

RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:
Travaux publics et Services gouvernementaux
Canada
Place Bonaventure, portail Sud-Est
800, rue de La Gauchetière Ouest
7^{ème} étage
Montréal
Québec
H5A 1L6
FAX pour soumissions: (514) 496-3822

REQUEST FOR PROPOSAL
DEMANDE DE PROPOSITION

**Proposal To: Public Works and Government
Services Canada**

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

**Proposition aux: Travaux Publics et Services
Gouvernementaux Canada**

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

Comments - Commentaires

| | |
|--|--|
| Title - Sujet Observation de la terre - ASC | |
| Solicitation No. - N° de l'invitation EE010-151057/B | Date 2014-11-18 |
| Client Reference No. - N° de référence du client R.068728.004 | |
| GETS Reference No. - N° de référence de SEAG PW-\$MTC-775-12996 | |
| File No. - N° de dossier MTC-4-37205 (775) | CCC No./N° CCC - FMS No./N° VME |
| Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2014-12-04 | |
| Time Zone Fuseau horaire Heure Normale du l'Est HNE | |
| F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/> | |
| Address Enquiries to: - Adresser toutes questions à: Aguilera, Maria Pia | Buyer Id - Id de l'acheteur mtc775 |
| Telephone No. - N° de téléphone (514) 496-3573 () | FAX No. - N° de FAX (514) 496-3822 |
| Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: MINISTERE DES TRAVAUX PUBLICS ET SERVICES GOUVERNEMENTAUX CANADA CE-SPT-Environnement COE-PTS-Environnement 1550 AVE D'ESTIMAUVILLE, NEQ QUEBEC Québec G1J 0C7 Canada | |

Instructions: See Herein

Instructions: Voir aux présentes

Vendor/Firm Name and Address

**Raison sociale et adresse du
fournisseur/de l'entrepreneur**

Issuing Office - Bureau de distribution

Travaux publics et Services gouvernementaux Canada
Place Bonaventure, portail Sud-Est
800, rue de La Gauchetière Ouest
7^{ème} étage
Montréal
Québec
H5A 1L6

| | |
|--|--|
| Delivery Required - Livraison exigée | Delivery Offered - Livraison proposée |
| Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur | |
| Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur | |
| Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie) | |
| Signature | Date |

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R.068728.004

Amd. No. - N° de la modif.

File No. - N° du dossier

MTC-4-37205

Buyer ID - Id de l'acheteur

mtc775

CCC No./N° CCC - FMS No/ N° VME

- *see document attached* -

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This bid solicitation cancels and supersedes previous bid solicitation number EE010-151057/A dated 2014-10-08 with a closing of 2014-10-28 at 14h00 DST

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TITLE : EARTH OBSERVATION - SPACE AGENCY

PART 1 - GENERAL INFORMATION

1. Security Requirement

NIL security screening required, no access to sensitive information or assets. Contractor personnel will be escorted in specific areas of the facility / site as and where required by Canadian Space agency personnel or those authorized by CSA to do so on its behalf.

2. Statement of Work

Development of specific detailed methods (Phase II) and demonstration of the applicability of Earth observation technology (Phase III) to an activity associated with the operations of Public Works and Government Services Canada.

3. Distribution of RFP Amendments

Canada will make available Notices of Proposed Procurement (NPP), bid solicitations and related documents for download through the Government Electronic Tendering Service (GETS). Canada is not responsible and will not assume any liabilities whatsoever for the information found on websites of third parties. In the event an NPP, bid solicitation or related documentation would be amended, Canada will not be sending notifications. Canada will post all amendments, including significant enquiries received and their replies, using GETS. It is the sole responsibility of the Bidder to regularly consult GETS for the most up-to-date information. Canada will not be liable for any oversight on the Bidder's part nor for notification services offered by a third party.

4. Debriefings

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days of receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

PART 2 - BIDDER INSTRUCTIONS

1. Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the [Standard Acquisition Clauses and Conditions Manual](https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The [2003](#) (2014-09-25) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

2. Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on page 1 of the bid solicitation.

Due to the nature of the bid solicitation, bids transmitted by facsimile to PWGSC will not be accepted.

3. Former Public Servant

Contracts awarded to former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts awarded to FPSs, bidders must provide the information required below before contract award. If the answer to the questions and, as applicable the information required have not been received by the time the evaluation of bids is completed, Canada will inform the Bidder of a time frame within which to provide the information. Failure to comply with Canada's request and meet the requirement within the prescribed time frame will render the bid non-responsive.

Definitions

For the purposes of this clause, "former public servant" is any former member of a department as defined in the [Financial Administration Act](#), R.S., 1985, c. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

- a. an individual;
- b. an individual who has incorporated;
- c. a partnership made of former public servants; or
- d. a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means a pension or annual allowance paid under the [Public Service Superannuation Act](#) (PSSA), R.S., 1985, c.P-36, and any increases paid pursuant to the [Supplementary Retirement Benefits Act](#), R.S., 1985, c. S-24 as it affects the PSSA. It does not include pensions payable pursuant to the [Canadian Forces Superannuation Act](#), R.S., 1985, c. C-17, the [Defence](#)

Services Pension Continuation Act, 1970, c. D-3, the Royal Canadian Mounted Police Pension Continuation Act, 1970, c. R-10, and the Royal Canadian Mounted Police Superannuation Act, R.S., 1985, c. R-11, the Members of Parliament Retiring Allowances Act, R.S. 1985, c. M-5, and that portion of pension payable to the Canada Pension Plan Act, R.S., 1985, c. C-8.

Former Public Servant in Receipt of a Pension

As per the above definitions, is the Bidder a FPS in receipt of a pension? **Yes () No ()**

If so, the Bidder must provide the following information, for all FPSs in receipt of a pension, as applicable:

- a. name of former public servant;
- b. date of termination of employment or retirement from the Public Service.

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with [Contracting Policy Notice: 2012-2](#) and the [Guidelines on the Proactive Disclosure of Contracts](#).

Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive? **Yes () No ()**

If so, the Bidder must provide the following information:

- a. name of former public servant;
- b. conditions of the lump sum payment incentive;
- c. date of termination of employment;
- d. amount of lump sum payment;
- e. rate of pay on which lump sum payment is based;
- f. period of lump sum payment including start date, end date and number of weeks;
- g. number and amount (professional fees) of other contracts subject to the restrictions of a work force adjustment program.

For all contracts awarded during the lump sum payment period, the total amount of fees that may be paid to a FPS who received a lump sum payment is \$5,000, including Applicable Taxes.

4. Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than five (5) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated, and the enquiry can be answered to all bidders. Enquiries not submitted in a form that can be distributed to all bidders may not be answered by Canada.

5. Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Quebec

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mtc775
CCC No./N° CCC - FMS No./N° VME

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the bidders.

PART 3 - BID PREPARATION INSTRUCTIONS

1. Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

Section I: Technical Bid (2 hard copies)
Section II: Financial Bid (1 hard copies)
Section III: Certifications (1hard copies)

If there is a discrepancy between the wording of the soft copy and the hard copy, the wording of the hard copy will have priority over the wording of the soft copy.

Prices must appear in the financial bid only. No prices must be indicated in any other section of the bid.

Canada requests that bidders follow the format instructions described below in the preparation of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper;
- (b) use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process [Policy on Green Procurement](http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html) (<http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html>). To assist Canada in reaching its objectives, bidders should:

- 1) use 8.5 x 11 inch (216 mm x 279 mm) paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and
- 2) use an environmentally-preferable format including black and white printing instead of colour printing, printing double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical Bid

In their technical bid, bidders should explain and demonstrate how they propose to meet the requirements and how they will carry out the Work.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with the Basis of Payment. The total amount of Applicable Taxes must be shown separately.

Section III: Certifications

Bidders must submit the certifications required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

1. Evaluation Procedures

- (a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the technical and financial evaluation criteria.
- (b) An evaluation team composed of representatives of Canada will evaluate the bids.

1.1 Technical Evaluation

1.1.1 Mandatory Technical Criteria

1. The bidding firm should have an expertise in Earth observation (EO) technology via satellite. This expertise should be demonstrated by the presentation of at least two similar projects executed during the past 4 years (provide the project description, location, start date and end date, dollar value and Employer's references (name, organization, phone no.))

The ensemble of projects submitted must clearly demonstrate the expertise of the firm in the following areas:

- a. Development of detailed methods and project realisation with EO technology via satellite.
 - b. Structure identification with EO technology
 - c. Thermal and multispectral data analysis.
2. The project manager in the current proposal should have a management position in one of the projects presented (*provide a copy of project manager's CV*)
 3. The total subcontractor workload should be less than 25% of the mandate (technical and financial). All subcontractors must be identified in the proposal.

1.2 Financial Evaluation

SACC Manual Clause [A0220T](#) (2014-06-26), Evaluation of Price

2. Basis of Selection

Basis of Selection - Mandatory Technical Criteria

A bid must comply with the requirements of the bid solicitation and meet all mandatory technical evaluation criteria to be declared responsive. The responsive bid with the lowest evaluated price will be recommended for award of a contract.

PART 5 - CERTIFICATIONS

Bidders must provide the required certifications and associated information to be awarded a contract.

The certifications provided by bidders to Canada are subject to verification by Canada at all times. Canada will declare a bid non-responsive, or will declare a contractor in default in carrying out any of its obligations under the Contract, if any certification made by the Bidder is found to be untrue whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority may render the bid non-responsive or constitute a default under the Contract.

1. Certifications Required Precedent to Contract Award

1.1 Integrity Provisions - Associated Information

By submitting a bid, the Bidder certifies that the Bidder and its Affiliates are in compliance with the provisions as stated in Section 01 Integrity Provisions - Bid of Standard Instructions [2003](#). The associated information required within the Integrity Provisions will assist Canada in confirming that the certifications are true.

1.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "[FCP Limited Eligibility to Bid](#)" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available from [Employment and Social Development Canada \(ESDC\) - Labour's website](#).

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "[FCP Limited Eligibility to Bid](#)" list at the time of contract award.

2. Additional Certifications Required Precedent to Contract Award

The certifications listed below should be completed and submitted with the bid, but may be submitted afterwards. If any of these required certifications is not completed and submitted as requested, the Contracting Authority will inform the Bidder of a time frame within which to provide the information. Failure to comply with the request of the Contracting Authority and to provide the certifications within the time frame provided will render the bid non-responsive.

2.2 Status and Availability of Resources

SACC Manual clause [A3005T](#) (2010-08-16)

2.4 Education and Experience

SACC Manual clause [A3010T](#) (2010-08-16)

PART 6 - RESULTING CONTRACT CLAUSES

1. Security Requirement

There is no security requirement applicable to this Contract.

2. Statement of Work

See Annex "A"

3. Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the [Standard Acquisition Clauses and Conditions Manual](https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual)(<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

3.1 General Conditions

2010C (2014-09-25), General Conditions - Services (Medium Complexity) apply to and form part of the Contract.

4. Term of Contract

4.1 Period of the Contract

The period of the contract is from date of contract until 31 March 2016 inclusive.

5. Authorities

5.1 Contracting Authority

The Contracting Authority for the Contract is:

Maria Pia Aguilera
Supply Agent
Public Works and Government Services Canada
Acquisitions Branch
800 rue de la Gauchetière Ouest, local 7300
Place Bonaventure
Montréal QC H5A 1L6
Telephone: (514) 496-3573
Facsimile: (514) 496-3822
E-mail address: mariapia.aguilera@pwgsc-tpsgc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

5.2 Project Authority

The Project Authority for the Contract is: *(will be completed on contract award)*

Name: _____
Title: _____
Organization: _____
Address: _____

Telephone : _____
Facsimile: _____
E-mail address: _____

The Project Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Project Authority, however the Project Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

5.3 Contractor's Representative

Name : _____
Title : _____
Telephone : _____
Facsimile : _____
Email address : _____

6. Proactive Disclosure of Contracts with Former Public Servants

By providing information on its status, with respect to being a former public servant in receipt of a [Public Service Superannuation Act](#) (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with [Contracting Policy Notice: 2012-2](#) of the Treasury Board Secretariat of Canada.

7. Payment

7.1 Basis of Payment

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in Annex "A", to a limitation of expenditure of \$ _____ *(insert the amount at contract award)*. Customs duties are included and Applicable Taxes are extra.

7.2 Limitation of Expenditure

1. Canada's total liability to the Contractor under the Contract must not exceed \$ _____ *(to be completed at contract award)* _____ Customs duties are included and Applicable Taxes are extra.
2. No increase in the total liability of Canada or in the price of the Work resulting from any design changes, modifications or interpretations of the Work, will be authorized or paid to the Contractor unless these design changes, modifications or interpretations have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

The Contractor must not perform any work or provide any service that would result in Canada's total liability being exceeded before obtaining the written approval of the Contracting Authority. The Contractor must notify the Contracting Authority in writing as to the adequacy of this sum:

- a. when it is 75 percent committed, or
 - b. four (4) months before the contract expiry date, or
 - c. as soon as the Contractor considers that the contract funds provided are inadequate for the completion of the Work,
whichever comes first.
3. If the notification is for inadequate contract funds, the Contractor must provide to the Contracting Authority a written estimate for the additional funds required. Provision of such information by the Contractor does not increase Canada's liability.

7.3 Multiple Payments

SACC *Manual* clause [H1001C](#) (2008-05-12) Multiple Payments

8. Invoicing Instructions

1. The Contractor must submit invoices in accordance with the section entitled "Invoice Submission" of the general conditions. Invoices cannot be submitted until all work identified in the invoice is completed.

Each invoice must be supported by:

- a. a copy of time sheets to support the time claimed;
 - b. a copy of the release document and any other documents as specified in the Contract;
 - c. a copy of the invoices, receipts, vouchers for all direct expenses, and all travel and living expenses;
2. Invoices must be distributed as follows:
- . The original and one (1) copy must be forwarded to the address shown on page 1 of the Contract for certification and payment.

