Environmental Sensitivity Atlas for the St. Marys River Shorelines

Environment Canada
Environmental Protection Branch
Ontario Region

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

Legend

Shoreline Habitats

ESI* Ranking

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

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Environmental Sensitivity Atlas for the St. Marys River Shorelines

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Prepared by:

Environment Canada
Environmental Protection Branch
Ontario Region
Canadian Coast Guard
1994

United States Coast Guard - District 9
United States National Oceanic and Atmospheric Administration

These maps are not to be used for navigational purposes.

Acknowledgements

Environment Canada's Environmental Protection Branch, Ontario Region, the National Oceanic and Atmospheric Administration, Canadian Coast Guard and the United States Coast Guard - District 9 would like to express their appreciation for the time and effort of all those who contributed to the development of the Environmental Sensitivity Atlas for the St. Marys River Shorelines. Appendix A has a list of these agencies and contact persons for the data they contributed.

We would particularly like to acknowledge the extensive help we received from the following: the Ontario Ministry of Natural Resources District Office in Sault Ste. Marie; Dan Badger of Canadian Coast Guard's Parry Sound Base; the Great Lakes Response Corporation (PIMEC, Inc.); Jacqui Michel of Research Planning, Inc.; the Ontario Ministry of the Environment and Energy, and the Environmental Conservation Branch of Ontario Region. Elements of base topographic maps showing on each atlas page have been reproduced with Natural Resources Canada's (NRC) permission.

This project was funded by Environment Canada, with support from Canada's Green Plan. Substantial funding assistance for atlas development for the Connecting Channels was provided by the Great Lakes Response Corporation (PIMEC, Inc.). The Canadian Coast Guard made a significant contribution in the form of helicopter time and crews.

Atlas and Supplement Project Team

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Table of Contents

1.0 Introduction

The **"Environmental Sensitivity Atlas for the St. Marys 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. Marys River, from the Lake Superior entrance to the river, west of Sault Ste. Marie, Ontario (and the Michigan city of the same name) to the beginning of Lake Huron and the North Channel at St. Joseph Island and Drummond Island. The Canadian and United States shorelines west of the study area in this atlas can be found in Environment Canada's "Environmental Sensitivity Atlas for Lake Superior s Canadian Shoreline" (DOE 1993) and NOAA's "Lake Superior Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (U.S. shores - RPI, 1994). For environmental sensitivity information east of the study area, see Environment Canada's "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline" (DOE 1994) and NOAA's "Lake Huron Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (U.S. shores - 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 and Connecting Channels 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. Marys 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 for the St. Marys River area.

The St. Marys 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 entire 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. Marys 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 1985-86) 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 1:250,000 have been used to create the digital Canadian shorelines for the St. Marys River. Digital maps at a scale of 1:50,000 (the scale available for southern Ontario) were not yet available from Natural Resources Canada for this northern study area. The digital U.S. shoreline of the St. Marys 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 1:50,000, covering the entire 397 kilometres (248 miles) of the St. Marys River shorelines (including islands) contained within the study area; 207 kilometres (129 miles) of Canadian shoreline and 119 miles (190 kilometres) of American shoreline, on a total of 16 map pages. Maps 3 and 4 for the St. Marys River Atlas are an exception; in order to show the detail of the developed Sault Ste. Marie area concentrated along a relatively narrow river, a scale of 1:25,000 has been used for these two map plates.

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. Marys 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 Canadian and American shorelines of the St. Marys River 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. On–site examination (or 'ground truthing') will ensure that any minor discrepancies are identified during spill response.

5.0 Atlas Design and Function

5.1 Symbology 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–use 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. Marys 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 priorizing decisions will be made by qualified response experts at the time of the spill.

6.0 Description of Atlas Legend Features

A colour example of the Environmental Sensitivity Atlas legend is shown in Figure 1. Figure 2 identifies standard features appearing on the base maps in the Atlas and Supplement. 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.

Figure 1: Environmental Sensitivity Atlas Legend

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
- Unclassified streets
- Trail or cut line
- Railway
- Railway tunnel
- Pipeline (underground)
- Ferry
- Vehicle Tunnel

Note: U.S. roads are not classified for this atlas and are represented by a single red line.

Figure 2: Standard Cartographic Legend for Base Maps

Legend

Shoreline Habitats

ESI* Ranking

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

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. Marys 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.

A limited amount of data was available for rare plants along the St. Marys 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. Marys 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. Marys 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. Marys River is derived from information supplied by the various District Offices of the Ontario Ministry of Natural Resources (OMNR), "Freshwater Fishes of Canada" (Scott and Crossman 1973) and the "Upper Great Lakes Connecting Channels Study" (1988). This general information will complement details found on the individual maps.

Commercial fish species in the St. Marys River once included lake whitefish; some commercial herring and walleye fisheries activity continues. Sport fishing species include: rainbow and lake trout; chinook and pink salmon; yellow perch; smallmouth bass; northern pike; walleye; whitefish and rainbow smelt. Brown bullhead; longnose and white sucker are also present in the river in various locations.

Lake trout are fall spawners over large boulder or rubble bottoms, often in shallow water.

Rainbow trout enter most tributaries to spawn during April and May after the peak smelt runs, and to some extent in the fall months

Lake whitefish adults congregate in shallow water (usually at depths of less than 8 metres) in November and December to spawn. Young whitefish are found in shallow waters until the early summer when they move into deeper water.

Chinook and pink salmon spawn in fall in the river and in many tributaries.

Spawning activity for walleye occurs along the St. Marys River during the spring, often over boulder or coarse gravel shoals.

Yellow perch spawn in the spring in the shallows of the river or in its tributary rivers.

Rainbow smelt are present spawning in most streams in spring.

Smallmouth bass spawn in late spring to early summer in 0.5 to 6 metres of water on a sandy, gravel or rocky bottom of the river, usually near the protection of rocks or logs.

Northern pike are spring spawners over flooded margins of rivers, marshes or large bays in the St. Marys River.

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, black duck, northern pintail, American widgeon and teal), plus those species of more open water such as loons, grebes and diving ducks (including common goldeneye, scaup, old squaw, harlequin, bufflehead, scoter and merganser). Often the 'Notes' column will identify critical staging areas, feeding areas or wetlands for these migratory waterfowl.

'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 and Connecting Channels 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, great blue herons, black-crowned night herons (rare), ring–billed gulls, common terns and Caspian terns (rare along the St. Marys River).

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 "St. Marys River Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI), compiled in 1986, 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 in the new Great Lakes environmental sensitivity atlases, these two symbols are sometimes followed by a number (when available) representing the total number of nests for all species at that location. The species–specific nest numbers are available in the master database. These nest numbers were not readily available for this study area and do not appear on the individual maps for the St. Marys River.

The total nests number (when available) 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. Marys River during the ice free season.

'Raptors'

The three most important raptor species found along the St. Marys River shorelines are peregrine falcons (very rare), ospreys and bald eagles. The maps show general locations of nest sites. However, bald eagles and ospreys can forage up to 20 kilometres from the nest, so all shallow water areas along the river's shore are potential feeding areas. 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.

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. Marys 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. Marys 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. Marys 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'

The majority of the St. Marys River no longer supports any commercial fishing activity, although at one time a whitefish commercial fishing industry was successful. At the south end of St. Joseph Island, at Old Fort St. Joe Point, there is commercial fisheries activity for herring and walleye. 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. No commercial fish farms were identified on the St. Marys River. 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 Canadian shoreline of the St. Marys River; Garden River and Ojibways of Batchewana First Nation Rankin Location (Map 5). There is one Native American Reservation along the U.S. shoreline of the St. Marys River, however, the Bay Mills Native American Reservation occupies two segments of shoreline (Map 1 and Map 7). Where First Nations or Reservations are identified, a reference is made in the 'Notes' column in each case advising responders to contact the local First Nation/Native American Reservation Chief 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.

'National Park/National Forest'

National Parks (including National Heritage Sites) are managed by Heritage Canada's Canadian Parks Service in Canada. Fort St. Joseph National Historic Site is the only Canadian example in the study area. National Forests and Parks in the United States are managed by the Department of the Interior. Hiawatha National Forest (Map 1) is the only American example of this sort in the study area. 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., spills affecting State Parks and State Forests are under the jurisdiction of the Michigan State 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.

'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. Marys 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 State 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.

The submergent vegetation beds located along the St. Marys 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 accomodate 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 open–water 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. Marys 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. Marys 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. Marys 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 (ring–bills 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. Marys River shoreline areas most activities at the nesting colonies will take place during April through August.

7.2.3 Wading Birds

Herons, 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 St. Marys River shorelines, most activities at the nesting colonies will take place during April 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. Marys River shorelines. 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, and for peregrine falcons, 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. Marys River shorelines.

Table 1A: St. Marys River Bird Seasonality: Colonial Waterbirds

				Category			Abundance		
Species	Period present on St. Marys River	Breeding SeasonΔ	Nest Location	Migrant	Summer Resident	Winter Visitor	Common	Uncommon	Rare
Double-crested Cormorant	April to October	April to August	On ground and in trees (islands and peninsulas).	√	√		√		
Great Blue Heron	April to October	April to August	In trees (islands and on mainand)	√	√			√	
Herring Gull	March to December	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)	√	√			√	
Black-crowned Night heron	Late April to October	May to August	In trees (islands)		√				√
Caspian Tern	May to October		On ground (islands)		√				√

Δ From establishing nesting territories through fledgling chicks.

(CWS and the Canadian Forest Service, 1994)

Table 1B: St. Marys River Bird Seasonality: Waterfowl, Shorebirds, Raptors

Species	Status	Period Present on St. Marys River
Common Loon	Common migrant and common breeder	Whole ice-free period
Grebe species (red-necked grebe)	Common migrants	Whole ice-free period, particularly August to November (18000 plus)
Canada Goose	Very common migrant; common breeders	April to October
Dabbling Ducks (including mallard, black duck, northern pintail, American wigeon, teals)	Very common migrants; common breeders	Ice-free period (April, May, August to October)
Diving Duck (harlequin duck)	Rare but annual occurence in low numbers; winter visitor	October to May
Diving Ducks (including scaups, oldsquaw, common goldeneye, bufflehead, scoters, mergansers)	Abundant in migration; uncommon summer visitor	Ice-free period; highest counts during migration (April, May, August to November)
Shorebirds (including sandpipers and plovers)	Locally uncommon migrants; uncommon breeders	Mostly during migration (late April and May, August and September)
Bald Eagles	Common resident	Year round
Osprey	Common breeder	April to November
Peregrine Falcon	Very rare	April to October
American White Pelican	Rare migrant	May to August

(CWS and the Canadian Forest 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. Marys River Shoreline Habitat Classification Scheme

The Canadian shoreline of the St. Marys River has 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	
		Bedrock or Impermeable Shores
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
		Unconsolidated Sediment Shores
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)
		Vegetated Shores
9a	11	Low Vegetated Bank (Grass or Trees)
9b	12	Delta Mud Flat
10a	13a	Fringing Wetland
10b	13b	Broad Wetland

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. Marys 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 and Connecting Channels 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

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

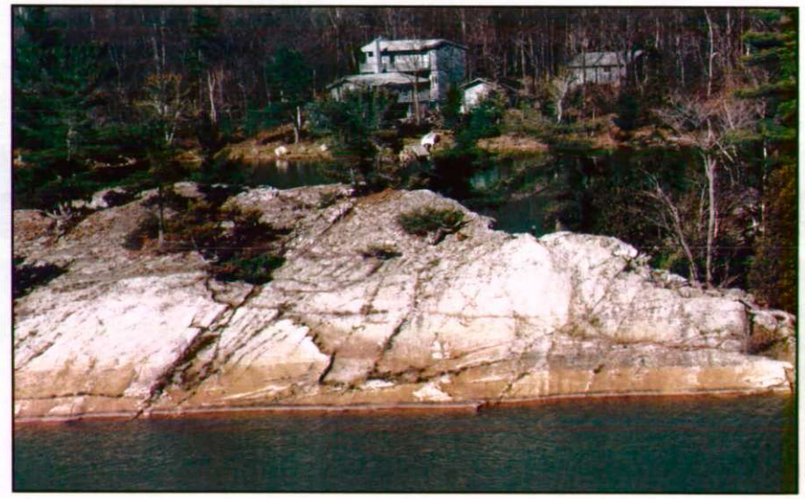
The combination of resistant bedrock surfaces, little sediment, steep slopes, and a constant, high wave energy environment make exposed bedrock bluffs the least sensitive shoreline to oiling. Exposed bedrock bluff is uncommon in the study area. Campement d'Ours Island in St. Joseph Channel has shore type 1a and 1b examples. Shoreline habitat 1c is rare; Belford Island north of Portlock Island in St. Joseph Channel is an example.

