Reserve/State Forest
  - Conservation Area or Municipal Park
  - Environmentally Sensitive Area\*
  - Area of Natural and Scientific Interest\*
  - Area of Ecological Significance (e.g. Wetland)
  - Dune Formations

\* As identified by Ontario Ministry of Natural Resources or Conservation Authorities

### Countermeasures

- Access Site (for land vehicles)
- Approach Concerns
- Exposed Rock
- Coast Guard Light Station
- Boat Launch: Excellent
- Boat Launch: Good
- Boat Launch: Poor
- Helicopter Landing Site
- Staging Area: Excellent
- Staging Area: Good
- Staging Area: Poor
- Automated Weather Stations

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