9. Certifications

9.1 Compliance

The continuous compliance with the certifications provided by the Contractor in its bid and the ongoing cooperation in providing associated information are conditions of the Contract. Certifications are subject to verification by Canada during the entire period of the Contract. If the Contractor does not comply with any certification, fails to provide the associated information, or if it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

10. Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____. (*Insert the name of the province or territory as specified by the Bidder in its bid, if applicable*)

11. Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (c) the general conditions 2010C (2014-09-25);
- (d) Annex A, Statement of Work;
- (e) Annex B, Basis of Payment
- (g) the Contractor's bid dated _____ (*insert date of bid*) as clarified on _____ " **or** ", as amended on _____ " *and insert date(s) of clarification(s) or amendment(s)*

ANNEX "A"

STATEMENT OF WORK

1 – Project title

Development of specific detailed methods (Phase II) and demonstration of the applicability of Earth observation technology (Phase III) to an activity associated with the operations of Public Works and Government Services Canada.

2 - Background – Report by VIASAT GeoTechnologies

Phase I of the project, which was carried out in 2010-11 in collaboration with the Canadian Space Agency (VIASAT 2010), was the first step in a strategy by Public Works and Government Services Canada (PWGSC) to develop Earth observation (EO) technology applications for a number of its key activities. This first step involved assessing the potential of applying EO technology to nine areas of activity undertaken by the Centre of Expertise – Professional and Technical Services (CE-PTS). The analysis demonstrated a high potential for three of these areas, namely:

- 1) Monitoring of turbidity plumes in projects involving the dredging and ocean disposal of sediment (*this activity will not be analyzed as part of this mandate*);
- 2) monitoring of shoreline erosion associated with waterfront infrastructure (*this activity will not be analyzed as part of this mandate*);
- 3) **Observation of access points to the St. Lawrence River and their use, including ice fishing sites.**

The project comprises an additional two phases. Phase II consists in developing the method for application associated with the most appropriate sensors for the area targeted, as well as preparing the plans and specifications for validating the methods and implementing demonstration projects. Phase III will involve the actual validation of the methods and the implementation of the demonstration projects.

PWGSC also wishes to add an additional area of activity, namely the monitoring of marine mammal watching excursions. This aspect was not analyzed in Phase I in 2010-11.

3 – Current project

3.1) The contractor must carry out Phase II, "Development of application methods and preparation of specifications for validation and demonstration," and Phase III, "Validation of methods and implementation of demonstration projects," for the following field of application: "*observation of access points to the St. Lawrence River and monitoring of their use, including ice fishing sites:*"

- 3.1.1** Update the assessment of the potential of the sensors identified in Phase I.
- 3.1.2** Identify other potential sensors that could be used to gather information relevant to the specific content of the field of application.

- 3.1.3 Compare the limitations and performance of each sensor identified and select the sensors with the best characteristics according to the specific context of the fields of application.
- 3.1.4 Develop satellite image processing methods and protocols according to the specific context of the fields of application.
- 3.1.5 Prepare the specifications required for the validation of the interpretation methods and protocols on the basis of the data collected in the field and subsequently demonstrate the application of the EO technologies to the areas in question. It may be necessary to explore several methods and protocols as part of this step.
- 3.1.6 Prepare the schedule and cost details of the various steps.
- 3.1.7 Participate in project validation and demonstration of the project.

Certain supplemental activities will be carried out only if the Canadian Space Agency obtain additional funding.

3.2) The contractor must perform the following activities for the application field "*Monitoring of marine mammal watching excursions:*"

- 3.2.1 Identify potential sensors for gathering information relevant to the specific context of the application field.
- 3.2.2 Compare the limitations and performance of each sensor identified and select the sensors with the best characteristics according to the specific context of the application fields.

The following activities will be carried out only if the identified sensors have real potential.

- 3.2.3 Develop satellite image processing methods and protocols according to the specific context of the application field. The contractor will have to coordinate the development of the methods with the stakeholders that conduct the field visits.
- 3.2.4 Prepare the specifications required for the demonstration of the interpretation methods and protocols on the basis of the field data. It may be necessary to explore several methods and protocols as part of this step.
- 3.2.5 Prepare the schedule and cost details of the various steps.
- 3.2.6 Participate in the validation and demonstration of the project.

4 – Description of the work plan for the application fields considered

4.1 Use of EO technology for acquiring information on the use of access points to the St. Lawrence River, including ice fishing sites

4.1.1 Background

Public uses of the St. Lawrence River and its banks include walking, nature watching, relaxation, swimming, pleasure boating and fishing. The Shoreline Access Coordination Committee (CCAR), which was established under the St. Lawrence Plan (phase IV) and dissolved in 2010, conducted an inventory of access sites and their uses with the collaboration of various stakeholders. The inventory showed the limitations of field visits (accessibility, travel costs, etc.) as a means of establishing a detailed and accurate inventory of existing access points, including monitored beaches, docks, marinas and boat ramps or, in the case of cities, fishing sites or simply areas for walking.

Part of the inventory was published on the website of the St. Lawrence Global Observatory (SLGO) in 2013. However, it revealed limitations in terms of the accuracy of the location of the sites inventoried. The main issue is the correspondence between the geodetic points provided by the stakeholders and the actual location of the points. The inaccuracies are due primarily to GPS user errors or data entry errors. The use of satellite images would make it possible to confirm the precise location of existing sites and accurately determine the location of new sites by minimizing human error.

In addition to the St. Lawrence River, the inventory maps 11 tributaries between Cornwall and Blanc Sablon, including the Magdalen Islands. PWGSC wishes to develop a method for using the images, including a determination of the costs associated with the two types of environment (tributaries and St. Lawrence River).

In a related field, the ice fishery would be a particularly interesting aspect with respect to satellite technology. One of the issues with respect to this winter activity is the lack of available information on the use of ice fishing sites over large areas, as well as the level of abandonment of the sites by users at the time of spring thaw, which may contribute to the pollution of aquatic environments. The use of satellite images could contribute to reducing the costs associated with field visits by making it possible to target sites that are actually occupied. Ice fishing sites would need to be geolocated.

4.1.2 Work plan – use and access points to the St. Lawrence River

Activity 1 – The contractor must perform the following activities.

- Update the list of existing sensors on the basis of Phase I and compare the limitations and performance of each.
- From the list of identified sensors, select those that have the best characteristics according to the specific context of the identification of river access points;
- Develop satellite image calibration and processing methods and protocols for the sensors identified as having the best performance.

Activity 2 – The contractor must perform the following activities. The extent of the proposed geographic areas for the validation and demonstration activities is presented in Appendix. It may be necessary to break down the area into sectors if the satellite geographic coverage is limited and depending on the image acquisition costs.

The validation phase will allow the comparison between the use of EO technology in various types of environments and for various types of access. The types of access points that may be

observed using EO technology will be validated, documented, and standardized using uniform terminology. One of the difficulties anticipated is the validation of the uses which, at first glance, would require identification of human presence at the time the satellite sensor passes over the area in question. This activity must take account of temporal and seasonal variables (winter versus summer, weekday versus weekend), which can complicate data acquisition and analysis. The various environments in which the access points are located can also have an impact on the degree of visibility on the satellite images.

- Prepare the specifications required for the validation of the interpretation methods and protocols on the basis of data from the inventory, namely Richelieu River (maps #31, #32, #35 to #37). The inventory is available in ArcGis format.
- Prepare the schedule and cost details associated with the validation phase as described in the specifications.
- Make a list of recent satellite images to acquire to validate the data from the inventory and perform validation. **Purchase of satellite images will be by PWGSC.**
- Prepare a report summarizing the benefits and limitations of the method on the basis of the field conditions present.

The contractor must also present in Annex B the additional cost (in option) for the Métis (map #98) region.

Activity 3– The contractor must perform the following activities. The demonstration phase includes the acquisition of images (by PWGSC) as close in time to the site visits as possible.

- Prepare the specifications required for the demonstration of the application of EO technology on the basis of the conclusions of the validation report (Activity #2). The proposed tributaries sites are identified in PWGSC report (May 2014).
- Prepare the schedule and cost details associated with the demonstration phase as described in the plans and specifications.
- Make a list of recent satellite images to acquire and conduct the demonstration in collaboration with the stakeholders in the field. **Purchase of satellite images will be by PWGSC.**
- Prepare a report summarizing Activity #3, including the development of the method for using the satellite images and a comparison of cost/area/work effort.

The contractor must also present in Annex B the additional cost (in option) if we send them on the field.

4.1.3 Work plan – ice fishing

Activity 1 – The contractor must perform the following activities.

-
- Update the list of existing sensors on the basis of Phase I and compare the limitations and performance of each.
 - Of the sensors identified, select those with the best characteristics on the basis of the specific context of ice fishing.
 - Develop satellite image calibration and processing methods and protocols for the sensors identified as having the best performance.

Activity 2 (optional) – The contractor must perform the following activities. The extent of the proposed geographic areas is presented in Appendix. It may be necessary to break down the area into sectors if the satellite geographic coverage is limited and depending on the image acquisition costs.

- Prepare the specifications required for the validation.
- Prepare the schedule and cost details associated with the validation phase as described in the specifications.
- Make a list of recent satellite images to acquire and conduct the validation in collaboration with the stakeholders in the field. **Purchase of satellite images will be by PWGSC.**
- Prepare a report summarizing the benefits and limitations of the method on the basis of the field conditions present, including the development of the method for using satellite images and a cost/area/work effort comparison.

4.2 Surveillance of marine mammal watching excursions

Marine mammal watching activities are regulated, and watching areas are documented and identified on the websites of various non-profit organizations. Although marine mammal watching may not appear feasible at first, indirect watching through the use of sensors on boats is a practice to be explored.

Activity 1 – The contractor must perform the following activities.

- Update the list of existing sensors on the basis of Phase I and compare the limitations and performance of each. Identify the list of new existing sensors for vessel traffic and compare the limitations and performance of each.
- Of the sensors identified, select those with the best characteristics on the basis of the specific context of whale watching and whale watching excursions boats.

Activity 2 (optional) – The contractor must perform the following activities. The extent of the proposed geographic areas for the validation activities is presented in PWGSC report (May 2014). It may be necessary to break down the area into sectors if the satellite geographic coverage is limited and depending on the image acquisition costs.

- Develop the methods and protocols for the calibration and processing of satellite images for the sensors identified as having the best performance, including their interpretation.

- Prepare the schedule and cost details associated with the validation phase as described in the plans and specifications.
- Make a list of recent satellite images to acquire closest to the actual observation time at the site and perform validation of the protocol and method. **Purchase of satellite images will be by PWGSC.**
- Prepare a report summarizing the benefits and limitations of the method on the basis of the field conditions and the costs associated with the site visit.

5 – Deliverables

5.1 Reports

The contractor must produce:

- a report including all activities #1 in all areas of Section 4;
- a report including all activities #2 in the areas of Section 4.1;
- a report including all activities #2 in the area of Section 4.1;
- if applicable: a report including all activities #2 of the area of Section 4.2.

The reports must be drafted in French and must contain, but not be limited to, the following information:

- an executive summary;
- a context piece on the project, including the general description of the work and the objectives;
- a summary of the results of the previous phase associated with the application field under study;
- list of existing sensors that can be used to meet the project objectives supported by a description of each sensor and examples from the literature;
- presentation of the characteristics of each sensor studied and selected, including their limitations, performance, frequency, scale and other relevant parameters in the form of tables and figures;
- presentation and justification of the sensor(s) with the best characteristics;
- a precise description of the methods required for processing the images and field data needed for calibration of the images, including software, etc.;
- for each application field, a precise description of the information required (baseline conditions) for calibration of the images; all information must be summarized in the text and presented in detail in an appended protocol;
- for each application field, the plans and specifications required for validation of the interpretation methods and protocols on the basis of the data collected in the field and from the inventory; all data must be summarized in the text, and the plans and specifications, including protocols, sampling site plans, etc. must be presented in detail in an appendix (activities #2 and #3 only);

- for each application field, schedules and detailed costs for each step;
- references;
- general conclusions and recommendations.

The preliminary reports must be delivered in electronic format (Word and PDF). The final reports, after acceptance of the modifications to the preliminary report, must be delivered in three (3) double-sided colour copies and two (2) electronic versions on CD-ROM. Particular attention must be given to the presentation of the reports (spelling mistakes, writing style, syntax, etc.). The electronic version must contain the complete final report in PDF format (including appendices) and all files in their original format (Word, Excel for tables, jpg for all photographs, and AutoCAD for plans and satellite image files, where applicable).

5.2 Presentation

The contractor will be required to prepare and present two joint presentations of all fields in Section 4, namely one for Phase #2 activities and one for Phase #3 activities.

The presentations must be in PowerPoint and PDF formats and electronic copies must be provided. All deliverables must be drafted in French.

All data, both raw and processed, and all tools and protocols developed as part of this mandate are the intellectual property of PWGSC.

ANNEX "B"

BASIS OF PAYMENT

| ITEM | SECTION | DELIVRABLE | DELIVERY DATE | PRICE |
|--------------------|--|---|--|-------|
| 2014 - 2015 | | | | |
| No1 | Section 4 sub-sections 4.1 and 4.2 <i>Including articles 4.1.2, 4.1.3</i> | Preliminary report of activity #1 | No later than 3 weeks after start of mandate | \$ |
| No2 | | Final report of activity #1 | No later than 5 days after receipt of comments | \$ |
| No3 | Section 4 Article 4.1.2 | Preliminary report of activity #2 | Before February 28 th , 2015 | \$ |
| No4 | <u>Tributary Portion</u> | Final report of activity #2 Presentation of Activity #2 | No later than 5 days after receipt of comments or before March 27 th , 2015 | \$ |
| No5 | Section 4 Article 4.1.2 <u>Fluvial portion</u> <i>OPTION*</i> | Preliminary report of activity #2 Final report of activity #2 Presentation of Activity #2 | To be included in deliverables No3 and No4 | \$ |
| No6 | Section 4 Article 4.1.3 <i>OPTION</i> | Final report of activity #2 Presentation of Activity #2 | | \$ |
| 2015-2016 | | | | |
| No7 | Section 4 Article 4.1.3 <i>OPTION</i> | Final report of activity #2 Presentation of Activity #2 | | \$ |
| No8 | Section 4 sub-section 4.2 | Preliminary report of activity #2 | | \$ |
| No9 | <i>OPTION*</i> | Final report of activity #2 Presentation of Activity #2 | | \$ |
| No10 | Section 4 Article 4.1.2 | Preliminary report of activity #3 | No later than November 1 st , 2015 | \$ |
| No11 | Including article | Final report of | No later than 5 days | \$ |

| | 4.1.2 | activity #3 Presentation of Activity #3 | after receipt of the project manager's comments on the preliminary reports or before January 1st, 2016 | |
|--------------|---|--|--|-----------|
| No12 | Section 4 sub- section4.1 <i>including article</i> <i>4.1.2</i> OPTION | Site Visit | | |
| TOTAL | | | | \$ |

** Items No5, 6,67, 8, 9, and 12 are considered as options, the prices submitted for them will be used in the financial evaluation; however they will not be a part of the initial contract.*

If deemed necessary and in order to add the items in question, the contracting authority will exercise an amendment later on, at the request of the Technical Authority.