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 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 often 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.



1b. Exposed Bedrock Bluff
1-5 metre elevation

1c. Exposed Bedrock Bluff
greater than 5 metre elevation

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)

Shelving bedrock shores are wide, flat expanses of bedrock, at or immediately below normal water levels. This shoreline type is rare in the study area. Old Quarry Point on the northeast side of St. Joseph Island is an example, as is Young Island on the north side of Drummond Island.

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 4)

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. The St. Marys River has only a few sections of exposed sediment bluff, for instance, on the northwest and southwest sides of Neebish Island and at Izaak Walton Bay. 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 tend to be shallow and uniformly sloping.

The depositional sand beaches in the study area tend to be quite thin and narrow, and are rarely backed by sand dunes. In fact, Pointe des Chênes and Brimley State Park are two of the few depositional sand beaches along the St. Marys River.

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, where 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. Marys River shoreline, although most are erosional. The west side of St. Joseph Island, for instance, has examples of shore type 5b, as does Izaak Walton Bay at the west end of the St. Marys River. On an erosional beach the gross annual amount of sediment leaving the system exceeds the gross annual amount 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 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 1 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.

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

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

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. There are only several examples of this shoreline type in the study area; on the north side of Neebish Island, along the east shore at Hiawatha National Forest and north of Munuscong State Forest.

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 effected 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 rare along the St. Marys River shorelines; Lime Island near Old Fort St. Joe Point is a good example. Pebble beaches are characteristically narrower and steeper than sand beaches; widths of 2–5 metres are common.

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)ç

Pebble/cobble beaches are fairly common in certain areas along the St. Marys River shorelines, for instance on the southwest side of St. Joseph Island and along Drummond Island. 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)

There are short stretches of cobble beach scattered throughout the eastern reaches of the St. Marys River, for instance, along the southeast side of St. Joseph Island. This shore type is made up of 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.

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

Boulder beaches are very rare in this study area. Whitney Bay near De Tour Passage has several examples. 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.

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

Mixed beaches are rare along the St. Marys River shorelines; there are only several examples mainly along the shore of Hiawatha National Forest and in Back Bay near Bay Mills Native American Reservation.

They 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. Marys 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. This shore type is widespread along the St. Marys River, especially in the channels surrounding Little Lake George.

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 deltaic mud flat shorelines are present in the study area.

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. Marys 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 along Lake George 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. Marys 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. Echo Bay and Munuscong Bay are excellent examples of 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. Marys River: Physical Overview

West of Sault Ste. Marie at Gros Cap Reefs in Whitefish Bay, Lake Superior drains into the St. Marys River, connecting the lake with the North Channel and Lake Huron at De Tour Passage. The river separates the Province of Ontario and the State of Michigan. Including islands, the Canadian shoreline length of the St. Marys River is 207 kilometres. The United States shoreline length of the St. Marys River is 119 miles (190 kilometres). The river's width varies from 300 metres (about 1000 feet) to 6.4 kilometres (4 miles). The shore is moderately populated, with industrial and commercial development in the Sault St. Marie area and primarily cottage and residential development in many other areas. Most of the shoreline is fairly accessible.

Between Lake Superior and Lake Huron, the St. Marys River water level drops 6.8 metres (22 feet) and the river has an average flow rate of 2200 cubic metres per second (Limno-Tech. 1985). The flow rate and water level of the St. Marys River is partially controlled by locks and compensating structures and power generation, therefore, the river is not subject to large unpredictable fluctuations. A series of locks (the St. Marys Falls Canal on the American side and the Sault Ste. Marie Canal on the Canadian side) allows commercial vessel traffic to move between Lake Superior and Lake Huron, typically from April until December or January.

The St. Marys River is a sheltered environment dominated by river currents rather than by wave generated processes, although waves generated by passing vessels can be as high as 0.5 metres and are an important factor on shores adjacent to shipping lanes. Maximum fetches (the area of open water over which waves are generated by wind) are very low compared with the open lakes (Owens, et al., 1992). The river's upper reach is a single channel but beyond the rapids (St. Marys Falls) and navigation locks at Sault Ste. Marie, the river separates around Sugar Island and St. Joseph Island into a series of channels, islands and lakes. This is a riverine environment in which the long, narrow lakes are relatively shallow.

The St. Marys River is a mixture of low rock outcrops, narrow mixed sediment beaches and extensive wetland areas. Marshes are common in sheltered bays where fine-grained sediments have accumulated, but beach deposits are restricted in length and isolated to a few sections. Because of the rocky shoreline and the narrow, winding channels of the St. Marys River it is considered a high risk area for vessel accidents (Owens, 1979).

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. Longshore sediment transport is the mechanism by which sediment material is moved parallel to the coast (by wave–induced processes). However, sediment availability is scarce in the St. Marys River, and wave induced processes are not predominant, making shoreline transport assessment rather straightforward in much of the study area. Table 2 summarizes the main features of the coastal environment for the St. Marys River shorelines region.

An important consideration on the St. Marys River 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.

Table 2: Coastal Environments of St. Marys River Shoreline

		Coastal Zone			
Subdivision	Relief and Geology	Shore-Zone Character	Beach Character	Fetch, Wave Exposure and Ice	Sediment Availability and Transport
St. Mary's River	Resistant Shield and sedimentary rocks outcrop in shore zone: low relief	Riverine coast with channels, islands and linear lakes: mixed character of low, rocky coast or narrow coarse-sediment beaches with extensive marshes in shallow areas	Beaches narrow and predominantly poorly-sorted sand to boulder size sediments	Very low energy levels: predominantly riverine environment: shore-zone ice up to 5 months/year	Sediments scarce: general transport direction follows river channels into Lake Huron

(Owens, 1979)

Wind driven currents form the dominant surface circulation on open water in the Great Lakes, while river currents and wind effects combine to form circulation patterns along the St. Marys River. The general pattern of the surface water flow in the river is from west to east and southeast (see Figure 3 on following pages).

The swiftest currents in the navigable channels of the St. Marys River occur at the Middle Neebish Channel dyke, the West Neebish Channel rock cut and the Little Rapids Cut. Currents are also strong at the power canals in Sault St. Marie. The following reaches are given with their respective usual, probable low and probable high current rates: West Neebish Channel rock cut - 1.7 knots, 1.1 knots, and 3 knots; Middle Neebish Channel dyke - 1.3 knots, 0.9 knots, and 2.6 knots; Michigan power canal - 2.1 knots, 1.7 knots, and 2.6 knots; and Ontario power canal - 1.7 knots, 0.9 knots, and 2.6 knots (DFO, Sailing Directions, 1984).

Maximum water surface temperatures on the St. Marys River typically reach above 18 C by late summer (Saulesleja, 1986). Figure 3 also gives general information such as communities with their populations.

10.2 Ice Cover

Normally ice begins to form on the St. Marys River in early December, with full coverage by January. A normal extensive ice cover exists throughout the winter on the river (see Figure 4). Ice thicknesses vary during the winter months, and from year to year.

> "The upper and lower parts of the St. Marys River attain average maximum thicknesses of 51 and 66 centimetres (20 and 26 inches), respectively. The river is not much affected by wind and the channel track remains well defined, with a stable ice sheet outside the channel. Broken pieces of ice accumulate in the channels and may become concentrated in some bottleneck areas."
> (DFO, Sailing Directions, 1984).

Break up of ice cover on the St. Marys River commences typically during early April, with the river typically being ice free by late April (Saulesleja, 1986). Figure 4 shows typical maximum and minimum mid-winter ice conditions on the St. Marys River.

(Saulesleja, 1986)

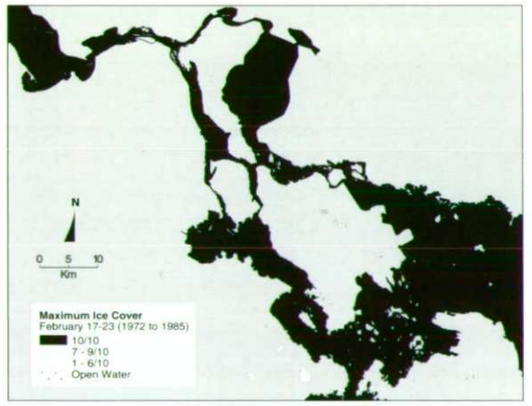


Figure 4a: St. Marys River: Maximum Mid-Winter Ice Cover

(Saulesleja, 1986)

