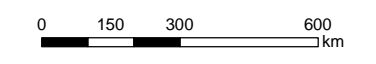


Overall ERI for Crude Oil Spills
South of the 60th Parallel



January 2014
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ERI Relative Scale	WSP Canada Inc.'s Boundary
Very Low	0 to 12 NM
Low	12 to 24 NM
Medium	24 to 200 NM
High	
Very High	

Risk Assessment for Marine Spills in Canadian Waters

Phase 1: Oil Spills South of 60th Parallel

ERI for Refined Products Spills (100 to 999.9 m³ spill volume) South of the 60th Parallel



January 2014

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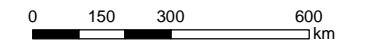


Map 9.2



ERI Relative Scale	WSP Canada Inc.'s Boundary
Very Low	0 to 12 NM
Low	12 to 24 NM
Medium	24 to 200 NM
High	
Very High	

Overall ERI for Fuel Oil Spills
South of the 60th Parallel



January 2014

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Map 9.3



ERI Relative Scale	WSP Canada Inc.'s Boundary
Very Low	0 to 12 NM
Low	12 to 24 NM
Medium	24 to 200 NM
High	
Very High	

Table 9.2 Highest Refined Oil ERI Ranked Zones (lowest return period, 100 to 999.9 m³)

100 to 999.9 m ³			
Rank	Sector	Sub-Sector	Zone
1	Great Lakes and St. Lawrence Seaway System	1	Nearshore
2	Estuary and Gulf of St. Lawrence	2	Nearshore
3	Estuary and Gulf of St. Lawrence	1	Nearshore
4	Estuary and Gulf of St. Lawrence	3	Nearshore
5	Estuary and Gulf of St. Lawrence	6	Nearshore
6	Atlantic Coast	6	Nearshore
7	Atlantic Coast	4	Nearshore
8	Atlantic Coast	2	Nearshore
9	Pacific Coast	5	Intermediate
10	Atlantic Coast	1	Nearshore

Table 9.3 Highest Fuel Oil ERI Ranked Zones (all volumes confounded)

Fuel Oil			
Rank	Sector	Sub-Sector No.	Zone
1	Great Lakes and St. Lawrence Seaway System	1	Nearshore
2	Estuary and Gulf of St. Lawrence	1	Nearshore
3	Pacific Coast	5	Nearshore
4	Estuary and Gulf of St. Lawrence	2	Nearshore
5	Estuary and Gulf of St. Lawrence	3	Nearshore
6	Estuary and Gulf of St. Lawrence	6	Nearshore
7	Pacific Coast	5	Intermediate
8	Atlantic Coast	6	Nearshore
9	Great Lakes and St. Lawrence Seaway System	1	Intermediate
10	Estuary and Gulf of St. Lawrence	4	Nearshore

9.2.2 Enhancement of Future Risk Assessments

Limitations were identified in the description of regional risk. If addressed, these limitations would help refining current risk estimates. Future risk assessments could be improved by addressing some of the following issues identified during the study:

- Reporting of spills in international data in the relatively small size ranges is somewhat suspect given the unusual distribution between “small, medium, and large spills” as defined in this study. Additional attention should be given in any future risks assessments to confirming spill details on the spill size ranges of interest.
- MPIRS, the database on pollution incidents maintained by CCG, should be examined for potential improvements related to the comprehensiveness and quality of recorded data.

- The consequence portion of the analysis was performed assuming that countermeasures were not employed or were ineffective. In future risk assessments, consideration could be given to including the effects of spill countermeasures, which could vary with oil type and spill size, and location with regards to remoteness, weather variability and other factors.
- The collection of environmental data is constantly improving over time. Assuring that all regions have the same level of details would allow for better comparisons. The development of databases in a GIS format should facilitate the production of reviewed risk values.
- For the Physical Sensitivity Index:
 - Data on the evolution of coastal areas facing climate change impacts would be beneficial, in particular for sensitive components such as coastal wetlands.
 - The analysis would benefit from integrating data on littoral geomorphology to capture erosion impacts. This data is often available at the provincial level.
- For the Biological Resource Indicator (BRI), the following elements could be considered:
 - Incorporating all protected marine areas identified under various jurisdictions.
 - Incorporating EBSA layers or equivalent layers with similar biological content. In this context, the risk analysis for the freshwater environments (Great Lakes/St. Lawrence Seaway System sector) should be considered as a separate analysis due to high discrepancy in the type of available data.
 - Incorporating the coverage of species at risk.
- For the Human-Use Resource Index (HRI), a revised risk assessment would benefit from:
 - Incorporating information on provincial and municipal conservation/protected areas.
 - Incorporating information on freshwater intake and utilization (drinking water, agriculture and industrial utilization).
 - Incorporating information on archeological sites and cultural heritage sites.
 - Overlaying the current risk estimate with information on Aboriginal communities presented in Appendix 3 of this study.

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APPENDIX 1

Marine Oil Spill Prevention in Canada

APPENDIX 1 Marine Oil Spill Prevention in Canada

Marine oil spill prevention measures, including regulatory oversight, inspection and enforcement measures, port policies, as well as industry's voluntary practices and procedures have a direct correlation with the low frequency of large oil spills in Canadian waters. The following are some of the measures that contribute to marine oil spill prevention (Transport Canada, 2013²).

A1.1 Navigation Safety

There are a number of regulations under the *Canada Shipping Act, 2001* to help ensure that vessels navigate safely in Canadian waters. These regulations outline the requirements for navigation equipment, navigational rules and procedures that are to be followed, and requirements for effective means of communication. Some specific measures are outlined below.

A1.1.1 Vessel Routing Measures

Routing measures seek to address both safety and environmental concerns, which may occur from vessel traffic. Such routing measures include:

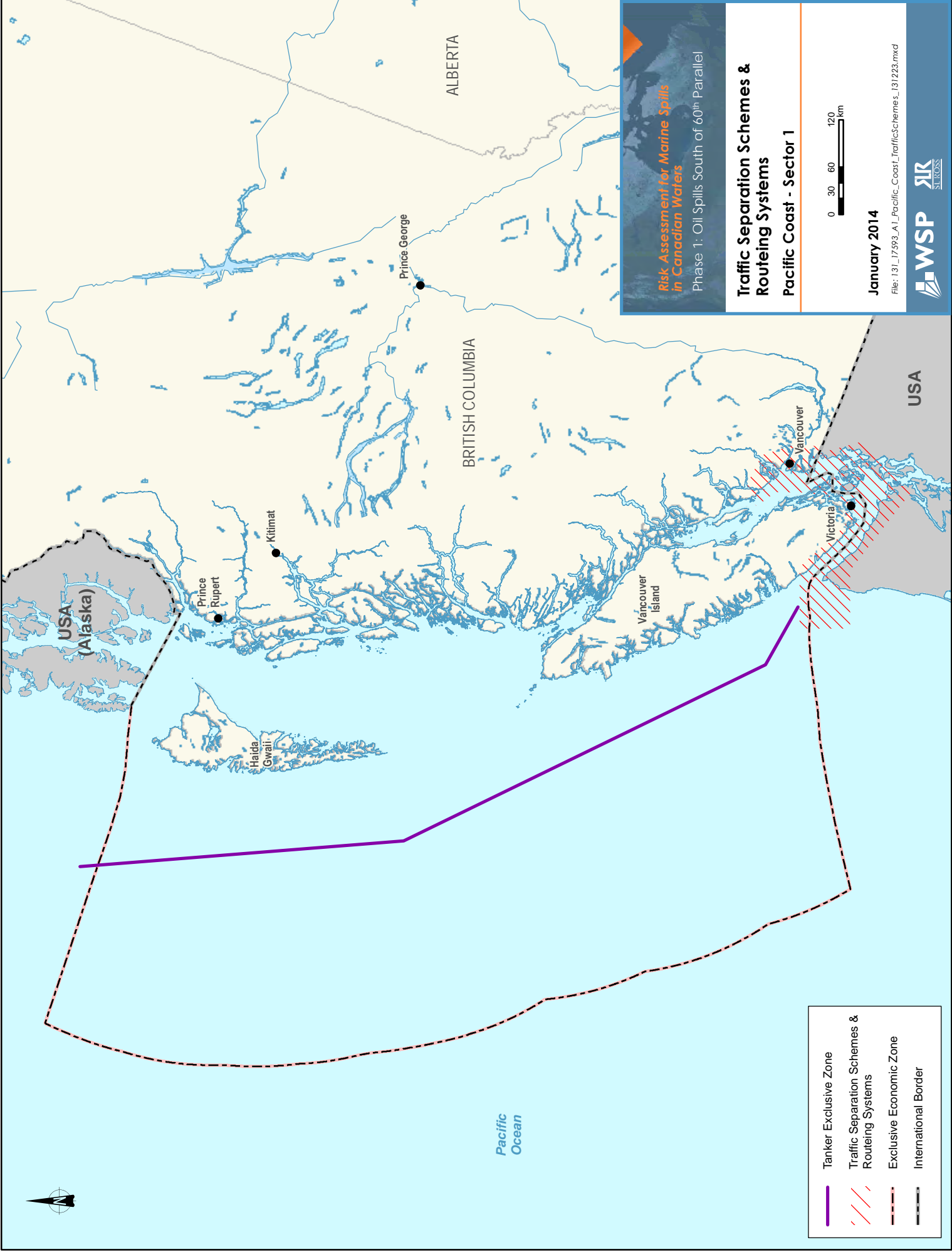
- Traffic separation schemes;
- Two-way routes;
- Recommended tracks;
- Precautionary areas; and
- Areas to be avoided.

There are also a number of additional measures and requirements that exist on the West Coast, such as the voluntary Tanker Exclusion Zone along British Columbia's coastline. This zone only applies to loaded oil tankers transiting between Valdez, Alaska and Puget Sound, Washington.

Refer to the three following maps for examples of routing measures in place in Canada (CCG, 2013³).

² TRANSPORT CANADA. 2013. *Tanker Safety and Spill Prevention*. [Online]
[<http://www.tc.gc.ca/eng/marinesafety/menu-4100.htm>]

³ CANADIAN COAST GUARD (CCG). 2013. *Notices to Mariners 1 to 46*. Annual Edition
April 2013 to March 2014. [Online]
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**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel





**Traffic Separation Schemes &
Routing Systems**
Pacific Coast - Sector 1



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-  Tanker Exclusive Zone
-  Traffic Separation Schemes & Routing Systems
-  Exclusive Economic Zone
-  International Border



Pacific Ocean

USA (Alaska)

Prince Rupert

Haida Gwaii

Kitimat

ALBERTA

BRITISH COLUMBIA

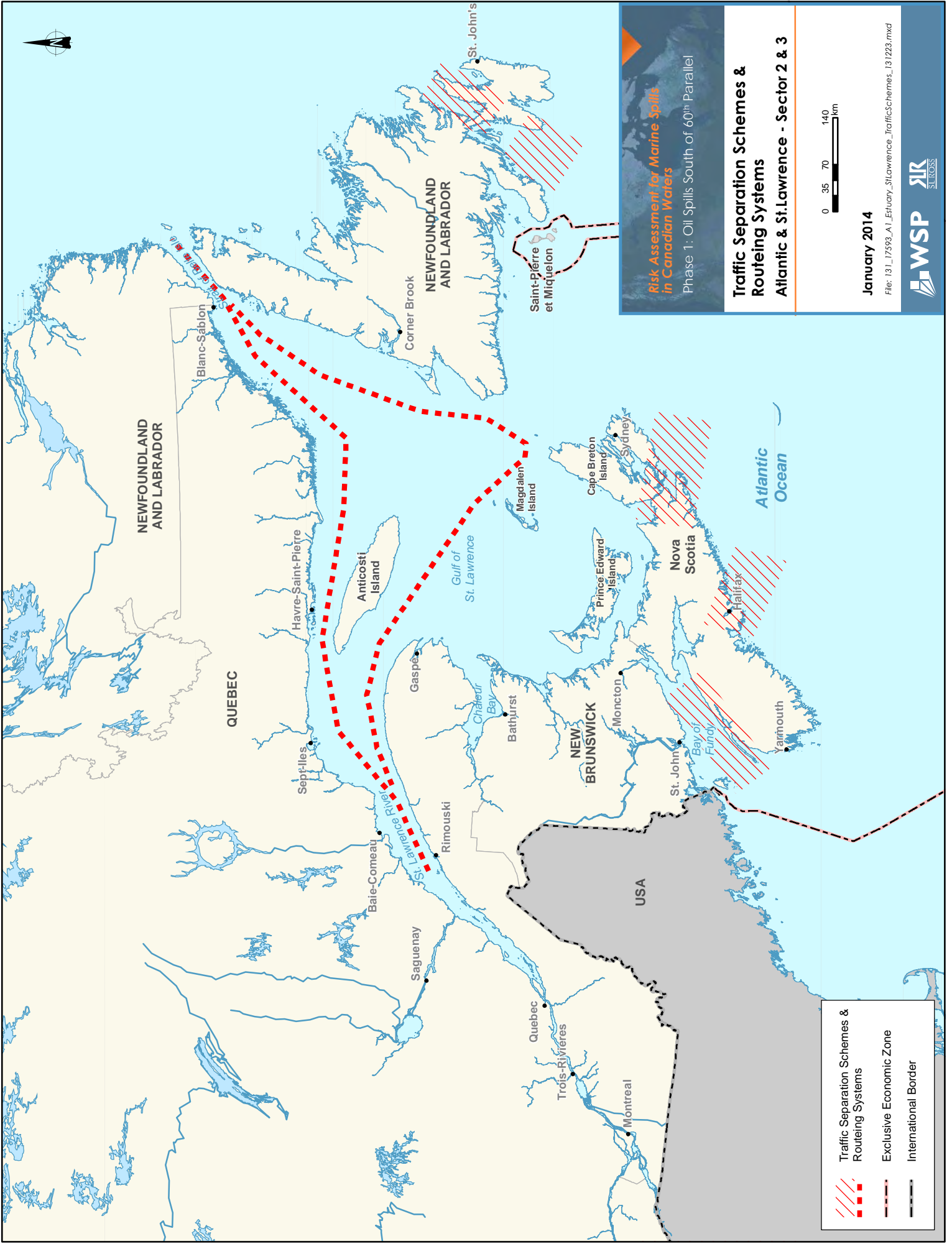
Vancouver Island

Prince George

Vancouver

Victoria

USA



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel

**Traffic Separation Schemes &
Routing Systems**

Atlantic & St. Lawrence - Sector 2 & 3

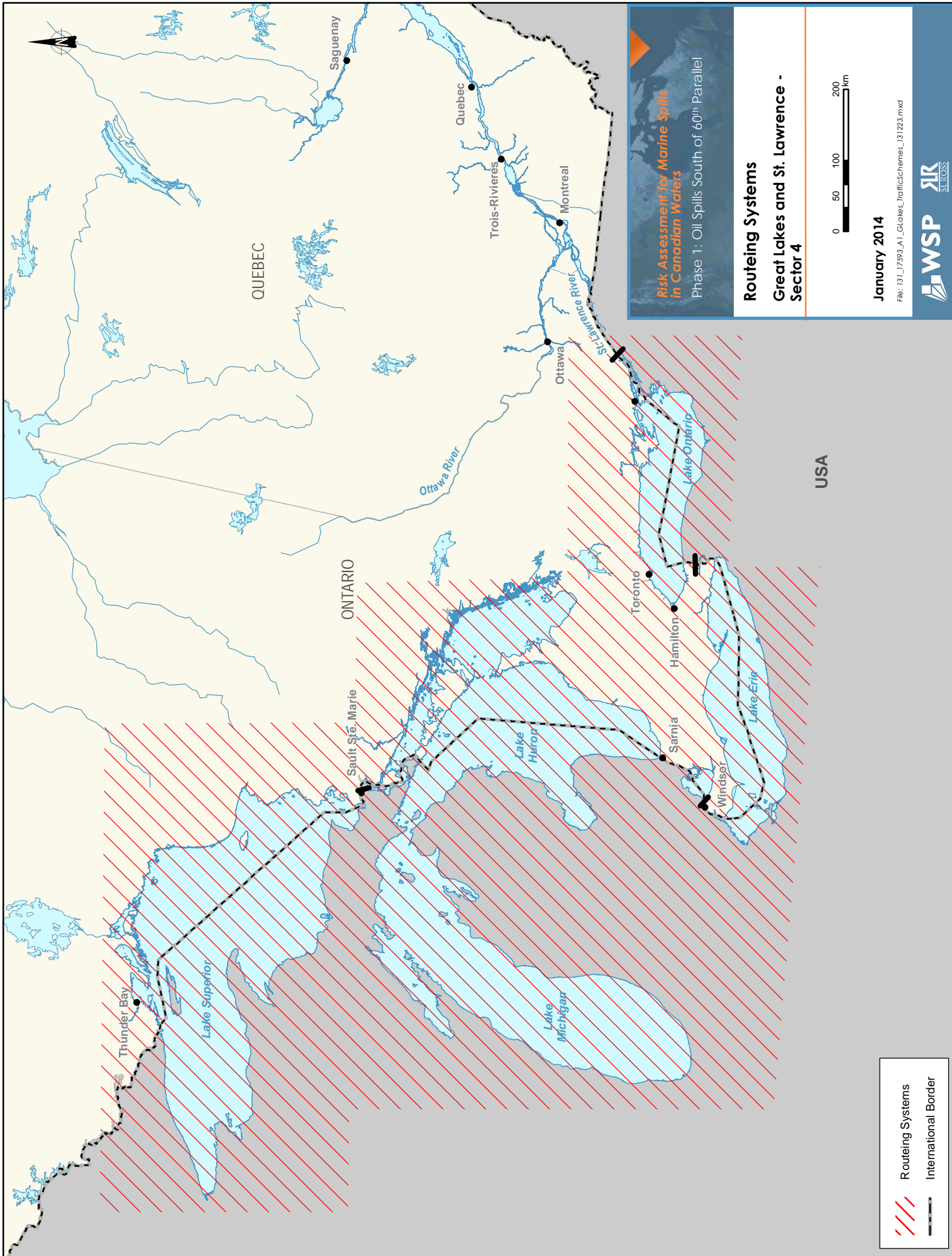


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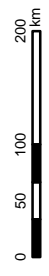
	Traffic Separation Schemes & Routing Systems
	Exclusive Economic Zone
	International Border



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel



**Routing Systems
Great Lakes and St. Lawrence -
Sector 4**



January 2014

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 Routing Systems
 International Border

A1.1.2 Compulsory Pilotage and Tug Escorts

Pilotage involves the use of certified pilots that board vessels in specific areas to navigate through difficult waterways to avoid local hazards. These pilots provide extensive expertise and knowledge of a local waterway for vessels travelling to and from Canadian ports.