Table 10: Information needed for inventorying and monitoring species at risk

| INFORMATION NEEDED BY PWGSC | LOCATION OF SITES | SIZE OF SITES | PRECISION OF INFORMATION | USE OF ARCHIVAL IMAGES | CONSTRAINTS | FREQUENCY | SCALE/ RESOLUTION |
|--|---------------------------------|------------------------------------|--------------------------|-------------------------------------|--|---------------------|---------------------|
| B1. Description of wildlife habitat (vegetation) on federal infrastructure sites | Federal sites and a buffer zone | Generally small (several hectares) | Presence or absence | Yes, combined with new acquisitions | Visible: cloud cover / Radar: none / Potentially coordinated with work | Occasional, 1x/year | Medium / 5.0–15.0 m |
| B2. Field surveys to identify animal and plant species on federal infrastructure sites and to verify, using the registry, whether species at risk are present | Federal sites and a buffer zone | Generally small (several hectares) | Presence or absence | Yes, combined with new acquisitions | Visible: cloud cover / Radar: none / Potentially coordinated with work | Occasional, 1x/year | Medium / 5.0–15.0 m |
| B3. Detection and location of marine mammals during wharf repair work involving blasting | Federal sites and a buffer zone | Generally small (several hectares) | Presence or absence | Yes, combined with new acquisitions | Visible: cloud cover / Radar: none / Potentially coordinated with work | Occasional | Medium / 5.0–15.0 m |

B. Potential for use

EO data cannot be used to detect and locate species at risk at PWGSC sites (need B2), except in a few cases (certain species that live in colonies, e.g. mammals such as prairie dogs) through direct location. The same is true for detecting and locating marine mammals as part of wharf repair work involving blasting (need B3), except in the case of groups of large marine mammals at the surface of the water when the satellite passes. However, most species cannot be identified, counted or mapped using satellite or airborne remote sensing for a number of reasons: the size of the species compared with the resolution of the sensors, the species' life cycle (nocturnal species cannot be identified by optical sensors), and the generally long revisit time make it difficult to monitor populations (Colby and Leimgruber 2007).

However, EO data can be used to indirectly locate and describe wildlife habitat, particularly on sites covering a large geographic area (e.g. several square kilometres). In such cases, a species-habitat relationship is established using models. The relationship between species richness and environmental variables depends on habitat variables such as vegetation cover and density, fragmentation, structure, productivity, land management and anthropogenic disturbance (Goetz et al. 2007). Biophysical and environmental characteristics that can be measured in the field can be used to develop empirical models that can be applied over a much greater area (Manley et al. 2004). EO data can quickly provide information that can be used to anticipate habitat losses for existing populations.

In that regard, remote sensing is a potentially valuable tool that can be used to characterize habitat and thus to draw inferences, by means of models, on the distribution of plant and animal species. However, it can be highly complex and may not be appropriate for small urbanized areas. The results of these models must always be analyzed with caution. Furthermore, although indirect, this approach to inventorying species at risk populations still requires fieldwork.

Passive multispectral optical satellite sensors such as LANDSAT, Terra-ASTER, SPOT, MODIS, IKONOS and QuickBird could be used to describe wildlife habitat on larger federal sites (e.g. several hectares), distinguish between types of vegetation and determine the horizontal structure of wildlife habitat vegetation cover (need B1). A number of studies have demonstrated the potential of these sensors for mapping terrestrial wildlife habitat using satellite imagery.

Table 11 provides an estimate of the potential of EO data from each sensor to be used for each need in the “Species at Risk Inventorying and Monitoring” field of application.

Table 11: Estimated potential of EO data to be used for needs related to species at risk inventoring and monitoring

| Sensor ⁽³⁾ | Need 1 ⁽¹⁾ | | | | | Need 2 | | | | | Need 3 | | | | | Acquisition Cost ⁽²⁾ | |
|-----------------------|-----------------------|--------------|--------------|-----------|----------------|--------------|--------------|-----------|----------------|--------------|--------------|-----------|----------------|--------------|--------------|---------------------------------|-----------|
| | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | | Potential |
| GeoEye-1 | ** | **** | **** | **** | * | **** | **** | **** | **** | ** | **** | **** | ** | **** | ** | **** | \$\$\$\$ |
| WorldView-2 | ** | **** | **** | **** | * | **** | **** | **** | **** | ** | **** | **** | ** | **** | ** | **** | \$\$\$\$ |
| WorldView-1 | | | | | | | | | | | | | | | | | |
| QuickBird-2 | ** | **** | **** | **** | * | **** | **** | **** | **** | ** | **** | **** | ** | **** | ** | **** | \$\$\$\$ |
| IKONOS-2 | ** | **** | **** | **** | * | **** | **** | **** | **** | ** | **** | **** | ** | **** | ** | **** | \$\$\$\$ |
| OrbView-3 | ** | **** | **** | **** | * | **** | **** | **** | **** | ** | **** | **** | ** | **** | ** | **** | \$\$\$\$ |
| Kompsat-2 | | | | | | | | | | | | | | | | | |
| ALOS PRISM | | | | | | | | | | | | | | | | | |
| CARTOSAT-1 | | | | | | | | | | | | | | | | | |
| CARTOSAT-2 | | | | | | | | | | | | | | | | | |
| Formosat-2 + | * | *** | **** | **** | | | | | | | | | | | | | |
| RapidEye | * | ** | **** | **** | | | | | | | | | | | | | |
| SPOT-5 | * | *** | **** | **** | | | | | | | | | | | | | |
| ALOS-AVNIR-2 | | | | | | | | | | | | | | | | | |
| SPOT-1 to -4 | | | | | | | | | | | | | | | | | |
| Terra-ASTER | | | | | | | | | | | | | | | | | |
| Landsat-5 | | | | | | | | | | | | | | | | | |
| Landsat-7 ++ | | | | | | | | | | | | | | | | | |
| MERIS | | | | | | | | | | | | | | | | | |
| MODIS | | | | | | | | | | | | | | | | | |
| AVHRR | | | | | | | | | | | | | | | | | |
| Cosmo-Skymed | | | | | | | | | | | | | | | | | |
| TerraSAR-X | | | | | | | | | | | | | | | | | |
| TanDEM-X | | | | | | | | | | | | | | | | | |
| RADARSAT-2 | | | | | | | | | | | | | | | | | |
| RADARSAT-1 | | | | | | | | | | | | | | | | | |
| ALOS-PALSAR | | | | | | | | | | | | | | | | | |
| ENVISAT-ASAR | | | | | | | | | | | | | | | | | |
| Thermography | | | | | | | | | | | | | | | | | |
| Hyperspectral | | | | | | | | | | | | | | | | | |
| LiDAR | | | | | | | | | | | | | | | | | |

(1)

| | |
|-------|--|
| + | Partial coverage, depending on location |
| ++ | Sensor problems: image area with no data |
| - | n/a: not applicable |
| ? | Does not meet any requirements |
| * | Information not available |
| ** | Meets few requirements |
| *** | Meets some requirements |
| **** | Meets most requirements |
| ***** | Meets all requirements |

(2)

| | |
|----------------|-----------------------|
| \$ to \$\$\$\$ | Low cost to high cost |
|----------------|-----------------------|

(3)

| |
|---------------------------|
| Optical satellite sensors |
| Radar satellite sensors |
| Airborne sensors |

(4)

| |
|----------|
| None |
| Unknown |
| Low |
| Moderate |
| High |

Note: Variable weighting of spectral, spatial and temporal resolution may result in different potential levels for the same number of stars.

C. Conclusion

B1- Description of wildlife habitat (vegetation) on sites containing new federal infrastructure

- ✓ High-resolution satellite data has the potential to be used to map and describe wildlife habitat vegetation on large federal sites (at least several hectares) and corresponding buffer zones. From a practical and operational standpoint, however, its potential is limited for small sites in urbanized areas (most of the sites managed by PWGSC), since biologists and other wildlife specialists can easily conduct inventories in the field. The potential is greater for large sites.

B2- Field surveys to identify animal and plant species on sites containing new federal infrastructure and to verify, using the registry, whether species at risk are present

- ✓ Satellite data cannot be used for direct detection and location of species at risk.
- ✓ There is some potential to identify species using models to infer the presence of species on the basis of habitat data. However, that potential is generally low, given the complexity of the models that would have to be developed.

B3- Detection and location of marine mammals during wharf repair work involving blasting

- ✓ Satellite data generally cannot be used for direct detection and location of marine mammals, except in the case of large mammals on the surface at the time of the satellite's passage.
- ✓ There is some potential to identify mammals using models to infer the presence of species on the basis of habitat data. However, that potential is generally low, given the complexity of the models that would have to be developed.

3.2.7 Monitoring of access points to the St. Lawrence River and visitor traffic

A. Background, issue and needs

The public uses the St. Lawrence and its shoreline for many purposes: walking, nature observation, relaxing, swimming, recreational boating and fishing. However, a number of users have identified an inability or difficulty accessing sites, whether supervised beaches, wharves, marinas or boat launches, or in cities, fishing grounds, or even areas for walking ([2002 survey](#)). The work of the Shoreline Access Coordination Committee (CCAR), which has conducted an exhaustive inventory of access points and their use, shows the need for a detailed inventory to be carried out in the field, which will require substantial resources.

The professional and technical services provided by PWGSC to the CCAR include the development, validation and updating of a database of access points. For example, it is hoped that imagery could be used to gather information on the number of vessels moored in a bay, marina or water body, the number of cars in a parking lot adjacent to a marina or to any activity related to the river (fishing, shell harvesting, kayaking or other sports), as well as the number of swimmers at given locations. The study area includes the St. Lawrence River and the following tributaries: L'Assomption River, Batiscan River, Boyer River, Bonaventure River, Chaudière River, Jacques Cartier River, Ottawa River, Richelieu River, Saguenay River, Saint-François River, Saint-Maurice River and Yamaska River.

PWGSC therefore wishes to explore the applicability of EO technology to the validation of the inventory data and implementation of a detailed inventory (complementing field observations) and to the detection and monitoring of visitor traffic for various uses at the various access points.

Through interviews with PWGSC staff, two specific needs were identified with regard to monitoring access points to the St. Lawrence River and visitor traffic:

B1- Validation and updating of the current database (access to the river)

B2- Detection and monitoring of visitor traffic for various uses (at the access points)

The requirements for meeting the needs of PWGSC are described in Table 19.

Table 19: Information needs for monitoring access points to the St. Lawrence River and visitor traffic

| INFORMATION NEEDED BY PWGSC | LOCATION OF SITES | SIZE OF SITES | PRECISION OF INFORMATION | USE OF ARCHIVAL IMAGES | CONSTRAINTS | FREQUENCY | SCALE / RESOLUTION |
|---|--|---|---|------------------------|---|------------------------------|-------------------------|
| B1. Validation and updating of existing PWGSC database of river access points | St. Lawrence River and the following tributaries: L'Assomption River, Batiscan River, Boyer River, Bonaventure River, Chaudière River, Jacques Cartier River, Ottawa River, Richelieu River, Saguenay River, Saint-François River, Saint-Maurice River and Yamaska River | Several square metres to several hectares | Presence or absence and recognition of type of access point | Yes | Visible: cloud cover / Radar: none | One-time acquisition | Large 1.0–2.0 m |
| B2. Detection and monitoring of visitor traffic for various uses at the various access points. For example: 1) number of vessels moored in a bay, marina or water body; 2) number of cars in a parking lot adjacent to a marina or to any other activity related to the river (fishing, shellfish harvesting, kayaking); 3) number of swimmers or fishers at given locations; 4) number of hikers or cyclists on the shoreline | St. Lawrence River and the following tributaries: L'Assomption River, Batiscan River, Boyer River, Bonaventure River, Chaudière River, Jacques Cartier River, Ottawa River, Richelieu River, Saguenay River, Saint-François River, Saint-Maurice River and Yamaska River | Several square metres to several hectares | Presence and number or absence | Yes | Visible: cloud cover / Radar: none / Period of activity | Periodical / Daily or weekly | Very large 0.5–1.0 m |

B. Potential for use

Multispectral sensors

No studies on the use of EO data to monitor access points to the St. Lawrence River or visitor traffic were found in the literature. However, the elements to be located and identified (marina, vessel, wharf, parking lot, harbour infrastructure, etc.) are comparable to urban infrastructure in terms of the size and shape of the targets. The studies mentioned in section 3.2.2 (Remote Monitoring of Work Progress), which show the potential of high-resolution satellite imagery for monitoring urban infrastructure, also demonstrate its strong potential for identification in the context of monitoring access points to the St. Lawrence River and visitor traffic.

High-resolution imagery from satellites such as GeoEye-1 (0.5 m), WorldView-1 and -2 (0.5 m), QuickBird-2 (0.6 m) and IKONOS-2 (1 m) has strong potential for use by PWGSC for this application. Given the high degree of availability of these satellite sensors and their potential for identifying land-based infrastructure, PWGSC could use this technology to monitor shoreline access paths and trails, harbour infrastructure, wharves, vessels and other marina infrastructure. The QuickBird image at right illustrates its potential for identifying elements at the Neuville marina in Quebec.



This type of imagery is appropriate for validating and updating the existing PWGSC database of access points to the St. Lawrence River (need B1).

High-resolution (<1 m) multispectral satellite data also have strong potential for detecting various elements related to visitor traffic, such as the number of cars in a parking lot adjacent to a marina or to any other activity related to the river, or the presence of pedestrians, fishers or cyclists (need B2). In the latter case, however, there is a risk of confusion in image interpretation. Furthermore, the time of passage of optical satellites (always between about 9:30 a.m. and 10:00 a.m.) restricts the monitoring of visitor traffic to that time of day. A methodology would have to be developed (through a pilot project, for example) to determine the actual potential.