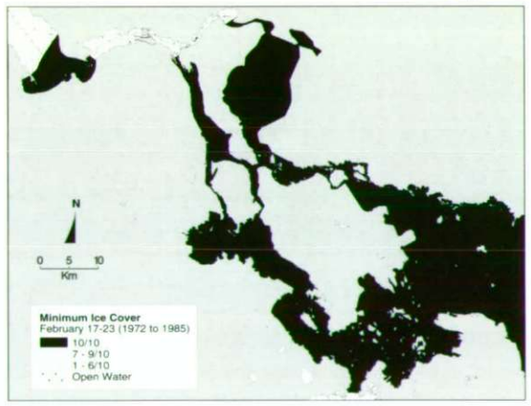
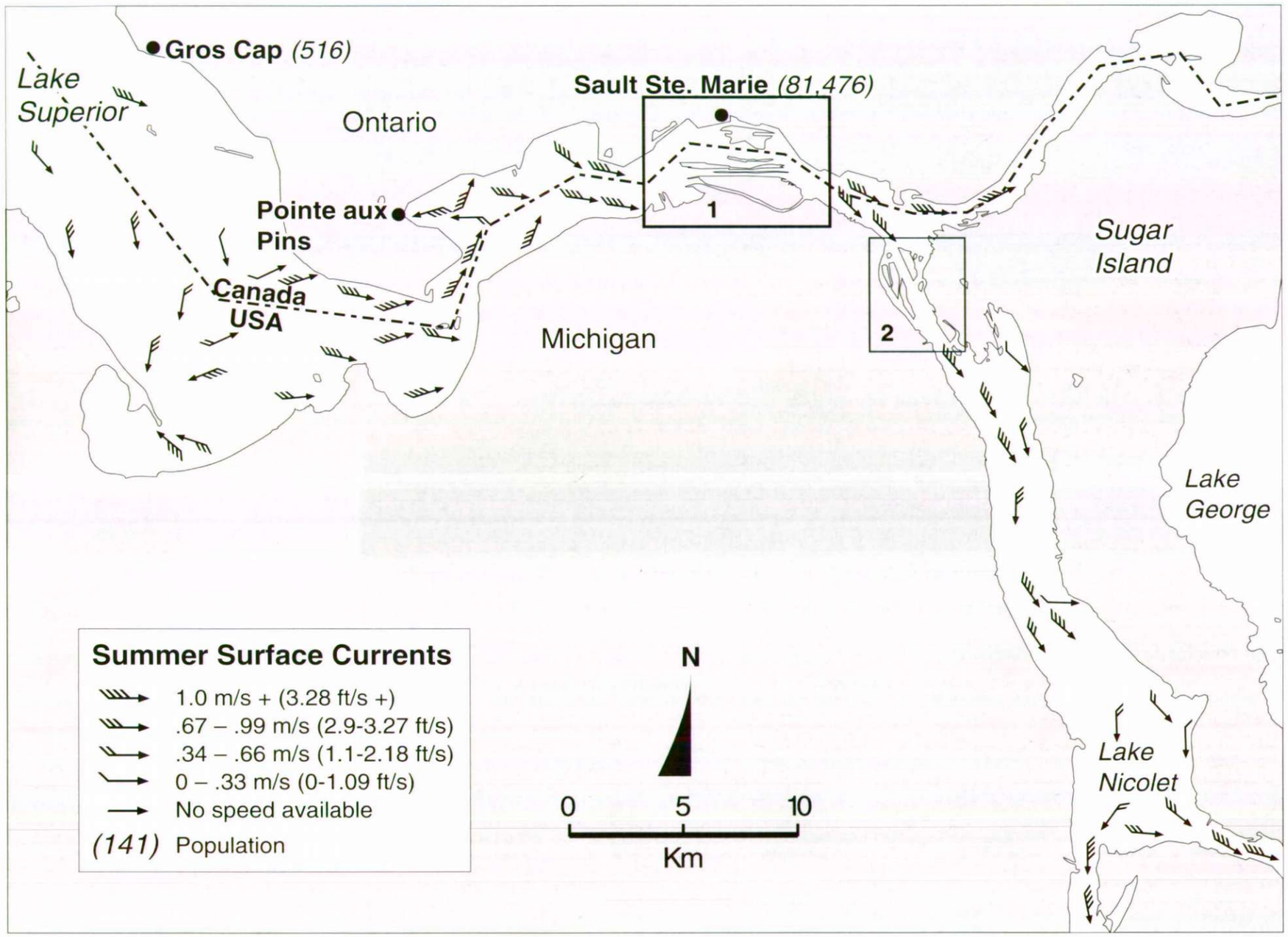
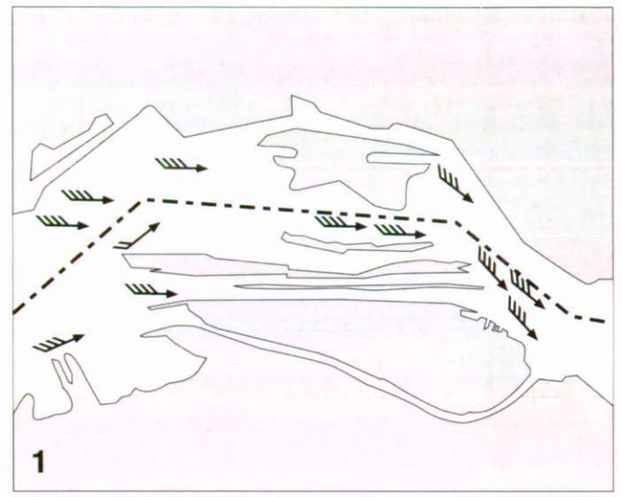


Figure 4b: St. Marys River: Minimum Mid-Winter Ice Cover

10.3 Wind and Waves on the St. Marys River

The prevailing winds for the St. Marys River alternate from the northwest and southeast along the length of the river. Wave energy levels are lower in the relatively sheltered environment of the river compared with the open lakes, although passing vessels will often generate waves from their wakes up to 0.5 metres in height at the shore. Near the Lake Superior entrance to the St. Marys River, waves up to 4 metres height are possible in strong winds due to the distance over Lake Superior that the waves have travelled. The same is true for the southern entrance to the river at De Tour Passage with strong southerly winds.





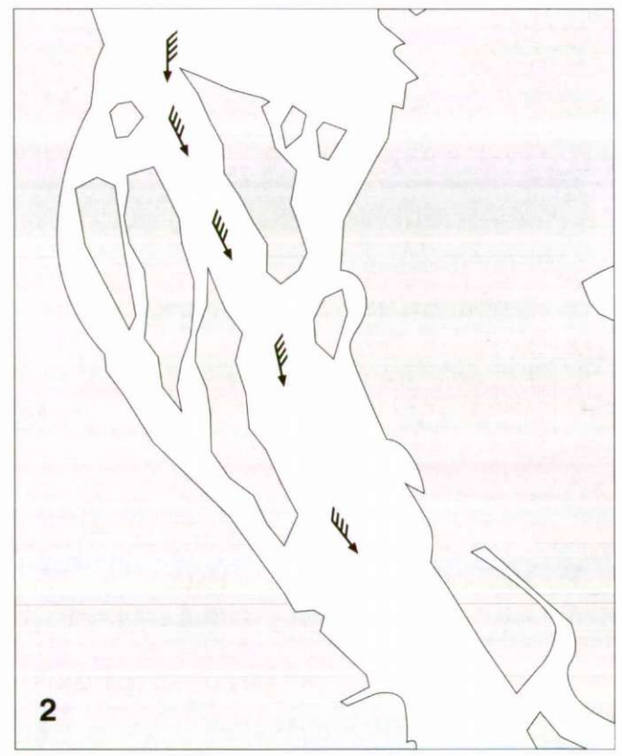


Figure 3a: St. Marys River Overview and Surface Currents (Canadian Coast Guard, 1981)
(Population Data Source: Statistics Canada Census, 1991)

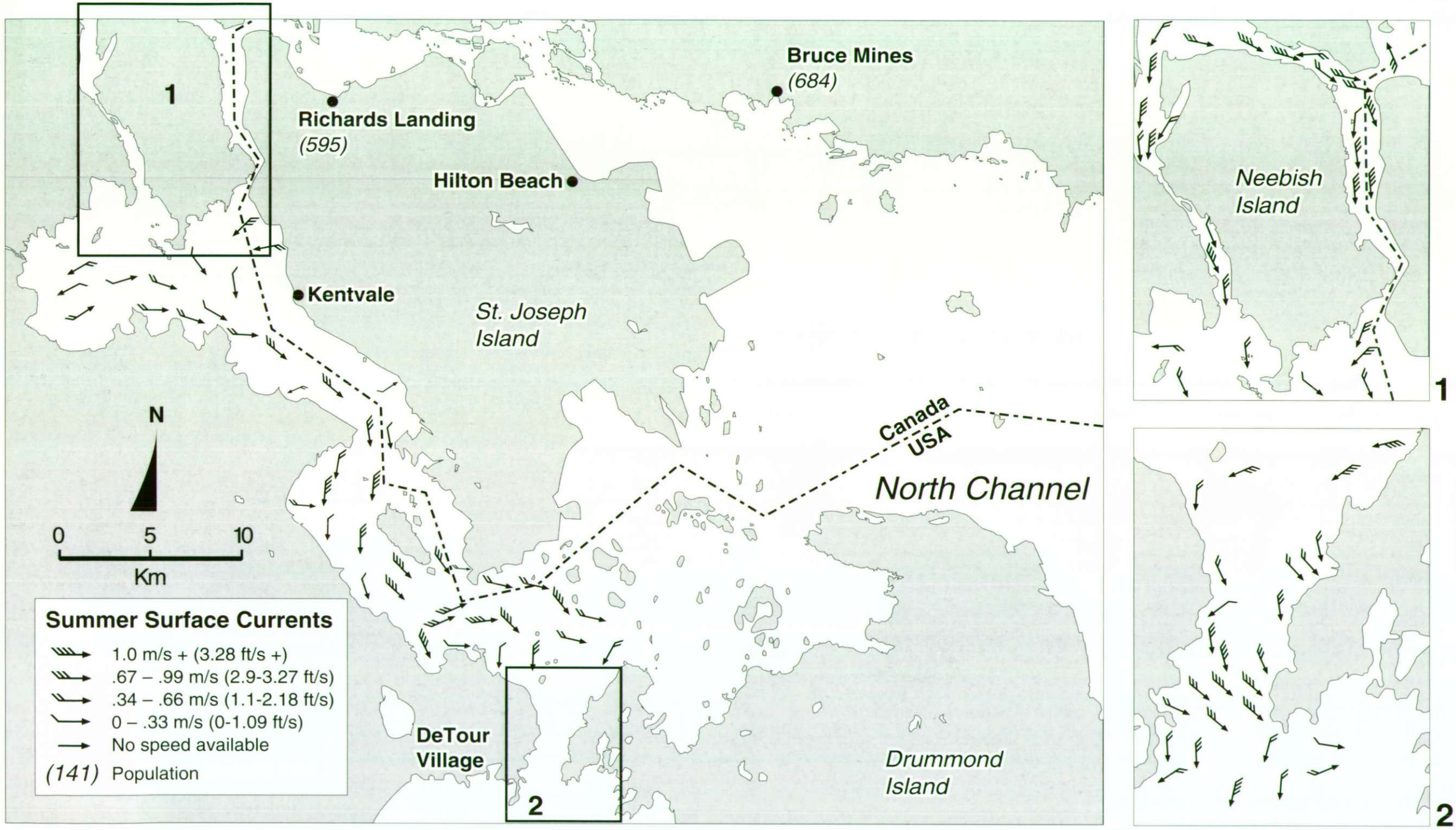
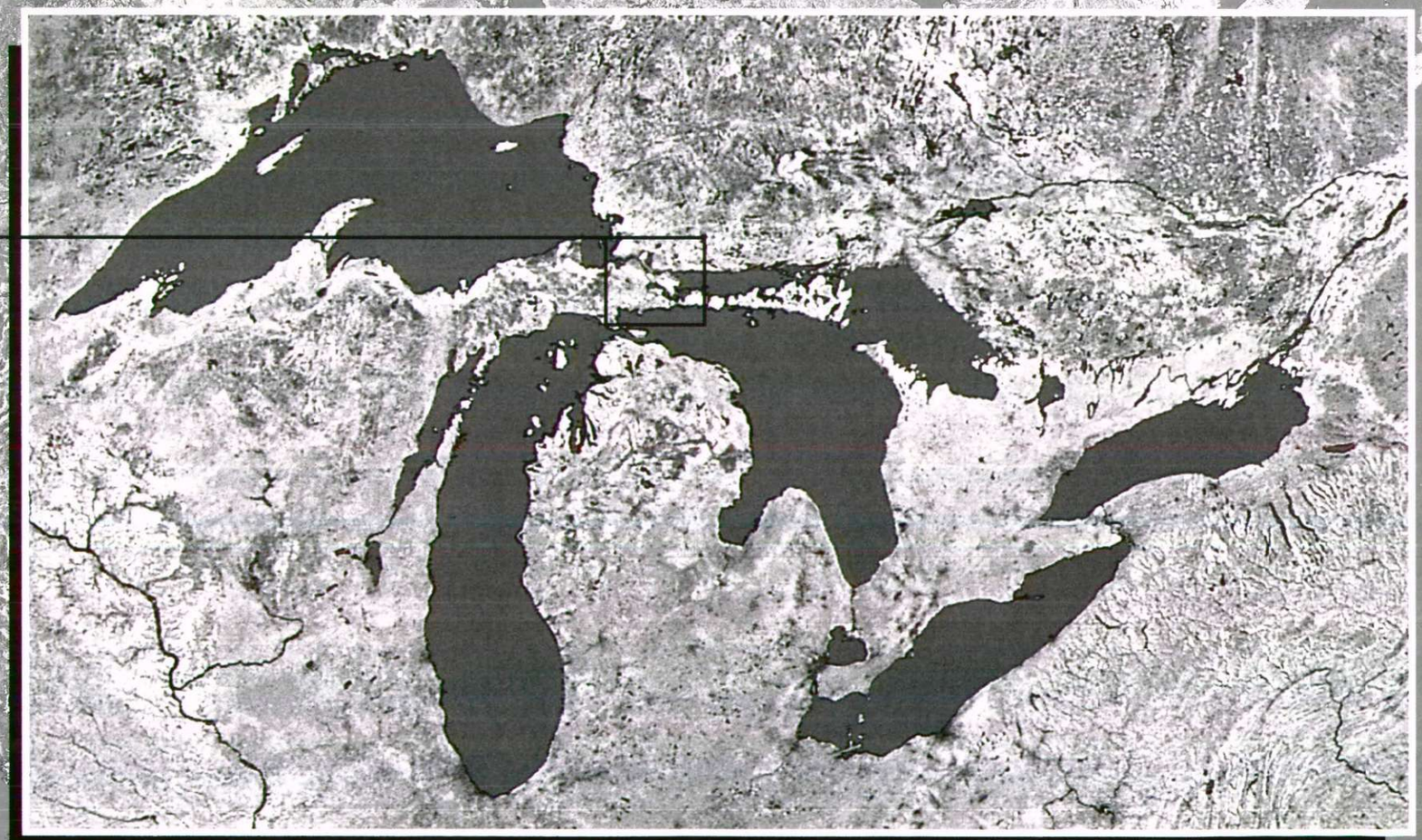