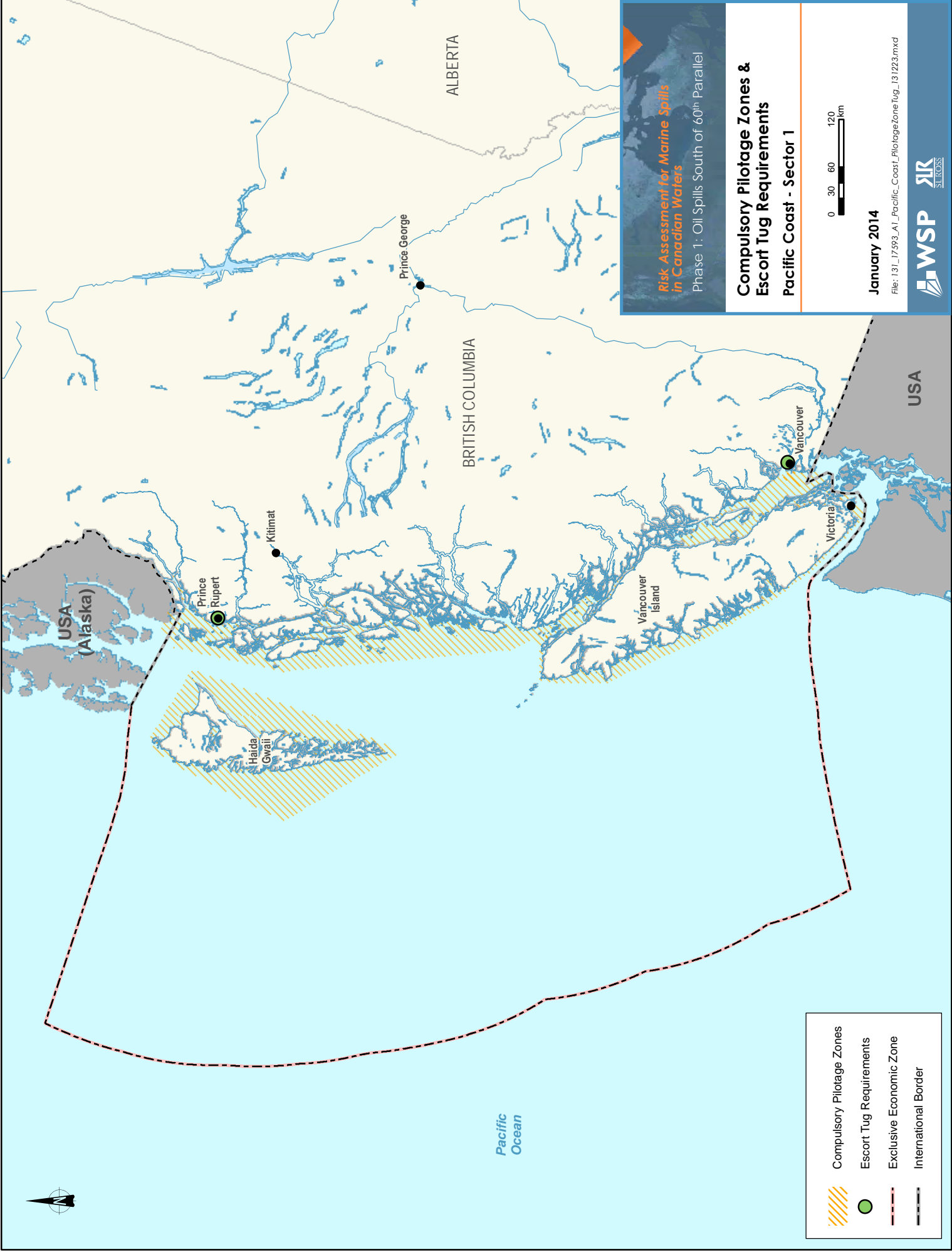
The four Pilotage Authorities in Canada that are responsible for setting requirements for and providing marine pilotage services in all geographic areas of the country are the Atlantic Pilotage Authority, the Great Lakes Pilotage Authority, the Pacific Pilotage Authority and the Laurentian Pilotage Authority. The Pilotage Authorities set in regulations the requirements for compulsory pilotage within which certain classes of vessels, including oil tankers, must take a marine pilot with local knowledge on board before entering a harbour or busy waterway. Port Authorities may establish requirements for escort tugs. The requirements in place vary by port. See the three following maps for the compulsory pilotage areas (Government of Canada, 2013a⁴; 2013b⁵; 2013c⁶; 2013d⁷) for the aforementioned pilotage authorities, as well as for port authorities that have voluntary tug requirements.

⁴ GOVERNMENT OF CANADA. 2013a. *Atlantic Pilotage Authority Regulations (C.R.C., c. 1264) – Part I: Compulsory Pilotage Areas of New Brunswick*. [Online] [http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1264/page-9.html#docCont].

⁵ GOVERNMENT OF CANADA. 2013b. *Great Lakes Pilotage Regulations (C.R.C., c. 1266) – Compulsory Pilotage Areas*. [Online] [http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.%2C_c._1266/page-2.html#docCont]

⁶ GOVERNMENT OF CANADA. 2013c. *Pacific Pilotage Regulations (C.R.C., c. 1270) – Establishment of Compulsory Pilotage Areas*. [Online] [http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1270/page-2.html]

⁷ GOVERNMENT OF CANADA. 2013d. *Laurentian Pilotage Authority Regulations (C.R.C., c. 1268) – Schedule I: Compulsory Pilotage Area*. [Online] [http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1268/page-14.html#docCont]



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel

**Compulsory Pilotage Zones &
Escort Tug Requirements
Pacific Coast - Sector 1**



January 2014

File: I3_L17593_A1_Pacific_Coast_PilotageZone.tug_131223.mxd



-  Compulsory Pilotage Zones
-  Escort Tug Requirements
-  Exclusive Economic Zone
-  International Border



Pacific
Ocean

USA
(Alaska)

USA

ALBERTA

BRITISH COLUMBIA

Prince
Rupert

Kitimat

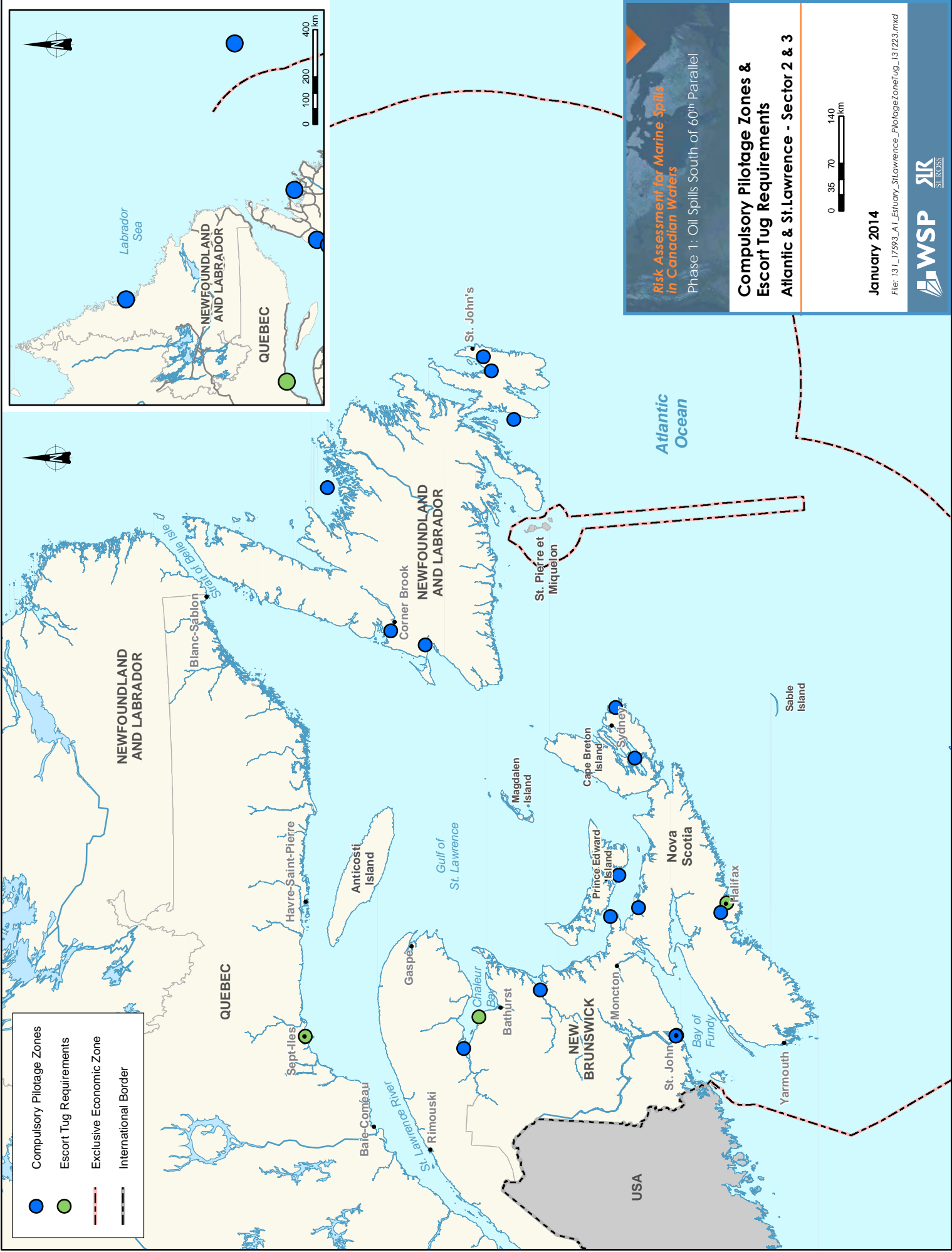
Prince
George

Vancouver
Island

Vancouver

Victoria

Haida
Gwaii



Risk Assessment for Marine Spills in Canadian Waters
 Phase 1: Oil Spills South of 60th Parallel

Compulsory Pilotage Zones & Escort Tug Requirements Atlantic & St. Lawrence - Sector 2 & 3

January 2014
 File: 13_L_17593_A1_Estuary_StLawrence_PilotageZoneFig_131223.mxd



- Compulsory Pilotage Zones
- Escort Tug Requirements
- Exclusive Economic Zone
- International Border



Labrador Sea

NEWFOUNDLAND AND LABRADOR

QUEBEC

NEWFOUNDLAND AND LABRADOR

NEW BRUNSWICK

Atlantic Ocean

Gulf of St. Lawrence

USA

Sable Island

St. Lawrence River

Blanc-Sablon

Havre-Saint-Pierre

Sept-Iles

Bate-Coméau

Rimouski

Chaleur Bay

Bathurst

Corner Brook

Magdalen Island

St. Pierre et Miquelon

Prince Edward Island

Cape Breton Island

Sydney

Nova Scotia

Halifax

Yarmouth

St. John's

Moncton

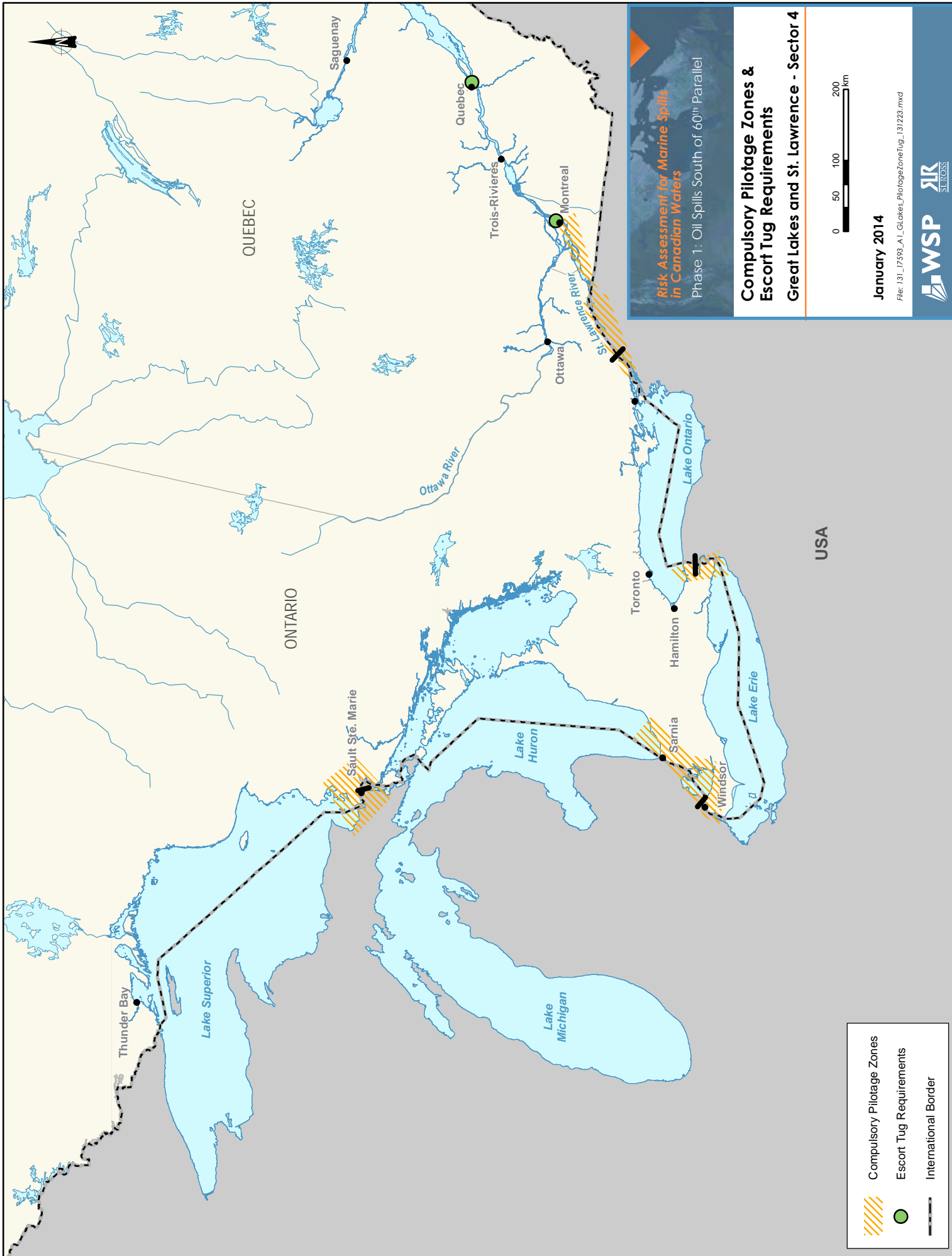
St. John's

Yarmouth

Halifax

St. John's




Yarmouth



Risk Assessment for Marine Spills in Canadian Waters
 Phase 1: Oil Spills South of 60th Parallel

Compulsory Pilotage Zones & Escort Tug Requirements
Great Lakes and St. Lawrence - Sector 4

January 2014
 File: 131_17593_A1_GlLakes_PilotageZoneTug_131223.mxd

-  Compulsory Pilotage Zones
-  Escort Tug Requirements
-  International Border

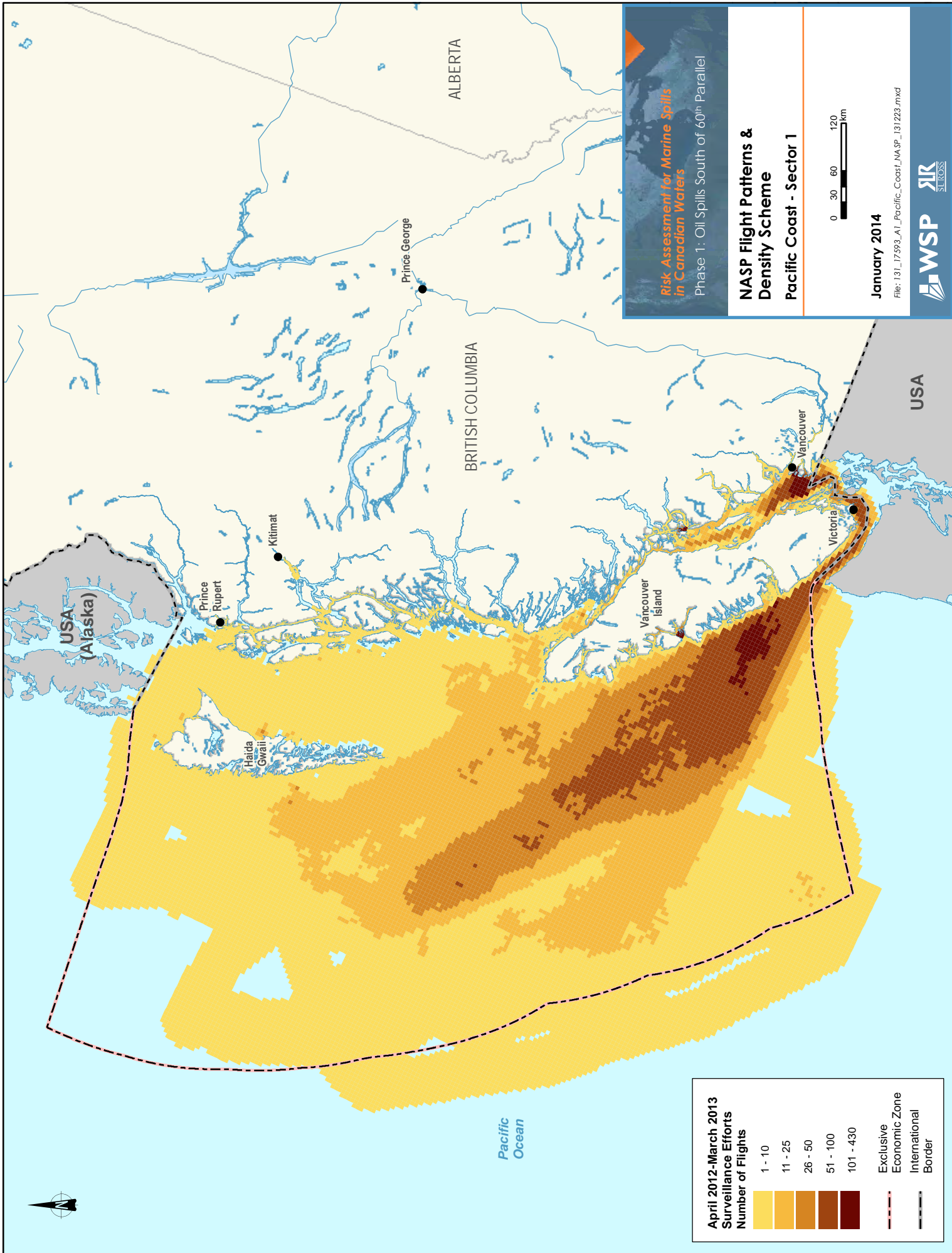
A1.2 Aerial Surveillance

Transport Canada conducts aerial surveillance, through its National Aerial Surveillance Program (NASP), over all Canadian waters to detect ship-source pollution.

Transport Canada owns and operates three specialized aircraft, with state of the art remote sensing equipment, which patrol Canada's three coasts, the Gulf of the St. Lawrence, the Great Lakes and the St. Lawrence Seaway. This works as an effective deterrent for oil discharges, and evidence gathered by the crew of the National Aerial Surveillance Program has led to successful prosecutions of polluters over the years.

See the three following maps representing density of recent NASP surveillance efforts⁸.

⁸ Data Source: Environment Canada.