Radar sensors

Although high-resolution radar imagery from satellites such as RADARSAT-2 or TerraSAR-X has some potential for detecting urban infrastructure, even through cloud cover, its potential for monitoring access points to the St. Lawrence River and visitor traffic is somewhat limited.

Table 20 provides an estimate of the potential of EO data from each sensor to be used for each need in the “Monitoring of Access Points to the St. Lawrence River and Visitor Traffic” field of application.

Table 20: Estimated potential of EO data to be used for needs related to monitoring access points to the St. Lawrence River and visitor traffic

| Sensor ⁽³⁾ | Need 1 ⁽¹⁾ | | | | Need 2 | | | | Acquisition Cost ⁽²⁾ |
|-----------------------|-----------------------|--------------|--------------|-----------|----------------|--------------|--------------|-----------|---------------------------------|
| | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | Potential | |
| GeoEye-1 | **** | **** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| WorldView-2 | **** | **** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| WorldView-1 | ** | **** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| QuickBird-2 | **** | **** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| IKONOS-2 | **** | ** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| OrbView-3 | **** | ** | * | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| Kompsat-2 | ** | * | **** | **** | **** | **** | ** | **** | \$\$ |
| ALOS PRISM | ** | * | **** | **** | **** | **** | ** | **** | \$\$ |
| CARTOSAT-1 | ** | * | **** | **** | **** | **** | ** | **** | \$\$ |
| CARTOSAT-2 | **** | ** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| Formosat-2 + | **** | * | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| RapidEye | **** | * | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| SPOT-5 | **** | * | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| ALOS-AVNIR-2 | | | | | | | | | |
| SPOT-1 to -4 | | | | | | | | | |
| Terra-ASTER | | | | | | | | | |
| Landsat-5 | | | | | | | | | |
| Landsat-7 ++ | | | | | | | | | |
| MERIS | | | | | | | | | |
| MODIS | | | | | | | | | |
| AVHRR | | | | | | | | | |
| Cosmo-Skymed | * | ** | **** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| TerraSAR-X | * | ** | ** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| TanDEM-X | * | ** | ** | **** | **** | **** | ** | **** | \$\$\$\$\$ |
| RADARSAT-2 | * | * | ** | **** | **** | **** | ** | **** | \$ |
| RADARSAT-1 | | | | | | | | | \$ |
| ALOS-PALSAR | | | | | | | | | |
| ENVISAT-ASAR | | | | | | | | | |
| Thermography | | | | | | | | | |
| Hyperspectral | | | | | | | | | |
| LIDAR | | | | | | | | | |

| (1) | |
|-------|--|
| + | Partial coverage, depending on location |
| ++ | Sensor problems: image area with no data |
| - | n/a: not applicable |
| ? | Does not meet any requirements |
| * | Information not available |
| ** | Meets few requirements |
| *** | Meets some requirements |
| **** | Meets most requirements |
| ***** | Meets all requirements |

| (2) | |
|------------------|-----------------------|
| \$ to \$\$\$\$\$ | Low cost to high cost |

| (3) | |
|---------------------------|--|
| Optical satellite sensors | |
| Radar satellite sensors | |
| Airborne sensors | |

| (4) | |
|----------|--|
| None | |
| Unknown | |
| Low | |
| Moderate | |
| High | |

Note: Variable weighting of spectral, spatial and temporal resolution may result in different potential levels for the same number of stars.

C. Conclusion

B1- Validation and updating of the existing PWGSC database of access points to the St. Lawrence River

- ✓ High-resolution (<1 m) multispectral satellite data have strong potential. Such data could be regularly obtained and used to view shoreline access paths and trails, harbour infrastructure, wharves, vessels and other marine infrastructure.

B2- Detection and monitoring of visitor traffic for various uses at the various access points

- ✓ High-resolution (<1 m) multispectral satellite data have strong potential for detecting various elements related to visitor traffic, but they also have limitations: satellites pass at set times in the morning, the spatial resolution is sometimes too limited to detect targets (pedestrians, cyclists, etc.), and there is a risk of confusion in image interpretation. A methodology would have to be developed (through a pilot project, for example) to determine the actual potential.

Table 21: Recommended sensors for needs related to monitoring access points to the St. Lawrence River and visitor traffic

| Needs | Name | EO Potential | Recommended EO Sensors | Comments/Recommendations |
|----------------|--|-----------------|--|--|
| B1 | Validation and updating of existing database | High | GeoEye-1 WorldView-2 QuickBird-2 IKONOS-2 | Appropriate for updating elements such as shoreline access paths and trails, harbour infrastructure, wharves, vessels and other marina infrastructure. |
| B2 | Detection and monitoring of visitor traffic for various uses | Moderate | GeoEye-1 WorldView-2 | Appropriate for detecting and monitoring number of vessels moored, number of cars in a parking lot at the satellites' time of passage (in the morning). Reduced potential for number of swimmers or fishers and number of hikers or cyclists on the shoreline. A higher resolution would give more precise results in those cases. |
| Overall | | Moderate | | |

3.2.8 Identification of ice fishing sites

A. Background, issue and needs

Ice fishing generally begins in late December and runs until mid-March. Some sites have only a handful of ice fishing huts, while others, such as Sainte-Anne-de-la-Pérade and La Baie au Saguenay, can have several hundred (see image at right). The fishing huts are about 4 m by 6 m and are usually clustered together. These small “ice villages” even have their own road networks for cars, snowmobiles and other vehicles, not to mention the many pedestrians. Some structures built to sell supplies or rent huts to fishers are larger.



Waste left on the ice at the end of the ice fishing season can have many harmful effects, such as water quality deterioration due to spills of lamp and heating oil, fishing gear and other fishing equipment, floating debris, which can cause safety problems for recreational boaters and other water users, and financial costs for cleaning up fishing debris that has washed up on the shoreline. The risk is higher in isolated areas ([New Brunswick](#)).

The CCAR’s work has shown that ice fishing is relatively widespread in Quebec, but that there is no means of identifying sites and impacts on the ecosystem. PWGSC would like to explore the applicability of EO technology to the detection and monitoring of ice fishing sites during the winter and to the monitoring of the sites during the spring melt.

Through interviews with PWGSC staff, three specific needs were identified with regard to identifying ice fishing sites:

B1- Detection and location of ice fishing sites

B2- Monitoring of ice fishing sites during the fishing season (number of huts, access routes to sites, vehicles on sites, waste that is harmful to the environment)

B3- Monitoring of ice fishing sites during the spring melt (abandoned huts, other debris and waste that is harmful to the environment)

The requirements for meeting PWGSC’s needs are described in Table 22.

Table 22: Information needed for identifying ice fishing sites

| INFORMATION NEEDED BY PWGSC | LOCATION OF SITES | SIZE OF SITES | PRECISION OF INFORMATION | USE OF ARCHIVAL IMAGES | CONSTRAINTS | FREQUENCY | SCALE / RESOLUTION |
|--|---|---|--------------------------|------------------------|--|----------------------|--------------------|
| B1. Detection and location of ice fishing sites | St. Lawrence River and the following tributaries: L'Assomption River, Batiscan River, Boyer River, | Tens of square metres to several hectares (several huts to several hundred) | Detection or absence | Yes | During the fishing season / January to March only / Visible: cloud cover | One-time acquisition | Large / 1.0–2.0 m |
| B2. Monitoring of ice fishing sites during the fishing season (number of huts, access routes to sites, vehicles on sites, waste that is harmful to the environment) | Bonaventure River, Chaudière River, Jacques Cartier River, Ottawa River, Richelieu River, Saguenay River, Saint-François River, Saint-Maurice River and Yamaska River | Tens of square metres to several hectares (several huts to several hundred) | Detection or absence | No | During the fishing season / January to March only / Visible: cloud cover | Occurrence - Weekly | Large / 1.0–2.0 m |
| B3. Monitoring of ice fishing sites during the spring melt (abandoned huts, other debris and waste that is harmful to the environment) | | Tens of square metres to several hectares (several huts to several hundred) | Detection or absence | No | During the spring melt / March to April only / Visible: cloud cover | Occurrence - Weekly | Large / 1.0–2.0 m |

B. Potential for use

Multispectral sensors

No studies on the identification of ice fishing sites were found in the literature. However, the elements to be located and identified (fishing huts and other infrastructure, cars, access routes, debris, etc.) are partially comparable to small urban infrastructure in terms of the size and shape of the targets. The studies mentioned in section 3.2.2 (Remote Monitoring of Work Progress), which show the potential of high-resolution satellite imagery for monitoring urban infrastructure, also suggest some potential for identifying ice fishing sites.

High-resolution imagery from satellites such as GeoEye-1 (0.5 m), WorldView-1 and -2 (0.5 m), QuickBird-2 (0.6 m) and IKONOS-2 (1 m) has strong potential for use by PWGSC for this application. Given the high degree of availability of these multispectral sensors and their potential for identifying land-based infrastructure in the presence of snow cover, PWGSC could use this technology to identify ice fishing sites (need B1). For example, it could monitor fishing huts and other infrastructure, cars, access routes to sites, and large debris or waste left on the ice during the fishing season (need B2).

However, monitoring of ice fishing sites during the spring melt (abandoned huts, other debris and waste that is harmful to the environment) has some limitations in terms of acquiring imagery when needed (need B3). The short duration of the season and the difficulty of anticipating the exact closing date of the fishing season could constitute a major limitation to EO data acquisition. It is important that data be acquired between the end of the fishing season and ice breakup in order to detect any debris left on the ice that could alter water quality. The small size of some debris and other waste may also be a limitation, given the spatial resolution of current satellite imagery. Some sites that are more isolated and whose exact location is not known will also be difficult to target. Because they are isolated, the environmental risk for those sites could be higher. However, the locations of a number of sites are well known. An initial phase could involve launching pilot project for well-known sites.

Radar sensors

High-resolution radar imagery from satellites such as RADARSAT-2 or TerraSAR-X has some potential for detecting urban infrastructure, even through cloud cover. However, studies would have to be conducted to assess its actual potential for detecting fishing huts and other structures present at ice fishing sites.

Table 23 provides an estimate of the potential of the EO data from each sensor to be used for each need in the “Identification of Ice Fishing Sites” field of application.

Table 23: Estimated potential of EO data to be used for needs related to identification of ice fishing sites

| Sensor ⁽³⁾ | Need 1 ⁽¹⁾ | | | | | Need 2 | | | | | Need 3 | | | | | Acquisition Cost ⁽²⁾ | |
|-----------------------|-----------------------|--------------|--------------|-----------|----------------|--------------|--------------|-----------|----------------|--------------|--------------|-----------|----------------|--------------|--------------|---------------------------------|------------|
| | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | Potential | Spectral Bands | Spatial Res. | Revisit Time | | Potential |
| GeoEye-1 | **** | **** | **** | Green | **** | **** | **** | Yellow | **** | **** | **** | Yellow | **** | **** | **** | Yellow | \$\$\$\$\$ |
| WorldView-2 | **** | **** | **** | Green | **** | **** | **** | Yellow | **** | **** | **** | Yellow | **** | **** | **** | Yellow | \$\$\$\$\$ |
| WorldView-1 | ** | **** | **** | Yellow | * | **** | **** | Red | **** | **** | **** | Red | **** | **** | **** | Red | \$\$\$\$\$ |
| QuickBird-2 | **** | **** | **** | Green | **** | **** | **** | Yellow | **** | **** | **** | Yellow | **** | **** | **** | Yellow | \$\$\$\$\$ |
| IKONOS-2 | **** | ** | **** | Yellow | **** | **** | **** | Yellow | **** | **** | **** | Yellow | **** | **** | **** | Yellow | \$\$\$\$\$ |
| OrbView-3 | | | | | | | | | | | | | | | | | |
| Kompsat-2 | **** | **** | * | Yellow | **** | **** | **** | Red | **** | **** | **** | Red | **** | **** | **** | Red | \$\$\$\$\$ |
| ALOS PRISM | ** | * | * | Red | | | | | | | | | | | | | |
| CARTOSAT-1 | ** | * | **** | Red | | | | | | | | | | | | | |
| CARTOSAT-2 | ** | ** | **** | Red | * | **** | **** | Red | * | **** | **** | Red | * | **** | **** | Red | \$ |
| Formosat-2 + | **** | * | **** | Red | **** | **** | **** | Red | **** | **** | **** | Red | **** | **** | **** | Red | \$\$\$\$\$ |
| RapidEye | **** | * | **** | Red | | | | | | | | | | | | | |
| SPOT-5 | **** | * | **** | Red | | | | | | | | | | | | | |
| ALOS-AVNIR-2 | | | | | | | | | | | | | | | | | |
| SPOT-1 to -4 | | | | | | | | | | | | | | | | | |
| Terra-ASTER | | | | | | | | | | | | | | | | | |
| Landsat-5 | | | | | | | | | | | | | | | | | |
| Landsat-7 ++ | | | | | | | | | | | | | | | | | |
| MERIS | | | | | | | | | | | | | | | | | |
| MODIS | | | | | | | | | | | | | | | | | |
| AVHRR | | | | | | | | | | | | | | | | | |
| Cosmo-SkyMed | * | ** | **** | Red | | | | | | | | | | | | | \$\$\$\$\$ |
| TerraSAR-X | * | ** | ** | Red | | | | | | | | | | | | | \$\$\$\$\$ |
| TanDEM-X | * | ** | **** | Red | | | | | | | | | | | | | \$\$\$\$\$ |
| RADARSAT-2 | * | * | ** | Red | | | | | | | | | | | | | \$ |
| RADARSAT-1 | | | | | | | | | | | | | | | | | \$ |
| ALOS-PALSAR | | | | | | | | | | | | | | | | | |
| ENVISAT-ASAR | | | | | | | | | | | | | | | | | |
| Thermography | | | | | | | | | | | | | | | | | |
| Hyperspectral | | | | | | | | | | | | | | | | | |
| LiDAR | | | | | | | | | | | | | | | | | |

Note: Variable weighting of spectral, spatial and temporal resolution may result in different potential levels for the same number of stars.