Figure 3b: St. Marys River Overview and Surface Currents
(Canadian Coast Guard, 1981)
(Population Data Source: Statistics Canada Census, 1991)

Environmental Sensitivity Maps for the St. Marys River Shorelines



Environment Canada

Environmental Protection Branch
Ontario Region

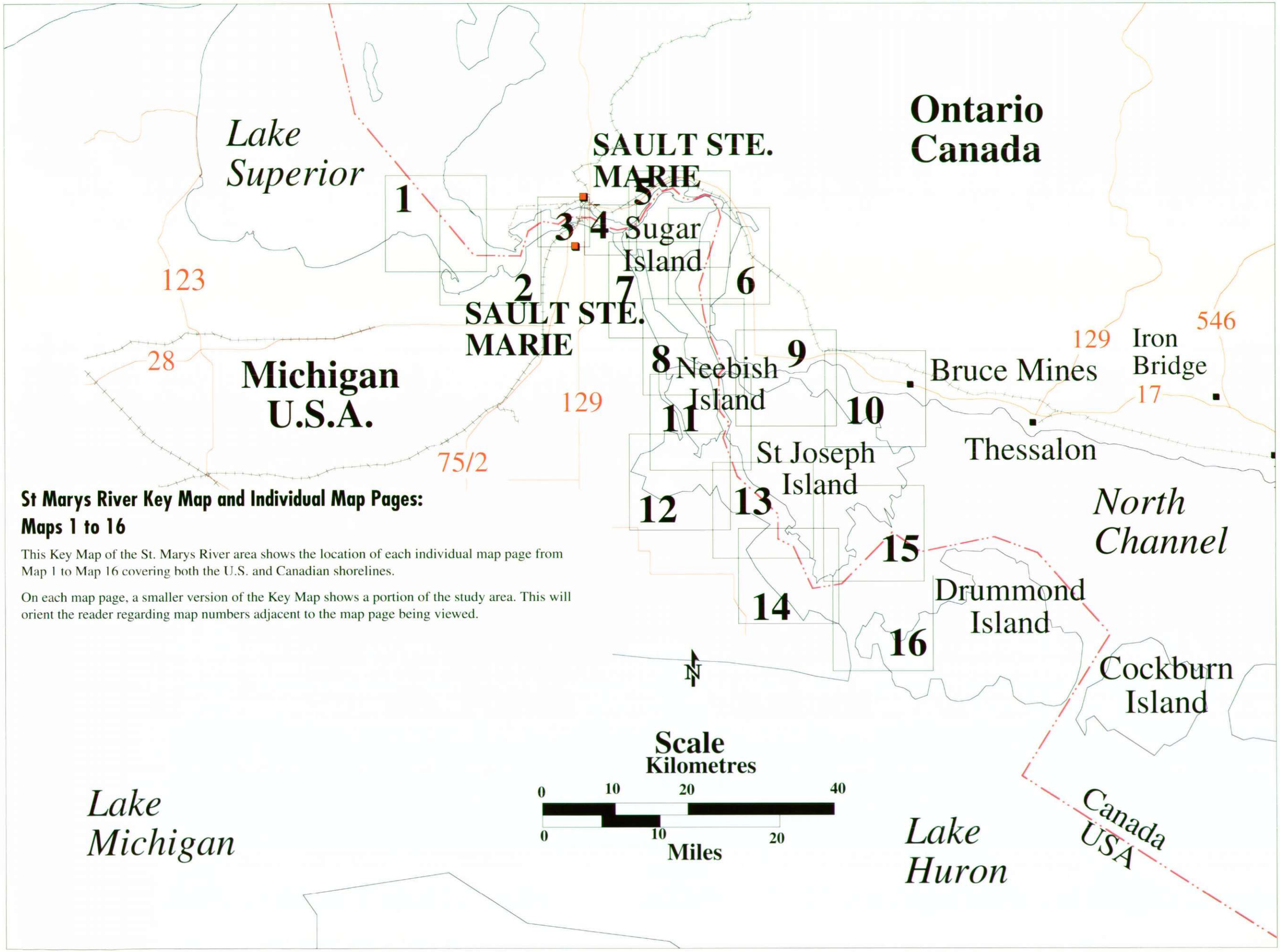
Environnement Canada

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

St Marys River Key Map and Individual Map Pages: Maps 1 to 16

This Key Map of the St. Marys River area shows the location of each individual map page from Map 1 to Map 16 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. Seasonal Lake Trout spawning occurs around Jackson Island, typically beginning in October.

2. Sault Ste. Marie Drinking Water Treatment Plant Intake - Call (705) 759-6520.
Gros Cap is a small community with a good staging area and access site.
There are several Highly Sensitive Classified Features in the area and a provincially designated Area of Natural and Scientific Interest.

3. Approach Concern: Rocky Reefs at Gros Cap Reefs. Canadian Coast Guard Lighthouse - Call 1-800-265-0237.

4. Chéne Island and the island to its west are habitats for Great Blue Herons and large colonies of Herring Gulls. The entire offshore area from Gros Cap Reef downstream into Marks Bay is a very important spawning area for Whitefish in the Fall and is also important for commercial fishing activity.

5. Shore Ridges Conservation Area is comprised of beach terraces surrounded by a marsh. The Marsh provides a natural habitat for a variety of wildlife and plants. Beavers are common in this area, as are Great Blue Herons and Broad-winged Hawks. The rare Sandhill Crane is also found in the Conservation Area.
Approach Concern: Rocky Reefs at Shore Ridge Conservation Area.
The Land between the shore and the road is a private development and not part of the Conservation Authority.

46° 33' 23" N
84° 42' 11" W

For Environmental Sensitivity information for the Canadian shoreline of Lake Superior, see Environment Canada's 1993 "Environmental Sensitivity Atlas for Lake Superior's Canadian Shoreline".

For the United States Shore , see NOAA's "Lake Superior Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI,1994).

Canada
U.S.A.

Lake Superior

Map 1

Contains Sections From NTS and USGS Maps:
41K/10 and 46084

December 1994

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

Nodaway Point

Point Iroquois

Hiawatha National Forest

Manoele Lake

Spectacle Lake

Bay Mills Native American Reservation

46° 26' 21" N
84° 42' 11" W

46° 33' 23" N
84° 31' 29" W

Walls Lake

Jackson Is.

Gros Cap

Hwy. 550

Gros Cap Reefs

(304)

Chêne Island

(255)

Shore Ridges Conservation Area

Ontario
Michigan

Pointe des Chênes

N

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

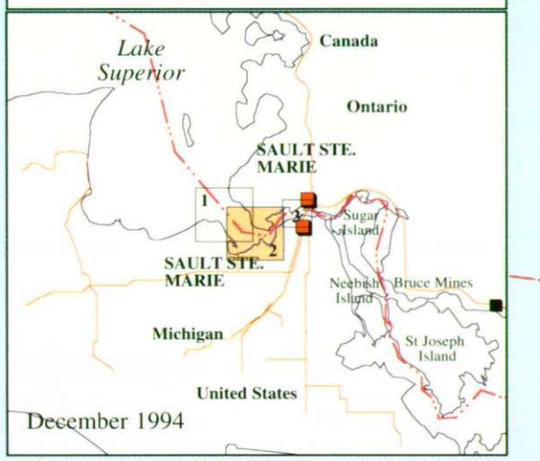
St. Marys River

46° 26' 21" N
84° 31' 29" W

Map 2

Contains Sections From NTS and USGS Maps:

41K/8, 41K/9, 41K/10 and 46084



46° 30' 57" N
84° 36' 26" W

46° 23' 55" N
84° 36' 26" W

46° 40' 57" N
84° 25' 45" W

46° 23' 55" N
84° 25' 45" W

Gros Cap Reefs

(304)

Chêne Island

(255)

Shore Ridges Conservation Area

Hwy. 565

Big Carp River

Little Carp River

Carpin Beach

Mary Ann Lake

Sault Ste. Marie Airport

Marks Bay

Ontario

Michigan

Pointe des Chênes Municipal Park

Pointe des Chênes

Pointe aux Pins

Brush Point

Point Louise

Canada

U.S.A

St. Marys River

Round Island Point

Cedar Point

Izaak Walton Bay

Munuscong State Forest

Back Bay

Dolphins Point

Waiska Bay

Brimley State Park

Waiska River

Beaver Meadow Creek

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Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

NOTES

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

3 Approach Concern: Rocky Reefs at Gros Cap Reefs. Canadian Coast Guard Lighthouse - Call 1-800-265-0237.

4 Chêne Island and the island to its west are habitats for Great Blue Herons and large colonies of Herring Gulls. The entire offshore area from Gros Cap Reef downstream into Marks Bay is a very important spawning area for Whitefish in the Fall and is also important for commercial fishing activity.

5 Shore Ridges Conservation Area is comprised of beach terraces surrounded by a marsh. The Marsh provides a natural habitat for a variety of wildlife and plants. Beavers are common in this area, as are Great Blue Herons and Broad-winged Hawks. The rare Sandhill Crane is also found in the Conservation Area.
Approach Concern: Rocky Reefs at Shore Ridge Conservation Area.
The Land between the shore and the road is a private development and not part of the Conservation Authority.

6 From Chêne Island south then east to Pointe aux Pins is a high use recreational beach and residential area.

7 Waterfowl migration typically occurs in Back Bay and Waiska Bay during the Spring through to the Fall. Responders should contact the Tribal Chairman of the Bay Mills Native American Reservation, at (906) 248-3241 before commencing shorelines and water intakes may be threatened.

8 This channel is the freighter entrance to the St. Marys River. A submerged gas pipeline crosses the channel here. Ministry of Natural Resources launch their aircraft from Marks Bay.

9 Approach Concern: Rocky Reefs at Marks Bay.

10 Wetlands at Point Louise and Carpin Beach provide nesting and staging areas for migratory waterfowl from Spring through Fall. There are several Highly Sensitive Classified Features at Pointe aux Pins.
Note that Map 3 and Map 4 are at a scale of 1:25,000.