Risk Assessment for Marine Spills in Canadian Waters

Phase 1: Oil Spills South of 60th Parallel

NASP Flight Patterns & Density Scheme
Pacific Coast - Sector 1



January 2014

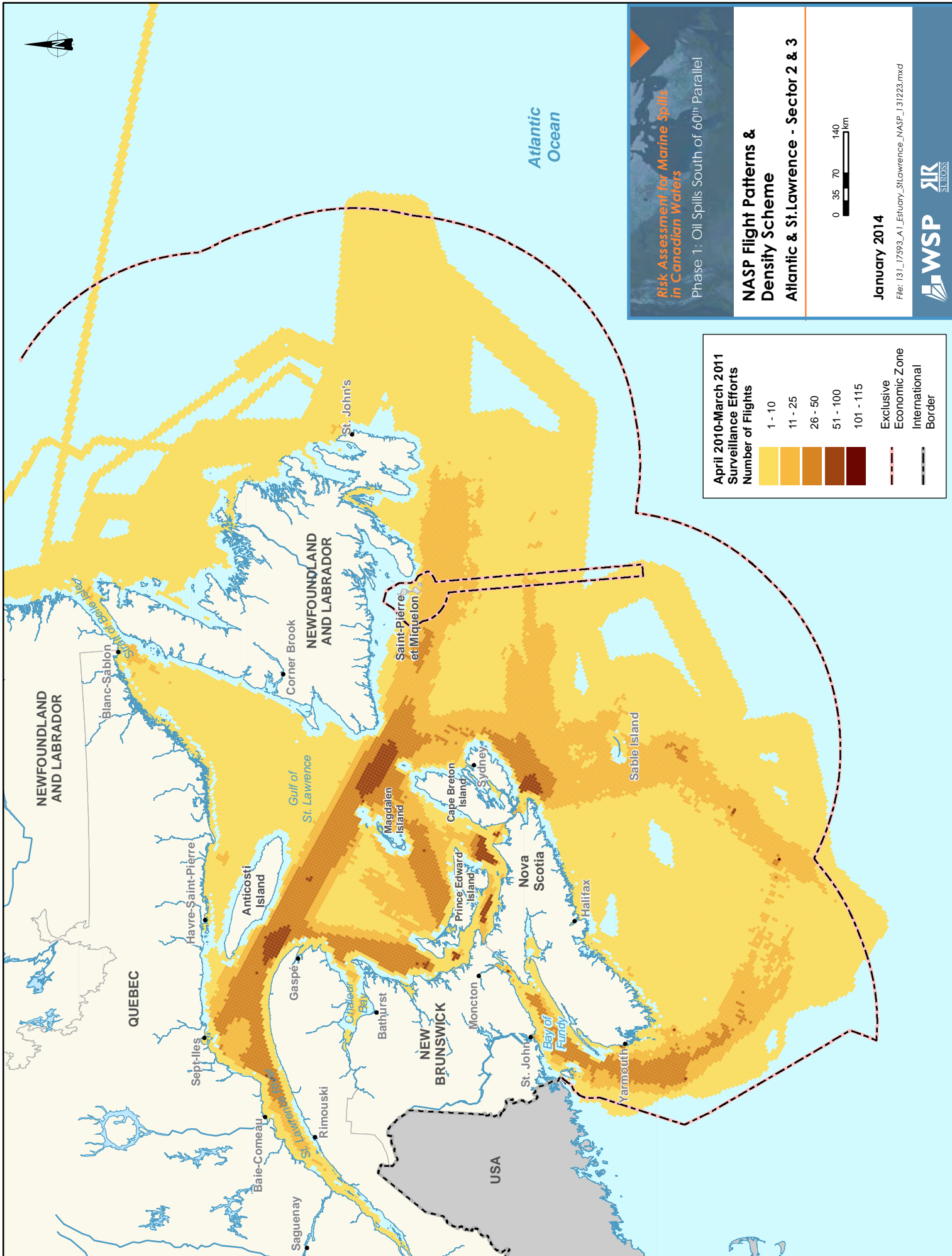
File: I3_L17593_AI_Pacific_Coast_NA.SP_131223.mxd



April 2012-March 2013 Surveillance Efforts
Number of Flights

- 1 - 10
- 11 - 25
- 26 - 50
- 51 - 100
- 101 - 430

- Exclusive Economic Zone
- International Border



**Risk Assessment for Marine Spills
in Canadian Waters**
Phase 1: Oil Spills South of 60th Parallel

**NASP Flight Patterns &
Density Scheme**
Atlantic & St. Lawrence - Sector 2 & 3

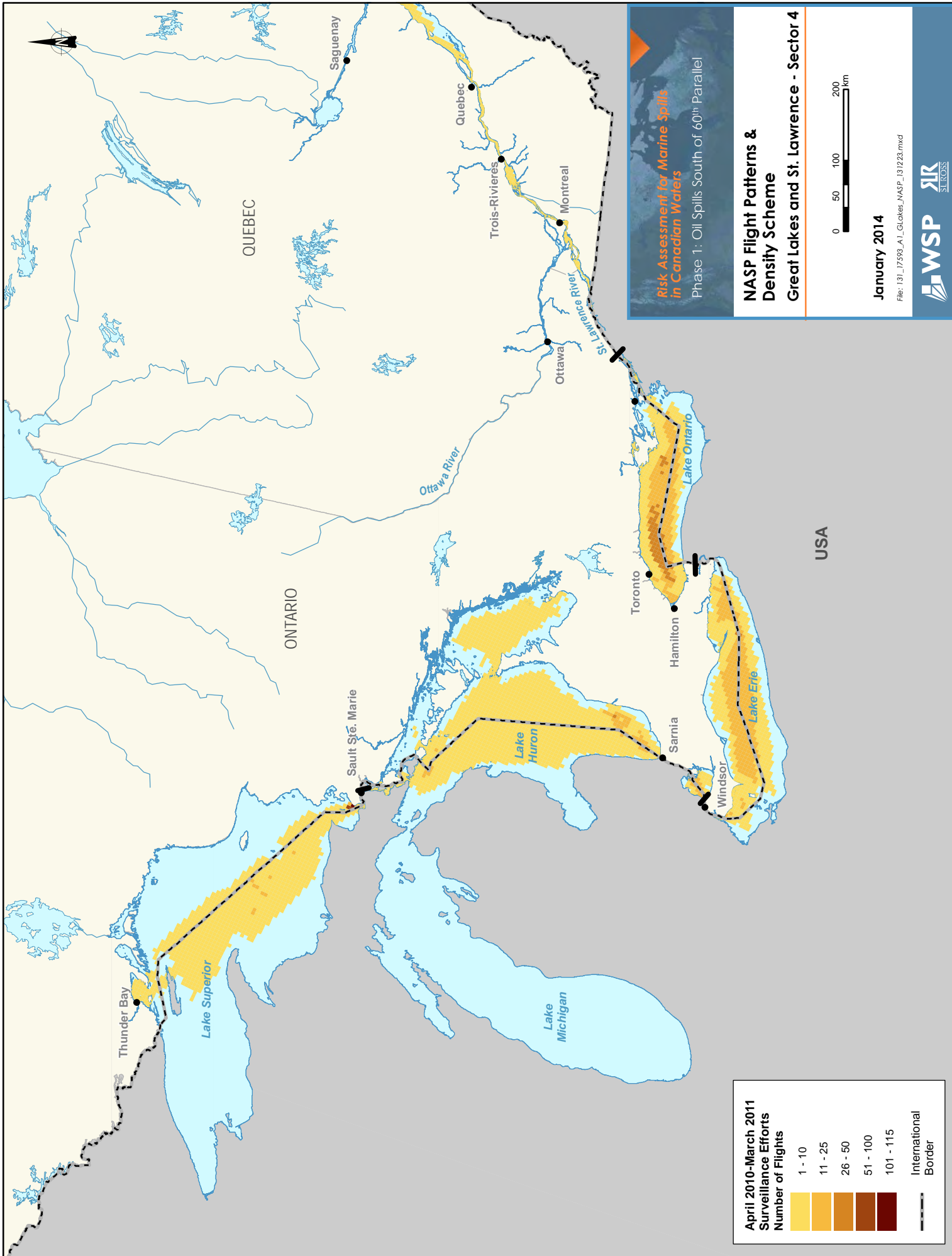
January 2014
File: 13_L_17593_AI_Estuary_StLawrence_NASP_131223.mxd



**April 2010-March 2011
Surveillance Efforts
Number of Flights**

1 - 10	11 - 25	26 - 50	51 - 100	101 - 115
--------	---------	---------	----------	-----------

- - - Exclusive Economic Zone
 - - - International Border



Risk Assessment for Marine Spills in Canadian Waters
 Phase 1: Oil Spills South of 60th Parallel

NASP Flight Patterns & Density Scheme
Great Lakes and St. Lawrence - Sector 4

January 2014
 File: 131_174993_A1_GlLakes_NASP_131223.mxd

0 50 100 200 km



April 2010-March 2011 Surveillance Efforts Number of Flights

1 - 10
11 - 25
26 - 50
51 - 100
101 - 115
International Border

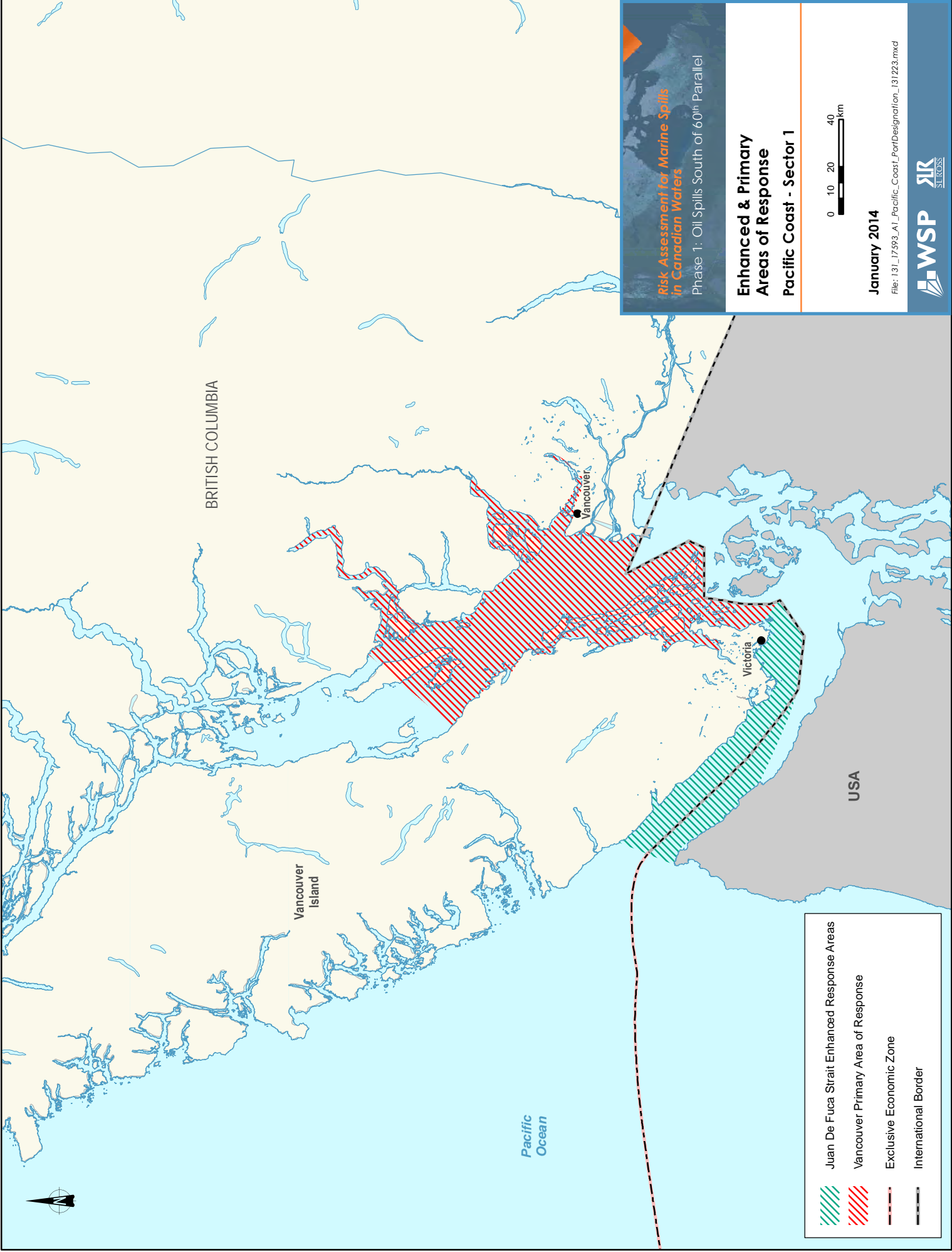
A1.3 Inspections

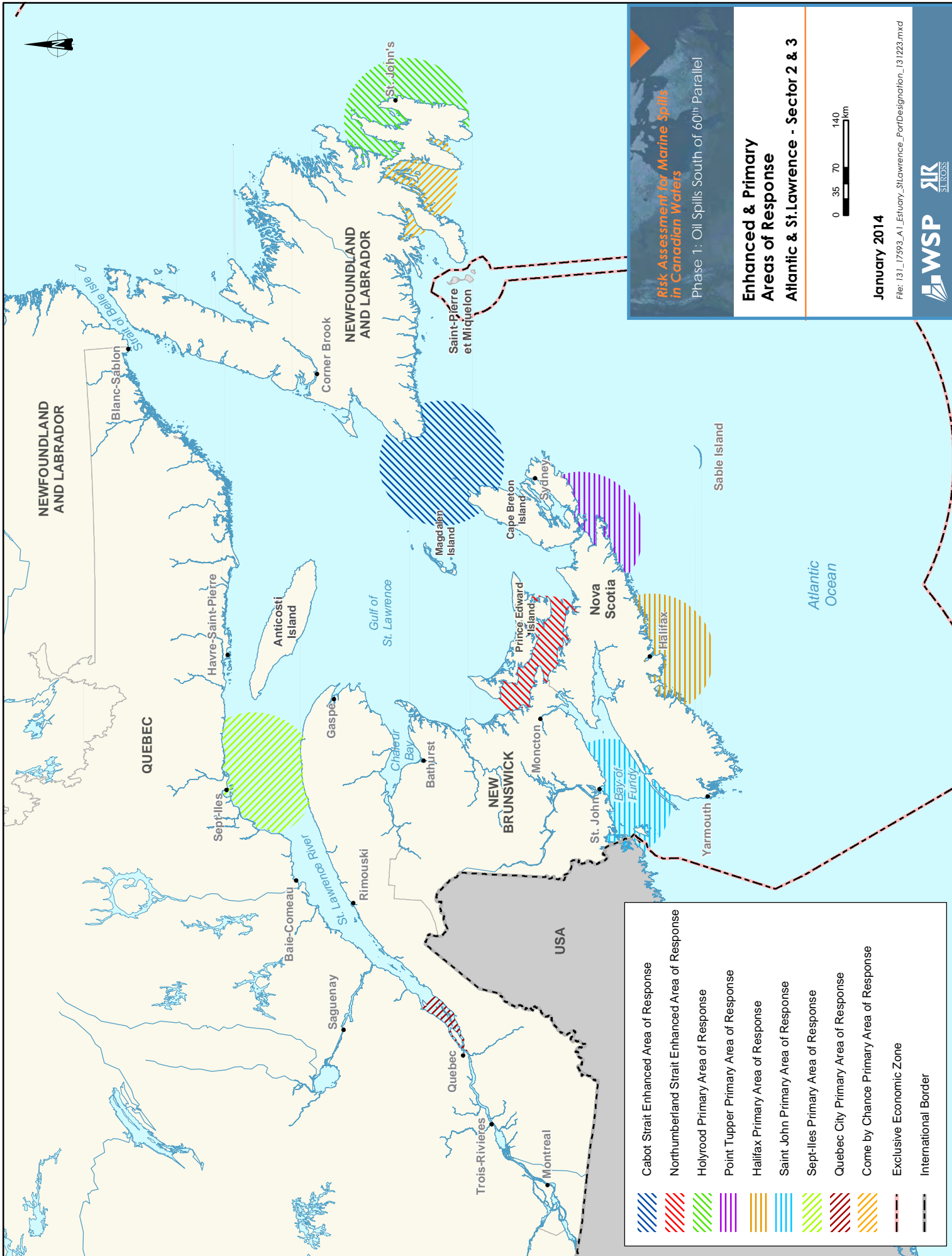
Ships entering Canadian waters are subject to inspections by Transport Canada, to ensure that domestic and international standards are met. Through the Port State Control inspection program, foreign vessels entering Canadian ports are boarded and inspected to ensure they are in compliance with key international maritime conventions. If safety standards are not met, vessels are detained until their deficiencies are rectified. Through the Flag State Control program, Marine Safety inspectors also conduct inspections of Canadian flagged vessels. Inspection programs such as these help to ensure that only ships that meet the highest safety standards enter and operate in Canadian waters.

A1.4 Designated Ports

Primary Areas of Response were established around designated ports that had higher response priorities. These are the marine regions, extending to a distance of 50 nautical miles in all directions, from the boundaries of a designated port as a point of reference. Similarly, Enhanced Response Areas were established in marine regions away from designated ports that warrant special consideration (e.g. due to high shipping volumes converging into confined waters). These designations are established by the Minister of Transport. See the three following maps for Primary Areas of Response and Enhanced Response Areas (Transport Canada, 1995)⁹.

⁹ TRANSPORT CANADA. 1995. *Response Organizations Standards*. [Online] [<http://www.tc.gc.ca/publications/EN/TP12401/PDF/HR/TP12401E.pdf>]





**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel












**Enhanced & Primary
Areas of Response
Atlantic & St. Lawrence - Sector 2 & 3**

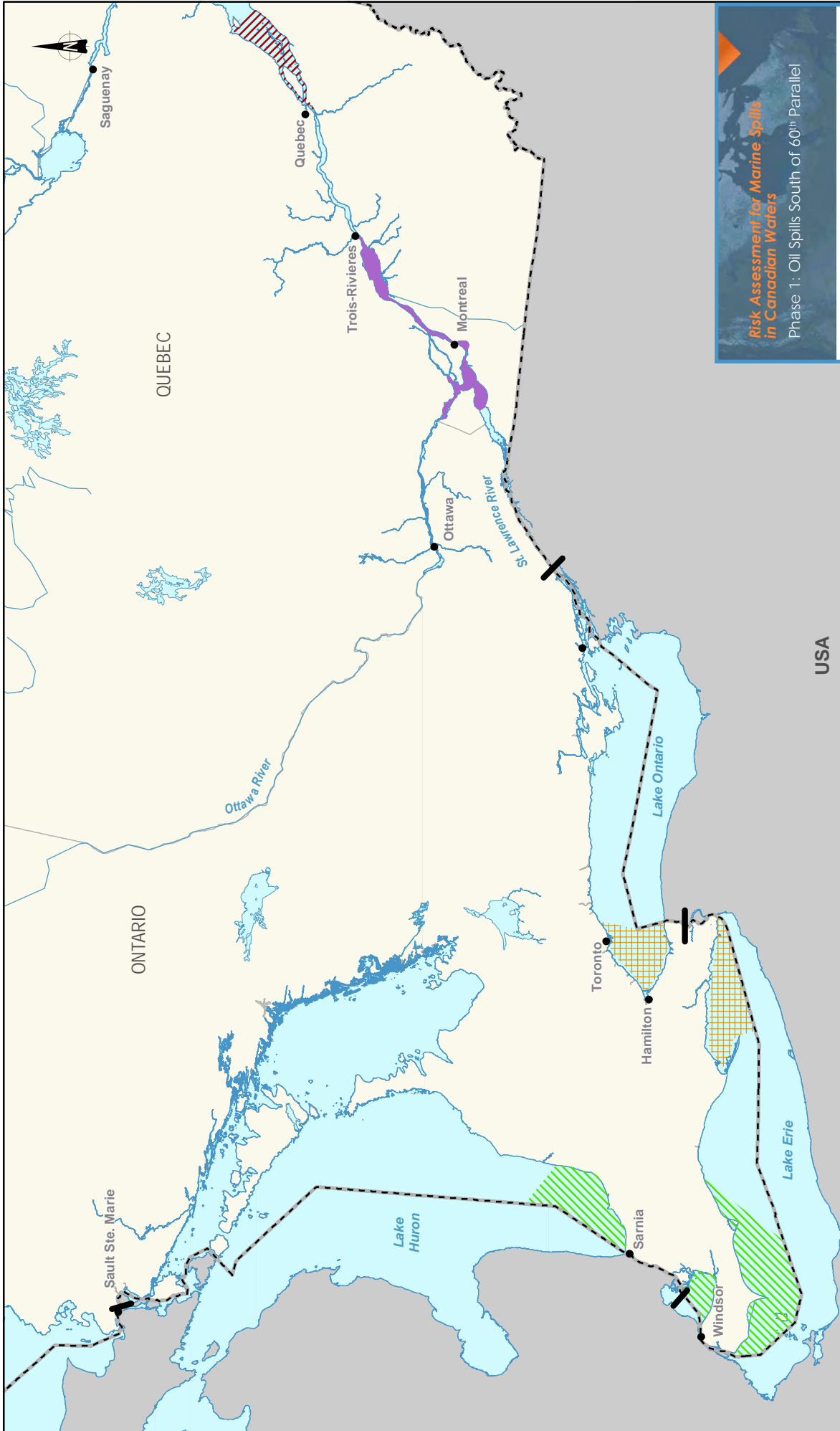


January 2014

File: 13_L_17593_A1_Estuary_StLawrence_PortDesignation_131223.mxd



-  Cabot Strait Enhanced Area of Response
-  Northumberland Strait Enhanced Area of Response
-  Holyrood Primary Area of Response
-  Point Tupper Primary Area of Response
-  Halifax Primary Area of Response
-  Saint John Primary Area of Response
-  Sept-Iles Primary Area of Response
-  Quebec City Primary Area of Response
-  Come by Chance Primary Area of Response
-  Exclusive Economic Zone
-  International Border