(1)

| | |
|-------|--|
| + | Partial coverage, depending on location |
| ++ | Sensor problems: image area with no data |
| - | n/a: not applicable |
| ? | Does not meet any requirements |
| * | Information not available |
| ** | Meets few requirements |
| *** | Meets some requirements |
| **** | Meets most requirements |
| ***** | Meets all requirements |

(2)

| | |
|------------------|-----------------------|
| \$ to \$\$\$\$\$ | Low cost to high cost |
|------------------|-----------------------|

(3)

| |
|---------------------------|
| Optical satellite sensors |
| Radar satellite sensors |
| Airborne sensors |

(4)

| |
|----------|
| None |
| Unknown |
| Low |
| Moderate |
| High |

C. Conclusion

B1- Detection and location of ice fishing sites

- ✓ High-resolution (<1 m) multispectral imagery has relatively strong potential. However, lack of knowledge about the location of most of the sites on St. Lawrence tributaries is a major challenge to planning image acquisition.

B2- Monitoring of ice fishing sites during the fishing season (number of huts, access routes to sites, vehicles on sites, waste that is harmful to the environment)

- ✓ High-resolution (<1 m) multispectral imagery has relatively strong potential.

B3- Monitoring of ice fishing sites during the spring melt (abandoned huts, other debris and waste that is harmful to the environment)

- ✓ High-resolution (<1 m) multispectral imagery has some potential, but has major limitations in terms of acquiring imagery at the time required.

Table 24: Recommended sensors for needs related to the identification of ice fishing sites

| Needs | Name | EO Potential | Recommended EO Sensors | Comments/Recommendations |
|----------------|---|--------------|--|---|
| B1 | Detection and location of ice fishing sites | High | GeoEye-1 WorldView-2 QuickBird-2 IKONOS-2 | Appropriate for detecting and locating sites, but planning image acquisition will be complex and costly because the sites are scattered. |
| B2 | Monitoring of ice fishing sites during the fishing season | High | GeoEye-1 WorldView-2 QuickBird-2 IKONOS-2 | Appropriate for the number of huts, access routes to sites, vehicles on sites. Potential is more limited for monitoring waste that is harmful to the environment. |
| B3 | Monitoring of ice fishing sites during the spring melt | Moderate | GeoEye-1 WorldView-2 QuickBird-2 IKONOS-2 | Monitoring is possible, but uncertainty about the timing and speed of the spring melt may sometimes make it difficult to know whether high-quality imagery will be available. |
| Overall | | High | | |



Use of Earth Observation Technology for Acquiring Data on the Use of Access Points to the St. Lawrence River

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For:

Canadian Space Agency

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1.0 BACKGROUND

Various recreational activities are carried out on the St. Lawrence River and along its shores, including walking, nature watching, swimming, pleasure boating and fishing. The Shoreline Access Coordination Committee (CCAR), which was established under the St. Lawrence Plan (Phase IV) and dissolved in 2010, conducted an inventory of St. Lawrence River public access points and their uses in collaboration with various stakeholders. The inventory revealed a number of limitations associated with the acquisition of data on access points through field visits relating to accessibility, travel costs, etc. In order to develop a precise, detailed inventory of the various access sites (e.g., monitored beaches, docks, marinas, boat launches, ice fishing sites or marine mammal watching sites) and locations (namely cities, open or remote areas), a number of difficulties must be overcome.

In 2011, the Professional and Technical Services group of Public Works and Government Services Canada (PWGSC) developed, in collaboration with CCAR, a public access database based on the inventory conducted by CCAR. Wherever possible, the information was also validated and updated by various local stakeholders. Although CCAR is no longer active, shoreline accessibility continues to be a priority of the St. Lawrence Plan's Comité de suivi de la pérennité des ouvrages.

Some of the inventory data was published on the website of the St. Lawrence Global Observatory (SLGO) on October 2013. Some data could not be posted for reasons associated with accuracy. The main issue is the correspondence between the geodetic points provided by local stakeholders and the actual location of the access points. The inaccuracies could be due to GPS user errors or data entry errors.

One of the methods for acquiring data on access to the St. Lawrence River is the use of satellite images, which unquestionably have the potential to determine the location of public access points and their uses.

The Canadian Space Agency (CSA) coordinates all civil, space-related activities on behalf of the Government of Canada. In support of this role, it established the Government Related Initiatives Program (GRIP), which focuses on Earth observation (EO) systems for land, ocean, and the atmosphere to enhance government services.

Within the framework of GRIP, PWGSC developed a project aimed at showing the potential of EO technology to identify and help inventory data on access to the St. Lawrence.

The EO technology project is being implemented in phases over three fiscal years, namely 2013-2014, 2014-2015 and 2015-2016:

| | |
|---|---|
| <p>A) Prioritization of needs in the area of validation of data on public access points to the St. Lawrence River and their uses (including ice fishing and marine mammal watching sites) and development of the methods and protocols required for interpretation of satellite images.</p> | <ul style="list-style-type: none"> • A.1 Identify the types of access points for which additional information is required (13-14). • A.2 Prioritize the access points identified on the basis of their observation potential using EO technology (13-14/ 14-15). • A.3 Identify the necessary methods and protocols for interpreting the satellite images on the basis of information needs associated with prioritized access points (14-15). |
| <p>B) Validation of the method and protocols developed</p> | <ul style="list-style-type: none"> • Implement the methods and protocols within the framework of the pilot exercises (14-15). • In collaboration with local partners, validate, enhance and refine the methods and protocols on the basis of the results of the pilot projects (14-15). |

| | |
|--|---|
| C) Implementation of the demonstration project | <ul style="list-style-type: none">• Conduct the observation of priority access points to the St. Lawrence River (15-16).• Acquire, interpret and compare the satellite data, and enter the results into the St. Lawrence Plan database on access points (15-16). |
|--|---|

This document presents the results of steps A.1 and A.2, namely:

- A.1 Identify the types of access points for which additional information is required;
- A.2 Prioritize the access points identified on the basis of the potential for their observation using EO technology.

2.0 APPROACH

The 2011 inventory of public access points to the St. Lawrence River (hereafter referred to as “the inventory”) identifies the St. Lawrence River itself and 11 of its tributaries considered priorities under the St. Lawrence Action Plan, namely the L’Assomption, Batiscan, Bonaventure, Chaudière, Jacques-Cartier, Ottawa, Richelieu, Saguenay, Saint-François, Saint-Maurice and Yamaska rivers.

The public access points are divided into 10 categories: riverbanks and beaches, docks, boats launches, marinas, safe harbours, waterfront parks, lookouts, ports, rest stops and water aerodromes. There are six types of use—boating, swimming, nature watching, recreational fishing, cycling, and hiking—and two types of facilities, namely rest areas and recreational sites.

With respect to ice fishing, there is no information on the river access points used. Although a number of associations exist along the St. Lawrence River, specific usage patterns are unknown.

Marine mammal watching is regulated and the watching sites are documented and well-defined on the internet sites of various non-profit organizations, such as GREMM.

2.1 Access to riverbanks

In order to be able to carry out Phase B of the project (Validation of the methods and protocols developed), it must be possible to compare the use of EO technology in various types of environments and for various types of access.

To facilitate the process, the types of access points that may be observed using EO technology will be validated, documented, and standardized using uniform terminology. One of the difficulties anticipated is the validation of the uses which, at first glance, would require identification of human presence at the time the satellite sensor passes over the area in question. This activity must take account of temporal and seasonal variables (winter versus summer, weekday versus weekend), which can complicate data acquisition and analysis.

The various environments in which the access points are located can also have an impact on the degree of visibility on the satellite images:

- Tributaries (restricted spaces) versus the vast shorelines of the St. Lawrence River (larger spaces)
- Denser urban environments versus isolated but more open sites.

In this context, various environments will be used for validating the suitability of using satellite images and determining the optimal parameters for their use. All definitions of access points will be adjusted for the photo-interpretation of the tributaries and stretches of the St. Lawrence River.

2.2 Ice fishing

Ice fishing is of particular interest with respect to EO technology. Little information is available on the usage of ice fishing sites and the activity is normally carried out over vast areas. The fate of the facilities at the time of spring thaw is also largely undocumented. The use of satellite images could contribute to documenting ice fishing activities over a large area with limited field visits.

We anticipate that thermal emission from heated huts in the middle of a cold environment is a parameter that may enable detection of the huts. This situation would therefore include a temporal variable that will be validated during the development of the methodology.

2.3 Marine mammal watching

Tourist interest in whale watching must be reconciled with the regulations aimed at protecting large marine mammals. In 2007, Fisheries and Oceans Canada (DFO) released the *Guidelines for Best Practices for Watching Marine Mammals in Quebec*. The guidelines are intended for the general public and are designed to minimize the risk of disturbance. In 2002, the Saguenay–St. Lawrence Marine Park, in consultation with scientists and boat operators, introduced the *Marine Activities in the Saguenay–St. Lawrence Marine Park Regulations*. They include a moratorium on the growth of the industry, provisions for the issuance of permits, and rules for approaching marine mammals. An alliance was also formed between marine tour businesses, the co-managers of the marine park, and the Groupe de recherche et d'éducation sur les mammifères marins (GREMM) to ensure responsible practices and the sustainable development of whale watching activities. EO technology could potentially be used to acquire data on the visitation rates of whale watching sites and on whale watching practices.

The monitoring of marine mammal watching businesses is the responsibility of stakeholders charged with ensuring compliance with the regulations. To ensure the relevance of the data potentially acquired using EO technology, stakeholder interest will be verified before pursuing this aspect any further.

3.0 IDENTIFICATION OF SECTORS

3.1 Access to riverbanks

During the analysis of the CCAR database, it was observed that most access points identified along the tributaries are associated with visible infrastructure accessible from the road. This was also true of the St. Lawrence River access points, most of which were identified near cities and towns.

The geology of the area along the St. Lawrence River and its tributaries appears to influence the types of access points and their locations. The St. Lawrence lowlands sector, with its flat terrain punctuated by the occasional hill, allows for easier access to the St. Lawrence for all types of use. The majority of the area has an elevation of less than 100 m, and largely corresponds to the geological province of the St. Lawrence Platform. On the south shore, it also incorporates the least rugged part of the Appalachian geological province.

By contrast, the Canadian Shield—a vast expanse of bedrock punctuated by hills separated by incised, rectilinear valleys and overlooked by huge massifs—and the rugged part of the Appalachians (Gaspé Peninsula), which consists of hills and mountains, restrict access to the St. Lawrence. Historically, access points in these sectors were urbanized by fishermen who settled in the area in the days of colonization. As a result, the access points are generally associated with fishing activity.

3.1.1 Tributaries

The Richelieu, St-Maurice, and Saguenay rivers and, to a lesser extent, the Chaudière River, are the tributaries that have a high degree of diversity in terms of the categories of access points. These rivers were historically used as key commercial waterways. In the case of the Saguenay and St-Maurice rivers, virtually all of the access points are located in cities or towns with access to the river. This is understandable given the geographic location of the rivers, which are contained within a mountain

corridor of the Canadian Shield. Along the Richelieu and Chaudière rivers in the St. Lawrence lowlands, a number of access points, such as boat launches, appear to be historical roadside access points that are not necessarily associated with a city or town.

The access points to the Batiscan, St-François and Yamaska rivers are primarily associated with accommodation facilities and marinas. Although they are not cut off by geological features and although road access is available over virtually their entire length, most of the inventoried access points to those rivers are in or near population centres.

The Nicolet, Jacques Cartier, L'Assomption, Bonaventure and Ottawa rivers (Abitibi sector) are the tributaries with the lowest number of inventoried access points. In contrast to the rivers mentioned above, these tributaries were not historically used as commercial waterways (except for the Ottawa River, for which the small number of access points could be explained by the remoteness of the large urban centres). With the exception of the Ottawa River, which is a branch of the St. Lawrence, the majority of access points are located at the mouth of the rivers at their confluence with the St. Lawrence (or Baie des Chaleurs in the case of the Bonaventure River). The Jacques-Cartier and Bonaventure rivers do not have road access. They are located for the most part in natural environments, namely the Canadian Shield and the Appalachians, respectively. In contrast, there are roads along almost the entire length of the Nicolet and L'Assomption rivers, as well as the portion of the Ottawa River in Abitibi (in the St. Lawrence Lowlands).

3.1.2 St. Lawrence River

Côte-Nord is the administrative region that has the largest number of inventoried access points (626 points, all activities combined), followed by Gaspésie–Îles-de-la-Madeleine, with 544 access points. For the reasons described above, essentially all of the points are associated with the presence of cities and towns. Given that these access points are associated with a number of uses, there are more entries for these regions. Abitibi-Témiscamingue is the administrative region with the fewest number of inventoried access points. In this region, all points are located along the Ottawa River (8 points, almost all of them ports).

The St. Lawrence River can be divided according to the predominant type of access points. The region west of Montreal (excluding Lac des Deux Montagnes) is characterized primarily by marinas and boat ramps. The Montreal region, including the North Shore (Laval) and the South Shore (Montérégie), is characterized by riverfront parks. From the eastern tip of the Island of Montreal to the Batiscan River, the main access points, on both the north and south shores of the St. Lawrence River, are boat launches associated with docks and marinas. From the Batiscan River to the eastern tip of Île d'Orléans, riverfront parks and shoreline access points (or beaches) are predominant. In the administrative regions of Chaudières–Appalaches and Bas-Saint-Laurent, the main access points are associated with rest areas (e.g., campgrounds). Physical access points (marinas, riverfront parks, shorelines) are restricted almost exclusively to cities and towns. A similar situation exists on the North Shore and along the Gaspé Peninsula.

3.2 Ice fishing

According to the Quebec Department of Tourism, the most heavily used access points are the open sectors of the St. Lawrence River that have an accessible shoreline and shallow waterfront, such as Lac des Deux Montagnes, Lake Champlain, Lake Saint-Pierre and Lake Saint-Louis. With respect to the tributaries, the Saguenay Fjord and Sainte-Anne River, near Trois-Rivières, are popular ice fishing sites.

3.3 Marine mammal watching

The North Shore of the St. Lawrence, between the Saguenay River and Baie-Comeau, is recognized as a critical marine mammal feeding area.