NOTES

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

11 There are several Highly Sensitive Classified Features along the Sault Ste. Marie, Ontario shoreline. Algoma Steel Corp. has one industrial intake and nine industrial outfalls - Call (705) 945-2271.
Sault Ste. Marie Sewage water Pollution Control Plant Outfall - (705) 759-5158 (9 am - 5 pm) or call (705) 759-4989 after hours. Sault Ste. Marie Water Treatement Plant Intake - Call (705) 759-6520.
St. Marys Paper Inc. Intake and Outfall - Call (705) 942-6070.
Union Carbide Canada Ltd. Outfalls call (705) 759-2103.
The canal adjacent to the mainland is the Great Lakes Power Corp. power canal (generators only - no dam). The company can control the water flow through the canal. Call (705) 253-0211.
The gap south of Whitefish Island is bridged by 16 gates - 8 controlled by Great Lakes Power Corp. and 8 on the U.S. side controlled by the U.S. Army Corp. of Engineers. Call (906) 632-3311.

12 The Edison Sault Electric Co. can control the flow of the power canal. Call (906) 632-3101.

13 The St. Marys River between Sault Ste. Marie, Ontario and Sault Ste. Marie, Michigan, provides wintering habitat for migratory waterfowl and is also important for fish spawning activities in the spring.
The Sault Ste. Marie (Canada) Canal is under the jurisdiction of Heritage Canada's Canadian Parks Service.
Note that Map 3 and Map 4 are at a scale of 1:25,000.

46° 31' 49" N
84° 26' 7" W

Brookfield

46° 31' 49" N
84° 20' 36" W

Steelton

Sault Ste. Marie
Ontario

Canadian Pacific

The Algoma Steel Corporation Ltd.

Leigh Bay

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

Whitefish Island

Sault Ship Canals

International Bridge

Ontario
Michigan

St. Marys Falls Canal

Old Vessel Point

Canada
U.S.A.

City of Sault Ste. Marie, Michigan Municipal Drinking Water Intake. For this intake, and to arrange notification for other private residential water users along the U.S. side of the St. Marys River, contact the Chippewa County Sheriff at (906) 635-6355.

Ashmun Bay

Sault Ste. Marie
Michigan

Big Point

Ashmun Creek

Seymour Creek

Atlantic

allows

Interstate 75

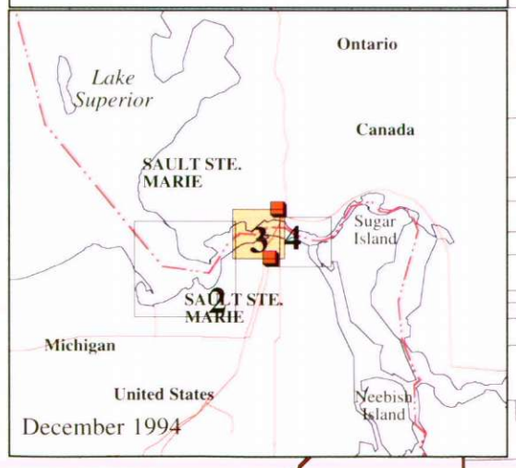
Scale
Kilometres
0 0.5 1
0 0.25 0.5
Miles
1:25,000

46° 28' 11" N
84° 26' 7" W

46° 28' 11" N
84° 20' 36" W

Map 3

Contains Sections From NTS and USGS Maps:
41K/8, 41K/9 and 46084



December 1994

46° 31' 14" N
84° 21' 11" W

46° 31' 14" N
84° 15' 40" W

Sault Ship Canals

Pine St.

Hwy. 17B

Sault Ste. Marie

Canadian Pacific

Wellington St

Queen St

Albert St.

Elgin St.

Bay Street

Eastside

Meadow Park

Grandview Gardens

Hwy. 17B

Queen Elizabeth Park

Bellevue Park

St. Marys River

Edison Sault Electric Co. Canal

Canada
U.S.A.

Topsail Island

Shingwauk Island

Cook I

Portage Avenue East

Sault Ste. Marie

Mission Point State Park

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

Sugar Island Road

Mission Creek

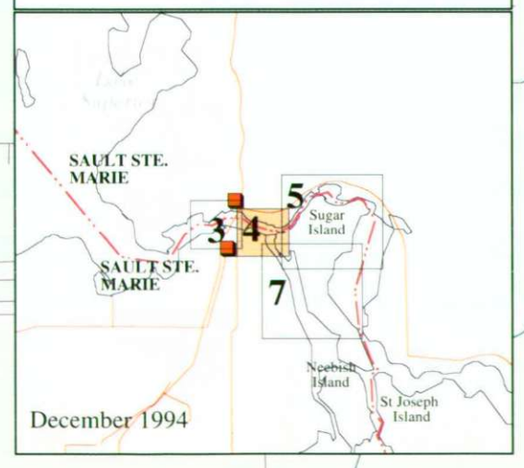
Shawnee Lake

Sugar Island

Gardenville

Map 4

Contains Sections From NTS and USGS Maps:
41K/8, 41K/9 and 46084



December 1994

N

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

46° 27' 36" N
84° 21' 11" W

46° 27' 36" N
84° 15' 40" W

NOTES

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

13 The St. Marys River between Sault Ste. Marie, Ontario and Sault Ste. Marie, Michigan, provides wintering habitat for migratory waterfowl and is also important for fish spawning activities in the spring.
The Sault Ste. Marie (Canada) Canal is under the jurisdiction of Heritage Canada's Canadian Parks Service.
Note that Map 3 and Map 4 are at a scale of 1:25,000.

14 Fish Hatchery Intake. Notify the Lake Superior State University security at (906) 635-2210.
The power station flow Edison Sault Electric Co. is at the end of the power canal. For water flow regulations call (906) 632-3101.
Both the Canadian Coast Guard and the Great Lakes Response Corporation have equipment depots in Sault Ste. Marie, Ontario.
The United States Coast Guard has an Equipment depot.

15 Numerous, undocumented private water intakes exist south of Sugar Island. Contact Chippewa County 24 hour emergency line at (906) 635-9111, or (906) 635-1655 (8am - 4pm).

16 Sault Ste. Marie Water Pollution Control Plant East Outfall - Call (705) 759-5158 (8 am - 4 pm) or (705) 942-4242.

NOTES

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

17 Approach Concern: Rocky Reefs at Masta Bay.

18 Nesting and staging areas for migratory waterfowl occur along the St. Marys River shoreline between Cook Island and Bell Point from Spring through Fall. Responders should contact the Chief of the Batchawana First Nation at (705) 759-0914 (9 am - 4 pm), and the Chief of Garden River First Nation at (705) 942-1500 before commencing response activities in the area or when shorelines and water intakes may be threatened.

19 Approach Concern: Submerged aquatic vegetation.

20 Lake George near Churchville Point provides nesting and staging habitats for migratory waterfowl from Spring through Fall. Responders should also be aware of a submerged water intake in the area.

23 Approach Concern: Rocky Reefs at Hay Point, Lake George.

46° 33' 42" N
84° 16' 30" W

46° 33' 42" N
84° 5' 48" W

Root River
Batchawana First Nation
French Bay
Garden River First Nation
Boss Lake
Garden River
Hwy. 17
Bells Point
Little Lake George
Palmers Point
Point Charles
Batchawana First Nation
Manitou Park
Sucker Creek
Payment
Squirrel Island
Partridge Point
Eastside
Churchville Point
Sand Island
Lewis Point
Brassar
Grandview Gardens
Masta Bay
Brassar Pt
Cass Point
Cook I
Sugar Island Road
Sugar Island
Hay Point
Michigan
Ontario
U.S.A.
Canada
Lake George
Baie de Wasai
Lake Nicolet

Map 5

Contains Sections From NTS and USGS Maps:
41K/8, 41K/9 and 46084

Ontario
Lake Superior
Canada
SAULT STE. MARIE
Sugar Island
SAULT STE. MARIE
Michigan
United States
Bruce Mines
Neebish Island
Thessalon
St Joseph Island
North Channel

December 1994

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

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 26' 41" N
84° 16' 30" W

46° 26' 41" N
84° 5' 48" W

46° 31' 0" N
84° 12' 22" W

Point

Sand Island

10

20

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

U.S.A.
Canada

Sugar Island Road

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

Sugar Island

Hay Point

Michigan
Ontario

23

Lake George

24

Whipple Point

Ontario
Michigan

46° 23' 58" N
84° 12' 22" W

46° 31' 0" N
84° 1' 40" W

Lower River

Echo Bay

21

Stony Pt.

Echo Bay

22

Hwy.17

Bar River

Bar River Airfield

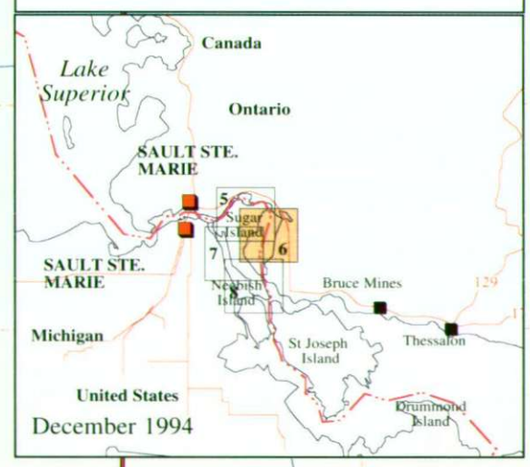
11

Laird

46° 23' 58" N
84° 1' 40" W

Map 6

Contains Sections From NTS and USGS Maps:
41K/8, 41K/9 and 46084



December 1994

NOTES

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

20 Lake George near Churchville Point provides nesting and staging habitats for migratory waterfowl from Spring through Fall. Responders should also be aware of a submerged water intake in the area.

21 Echo Bay is a provincially designated Environmentally Sensitive Area and provides a good habitat for large numbers of raptors and staging waterfowl. Raptors may forage up to 20 km (12 miles) from their nesting sites; therefore, virtually all shallow-water areas along the margins of the St. Marys River may be used as feeding areas. This area is important for fish spawning activities.
Responders should contact the Chief of the Garden River First Nation at (705) 942-1500 before commencing response activities in the area or when shorelines and water intakes may be threatened.
Responders should avoid damaging the dune system northwest for Stony Point.

22 Reponders should note that a water intake and an outfall will be installed near Echo Bay in 1995.

23 Approach Concern: Rocky Reefs at Hay Point, Lake George.

24 Lake George Wetland is a provincially significant area. It contains extensive populations of shorebirds, migratory waterfowl, fur bearers, wading birds and spawning fish. There is also an offshore bullrush habitat which is part of this wetland. Waterfowl nesting and migration occurs here from Spring through Fall.

NOTES

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

23 Approach Concern: Rocky Reefs at Hay Point, Lake George.

25 Waterfowl nesting and migration occur typically from Spring through Fall in Lake Nicolet. Responders should contact the Tribal Chairman of the Bay Mills Native American Reservation at (906) 248-3241 before commencing response activities in the area or when shorelines and water intakes may be threatened.

26 Waterfowl migration occurs typically from Spring through Fall in Lake George near Rock Island. The area also supports habitats for waterfowl nesting in Spring and Summer.