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel

**Enhanced & Primary
Areas of Response**






Great Lakes and St. Lawrence - Sector 4



January 2014

File: 131_17593_A1_GlLakes_PortDesignation_131223.mxd



-  Sarnia Primary Area of Response
-  Niagara/Welland Canal Enhanced Area of Response
-  Montreal Primary Area of Response
-  Quebec City Primary Area of Response
-  International Border

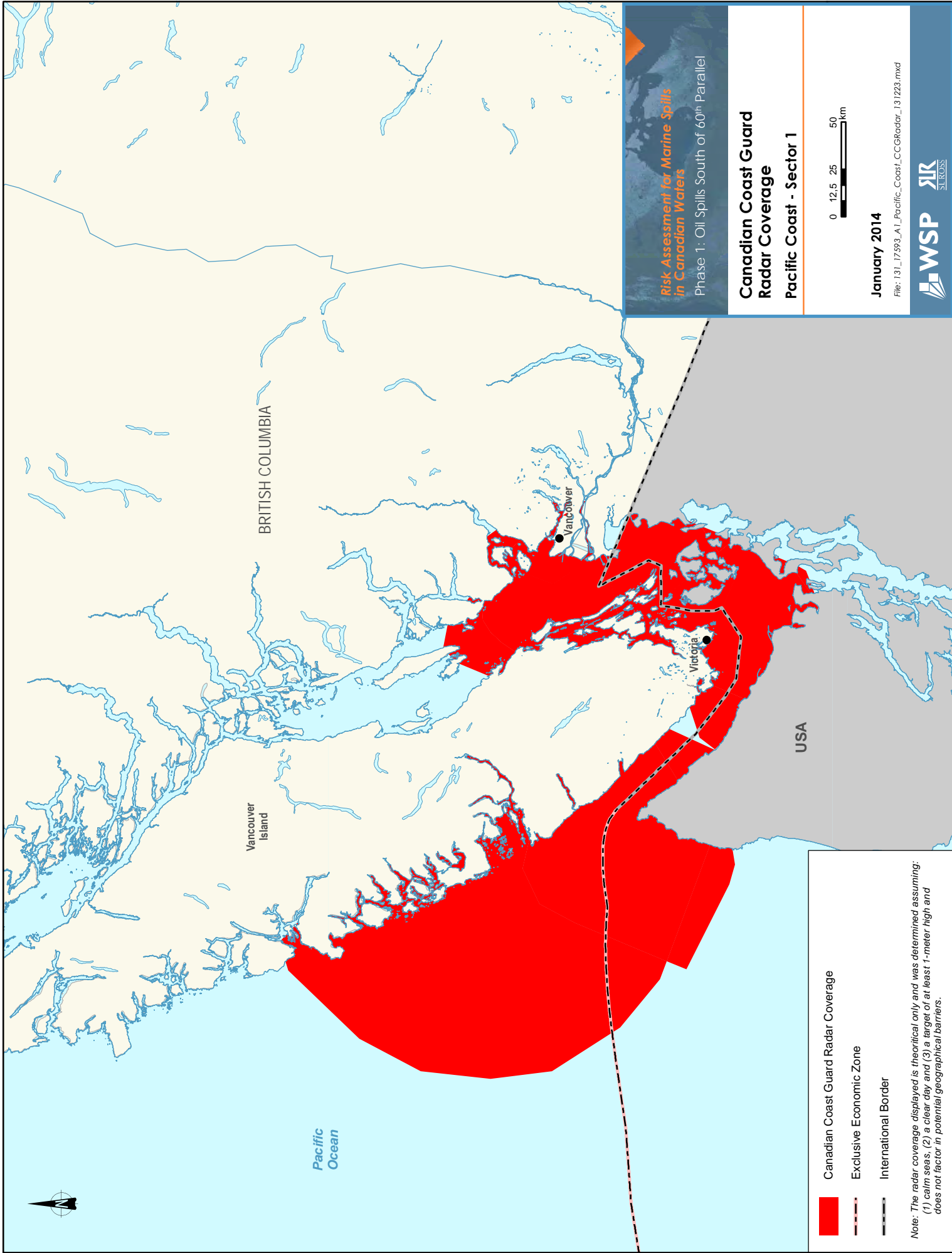
A1.5 Technology and Innovation

The use of technology in marine activities has drastically reduced human error and the number of spills worldwide. The federal government has a wide range of devices or systems, external to a vessel, to help mariners as they navigate Canadian waters. For example, Canadian Coast Guard's radar sites facilitate the monitoring of vessel traffic. See the three following maps for Canadian Coast Guard's radar coverage¹⁰. ***Note: The radar coverage displayed is theoretical only and was determined assuming: (1) calm seas, (2) a clear day and (3) a target of at least 1-meter high and does not factor in potential geographical barriers.***

A1.6 Ship Design and Construction

Government regulations require all large crude oil tankers operating in Canadian waters to be double hulled. The phase-in periods for double hulled smaller tankers operating in Canadian waters range up to the end of 2014.

¹⁰ Data Source: Canadian Coast Guard.



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel

**Canadian Coast Guard
Radar Coverage
Pacific Coast - Sector 1**



January 2014

File: 13_L_17593_A1_Pacific_Coast_CCGRadar_131223.mxd

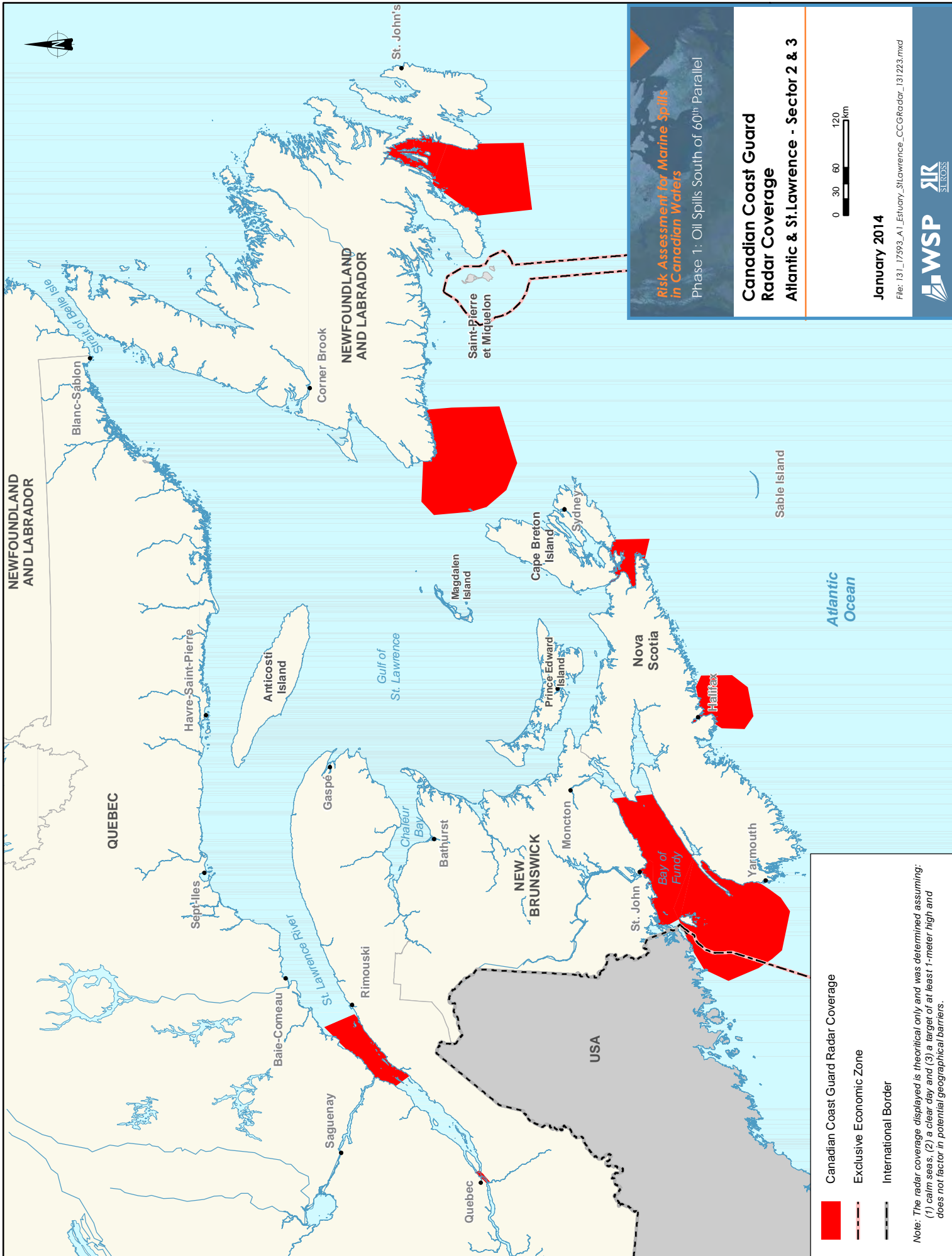


Canadian Coast Guard Radar Coverage

Exclusive Economic Zone

International Border

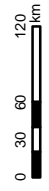
Note: The radar coverage displayed is theoretical only and was determined assuming:
(1) calm seas, (2) a clear day and (3) a target of at least 1-meter high and
does not factor in potential geographical barriers.



Risk Assessment for Marine Spills in Canadian Waters

Phase 1: Oil Spills South of 60th Parallel

**Canadian Coast Guard Radar Coverage
Atlantic & St. Lawrence - Sector 2 & 3**



January 2014
File: 13_L_17593_A1_Estuary_StLawrence_CCGRadar_131223.mxd

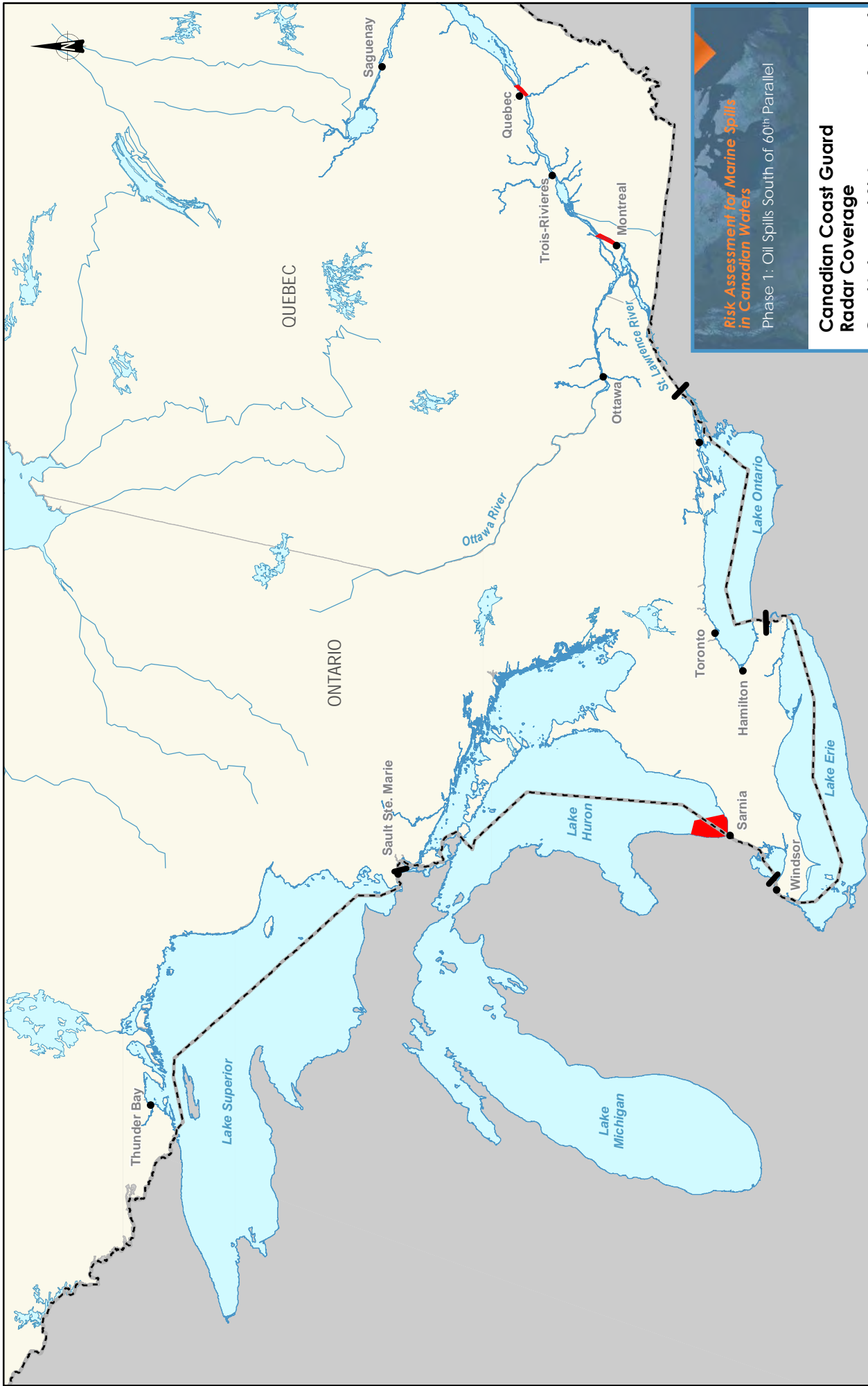


Canadian Coast Guard Radar Coverage

Exclusive Economic Zone

International Border

*Note: The radar coverage displayed is theoretical only and was determined assuming:
(1) calm seas, (2) a clear day and (3) a target of at least 1-meter high and does not factor in potential geographical barriers.*



**Risk Assessment for Marine Spills
in Canadian Waters**
Phase 1: Oil Spills South of 60th Parallel

**Canadian Coast Guard
Radar Coverage
Great Lakes and St. Lawrence - Sector 4**

January 2014
File: 131_17593_A1_GlLakes_CCGRadar_131223.mxd



- Canadian Coast Guard Radar Coverage
- International Border

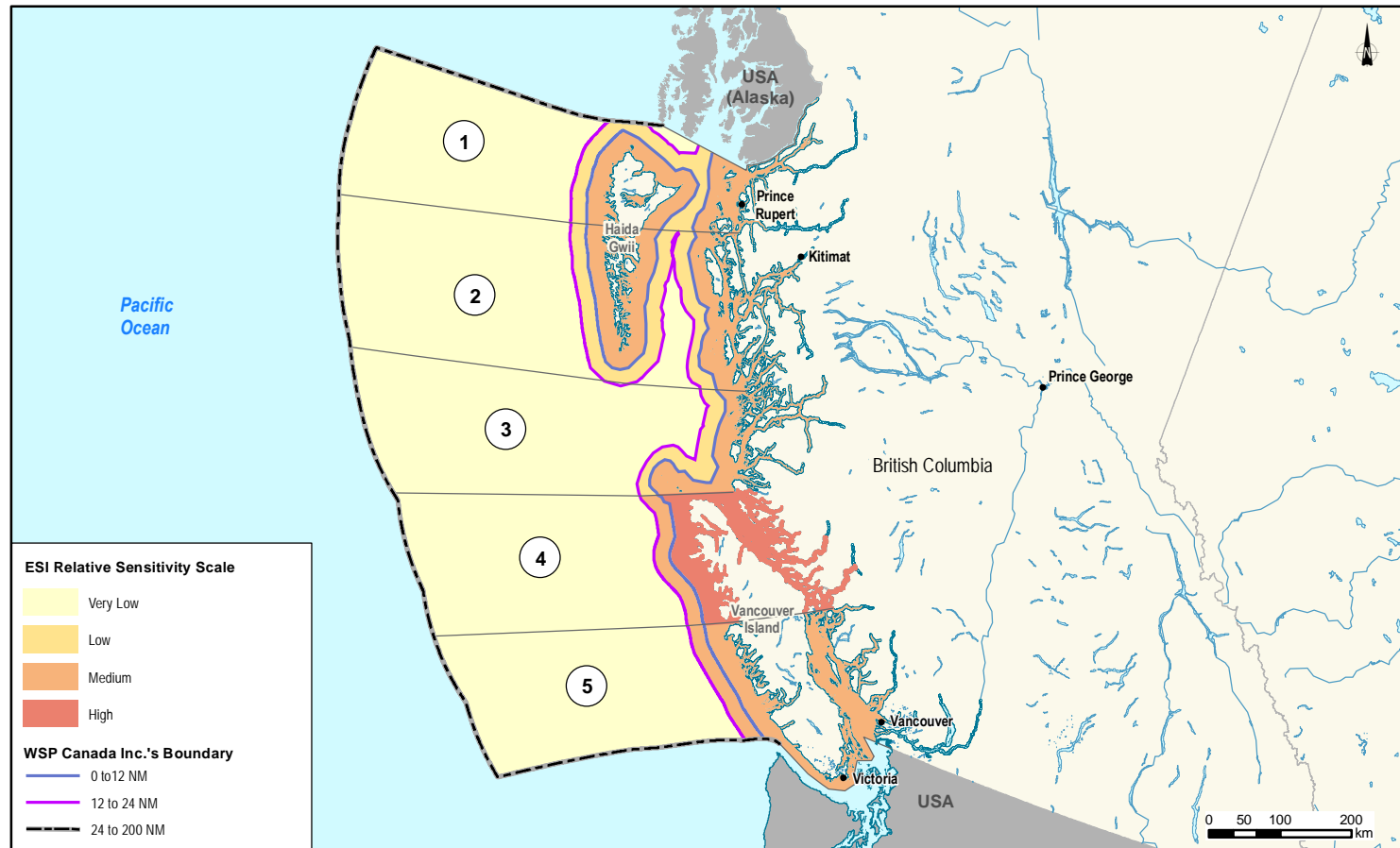
*Note: The radar coverage displayed is theoretical only and was determined assuming:
(1) calm seas, (2) a clear day and (3) a target of at least 1-meter high and
does not factor in potential geographical barriers.*