4.0 PRIORITIZATION OF SECTORS

4.1. Access to riverbanks

As mentioned above, different types of environment must be assessed in order to be able to determine the effectiveness of the use of satellite images. Sites must be selected in such a way as to include all types of access points present. If the satellite geographic coverage is limited, it may be necessary to select a specific area in each sector.

4.1.1 Tributaries

The types of access points primarily found along the tributaries are associated with marinas, boat ramps, docks, and to a lesser extent, waterfront rest stops and shore access.

In order to be able to validate the potential of EO technology to identify access points, a pilot tributary will be used by photo-interpretation specialists. The sites found via photo-interpretation will then be validated by means of field observations. The tributary must therefore be accessible and must have a number of access points. The Richelieu River, from the St. Lawrence River to Lake Champlain, would be selected as the pilot tributary because of its large variety of access points and its accessibility via Route 133.

Once the identification methodology has been developed, one or more test tributaries must be selected to validate the method. The tributary selected must have some degree of diversity in terms of types of access points.

The presence of a road access is a valuable financial and technical criterion for the identification of the test-tributary. However, this aspect should not be a requisite condition. Rivers can also be accessed by other means (bike paths, walking paths) that are often not visible on conventional maps. Given the distance between the tributaries analyzed (particularly those located in different administrative regions), the collaboration of stakeholders who may have an interest in the project will be sought. As a result, upstream consultation with stakeholders will be important to confirm the prioritization of our choices.

The L'Assomption River between the St. Lawrence River and Saint-Félix-de-Valois or the Chaudière River between the St. Lawrence River and Sainte-Marie would be our first two choices due to the presence of cities and towns alternating with natural environments along the rivers. The characteristics of these rivers in near-urban areas suggest that there may be non-documented access points at a number of locations.

If road access turns out to be an important parameter from a technical and financial viewpoint, the Nicolet River, from the St. Lawrence River to the points where it crosses Highway 20, or the Saint-Maurice River, from its mouth at its confluence with the St. Lawrence River to Parc de la Mauricie, would be excellent choices. Their degree of accessibility and their location in a relatively natural environment along part of the shore are significant advantages. Located in areas of relatively high population density, these tributaries would be particularly valuable for validating access points characterized by minimal human infrastructure (riverfront park, beach, etc.).

If financial and technical resources are available, the portion of the Ottawa River in Abitibi would be particularly attractive for validating access points that are known only locally, in an area of lower population density. Most of the inventoried access points for this region are ports. It should be relatively easy to confirm these access points, which are visible structures along the river's edge. The large distance between the structures and the proximity of a section of Route 101 to the river suggests that there could also be undocumented boat ramps at various locations.

4.1.2 St. Lawrence River

As with the tributaries, a pilot sector of the St. Lawrence River will be selected to enable photo-interpretation specialists to validate the potential for identifying access points. The majority of the access points to the St. Lawrence River (primarily marinas, shore access, riverfront parks and docks) are associated with the presence of cities and towns. In order of priority, the cities of Métis, Kamouraska or Lévis are characterized by a diversity of access points associated with a moderate urban concentration and partial shoreline development and are easy to access for purposes of validation in the field. Owing to its size, the entire area of the selected city could be targeted by the project.

Once the identification methodology is developed using the same approach and under the same conditions as those used for the tributaries, a number of test sectors will be selected for validation.

The first potential area would be the area between Port Lewis and Dundee, which is located at the southwesternmost point of the St. Lawrence River in Quebec. Various types of access points are identified in this portion of the river, which is occupied by small urban hamlets. The many access channels to the St. Lawrence associated with these hamlets offer a high level of potential for validation of the method in a semi-open environment.

The second choice would be the Lac des Deux Montagnes sector, between Kanasetake and Saint-André-D'Argenteuil. There are very few access points identified in the inventory for this sector. As with the section of the Ottawa River in Abitibi-Témiscamingue, these access points are primarily associated with urban ports. The small number of urban concentrations along this part of the lake, the proximity of Route 344 to the lake and the lake's popularity with Quebecers suggest that there are also undocumented boat ramps in some locations.

Most of the shorelines of areas with high urban concentrations, such as Montreal, Longueuil, Trois-Rivières and Quebec City, have been developed. Although the concern regarding shore access within their territories is recognized, the main type of access identified for these sections of river in the inventory is riverfront park. This type of access is under municipal or provincial jurisdiction and is well documented. It would be more valuable to identify access points in sectors located at greater distances from large centres, such as the eastern tip of the Island of Montreal, the area west of the Port of Quebec or the sector between the outlet of Lake Saint-Pierre and downtown Trois-Rivières, where the potential of finding private boat ramps is higher.

If the financial and technical resources are available, the Côte-Nord and Gaspésie sectors could also be analyzed. However, most of the identified access points in these areas are related to harbours or marinas that are primarily associated with fishing or pleasure boating. The identification of preferred areas could be done in consultation with local organizations.

4.2 Ice fishing

As with the preceding aspect, a pilot area will be selected to enable the photo-interpretation specialists to establish the identification method. The preferred sector is that of Lake Saint Pierre, where various ice fishing associations exist. Owing to the small size of the associations, it would be possible to effectively identify a known use area without having any "background noise" associated with the cumulative effect of heat emitted by the huts. Lake Saint-Louis is the preferred test area because of the small number of ice fishing associations and because it is an area where the accessibility of the lake would increase the potential of finding independent huts.

4.3 Marine mammal watching

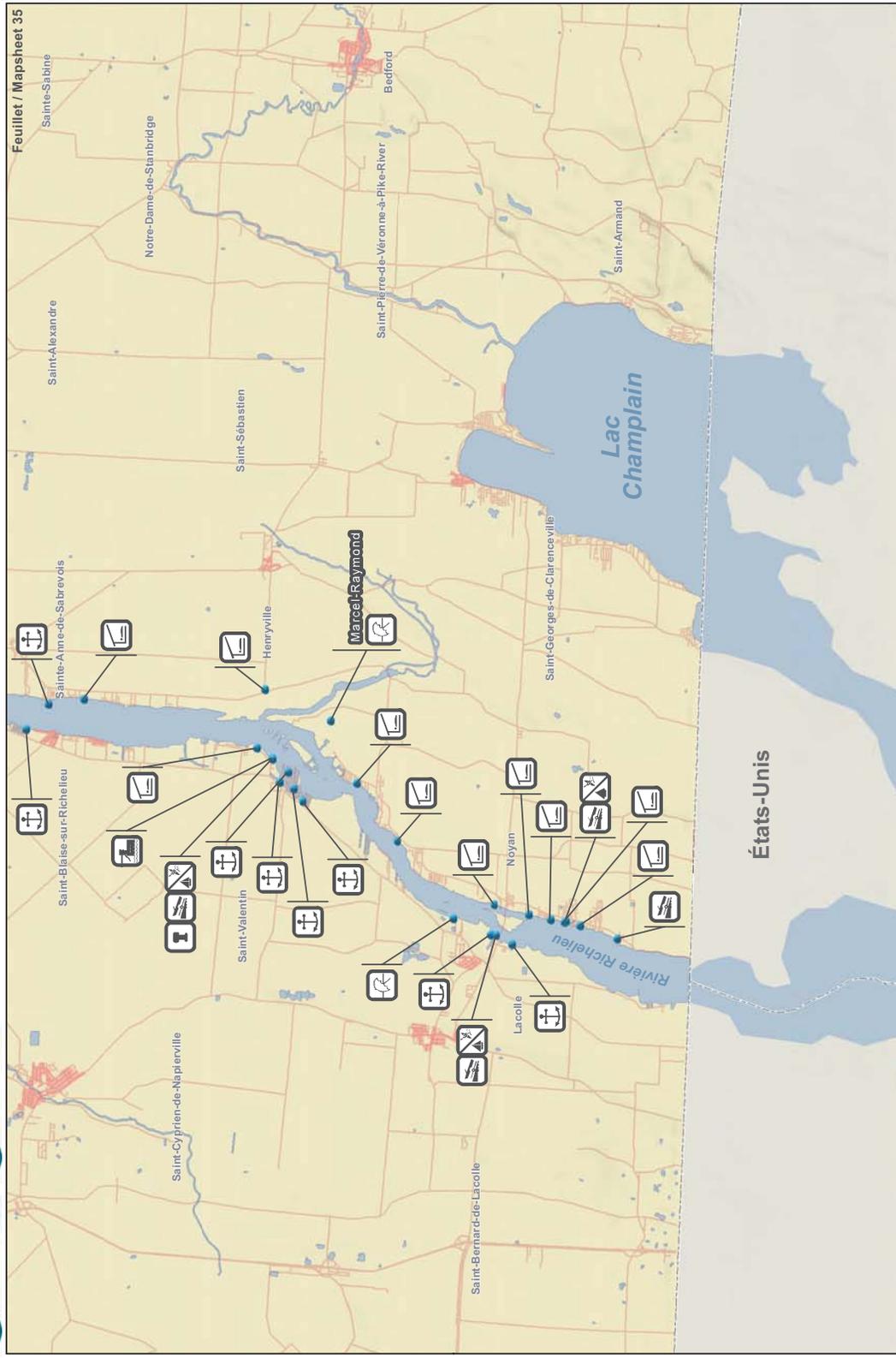
According to the maps of GREMM and the Quebec Department of Tourism, the sector slightly east of the mouth of the Saguenay River is a popular marine mammal watching site. It is also the site with the highest concentration of tour boats. It is therefore the sector that will be selected.

5.0 NEXT STEPS

The next step will involve the assessment of the sensor already identified in Phase I, along with other new sensors with potential in terms of the study objectives. The availability of radar sensors will be verified and their potential to be used in the project will be validated.

During the step consisting of the development of the methodology and validation protocols, dialogue and coordination meetings will be held with the various stakeholders already involved in developing the inventory. They include the Quebec Department of Municipal Affairs, Regions and Land Occupancy (MAMROT) and various St. Lawrence ZIP committees. Coordination will be essential for taking into account their interest in the development of the project, validating the data to be acquired on a priority basis and discussing a possible collaboration at the in-situ satellite data validation phase.

Accès au Saint-Laurent / Access to the St. Lawrence



**Région du Haut-Richelieu
Haut-Richelieu Region**

Accès riverain / Waterfront Access
 Zone d'intervention prioritaire (ZIP) /
 Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Plans de secours nautiques - safety divergence /
 Safety harbour facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature /
 Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnée /
 Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

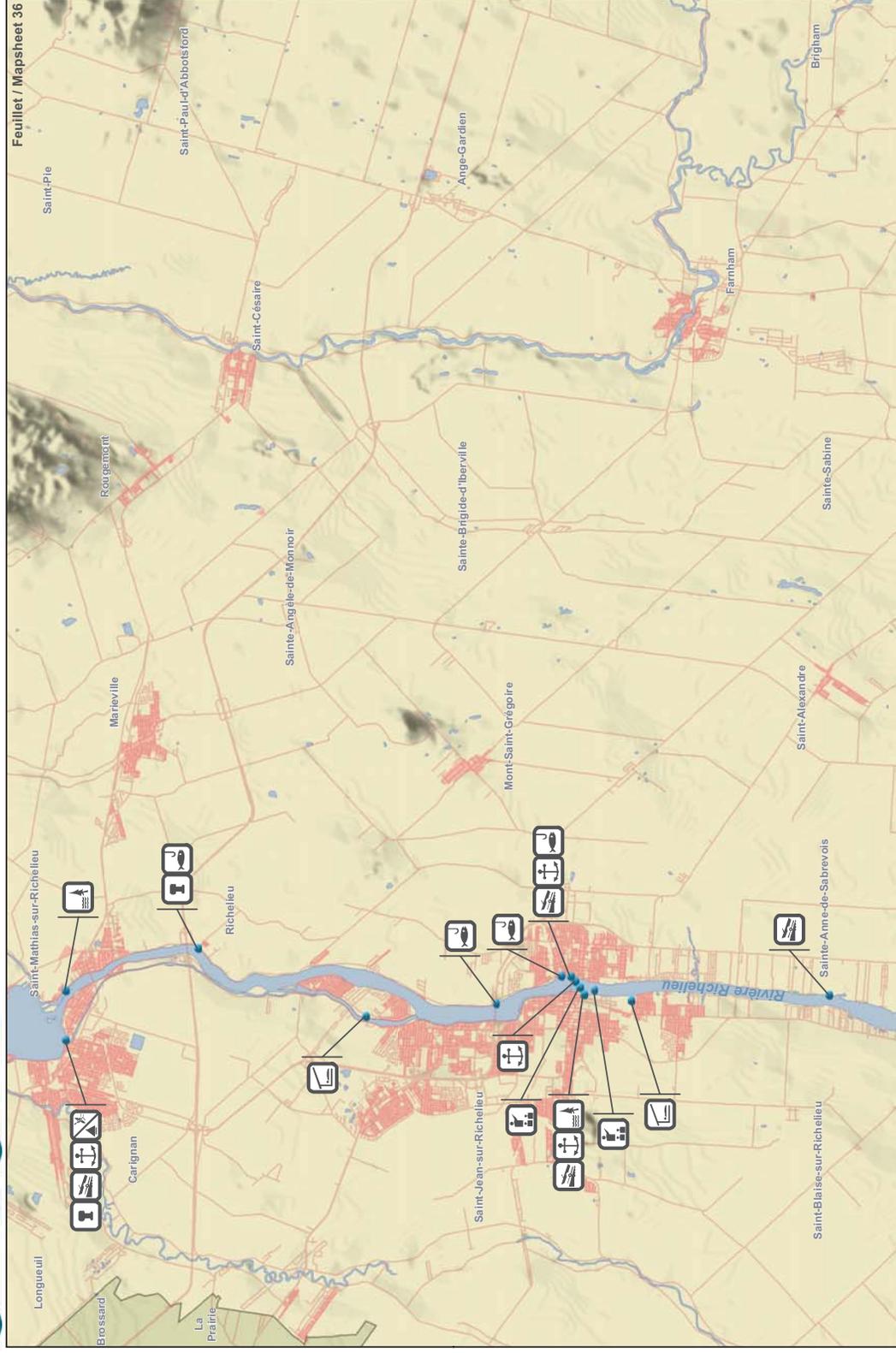
Installations / Facilities

- Aire de repos - Hébergement /
 Rest Area - Lodging
- Récréatif / Recreational

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Accès au Saint-Laurent / Access to the St. Lawrence