27 Approach Concern: Rocky Reefs at Bay Mills Native American Reservation and along the opposite side of the river.

46° 28' 35" N
84° 18' 37" W

Sugar Island

Gardenville

Baie de Wasai

Baie de Wasai

Little Rapids Channel

Lake Nicolet

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

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

Sugar Island

46° 28' 35" N
84° 7' 56" W

Hay Point

Lake George

Whipple Point

Ontario
Michigan

Bay Mills Native American Reservation

St. Marys River

Pumpkin Point

Rock Island

Advance Island

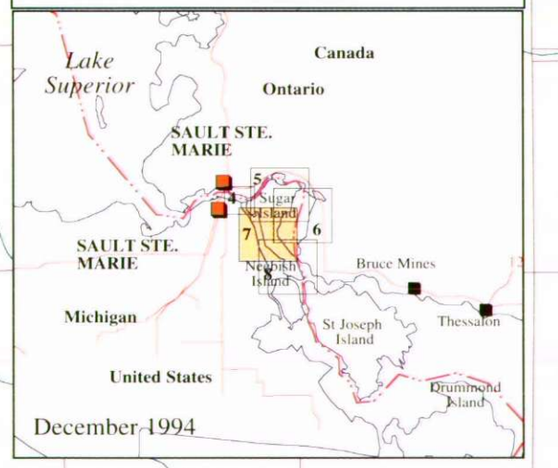
Shingle Bay

46° 21' 33" N
84° 18' 37" W

46° 21' 33" N
84° 7' 56" W

Map 7

Contains Sections From NTS and USGS Maps:
41K/8 and 46084



Map 8

Contains Sections From NTS and USGS Maps:

41K/8 and 46084

46° 24' 25" N
84° 15' 2" W

46° 24' 25" N
84° 4' 22" W

St. Marys River

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

Pumpkin Point

(47)

Rock Island

Advance Island

Birch Point

(3)

Shingle Bay

Lake Nicolet

Sugar Island

East Neebish Channel

Neebish

Ned Point

Sankey Island

East Neebish Island

(1)

Long Point

Maskinonge Bay

Homestead

Thorn Island

Niles Point

Forshaw Island

Pine Island

Duval Island

Harwood Point

Foote Island

Middle Neebish Channel

Charlotte River

Stribling Pt.

Hen Island

Stribling Pt.

Shoal Is.

Boulanger Pt.

Chicken Islands

Kerby Is.

Ontario

Michigan

St. Joseph Island

Neebish Island

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

Oak Ridge

Field Pt.

Green Pt.

46° 17' 23" N
84° 15' 2" W

46° 17' 23" N
84° 4' 22" W

NOTES

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

26 Waterfowl migration occurs typically from Spring through Fall in Lake George near Rock Island. The area also supports habitats for waterfowl nesting in Spring and Summer.

27 Approach Concern: Rocky Reefs at Bay Mills Native American Reservation and along the opposite side of the river.

28 Waterfowl migration occurs typically from Spring through Fall in Lake Nicolet near Shingle Bay. The area also supports habitats for waterfowl nesting in Spring and Summer and is important for fish spawning activities.

29 From Pumpkin Point south to Neebish Island is a high use recreational beach and residential area.

30 East Neebish Island provides habitats for fur bearers and large numbers of osprey nests. Ospreys can forage up to 20 km from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys River may be used as feeding areas.

31 Beware of above surface hydro lines between islands.

32 Approach Concern: Rocky Reef at Stribling Point.

33 The Neebish Island Ferry provides ferry service between Oak Ridge, Neebish Island and the United States mainland.

34 Approach Concern: Rocky Reef at Shoal and Kerby Islands.

NOTES

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

34 Approach Concern: Rocky Reef at Shoal and Kerby Islands.

35 The Anderson Creek Wetland supports wading birds, waterfowl, shorebirds, nesting raptors and fur bearing mammals. The creek is an important fish spawning and migration watercourse.

36 Seasonal fish spawning and migration occurs in Bamageseck Bay in Spring for Northern Pike, Smallmouth Bass and Walleye.

37 The Sucker Creek Wetland supports wading birds, shorebirds and migratory waterfowl. It provides a habitat for migrating fish and fur bearing mammals.

38 Seasonal fish spawning occurs in the St. Joseph Channel for Northern Pike and Walleye in Spring.
Desbarats Municipal Water Intake - Call (705) 782-6601.

39 The Desbarats River Wetland is a provincially significant wetland which is classified as an Environmentally Sensitive Area. It supports wading birds, shorebirds, migratory waterfowl, raptors and fur bearing mammals. The Debarats River is an important fish spawning and migration watercourse.

46° 22' 8" N
84° 5' 17" W

46° 22' 8" N
83° 54' 37" W

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

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

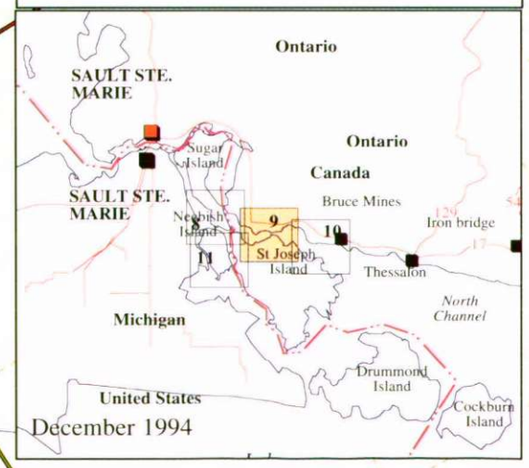
MacLennan
Desbarats
Hwy. 17
Slewfelt Creek
Anderson Creek
Maskinonge Bay
Forshaw Island
Pine Island
Sutton Is.
Foote Island
Bowen Is.
Shoal Is.
Boulanger Pt.
Horse Is.
(13)
Kerby Is.
McGregor Bay
Neyland Island
Port Findlay
Pasture Pt.
Findlay Pt.
(33)
St. Joseph Channel
Rosseau Island
Chicken Pt.
Hattie Is.
Richards Landing
Hwy. 548
St. Joseph Island
Coulters Ck
Sailors Encampment
Anderson Creek Wetland
Quebec Bay
Wilson Is.
Devils Is.
Killaly Pt.
Picture Is.
Copper Is.
Snapper Is.
Story Is.
Montague Is.
Humbug Pt.
Colter Is.
Bamageseck Bay
Kensington Point
Walker Is.
McNab Is.
Davis Is.
Lasher Is.
Mink Point
Whippoorwill Pt.
Poole Is.
McQueen Is.
Boswell Is.
Jermyn Is.
Weightman Is.
Agate Is.
(12)
Holmes Is.
(3)
Woodward Pt.
Canoe Pt.
Campement d'Ours Island
Desjardins Bay
Sucker Creek
Gawas
Hwy. 548

35 36 37 38 39

M MM

Map 9

Contains Sections From NTS and USGS Maps:
41K/8 and 41J/5



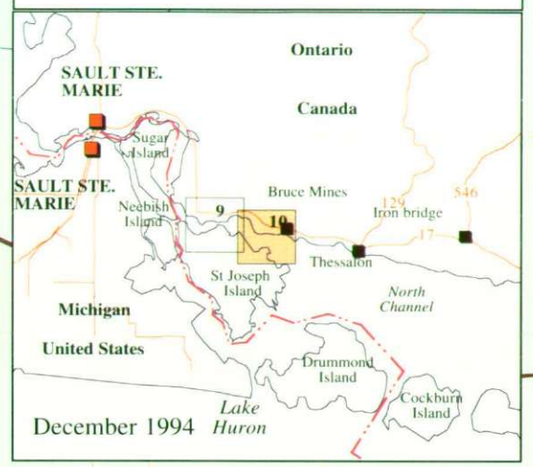
December 1994

46° 15' 7" N
84° 5' 17" W

46° 15' 7" N
83° 54' 37" W

Map 10

Contains Sections From NTS and USGS Maps:
41J/4 and 41J/5



46° 20' 38" N
83° 55' 54" W

46° 20' 38" N
83° 45' 14" W

Portlock

Stobie Creek

avis Is.

Lasher Is.

Lambe Is

Mink Point

Coatsworth Is.

Alice Is.

Cricket Is.

Whippoorwill Pt.

Edith Is.

Poole Is.

Dawson Island

McQueen Is.

Boswell Is.

Jermyn Is.

Weightman Is.

Hat Is.

Dunlevie Pt.

Agate Is.

(12)

Canada Rk.

Belford Is.

Portlock Island

Holmes Is.

(3)

Plummer Is.

Cox Is.

Colby Is.

Woodward Pt.

Canoe Pt.

(12)

(69)

Piercy Rocks

Woodman Pt.

(1413)

Green Island

One Tree Is.

Fremlin Island

(37)

McPhail Rock

Duncan Rock

(22)

(67)

Bowker Point

Bruce Station

Jordan River

Hwy. 17

Bruce Mines

Bruce Bay

Garden Bay

Jacks Island

French Island

McKay Island

Little Is.

St Joseph Channel

Hwy. 548

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

Pointe Au Gravier

Fisher Bay

Hilton Beach

Old Quarry Point

McMenomy Bay

Recollet Point

For environmental sensitivity information for the Canadian shoreline of Lake Huron, see Environment Canada's 1994 "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline".

St. Joseph Island

Hilton Lake

North Channel

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 13' 36" N
83° 55' 54" W

46° 13' 36" N
83° 45' 14" W

NOTES

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

39 The Desbarats River Wetland is a provincially significant wetland which is classified as an Environmentally Sensitive Area. It supports wading birds, shorebirds, migratory waterfowl, raptors and fur bearing mammals. The Debarats River is an important fish spawning and migration watercourse.

40 Dawson Island and Portlock Island provide habitats for numerous nesting raptors. Raptors can forage up to 20 km from nesting sites; therefore, virtually all shallow-water areas along the margins fo the St. Marys River may be used as feeding areas.

41 The Stobie Creek Wetland is a provincially significant wetland that is classified as an Environmentally Sensitive Area. It supports wading birds, shorebirds, raptors, migratory waterfowl and fur bearing mammals. Stobie Creek is an important fish spawning and migration watercourse.

42 Numerous recreational cottages are located along the St. Joseph Channel shoreline from Mink Point to Dunlevie Point.
Nesting colonial water birds are located near Plummer Island.
Seasonal fish spawning occurs in the St. Joseph Channel: Northern Pike and Walleye in Spring.

43 Hilton Beach is an important recreational area with a marina, a beach and numerous cottages. A wastewater treatement plant with outfall was installed in 1994.
The town water is supplied by a well.

44 Bruce Mines Water Treatment Plant water intake and Sewage Treatment Plant water outfall: Call (705) 785-3445.
Small wetlands at Bruce Mines support migratory waterfowl and shorebirds.
The Peat Wetland and Hay Bay provide a habitat for wading birds, shorebirds, and migratory waterfowl.

NOTES

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

32 Approach Concern: Rocky Reef at Stribling Point.

33 The Neebish Island Ferry provides ferry service between Oak Ridge, Neebish Island and the United States mainland.

34 Approach Concern: Rocky Reef at Shoal and Kerby Islands.

45 Numerous recreational cottages are located along the Munuscong Channel shoreline from Stribling Point to Everens Point.

47 The Munuscong State Forest provides extensive habitats for raptors. Raptors can forage up to 20 km (12 miles) from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys River may be used for feeding areas.

48 Approach Concern: Rocky Reef at southwest tip of Neebish Island, Munuscong Bay.

46 Neebish Island supports habitats for waterfowl migration activity from Spring through Fall.

46° 18' 56" N
84° 14' 18" W

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

Neebish Island

Oak Ridge

33

Hen Island

Stribling Pt.

Shoal Is.

46° 18' 56" N
84° 8' 39" W

Boulanger Pt.

Horse Is.

(13)

Chicken Islands

32

34

Kerby Is.

McGregor Bay

Ontario

Michigan

St. Joseph Island

Field Pt.

Green Pt.

Munuscong Channel

45

Hwy. 548

Coyle Pt.

Reed Pt.

Mirre Pt.