USA

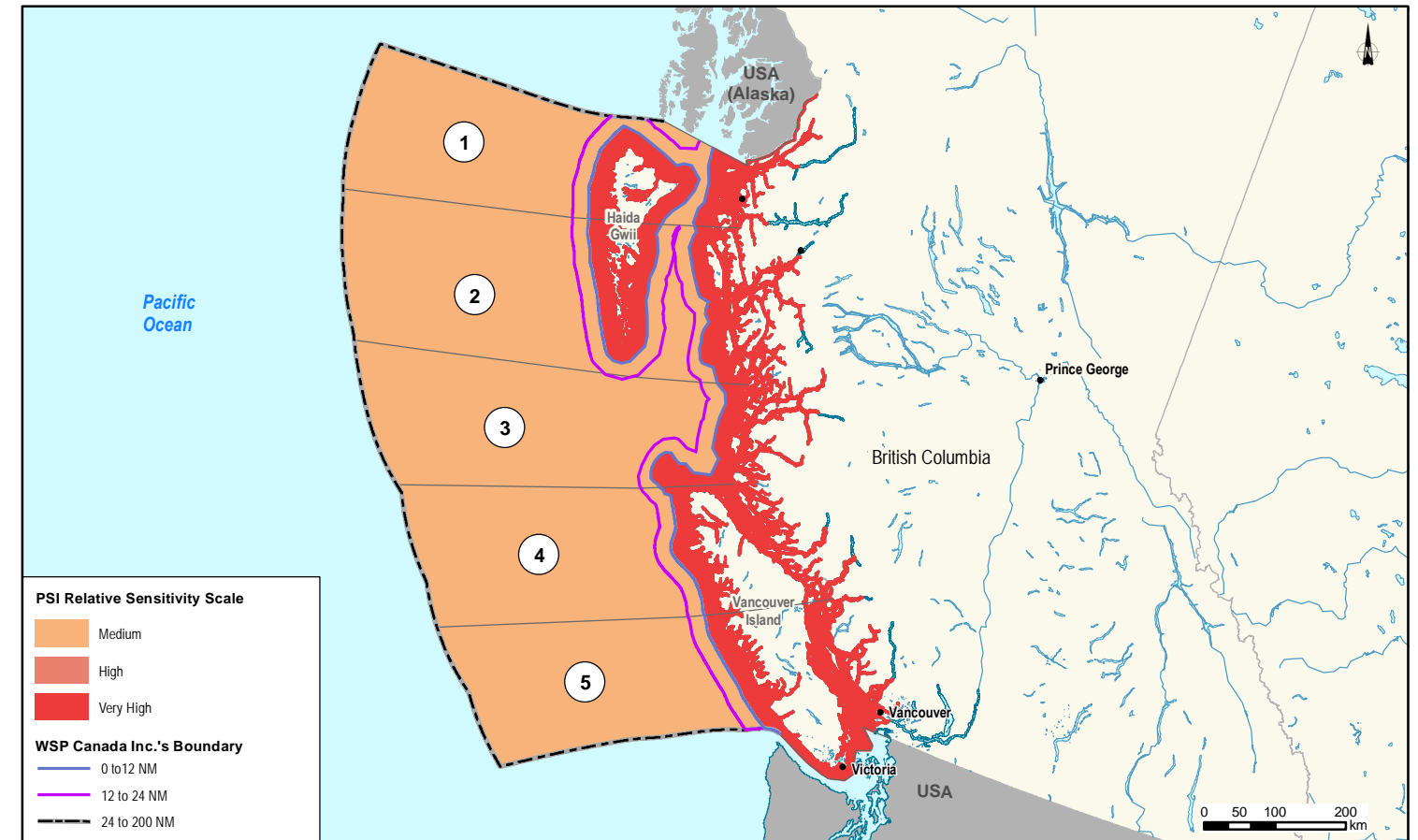
APPENDIX 2

Environmental Sensitivity Results

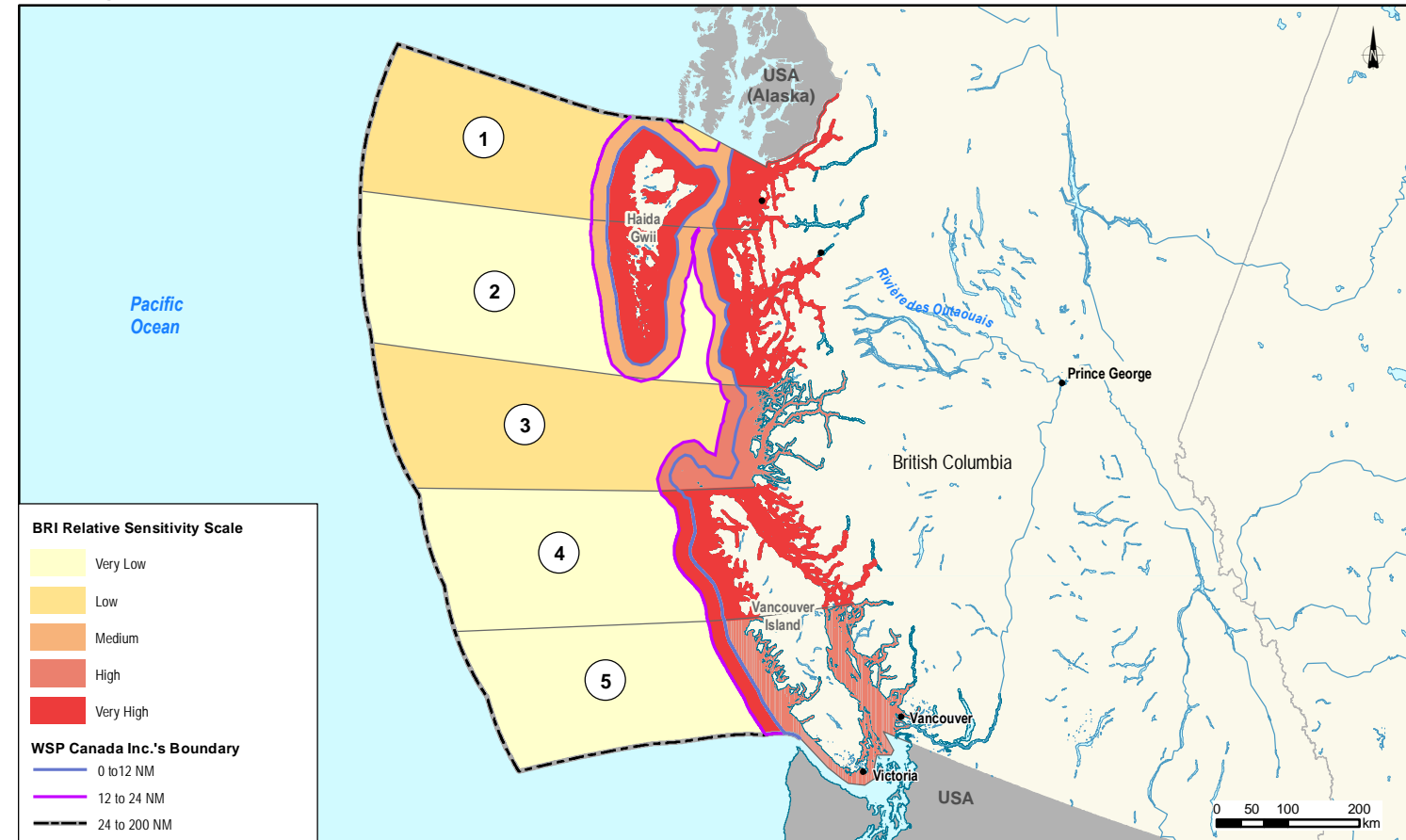
a) Environmental Sensitivity Index (ESI)



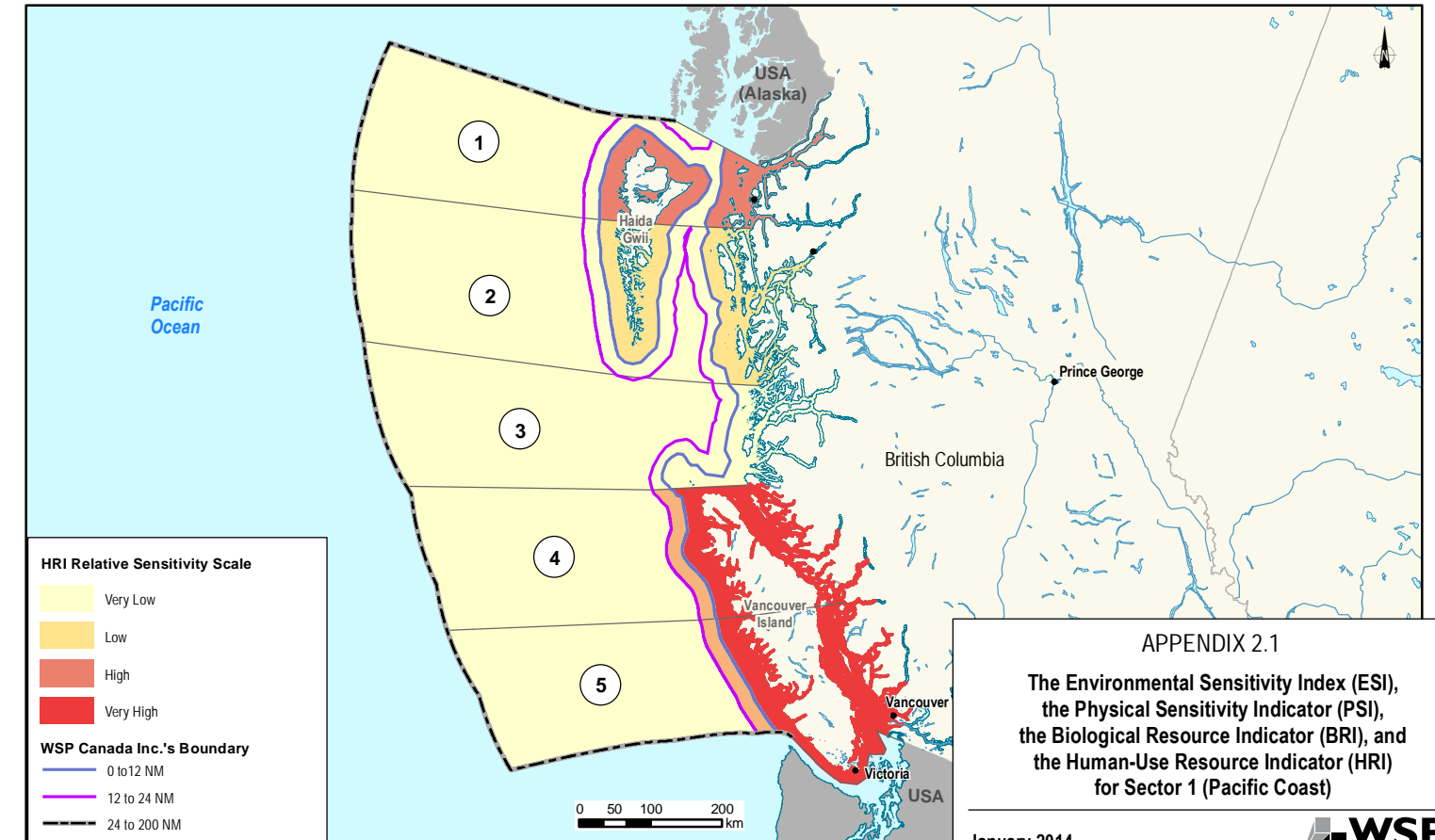
b) Physical Sensitivity Indicator (PSI)



c) Biological Resource Indicator (BRI)



d) Human-Use Resource Indicator (HRI)



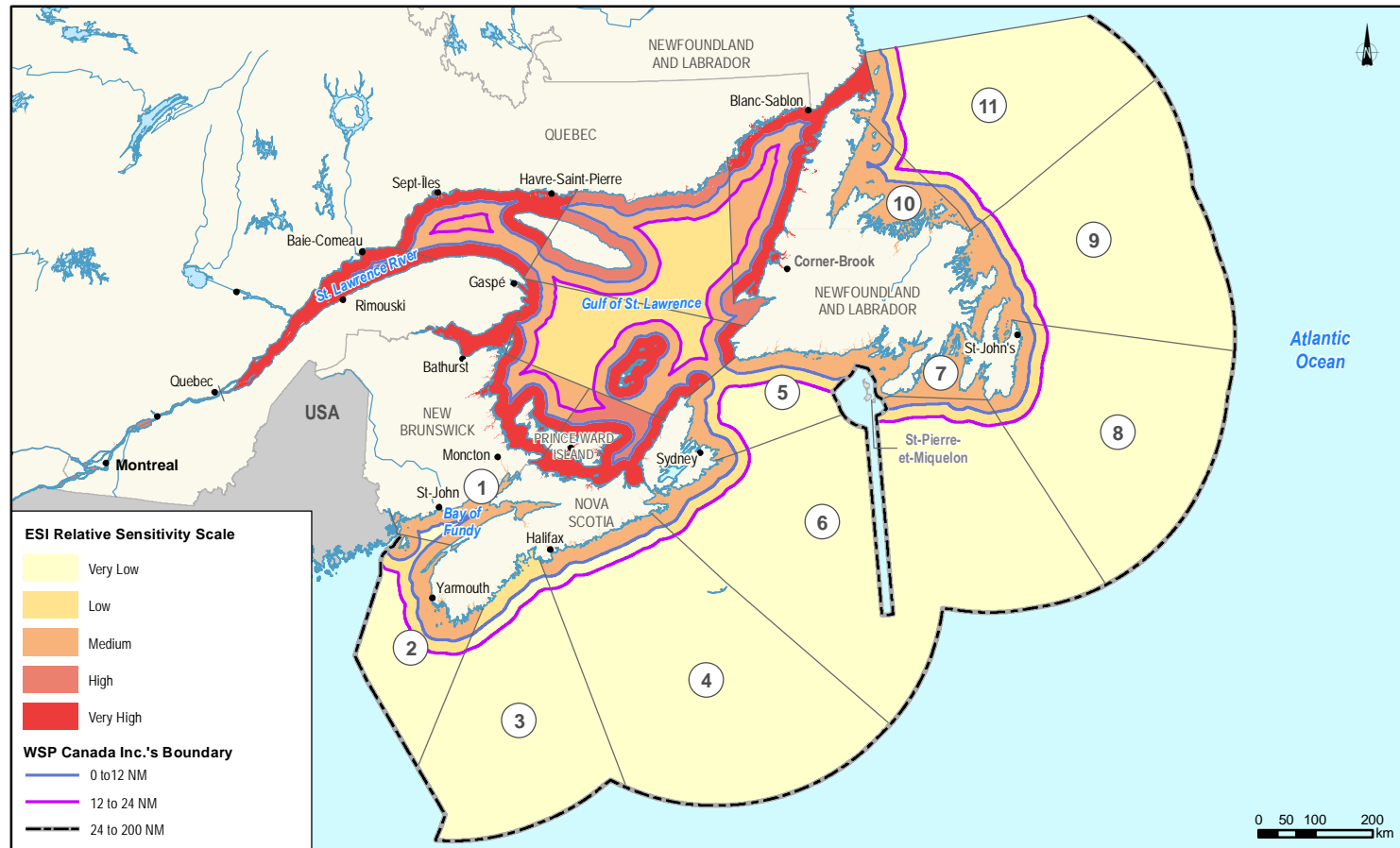
APPENDIX 2.1

The Environmental Sensitivity Index (ESI),
the Physical Sensitivity Indicator (PSI),
the Biological Resource Indicator (BRI), and
the Human-Use Resource Indicator (HRI)
for Sector 1 (Pacific Coast)