**Région du Haut-Richelieu
Haut-Richelieu Region**

Accès riverain / Waterfront Access
Zone d'intervention prioritaire (ZIP) /
Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Plan de secours nautique - arrêt d'urgence /
Safety harbor facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature /
Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnées /
Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

Installations / Facilities

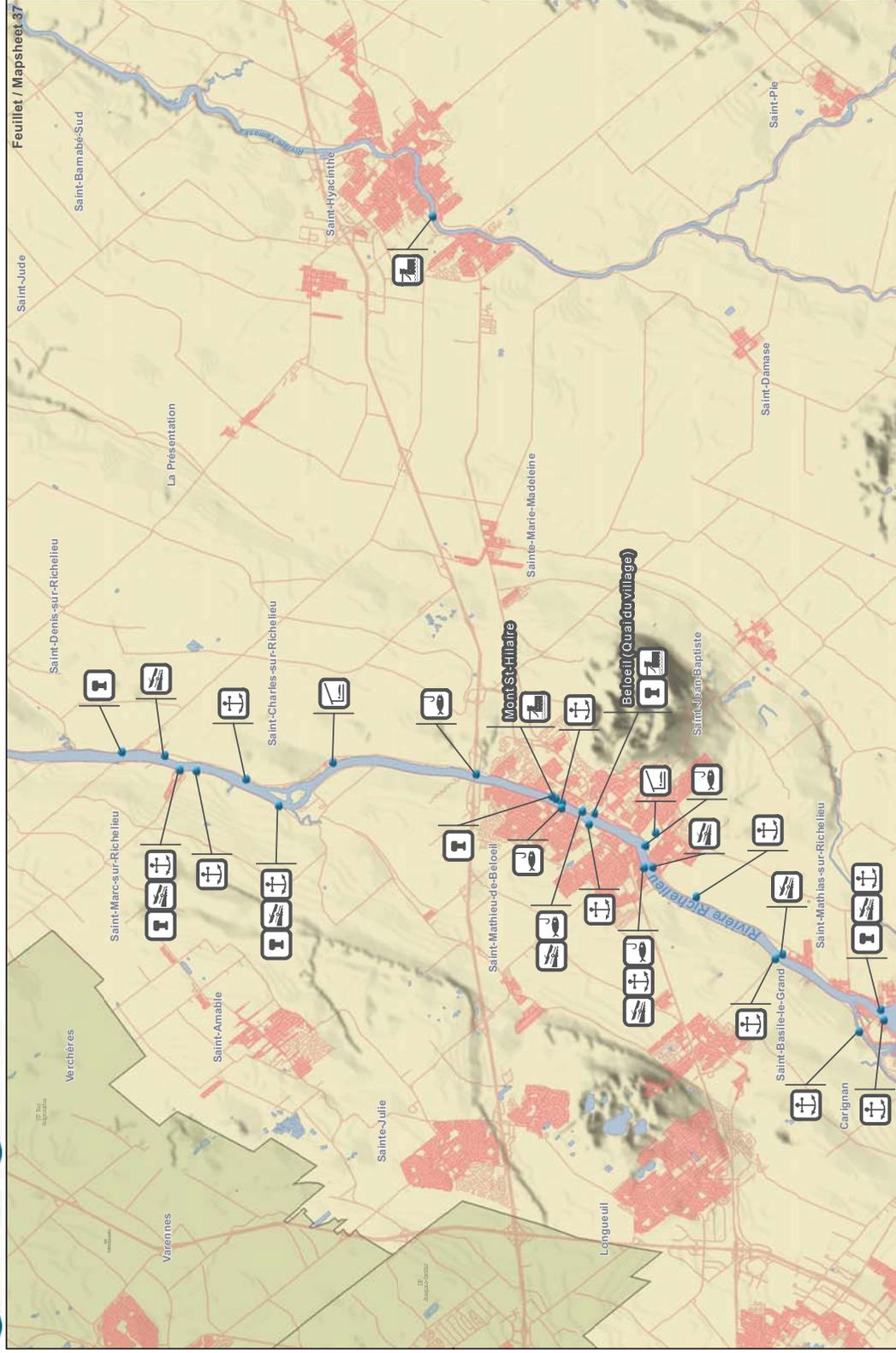
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Région de La Vallée-du-Richelieu
La Vallée-du-Richelieu région

Accès riverain / Waterfront Access
 Zone d'intervention prioritaire (ZIP) /
 Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Sites de secours nautiques - airtel d'urgence /
 Safety harbor facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature /
 Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnées /
 Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

Installations / Facilities

- Aire de repos - Hébergement /
 Rest Area - Lodging
- Récréatif / Recreational

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Feuillelet / Mapsheet 98



Région La Mitis / La Mitis Region

Accès riverain / Waterfront Access

Zone d'intervention prioritaire (ZIP) / Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Plans de secours nautiques - arrêt d'urgence / Safety harbor facility - emergency stop
- Parc riverain / Waterfront Park
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Usages / Uses

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- Baignade / Swimming
- Observation de la nature / Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnée / Cycling and hiking

Intérêts / Interests

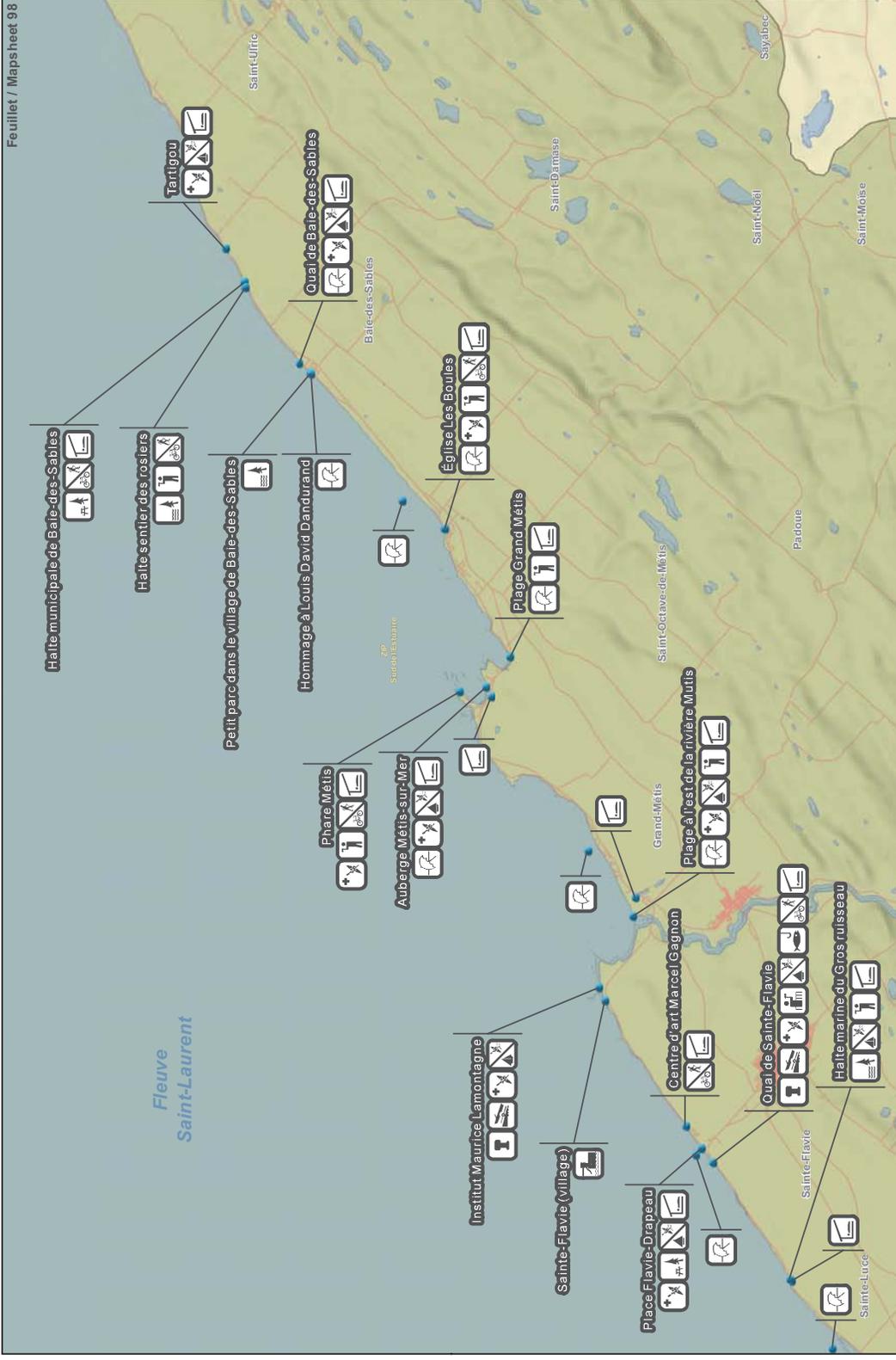
- Territoire protégé / Protected Area

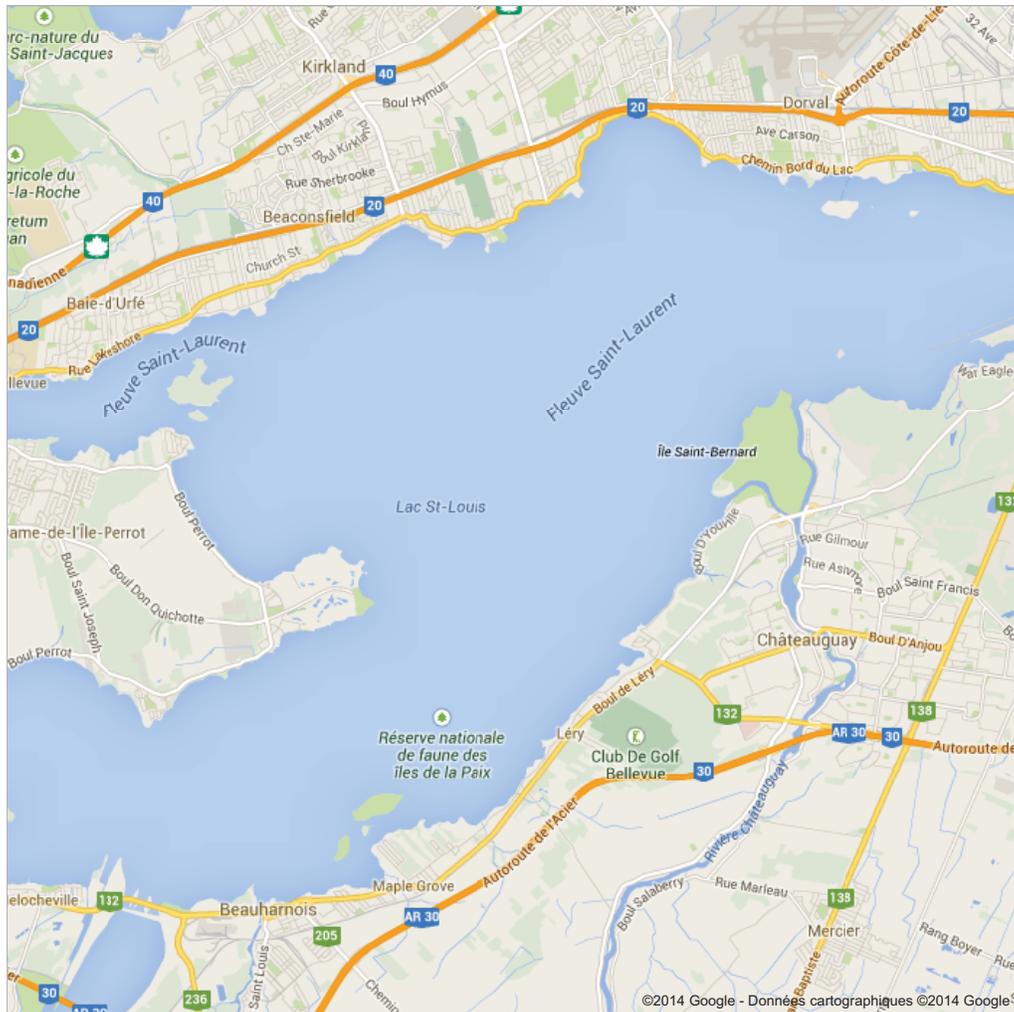
Installations / Facilities

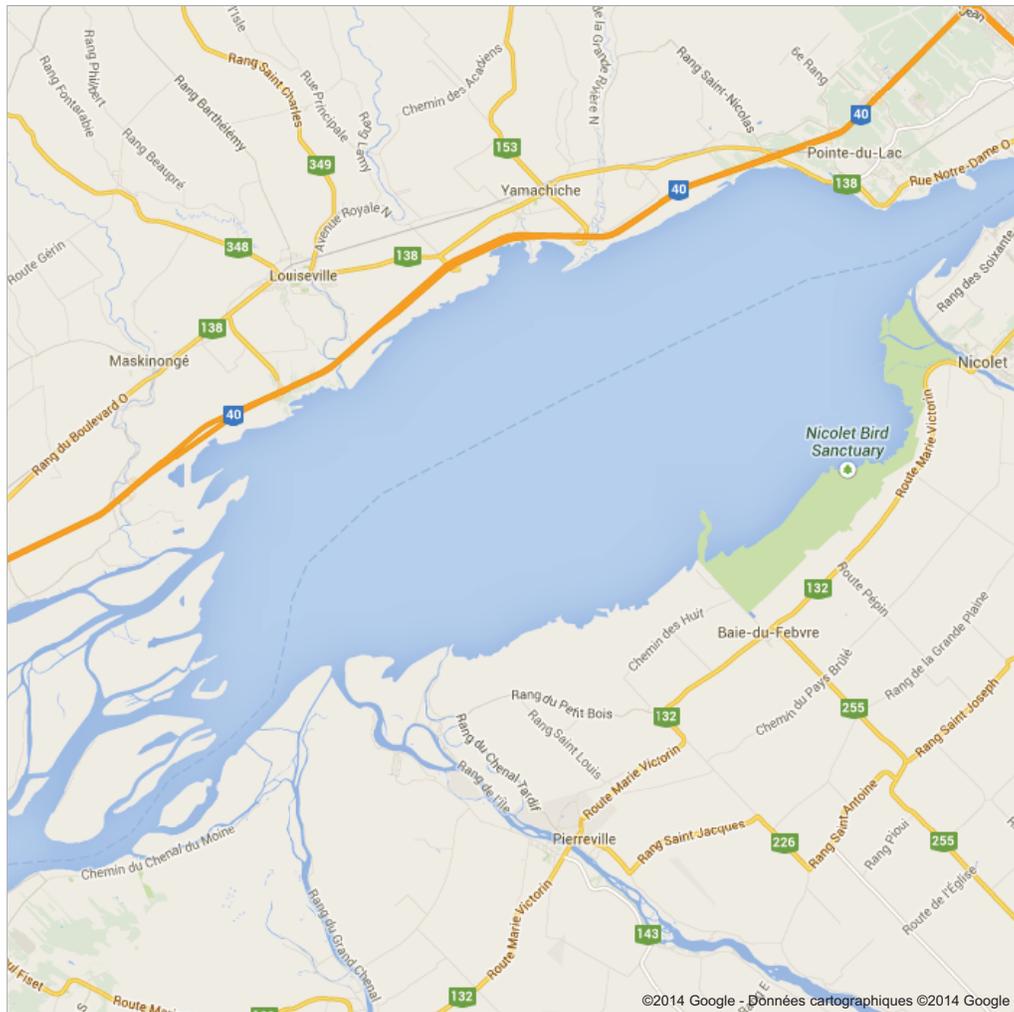
- Aire de repos - Hébergement / Rest Area - Lodging
- Récréatif / Recreational