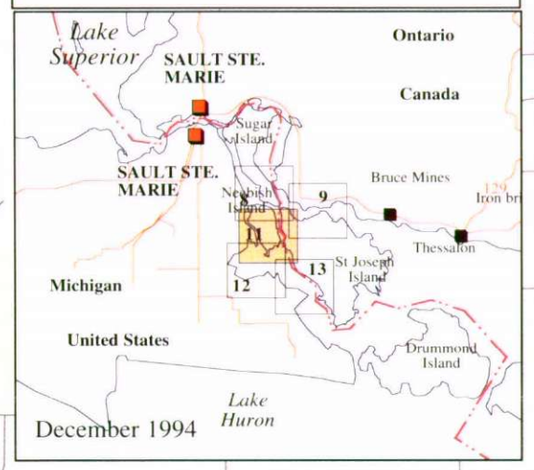
Coulters Ck

Sailors Encampment

Johnson Point

Map 11

Contains Sections From NTS and USGS Maps:
41K/1, 41K/8 and 46084



Munuscong State Forest

West Neebish Channel

M

17

47

Munuscong Bay

48

Neebish Island

46

Everens Point

Canada

U.S.A.

Two Tree River

Moon Is.

Winter Pt.

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

Court Point

Munuscong Lake

46° 11' 54" N
84° 14' 18" W

46° 11' 54" N
84° 8' 39" W

46° 14' 34" N
84° 16' 29" W

Munuscong State Forest

Munuscong Bay

Neebish Island

46° 14' 34" N
84° 5' 51" W
Everens Point

Canada
U.S.A.

Munuscong Lake

Moon Is.

Winter Pt.

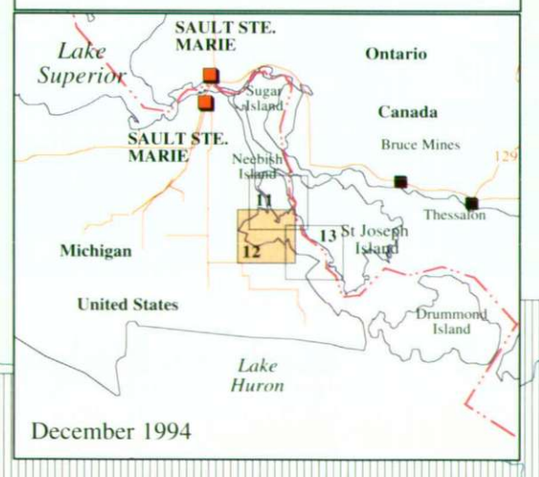
Obtain permission from private property owners prior to crossing or using private property, access sites, or boat launches.

Rocky Point

Gogomain River

Map 12

Contains Sections From NTS and USGS Maps:
41K/1 and 46084



December 1994

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 7' 32" N
84° 16' 29" W

46° 7' 32" N
84° 5' 51" W

NOTES

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

47 The Munuscong State Forest provides extensive habitats for raptors. Raptors can forage up to 20 km (12 miles) from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys River may be used for feeding areas.

48 Approach Concern: Rocky Reef at southwest tip of Neebish Island, Munuscong Bay.

46 Neebish Island supports habitats for waterfowl migration activity from Spring through Fall.

49 The Gogomain River Wetland is a highly sensitive area. It supports wading birds, shorebirds, migratory waterfowl, raptors and fur bearing mammals.
A Protection strategy for this area is contained in the Sault Ste. Marie, Michigan Area Contingency Plan (USCG 1994).
Responders should contact the U.S. Coast Guard MSO Sault Ste. Marie at (906) 635-3232, before commencing response activities.

NOTES

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

49 The Gogomain River Wetland is a highly sensitive area. It supports wading birds, shorebirds, migratory waterfowl, raptors and fur bearing mammals.
A Protection strategy for this area is contained in the Sault Ste. Marie, Michigan Area Contingency Plan (USCG 1994).
Responders should contact the U.S. Coast Guard MSO Sault Ste. Marie at (906) 635-3232, before commencing response activities.

50 The St. Joseph Island shoreline from Court Point to south of Otter Lake contains numerous small wetlands which support colonial waterbirds, waterfowl, shorebirds, wading birds, raptors and fur bearing mammals.

51 The Munuscong State Forest provides extensive habitats for raptors. Raptors can forage up to 20 km (12 miles) from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys river may be used as feeding areas.

52 The Hay Marsh is a provincially significant wetland which is classified as an Environmentally Sensitive Area. It supports colonial waterbirds, wading birds, shorebirds and raptors. It is a significant bird sanctuary supporting migratory waterfowl. This wetland provides a habitat for fish spawning and for fur bearing mammals. Responders should avoid damaging the dune system at Hay Point.

46° 12' 29" N
84° 7' 44" W

46° 12' 29" N
83° 57' 6" W

Court Point

Sunset Point

Richardson Creek

Mountain Lake

Rocky Point

St. Marys River

Otter Lake

Ontario
Michigan

Twin Island

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

Gogomain River

Munuscong Lake

Point aux Frenes

Munuscong State Forest

Hay Point

(130)

Round Island

Love Island

Raber Bay

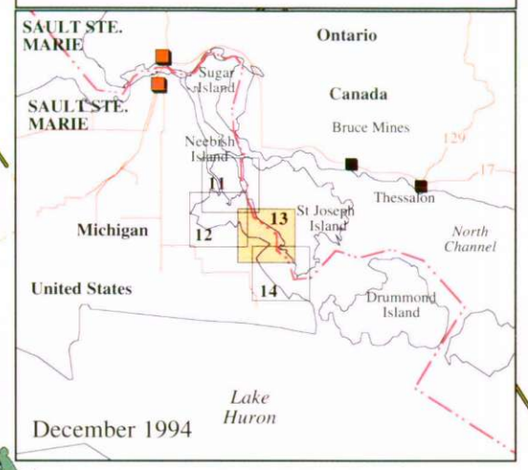
Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 5' 28" N
84° 7' 44" W

46° 5' 28" N
83° 57' 6" W

Map 13

Contains Sections From NTS and USGS Maps:
41K/1, 41J/4 and 46084



December 1994

St. Joseph Island

46° 7' 41" N
84° 5' 2" W

46° 7' 41" N
83° 54' 25" W

Munuscong State Forest

Hay Point

51

52

Round Island

Love Island

Raber Bay

St. Joseph Island

Raber

Hart Island

Lime Island

19

Fort St. Joseph National Historic Site

53

Raber Point

St. Marys River

Little Lime Island

20

54

Rains Point

La Pointe

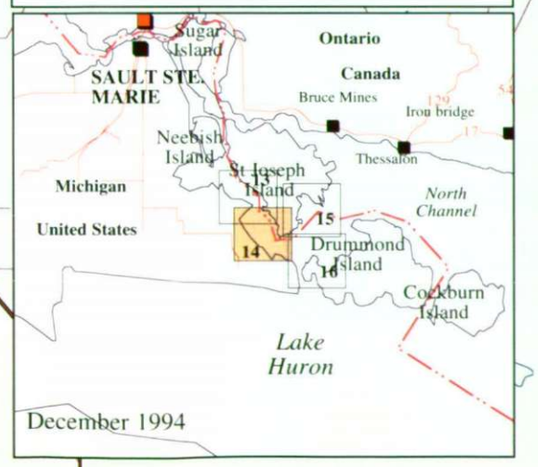
Old Fort St. Joe Point

Canada

U.S.A.

Map 14

Contains Sections From NTS and USGS Maps:
41K/1, 41J/4, 46084, 46083 and 45083



December 1994

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

Sweets Point

Maud Bay

Gaffney Point

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 0' 39" N
84° 5' 2" W

46° 0' 39" N
83° 54' 25" W

NOTES

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

51 The Munuscong State Forest provides extensive habitats for raptors. Raptors can forage up to 20 km (12 miles) from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys river may be used as feeding areas.

52 The Hay Marsh is a provincially significant wetland which is classified as an Environmentally Sensitive Area. It supports colonial waterbirds, wading birds, shorebirds and raptors. It is a significant bird sanctuary supporting migratory waterfowl. This wetland provides a habitat for fish spawning and for fur bearing mammals. Responders should avoid damaging the dune system at Hay Point.

53 Lime Island provides extensive habitats for raptors. Raptors can forage up to 20 km (12 miles) from nesting sites; therefore, virtually all shallow water areas along the margins of the St. Marys River may be used as feeding areas.

54 The St. Joseph Island shoreline from Old Fort St. Joe Point to La Pointe contains small wetlands which support shorebirds, raptors, waterfowl and furbearing mammals. A Herring fishery is active west of Old Fort St. Joe Point, and a commercial Walleye fishery is active east of the point.

NOTES

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

55 The Whiskey Bay shoreline is an area of recreational cottage use and is a significant deer migration region.

56 Sterling Bay provides a habitat for shorebirds and raptors. There is a recreational beach and several cottages nearby.

57 Small wetlands in Tenby Bay support migratory waterfowl, wading birds, shorebirds, raptors and fur bearing mammals. Gordon Creek is an important fish spawning watercourse: Rainbow Smelt in Spring.

58 Milford Haven Wetland provides a habitat for colonial waterbirds, wading birds, shorebirds and fur bearing mammals. Milford Haven Creek is an important fish spawning and fish migration watercourse. An old sawmill exists in Milford Haven. Responders must take care not to cause damage in this area. A boat launch exists along the access road. Nesting colonial waterbirds are located on Salt Island and Perrique Island. Seasonal commercial fishing and fish spawning activities occur in Lake Huron, near O'Donnell Island and the Sein Islands: Lake Whitefish is late Fall.

59 Important wetlands at Richmond Bay and Richmond Point provide a habitat for rare colonial waterbirds, wading birds, shorebirds, migratory waterfowl, raptors and fur bearing mammals. Small wetlands at Garside Bay support migratory waterfowl, wading birds and raptors. They provide a habitat for fur bearing mammals and fish spawning activities.
Nesting colonial waterbirds occur on Ironsides Reef (north of Fox Island). Seasonal fish spawning and commercial fishing activities occur in this area of Lake Huron: Lake Whitefish in late Fall.

46° 10' 47" N
83° 56' 4" W

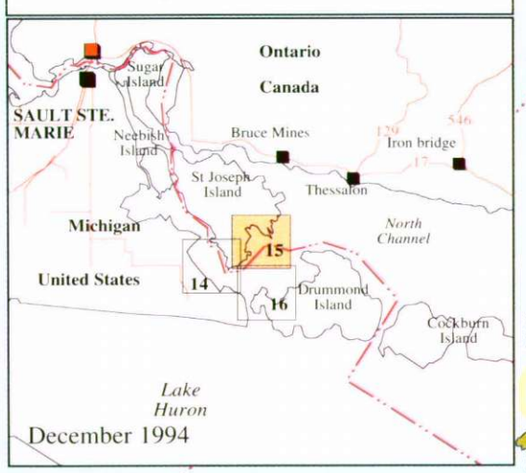
For environmental sensitivity information for the Canadian shoreline of Lake Huron, see Environment Canada's 1994 "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline".

For the United States shore, see NOAA's "Lake Huron Atlas: Sensitivity of Coastal Environments and Wildlife to Spill Oil" (RPI,1993).