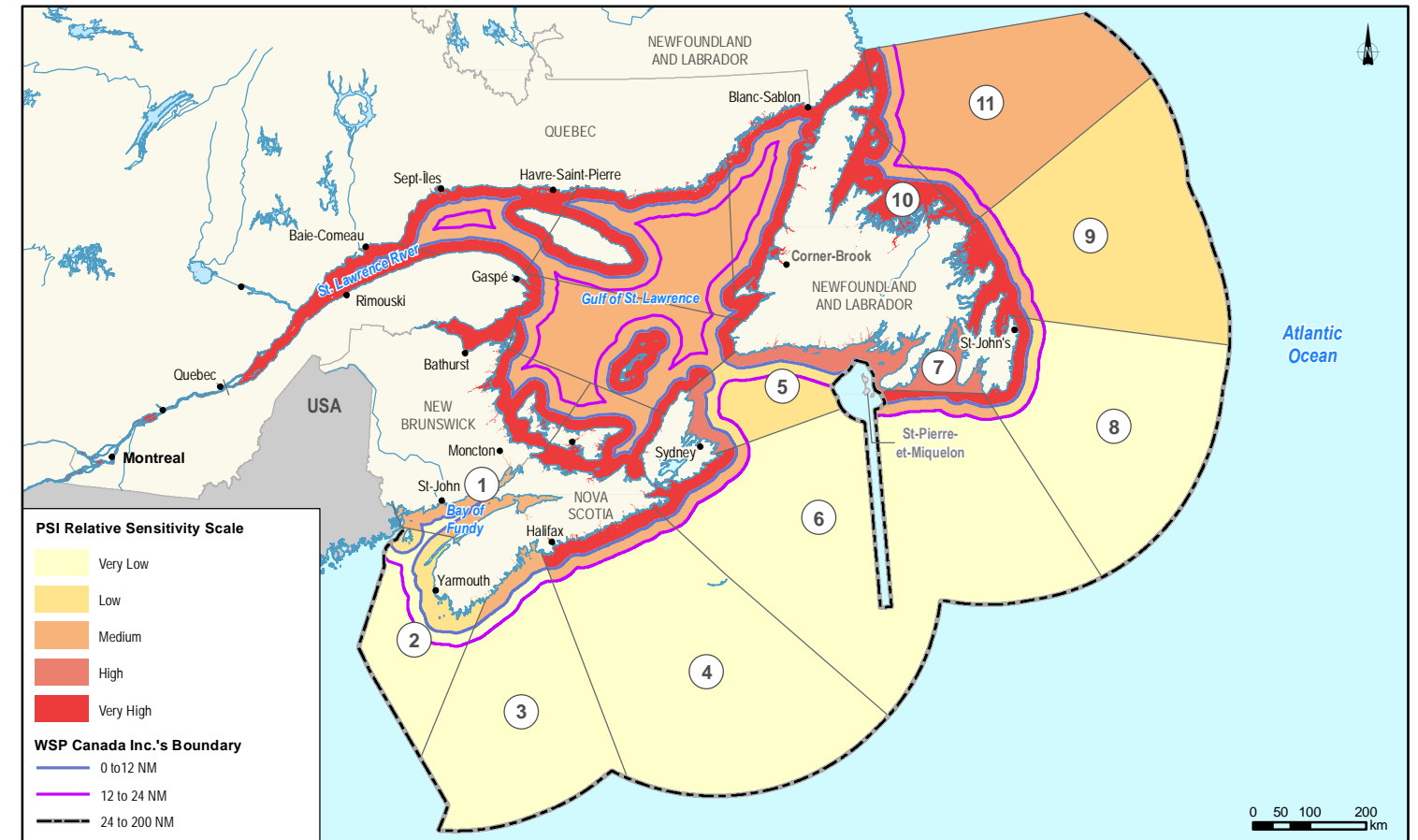
January 2014



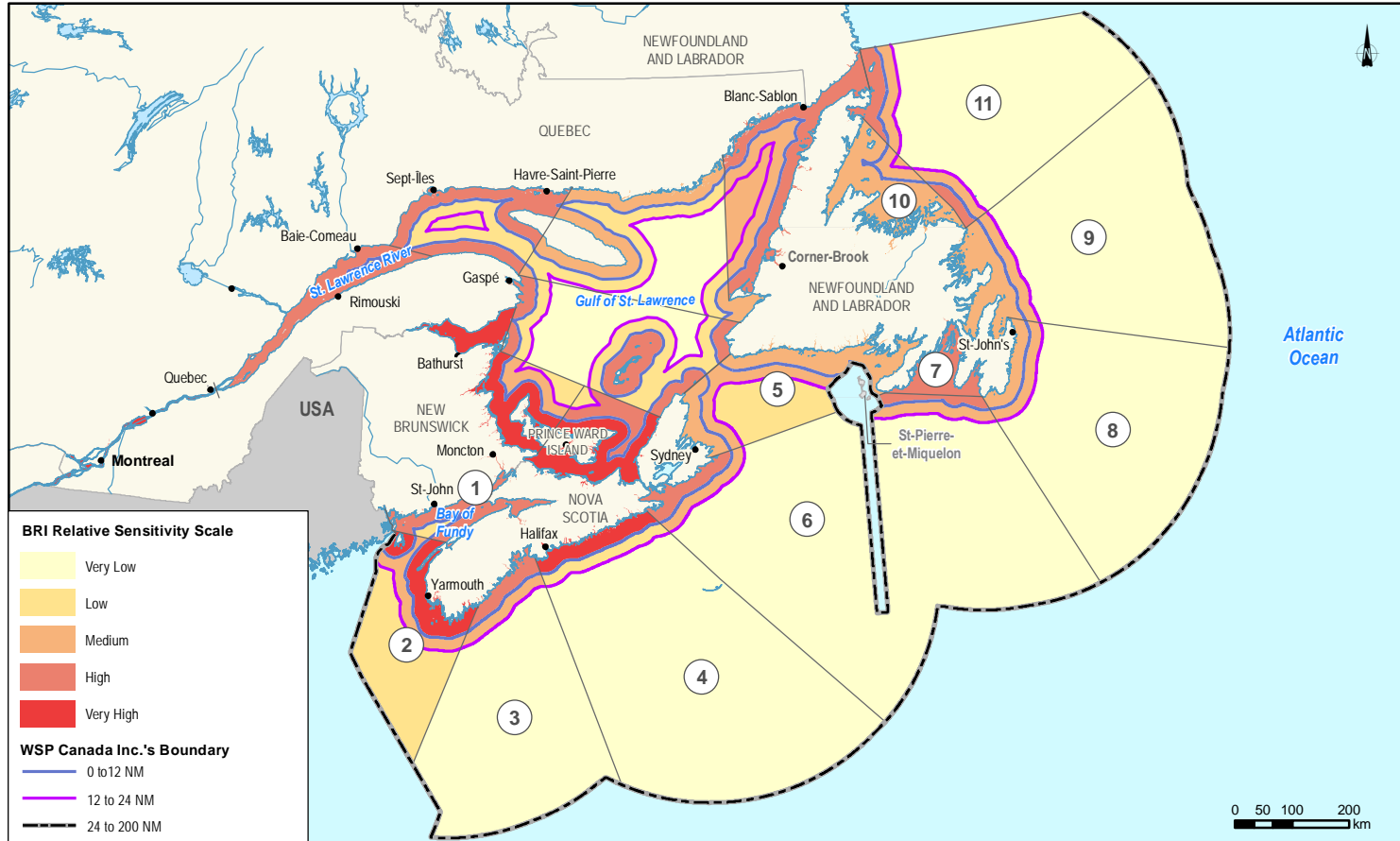
a) Environmental Sensitivity Index (ESI)



b) Physical Sensitivity Indicator (PSI)



c) Biological Resource Indicator (BRI)



d) Human-Use Resource Indicator (HRI)



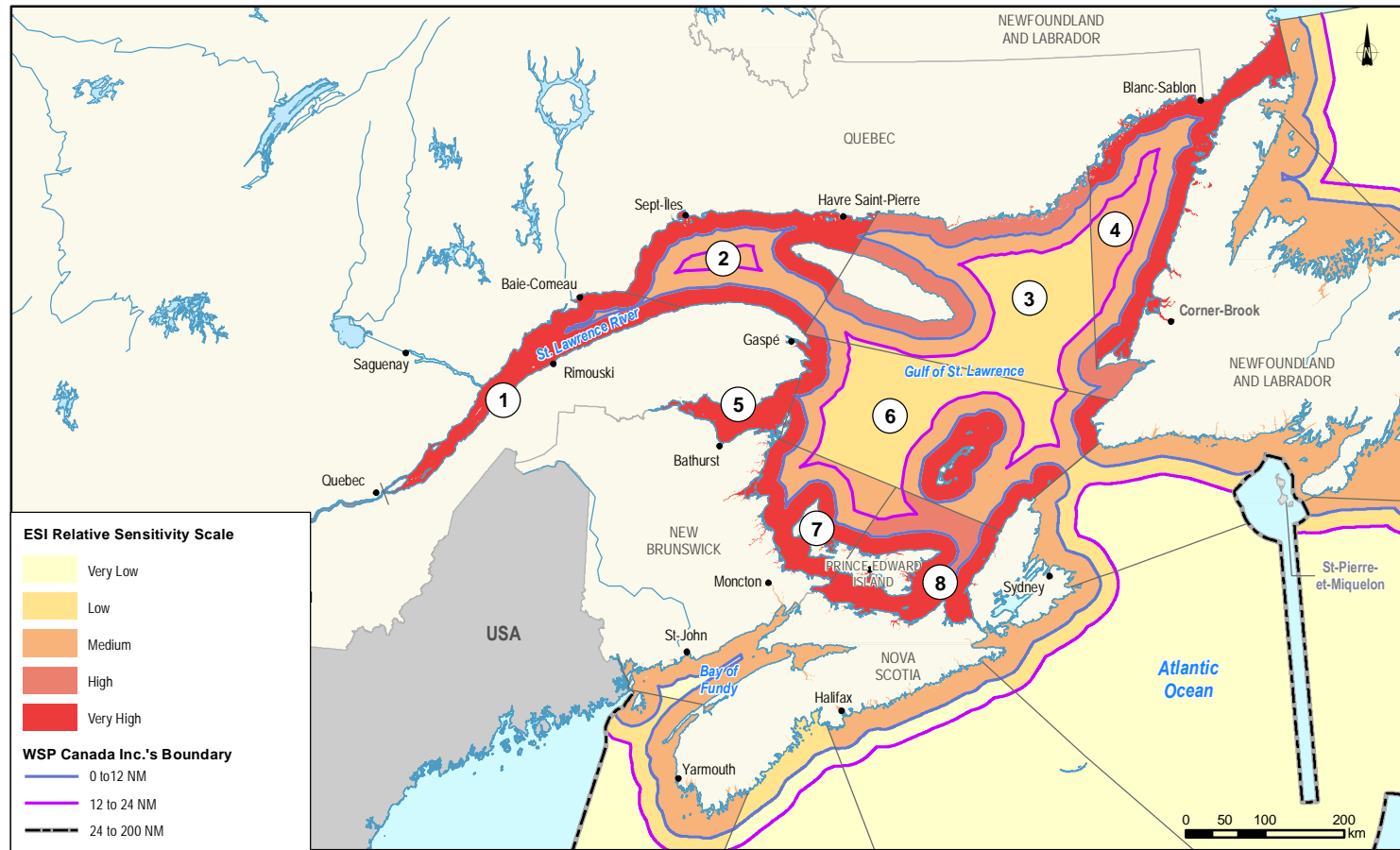
APPENDIX 2.2

The Environmental Sensitivity Index (ESI),
the Physical Sensitivity Indicator (PSI),
the Biological Resource Indicator (BRI), and
the Human-Use Resource Indicator (HRI)
for Sector 2 (Atlantic Coast)

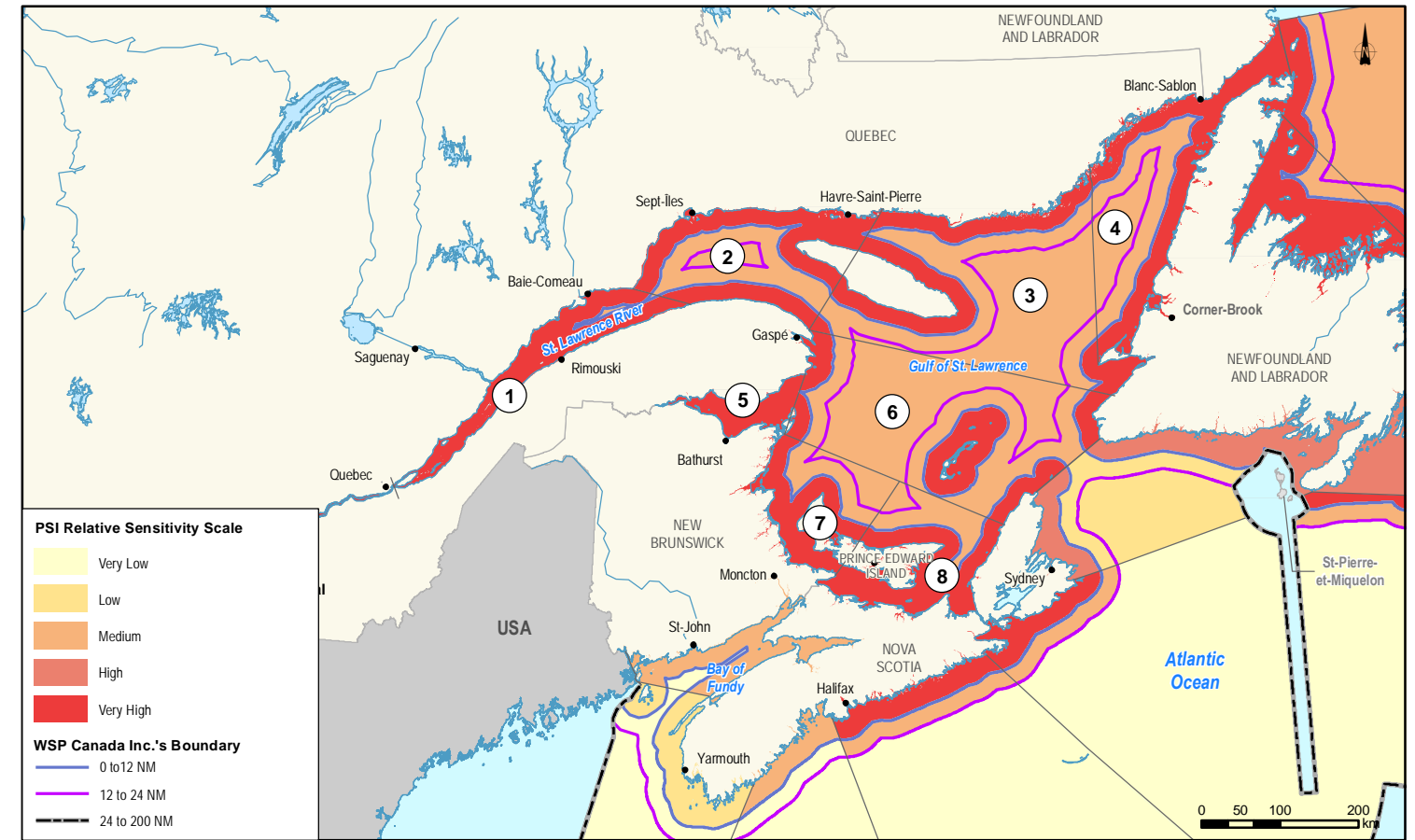
January 2014



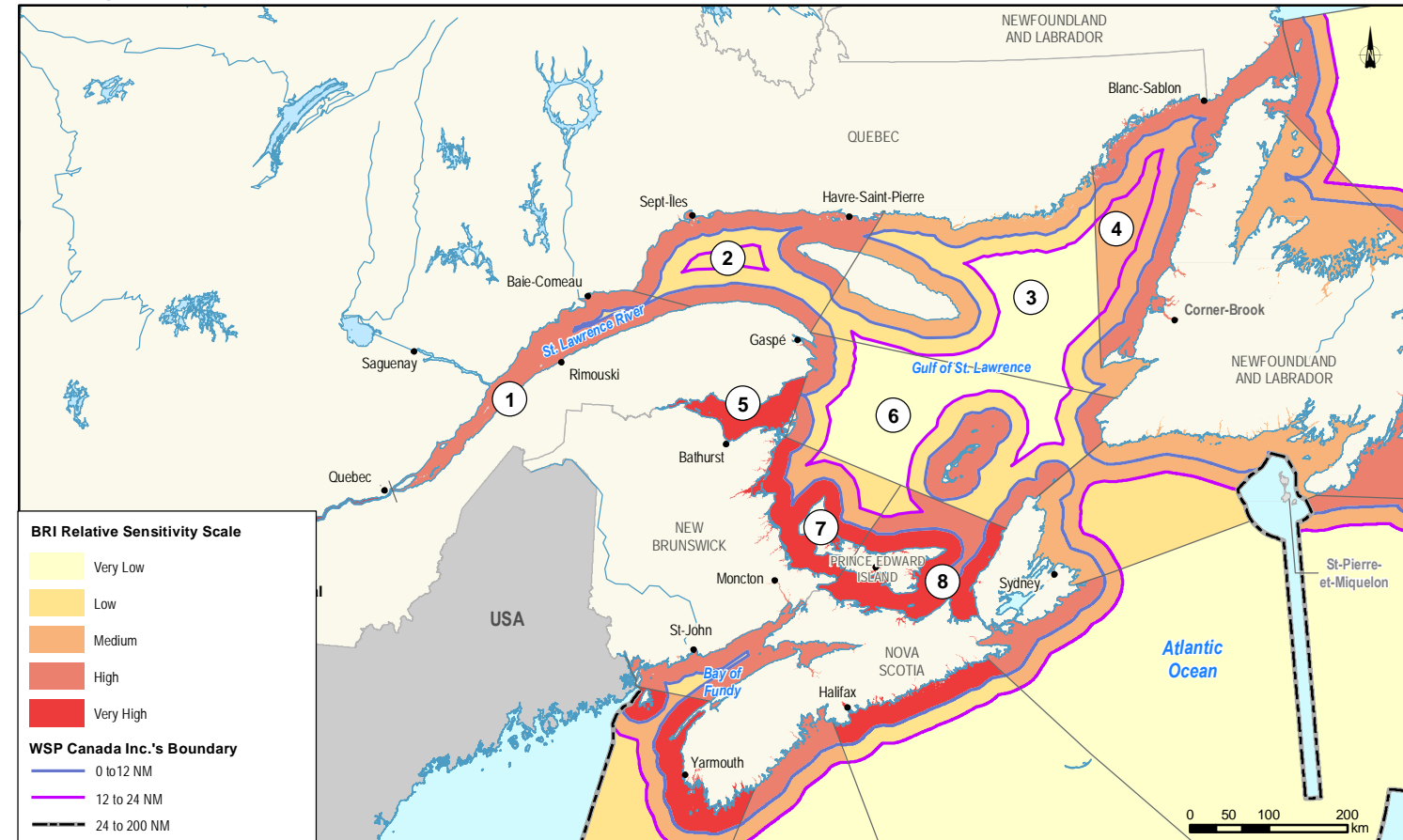
a) Environmental Sensitivity Index (ESI)



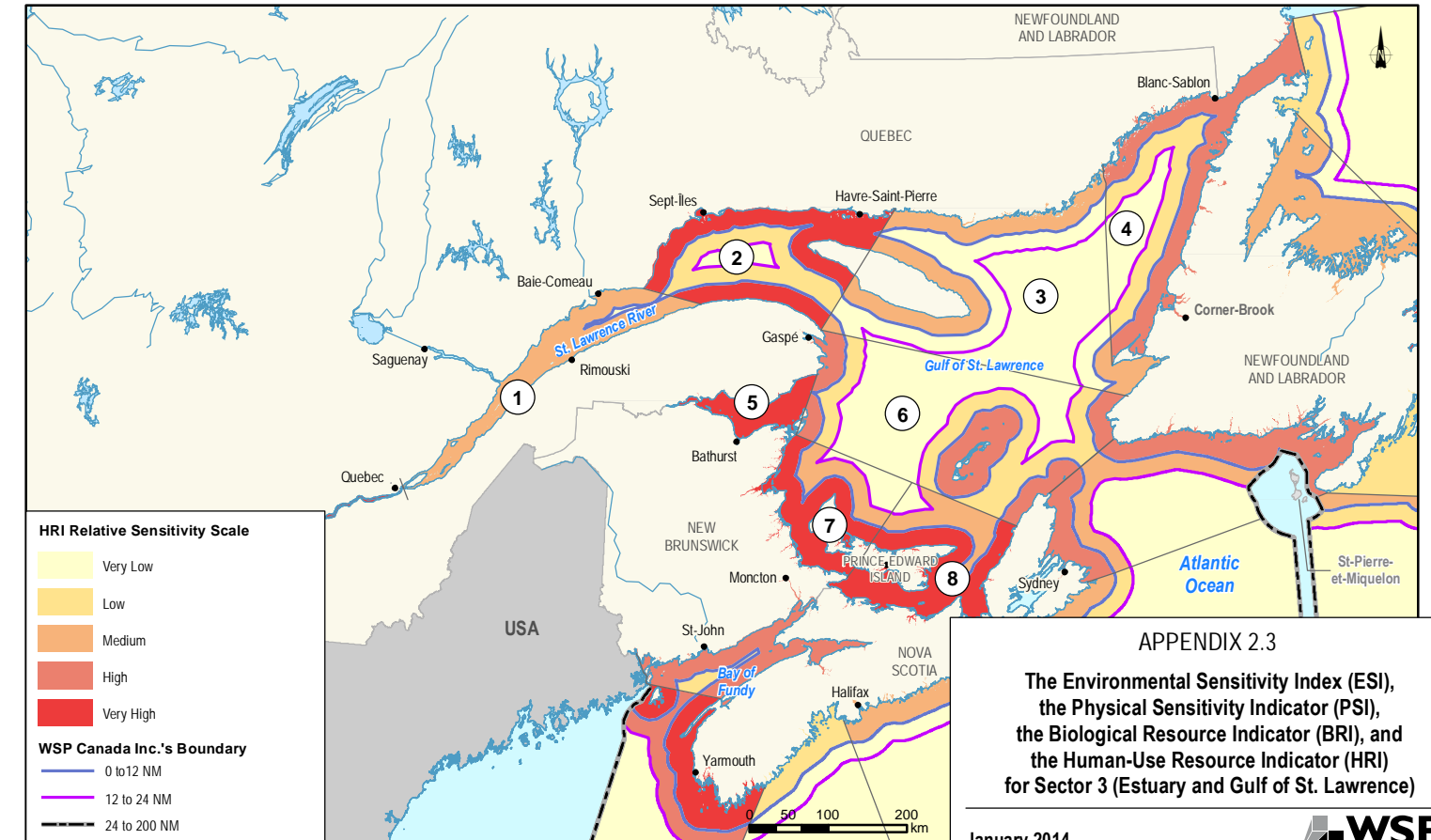
b) Physical Sensitivity Indicator (PSI)



c) Biological Resource Indicator (BRI)



d) Human-Use Resource Indicator (HRI)



APPENDIX 2.3

**The Environmental Sensitivity Index (ESI),
the Physical Sensitivity Indicator (PSI),
the Biological Resource Indicator (BRI), and
the Human-Use Resource Indicator (HRI)
for Sector 3 (Estuary and Gulf of St. Lawrence)**

January 2014



a) Environmental Sensitivity Index (ESI)



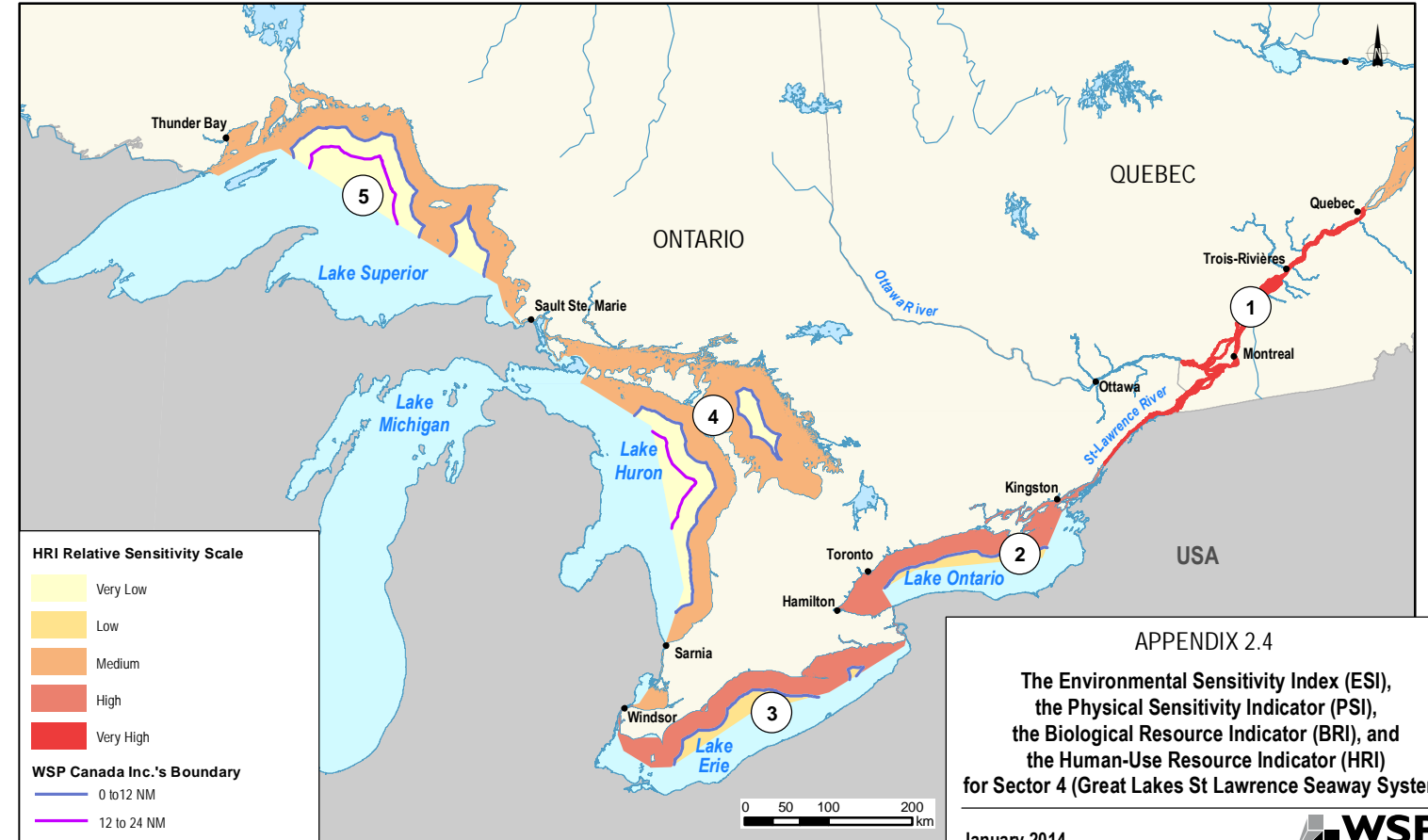
b) Physical Sensitivity Indicator (PSI)



c) Biological Resource Indicator (BRI)



d) Human-Use Resource Indicator (HRI)



APPENDIX 2.4
 The Environmental Sensitivity Index (ESI),
 the Physical Sensitivity Indicator (PSI),
 the Biological Resource Indicator (BRI), and
 the Human-Use Resource Indicator (HRI)
 for Sector 4 (Great Lakes St Lawrence Seaway System)
 January 2014



APPENDIX 3

Canada's Aboriginal People

APPENDIX 3 Canada's Aboriginal People

Canada's Aboriginal peoples have potential and established Aboriginal and treaty rights that are exercised in and around the marine environment. To help provide some context for this Pan-Canadian risk assessment, Aboriginal communities and population sizes have been mapped and included in this Appendix. Surveyed Aboriginal lands (GeoBase, 2013¹¹) and 2011 census (Statistics Canada, 2013¹²) data was used; as such, it should be noted that the maps of communities included in this report identify established First Nations reserves and populations, but do not provide the locations of the following:

- Boundaries of historic and modern treaties of First Nations and Métis groups;
- Asserted First Nations and Métis territories and potential boundaries of lands subject to land claims, self-government and specific and special claims (AANDC, 2012¹³) negotiations; and
- Métis communities and settlements.

In the context of future regional risk assessment, should they occur, data on the exercising of Aboriginal and Treaty rights in the marine environment would provide a more complete understanding of regionally-specific considerations and would contribute to enhanced analysis to further limit potential environmental and socioeconomic impacts, including adverse impact to potential and established Aboriginal or Treaty rights. This data would also support the identification of potential opportunities for Aboriginal engagement in the marine oil spill preparedness and response regime.

Should this work be pursued, it is recommended that Aboriginal communities be engaged in the data collection.

¹¹ GEOBASE, 2013. *Aboriginal Lands*. [Online]

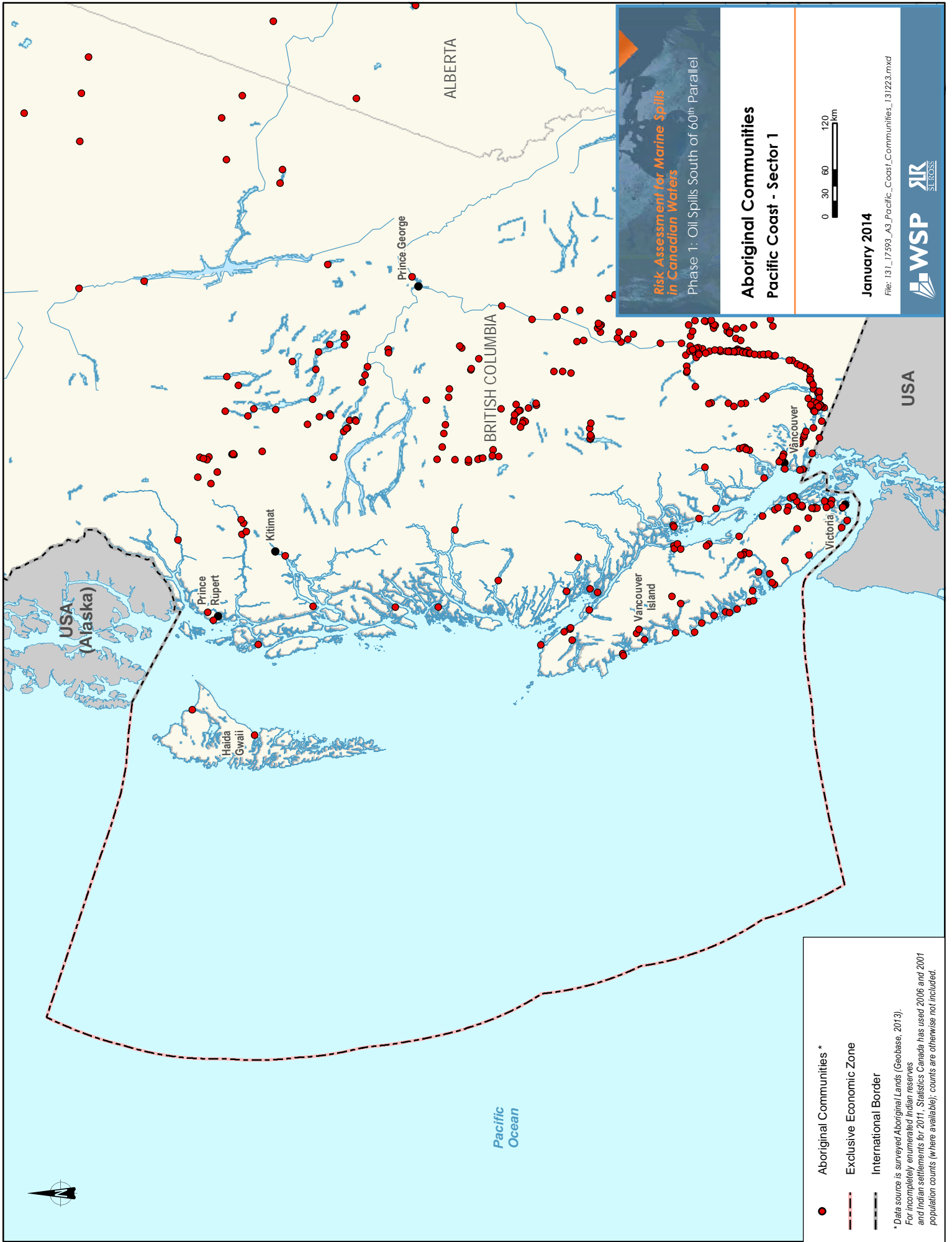
[<http://www.geobase.ca/geobase/en/data/admin/alta/description.html>]

¹² STATISTICS CANADA. 2013 Appendix 1: 2011 incompletely enumerated Indian reserves and Indian settlements, showing enumeration status, 2006 and 2011 population counts (where available). [Online]

[<http://www12.statcan.gc.ca/census-recensement/2011/ref/irr-app-ann-1-eng.cfm>]

¹³ ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC). 2012. Specific Claims. [Online]

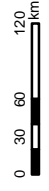
[<http://www.aadnc-aandc.gc.ca/eng/1100100030291/1100100030292>]



**Risk Assessment for Marine Spills
in Canadian Waters**

Phase 1: Oil Spills South of 60th Parallel

**Aboriginal Communities
Pacific Coast - Sector 1**



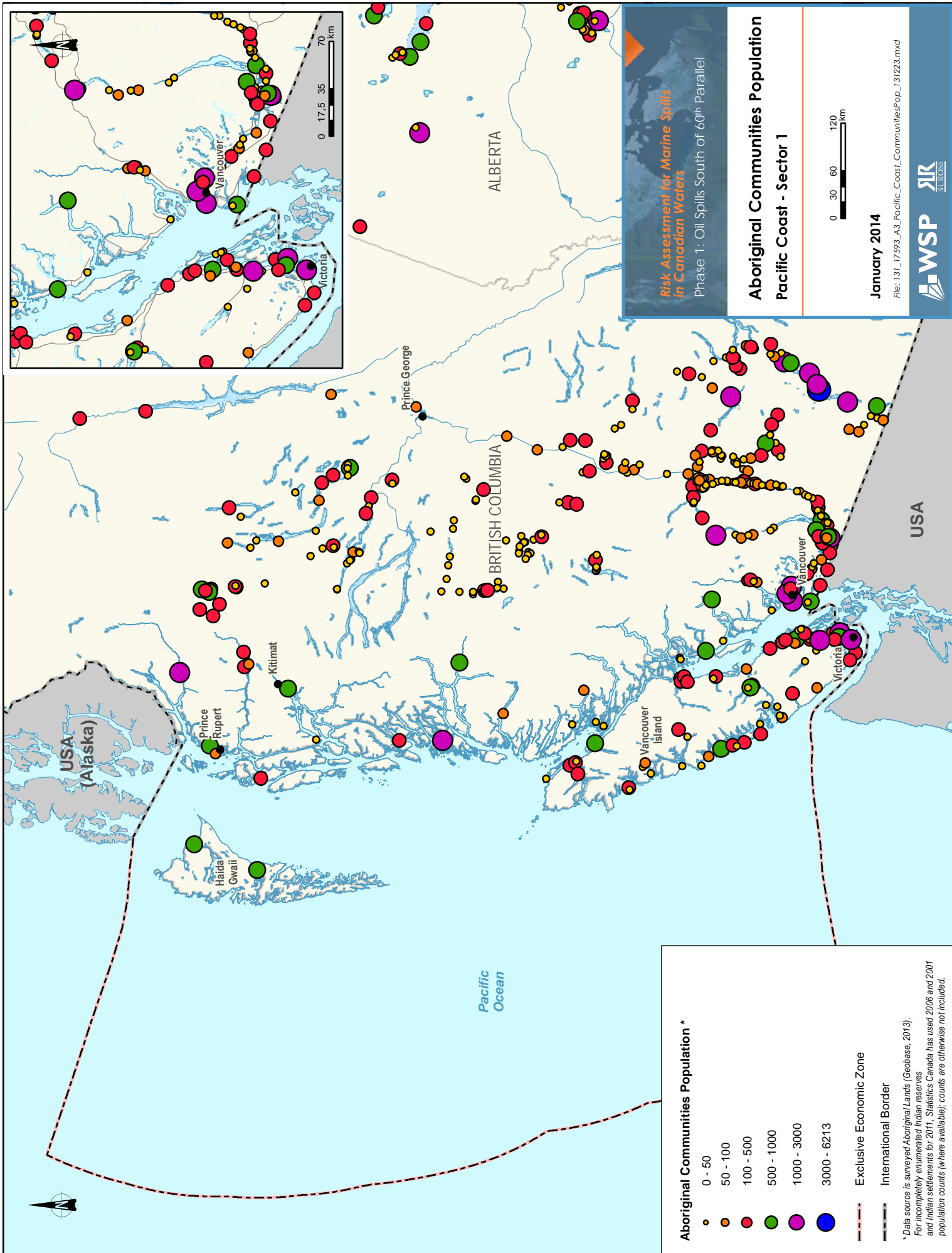
January 2014

File: 13_L_17593_A3_Pacific_Coast_Communities_131223.mxd



- Aboriginal Communities*
- - - Exclusive Economic Zone
- - - International Border

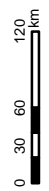
* Data source is surveyed Aboriginal Lands (Geobase, 2013).
For incompletely enumerated Indian reserves
and Indian settlements for 2011, Statistics Canada has used 2006 and 2001
population counts. (Where available); counts are otherwise not included.



Risk Assessment for Marine Spills in Canadian Waters

Phase 1: Oil Spills South of 60th Parallel

Aboriginal Communities Population
Pacific Coast - Sector 1



January 2014

File: I31_17593_A3_Pacific_Coast_CommunitiesPop_131223.mxd

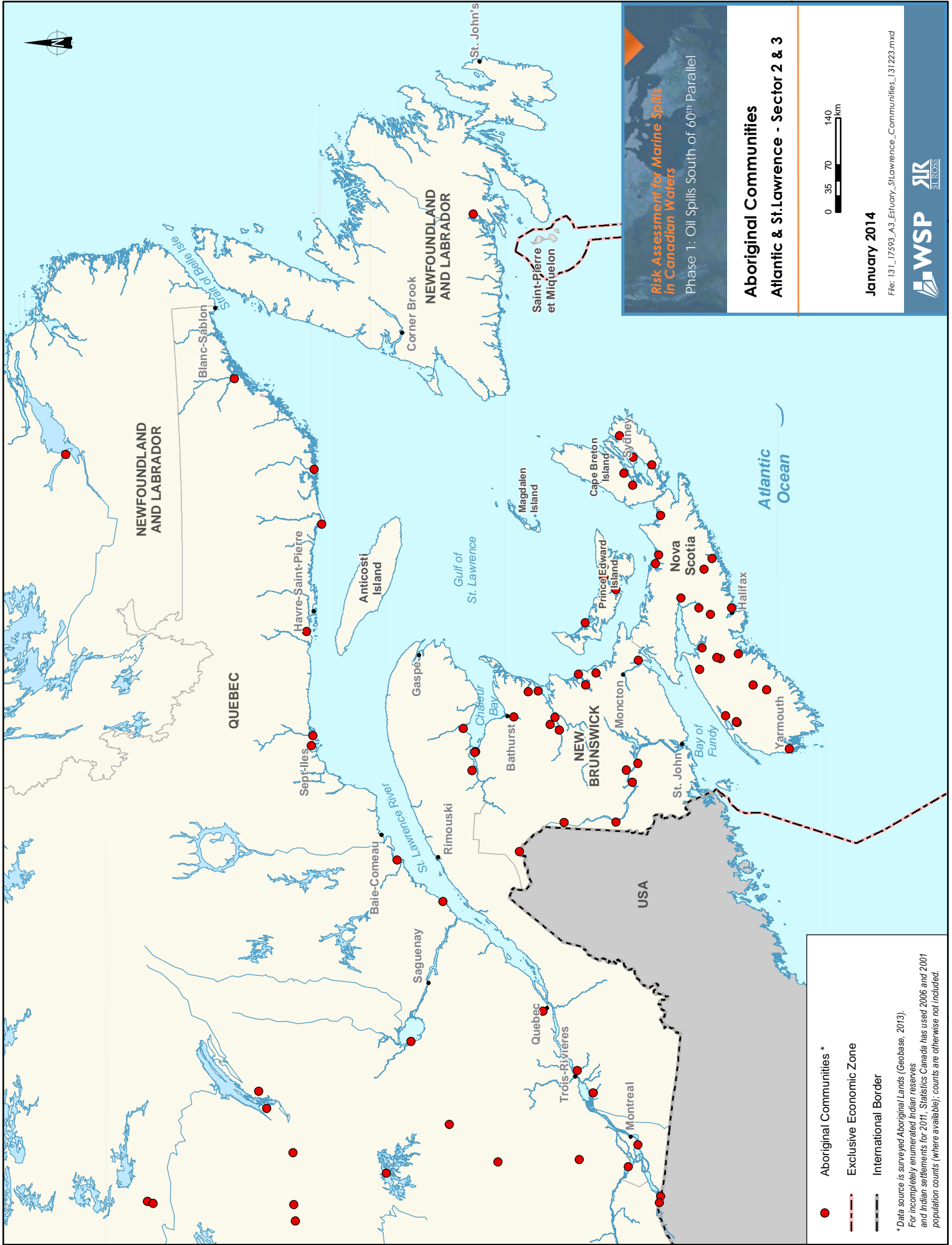


Aboriginal Communities Population *

- 0 - 50
- 50 - 100
- 100 - 500
- 500 - 1000
- 1000 - 3000
- 3000 - 6213

- Exclusive Economic Zone
- International Border

* Data source is surveyed Aboriginal Lands (Geobase, 2013). For incompletely enumerated Indian reserves and Indian settlements for 2011, Statistics Canada has used 2006 and 2001 population counts (where available); counts are otherwise not included.