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

Map 15

Contains Sections From NTS and USGS Maps:
41K/1, 41J/4 and 46083



December 1994

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

46° 10' 47" N
83° 45' 26" W

Fox Island
Barside Bay
Richmond Point
59
Emily Island
Milford Haven
Richmond Bay
Wallace Island
Lyon Cove
Colville Island
Perrique Island
Beef Island
Pecks Point
O'Donnell Island
(85)
58
Koshkawong Point
Salt Island
(49)
North Seine Island
South Seine Island
Milford Island
Ontario
Michigan
Norris Island
21
Burnt Island
Spence Island
Wilson Island
Cedar Island
Claw Island
Harris Island
Cherry Island
Twin Sister Islands
Butterfield Island
Long Island
North Channel
Standerson Island
46° 3' 46" N
83° 45' 26" W
Mare Island
Tenby Bay
Gordon Creek
Haven Creek
Watson Creek
Tenby Bay
Collins Point
57
Whitman Point
Worsley Bay
56
Whiskey Point
Sterling Bay
St. Joseph Island
Rains Lake
Burnt Point
Whiskey Bay
55
M
19
Fort St. Joseph National Historic Site
Elliot Point
Duncan Island
Archibald Island
Janden Island
Malcolm Island
Potagannissing Bay
Cass Island
Maple Island
Canada
U.S.A
46° 3' 46" N
83° 56' 4" W
Rains Point
La Pointe
Pirate Island

46° 4' 13" N
83° 55' 6" W

La Pointe

Pirate Island

Canada
U.S.A

Cass Island

Potagannissing Bay

Maple Island

Trout Island

Andrews Island

Bacon Island

Mare Island

Saltonstall Island

Standerson Island

46° 4' 13" N
83° 44' 30" W

Harbour Island

North Channel

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

Little Trout Island

Little Rogg

Boulenger Island

Gulf Island

Bow Island

Scale
Kilometres
0 0.5 1 2
0 0.5 1
Miles
1:50,000

Wreck Island

Sam I

Seastone Point

Dix Point

Homberg Point

Surveyors Island

Arrow Island

Pipe Island Twins

Gaffney Point

Sturgeon Point

Willoughby I

Pipe Island

Sturgeon Bay

Adelaide I

Picnic Island

Pigeon Point

Fairbank Point

Young I

Rabbit Bay

Stringham Lake

St. Marys River

De Tour Village

Pigeon Cove

Cove Point

Jones Lake

De Tour Passage

Quarry

Parish Lake

Munuscong State Forest

Drummond Island

Olmstad Bay

Roggs Bay

Whitney Bay

Seaman Lake

Quarry

Bennett Point

Barbed Point

Kempainen Lake

60

Fairview Cove

Pike Bay

Bear Lake

45° 57' 12" N
83° 55' 6" W

Lake Huron

45° 57' 12" N
83° 44' 30" W

Map 16

Contains Sections From NTS and USGS Maps:
41K/1, 41J/4 and 45083

December 1994

NOTES

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

60 For environmentally sensitive information for the Canadian shoreline of Lake Huron, see Environment Canada's 1994 "Environmental Sensitivity Atlas for Lake Huron's Canadian Shoreline".
For the United States shore, see NOAA's "Lake Huron Atlas: Sensitivity of Coastal Environments and Wildlife to Spilled Oil" (RPI, 1993).

Appendix A

Data Sources

Source agencies for data used in the creation of the Environmental Sensitivity Atlas for the St. Marys 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

Ontario Ministry of Natural Resources – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

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

Environment Canada, Canadian Wildlife Service, 152 Newbold Court, London, Ontario. N6E 1Z7. (519) 681–0980. Contact – D. Dennis, Waterfowl Specialist

Ducks Unlimited 1–800–665–DUCK

Long Point Bird Observatory - P. O. Box 106, Port Rowan, Ontario. N0E 1M0 (519) 586–3531. Contacts – Raptor Information - Ron Ridout, Bird Migration Specialist - John McCracken; Waterfowl Specialist - Dr. Richard Knapton

Ontario Ministry of Natural Resources – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

Ontario Ministry of Environment and Energy – Sault Ste. Marie District Office, 445 Albert St. E., Sault Ste. Marie, ON P6A 2J9 - 705-949-4640. Contact: Rod Stewart, Gerry La Haye.

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 – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

Ontario Ministry of Environment and Energy – Sault Ste. Marie District Office, 445 Albert St. E., Sault Ste. Marie, ON P6A 2J9 - 705-949-4640. Contact: Rod Stewart, Gerry La Haye.

Ontario Ministry of Natural Resources, Lake Erie Fisheries Station, RR #2, Wheatly, Ontario. N0P 2P0. 519-825-4684. Contact: Joseph Leach

A.1.3 Shore Associated Mammals

Ontario Ministry of Natural Resources – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

A.2 Countermeasures

Transport Canada, Canadian Coast Guard Base - Parry Sound District, 28 Waubeek St., Box 310, Parry Sound, ON P2A 2X4, phone - (705) 746-2196. Contact – Dan Badger

The following USCG - MSO - Sault Ste. Marie (address below) personnel participated in joint Countermeasures determination sessions:

L. Mouzer
United States Coast Guard - Marine Safety Office, 337 Water St., Sault Ste. Marie, Michigan 49783. Phone - 906-635-3233 (24 hour)

National Oceanographic 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

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 Officers, Environmental Protection Branch – Ontario Region, 25 St. Clair Avenue East, 7th Floor, Toronto, Ontario. M4T 1M2. Contact: Steve Clement - (416) 973–1061; Sheelagh Hysenaj - (416) 973-5854

John Bain, City of Sault Ste. Marie

Bob Davies, Sault Ste. Marie Police

Weather Information

Atmospheric Environment Service - Meterological Station Sites, Meterological 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 – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

Ontario Ministry of Environment and Energy – Sault Ste. Marie District Office, 445 Albert St. E., Sault Ste. Marie, ON P6A 2J9 - 705-949-4640. Contact: Rod Stewart, Gerry La Haye.

Sault Ste. Marie Region Conservation Authority, RR #2, 1100 5th Line E., Sault Ste. Marie, ON P6A 5K7, phone - 705-946-8530. Contact: Ralph Yanni

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

Natural Gas Wells and Pipelines
Ontario Ministry of Natural Resources, Petroleum Resources Section at 519-426-7650

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, Archaeological Site Database, 77 Bloor St. West, Toronto, Ontario. (416) 314–7161, (416) 314-7790 (fax). Contact – Bernice Field

Area of Ecological Significance
Environment Canada, Canadian Wildlife Service, Nepean, Ontario. (613) 952–0931

Ontario Ministry of Natural Resources – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

Harry Graham, Sault Ste. Marie Remedial Action Plan Volunteer

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 – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

Conservation Area Information
Sault Ste. Marie Region Conservation Authority, RR #2, 1100 5th Line E., Sault Ste. Marie, ON P6A 5K7, phone - 705-946-8530. Contact: Ralph Yanni

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

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

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 Heitshu, Rm. M2–17900, Bay Street, MacDonald Block, Toronto, Ontario. M7A 1C3. (416) 314–3803

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

Environmentally Sensitive Areas
Sault Ste. Marie Region Conservation Authority, RR #2, 1100 5th Line E., Sault Ste. Marie, ON P6A 5K7, phone - 705-946-8530. Contact: Ralph Yanni

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

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 – Sault Ste. Marie District Office: Contact Peter Burtch (St. Marys River); Sue Greenwood (Huron and Superior), 875 Queen St. E., Sault Ste. Marie, ON P6A 2B3, phone - 705-949-1231

First Nation/Native Land Information

Indian and Northern Affairs Canada, 25 St. Clair Avenue East, 5th Floor, Toronto, Ontario. M4T 1M2 (416) 973–6234

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

National Park/National Forests

Heritage Canada, 111 Water St. E., Cornwall, ON K6H 6S3. (613) 938-5745. Contact: Jim Barlow, Henry Schryver

There are no national parks in the study area. There is a National Historic Site at Old Fort St. Joseph, St. Joseph Island, Ontario. Hiawatha National Forest is located on the U.S. side.

Provincial/State Park, Nature Reserves or Wilderness Areas

Brimley State Park - 906-248-3422

There are no provincial parks in the study area.

A.4 Shoreline Habitats

Shoreline Classifications
Environment Canada, Environmental Emergencies Section, Environment 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

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 Electorial Districts, Toronto, Ontario (416) 326–6500

A.6 Main United States Data Sources

Primary biological resource information was extracted from NOAA's "St. Marys 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 State Department of Natural Resources.

Human-use, protection strategy, and sensitive area information was compiled from the USCG's Sault Ste. Marie Area Contingency Plan (1993).

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. Marys River. Elements of base topographic maps showing on each atlas page have been reproduced with Natural Resources Canada's permission.

Map Sheet	Year
41 K/1	1983
41 K/8 & 41 K/7	1983
41 K/9	1983
41 K/10	1983
41 J/4	1975
41 J/5	1975

The following USGS Quad map sheets (1:24,000 scale) cover the United States shoreline of the St. Marys 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
Goetzville, Mich.-Ont.	N4600-W8400/7.5
Brimley, Mich.-Ont.	N4622.5-W8430/7.5
Shallows, Mich.-Ont.	N4622.5-W8422.5/7.5
Baie De Wasai, Mich.-Ont	N4622.5-W8407.5/7.5
Payment, Mich.-Ont.	N4630-W8407.5/7.5
Sault Ste. Marie South, Mich.-Ont.	N4622.5-W8415/7.5
Oak Ridge, Mich.-Ont.	N4615-W8407.5/7.5
Munuscong, Mich.	N4607.5-W8407.5/7.5
Munuscong NE, Mich.-Ont.	N4607.5-W8400/7.5
Burnt Island, Mich.-Ont.	N4600-W8345/7.5
Whitney Bay, Mich.	N4552.5-W8345/7.5
Lime Island, Mich.-Ont.	N4600-W8352.5/7.5
De Tour Village, Mich.	N4552.5-W8352.5/7.5

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 Sixteenth Arctic and Marine Oil Spill Program (AMOP) Technical Seminar pp. 225-254. Environment Canada, Ottawa, Ontario.

Boyd, G.L., 1981: "Canada/Ontario Great Lakes Erosion Monitoring Programme - Final Report 1973/1980" Ocean Science and Surveys, Fisheries and Oceans Canada, Burlington, Ontario, Manuscript Report Series #12.

Department of Fisheries and Oceans, 1984: "Sailing Directions - Great Lakes", Volume 2 (Upper Great Lakes), Sixth Edition, Minister of Supply and Services Canada, Ottawa, Ontario.

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, Environmental Emergencies Section/Canadian Coast Guard, Central Region, 1981, Amended 1993: "St. Marys River Supplement to the Joint Canada – United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances", Environmental Protection Branch, Toronto, ON.

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, 1989: "Climatological Station Catalogue", Minister of Supply and Services Canada, Ottawa, ON.

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 1995: "Environmental Sensitivity Atlas for Lake Erie (Including the Welland Canal) and the Niagara River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/3-1994E

Environment Canada, Environmental Protection Branch - Ontario Region 1995: "Environmental Sensitivity Atlas for the St. Lawrence River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/5-1994E

Environment Canada, Environmental Protection Branch - Ontario Region 1995: "Environmental Sensitivity Atlas for the St. Clair River, Lake St. Clair and Detroit River Shorelines", Minister of Supply and Services Canada, Cat. No. En40-455/9-1994E

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 2 (St. Marys River) prepared for the Ontario Ministry of the Environment.

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

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". Queen's Printer for Ontario, Toronto, Ontario.

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.

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

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 (N.O.A.A.).

Research Planning, Inc., 1985: "St. Marys 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. shores 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. shores 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. shores 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., 1989: "Natural Resource Response Guide: Marine Mammals". Prepared for the Office of Oceanography and Marine Services, United States National Oceanic and Atmospheric Administration (N.O.A.A.).

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 (N.O.A.A.).

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 (N.O.A.A.).

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 (N.O.A.A.).

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

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.

Soper, J.H., 1962, "Botanical Observations Along the Lake Superior Route"; Proceedings of the Royal Canadian Institute, Series 5, Volume 10, pg. 12–24.

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 - Sault Ste. Marie, 1993: "Sault Ste. Marie Area Contingency Plan". USCG - MSO, 337 Water St., Sault Ste. Marie, Michigan 49783. Phone - 906-635-3233 (24 hour)

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

Upper Great Lakes Connecting Channels Study (UGLCCS), 1988: Volume 1 and 2, Final Report; Contributions by: U.S. Fish and Wildlife Service, Ontario 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
MOEE	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
U.S.	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

Shoreline Habitats

ESI* Ranking

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

Canada