**Risk Assessment for Marine Spills
in Canadian Waters**
Phase 1: Oil Spills South of 60th Parallel

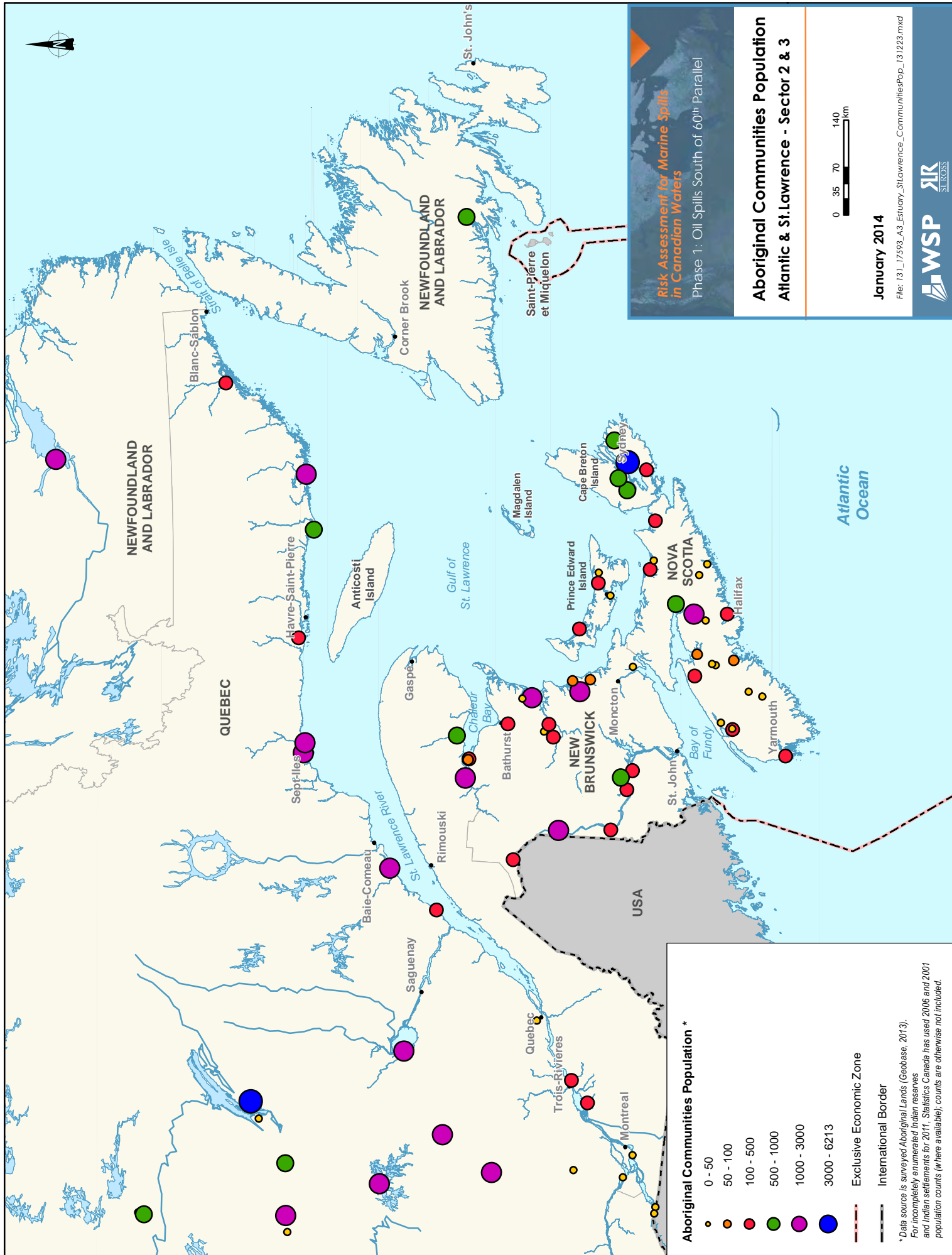
**Aboriginal Communities
Atlantic & St. Lawrence - Sector 2 & 3**

January 2014
File: 13_L_17593_A3_Estuary_StLawrence_Communities_131223.mxd



● Aboriginal Communities*
 - - - Exclusive Economic Zone
 ——— International Border

* Data source is surveyed Aboriginal Lands (Geobase, 2013). For incompletely enumerated Indian reserves and Indian settlements for 2011, Statistics Canada has used 2006 and 2001 population counts (where available); counts are otherwise not included.



Risk Assessment for Marine Spills in Canadian Waters

Phase 1: Oil Spills South of 60th Parallel

**Aboriginal Communities Population
Atlantic & St. Lawrence - Sector 2 & 3**



January 2014

File: 13_L_17593_A3_Estuary_StLawrence_CommunitiesPop_131223.mxd

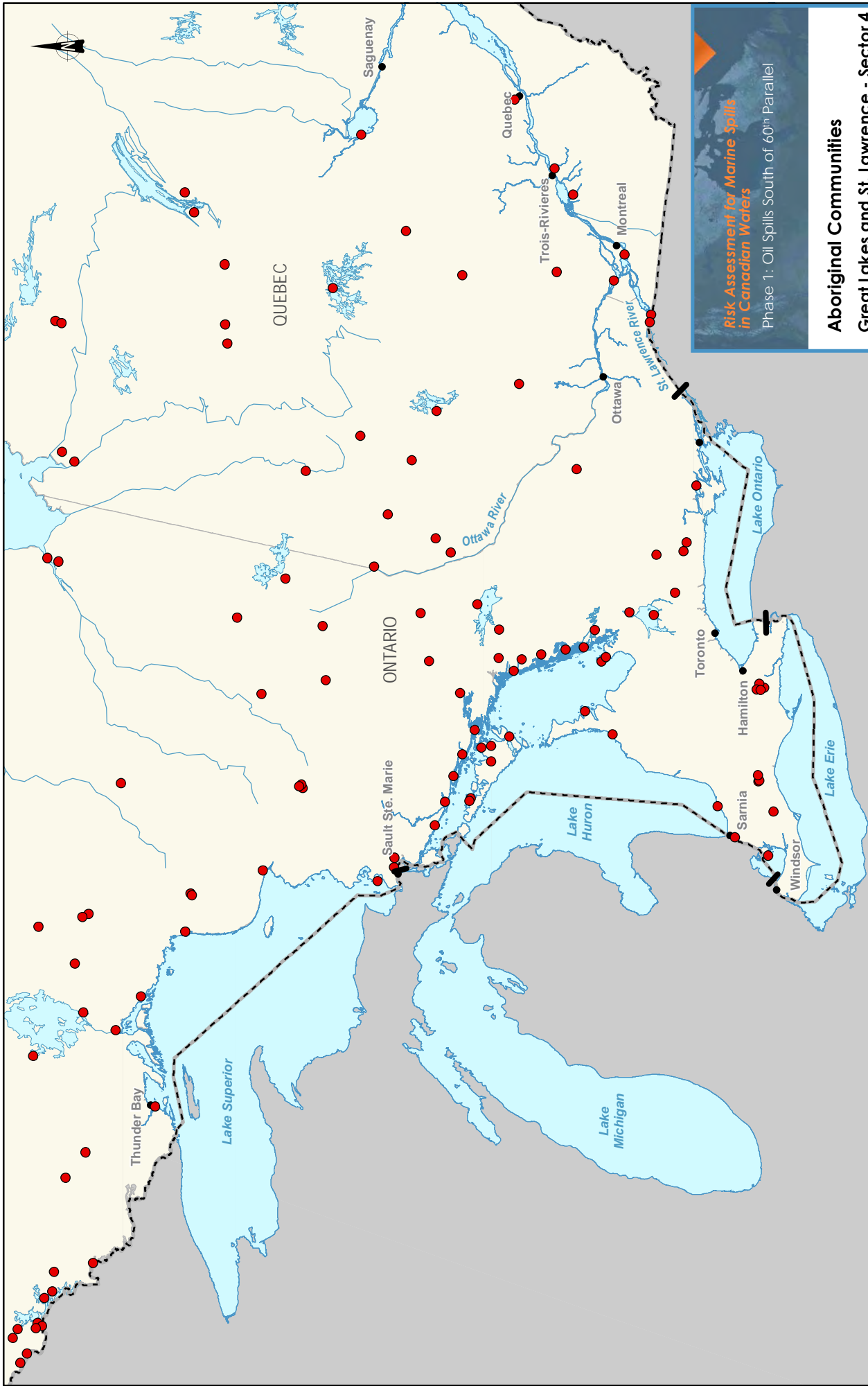


Aboriginal Communities Population *

- 0 - 50
- 50 - 100
- 100 - 500
- 500 - 1000
- 1000 - 3000
- 3000 - 6213

- Exclusive Economic Zone
- International Border

* Data source is surveyed Aboriginal Lands (Geobase, 2013).
For incompletely enumerated Indian reserves and Indian settlements for 2011, Statistics Canada has used 2006 and 2001 population counts (where available); counts are otherwise not included.



Risk Assessment for Marine Spills in Canadian Waters
 Phase 1: Oil Spills South of 60th Parallel

Aboriginal Communities
Great Lakes and St. Lawrence - Sector 4

0 50 100 200 km

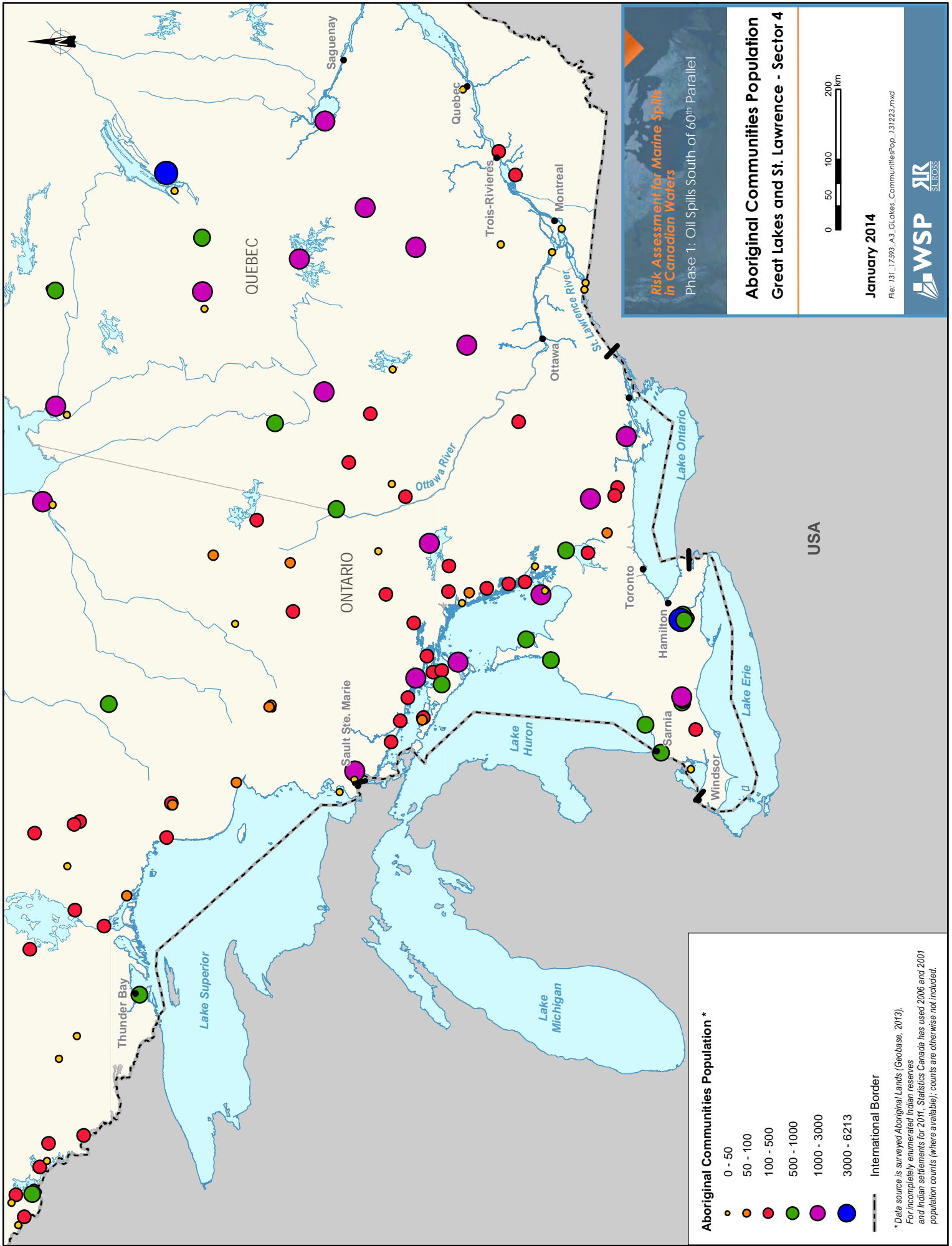
January 2014
 File: 131_17493_A3_Glakes_Communities_13123.mxd



● Aboriginal Communities *
 - - - International Border

* Data source is surveyed Aboriginal Lands (Geobase, 2013).
 For incompletely enumerated Indian reserves and Indian settlements for 2011, Statistics Canada has used 2006 and 2001 population counts (where available); counts are otherwise not included.

USA



APPENDIX 4

Future Projects Assessment

APPENDIX 4 Future Projects Assessment

A4.1 Overview

Several future oil related projects are currently considered in Canada. The section provides a description of four selected projects with a description of associated impacts on oil transport and potential consequences on environmental and risk metrics.

A4.1.1 Pacific Sector: Northern Gateway Pipeline and Terminal

Enbridge Inc. has proposed to construct a marine terminal at Kitimat, B.C. and a dual pipeline from the terminal to oil sands production in northern Alberta. The terminal would handle up to 193,000 barrels/day of imported diluents (i.e., low-gravity condensate) that would be piped to Alberta and used to dilute bitumen to enhance its flow properties. The diluted bitumen would then be piped to Kitimat at rates up to 525,000 barrels/day that would be shipped by tanker to export to markets in Asia and California.

At full capacity, the import of diluent and export of diluted bitumen would total up to 35 Mt/year. This amount is comparable to the currently-shipped volume in the Pacific sector related to volumes being exported from Vancouver and related to volumes being exported from the Alaskan to Washington State trade. The traffic would present a spill frequency and associated risk in Pacific sub-sector 2, which presently has negligible risk in the nearshore and intermediate zones, but significant potential spill frequency in the deep-sea zone related to the Alaskan trade. In addition, depending on the destination of import or export, adjacent sub-sectors to sub-sector 2 would also see an increase in spill frequency.

A4.1.1.1 Current Sensitivity and Risk

The Environmental Sensitivity Index (ESI) in Pacific sub-sector 2 currently ranges from “medium” to “very low” from nearshore to deep-sea zones, respectively. This sensitivity is mainly driven by a combination of physical and biological features. The main Environmental Risk Index (ERI) in the northern sub-sectors is associated to offshore large spill volumes rated as “medium” (1,000 to 9,999.9 m³). The other volume categories are all being rated as “low” risk.

A4.1.1.2 Potential Sensitivity and Risk

The expected increase in traffic in sub-sector 2 would likely increase ERI values and raise the nearshore risk from “very low” to “very high” as observed in the Vancouver region (sub-sector 5). For the largest spill category, deep-sea risk would likely increase from “low” to “medium” in sub-sectors 2, 3, 4 and 5 due to the increase in traffic of very large volumes from sub-sector 2 to Asia or California.

A4.1.2 Pacific Sector: Proposed Trans Mountain Pipeline Expansion

Kinder Morgan has proposed to expand their pipeline that runs from Edmonton to Burnaby, B.C. from an existing 300,000 barrels/day to 890,000 barrels/day per day. Of the proposed expanded volume, up to 630,000 barrels/day may be exported by tanker from Westridge Marine Terminal in Burnaby to export to markets in California and possibly Asia. At full capacity, this translates into an annual volume of 31 Mt/year.

Currently, the Port of Vancouver handles an annual volume of crude cargo of 1.8 Mt (average for the period 2003 to 2012). However, the increase in crude oil cargo volumes is not quite as dramatic when compared with the total shipping volume through sub-sector 5 including the volume of crude oil imports to refineries in northern Washington State. In all zones associated to sub-sector 5, an additional potential spill frequency has been added to the existing analysis on the basis of crude oil imports to refineries in northern Washington State. These imports pose a significant risk to sub-sector 5 and to deep-sea zones of the other Pacific sub-sectors, depending on their origin. Annual crude volumes to these refineries are on the order of 28 Mt/year. Including the total crude traffic to and from BC and Washington, the proposed Kinder Morgan expansion would essentially double the volume of oil passing through Pacific sub-sector 5, with a corresponding increase in potential spill frequency and risk.

A4.1.2.1 Current Sensitivity and Risk

The ESI in Pacific sub-sector 5 currently ranges from “medium” to “very low” respectively from nearshore to deep-sea zones. This sensitivity is mainly driven by a combination of physical features both nearshore and deep-sea, by human-use features nearshore and by biological features in the intermediate zone. “High” to “very high” spill risks scores are associated to nearshore and intermediate zones in this sub-sector for all volume categories. Deep-sea spill risks are typically rated as “medium” or “high” across all volume categories.

A4.1.2.2 Potential Sensitivity and Risk

Doubling the volume of oil passing through Pacific sub-sector 5 would likely increase the spill risks to “very high” for all zones (nearshore, intermediate and deep-sea) for 10,000 m³ spill volume and greater.

A4.1.3 Great Lakes/ St Lawrence River and Estuary and Gulf of St. Lawrence Sectors: Line 9 Reversal

Enbridge Inc. has proposed to reverse the direction of flow of a pipeline known as “Line 9”. Line 9 was originally built as a West-to-East pipeline in 1975. However, it was reversed in 1998 to carry oil, which is imported to Montreal, to refineries in Sarnia, Ontario. The present proposal would now see Line 9 carry 300,000 barrels/day of Western Canadian crude oil to refineries in Montreal and Quebec City, with the potential for export as crude oil from those locations.

If the oil were to be used as feedstock for Quebec refineries, it could supplant existing tanker imports to those locations. At full capacity, the proposed volume equates to 15 Mt/year, which is approximately 170% of the existing total annual tonnage of crude oil imported to Montreal and Quebec. Conceivably, this could essentially eliminate crude oil imports by tanker to these two locations, but give rise to tanker crude oil exports by the amount in excess of refining capacity.

A4.1.3.1 Current Sensitivity and Risk

This project is affecting volumes and associated risk of 2 sectors (Great Lakes/ St Lawrence River and Estuary and Gulf of St. Lawrence). The ESI in sub-sector 5 including the cities of Montreal and Quebec currently range from “high” in the St. Lawrence River to “very high” in the St. Lawrence Estuary. This sensitivity is mainly driven by physical (river and estuary), biological (river and estuary) and human-use (mostly river) features. The ESI associated to very large crude oil volumes is rated as “high” in the river and “very high” in the estuary, with the risk decreasing to “medium” or “low” levels in the Gulf.

A4.1.3.2 Potential Sensitivity and Risk

This project could potentially eliminate crude oil imports by tanker to Montreal and Quebec with a corresponding reduction in potential spill frequency and risk. The amount that would potentially be shipped by pipeline exceeds the current imports and refining capacity, so crude exports could result, in the amount of approximately 70% of the current crude imports. The net effect of the elimination of imports and the initiation of crude exports would be a slight decrease in overall spill frequency and risk.

A4.1.4 Atlantic Sector: Energy East Pipeline

TransCanada Corporation has proposed to convert a 3,000 km pipeline, presently used to transport natural gas, to transport crude oil from Alberta and Saskatchewan to Quebec. It would also involve the construction of an additional 1,460 km of new pipeline, associated facilities, pump stations, and marine facilities to enable export to international markets by tanker. The project will include delivery to existing refineries in Montreal and near Quebec City as well as the refinery in Saint John, New Brunswick. If the pipeline plans are approved, it would result in increased product or crude shipment from Montreal, Quebec City, and Saint John. It would also result in the construction of new marine shipping terminals on the St. Lawrence River in Quebec and in the Saint John area.

The proposed volume of crude oil transport is up to 1.1-million barrels per day. At full capacity this equates to 54.2 Mt/year, or approximately 2.5 times the existing crude oil import volumes to Montreal, Quebec City, and Saint John (total crude imports 21.2 Mt/year) combined. This could essentially eliminate crude oil imports by tanker to these three locations, and give rise to tanker crude oil exports by the amount in excess of refining capacity.

A4.1.4.1 Current Sensitivity and Risk

The ESI in Atlantic sub-sectors 1 and 2 currently ranges from “medium” to “very low” respectively from nearshore to deep-sea zones. This sensitivity is mainly driven by biological and human-use features, both with increased sensitivity for nearshore zones. In these sub-sectors 1 and 2, “medium” to “high” large volume spill risks (ERI) are associated to nearshore and intermediate zones. For the same volume, the deep-sea spill risk is rated as “low”.

A4.1.4.2 Potential Sensitivity and Risk

In the event this project eliminates the need for crude oil imports in Montreal, Quebec City and St. John, the increase of crude oil exports (equivalent to the amount in excess of refining capacity, estimated to be comparable to the existing crude oil import volumes to Montreal, Quebec City, and St. John) would likely maintain the ERI at close to its current level.



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