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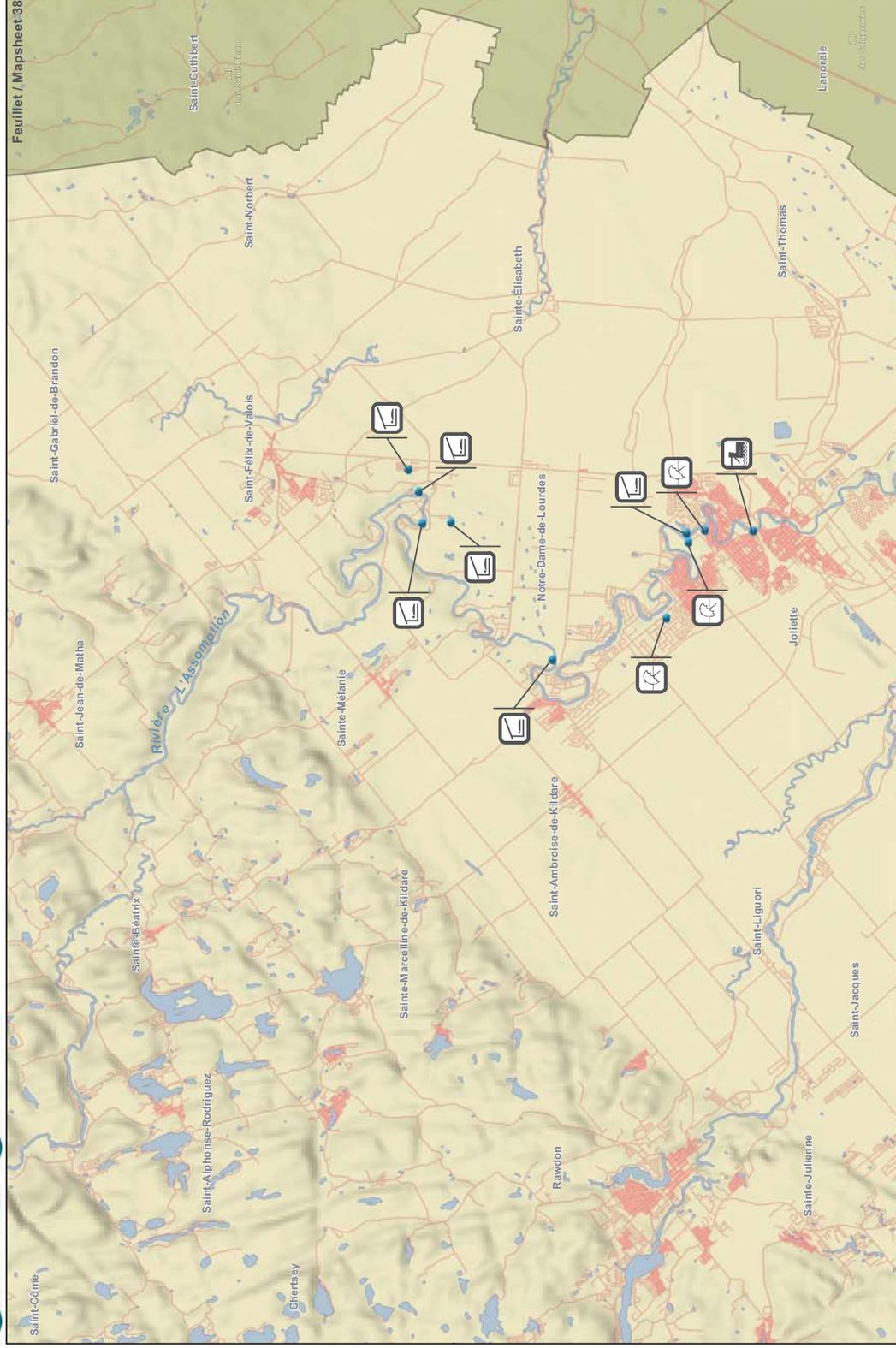
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Région de Joliette
Joliette Region

Accès riverain / Waterfront Access
 Zone d'intervention prioritaire (ZIP) /
 Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Plan de secours nautique - arrêt d'urgence /
 Safety harbour facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature /
 Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnées /
 Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

Installations / Facilities

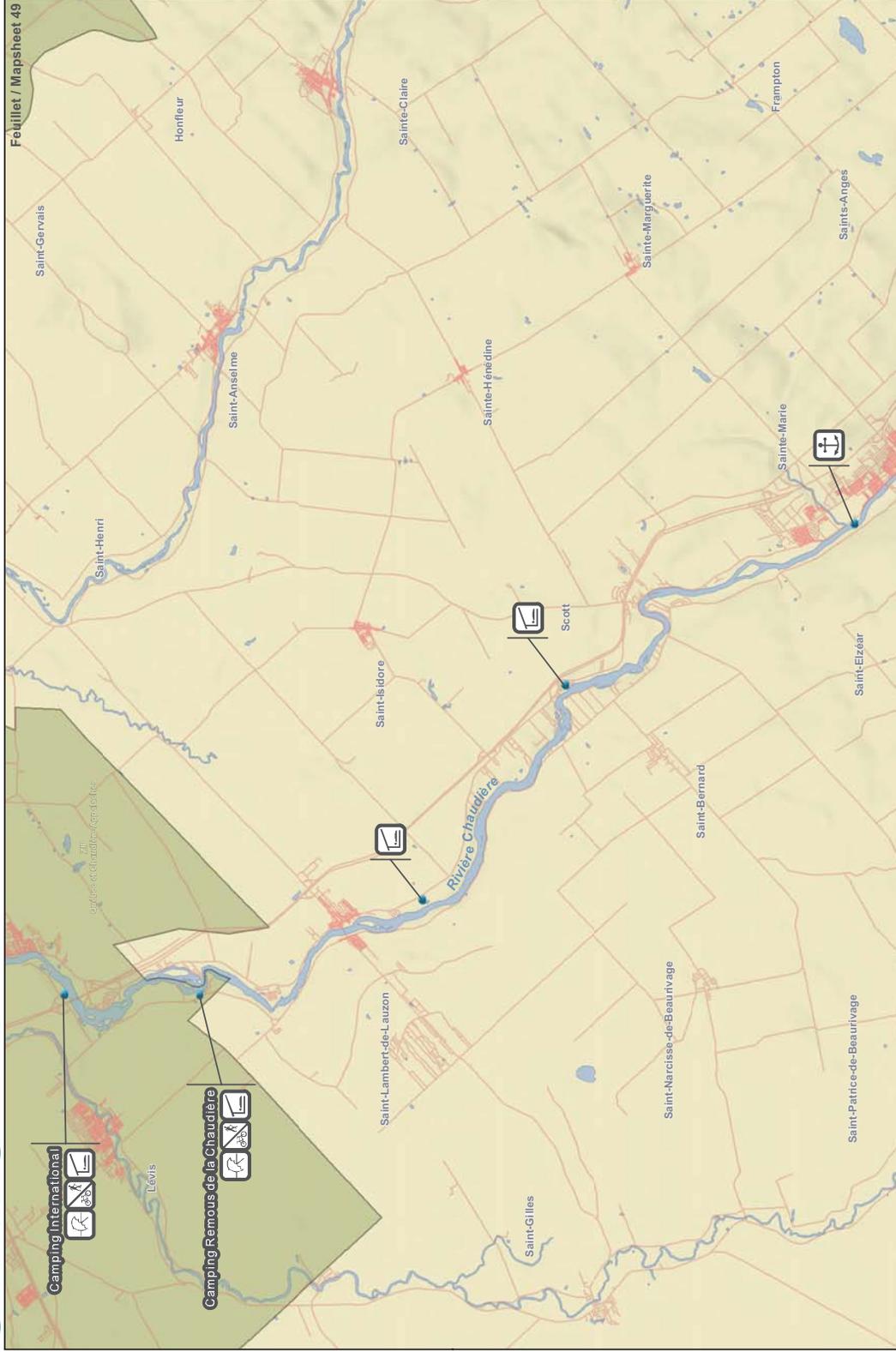
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- Récréatif / Recreational

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**Région de la Nouvelle-Beauce
La Nouvelle-Beauce Region**

Accès riverain / Waterfront Access
 Zone d'intervention prioritaire (ZIP) /
 Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Plan de secours nautique - arrêt d'urgence /
 Safety harbour facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature /
 Wildlife Observation
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- Cyclisme et randonnées /
 Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

Installations / Facilities

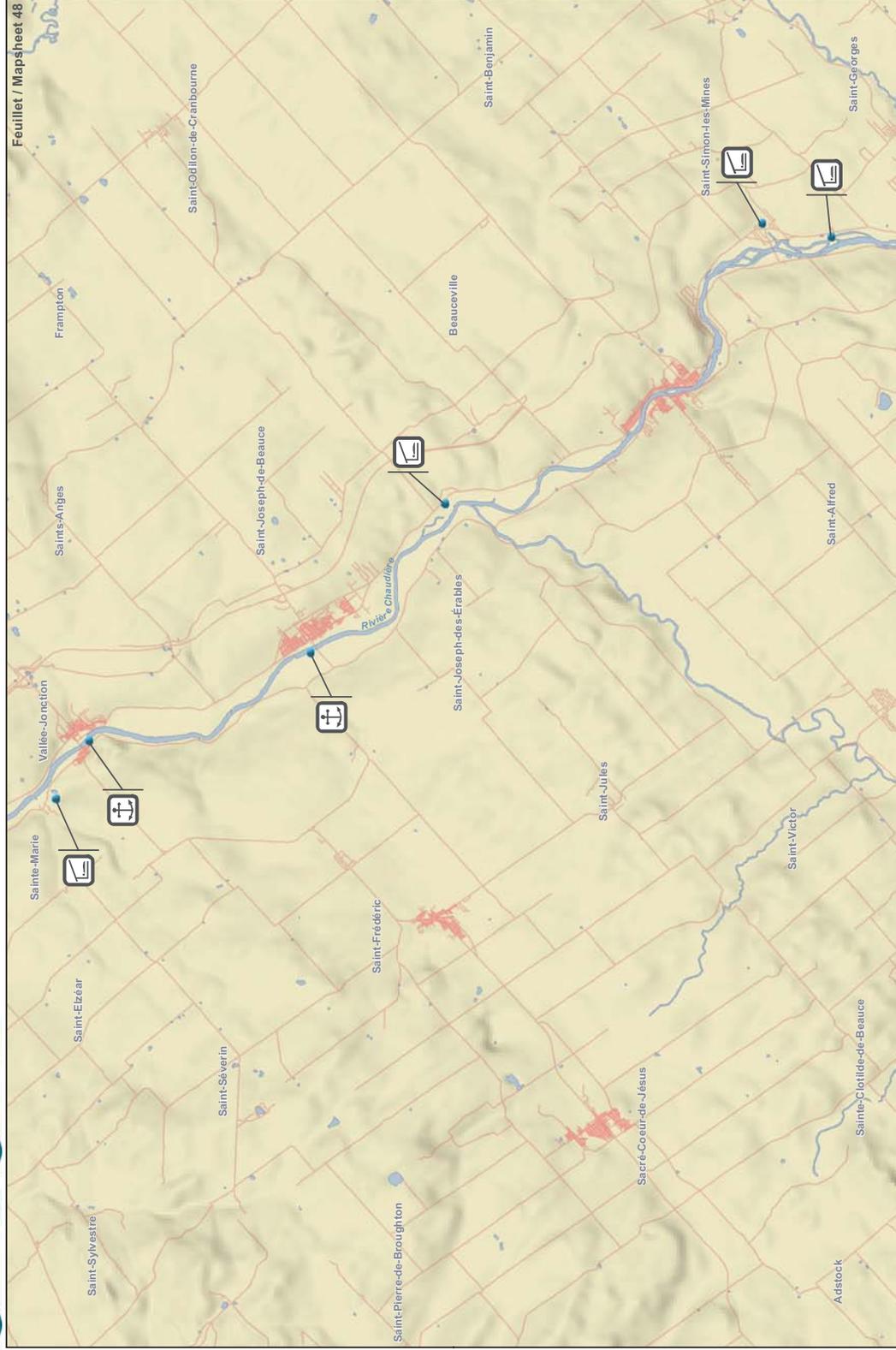
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 Rest Area - Lodging
- Récréatif / Recreational

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Accès au Saint-Laurent / Access to the St. Lawrence



Région de Robert-Cliche Robert-Cliche Region

- Accès riverain / Waterfront Access
- Zone d'intervention prioritaire (ZIP) / Areas of Prime Concern (ZIP)

Types d'accès / Access Types

- Rive - Plage / Shore - Beach
- Quai / Wharf
- Rampe de mise à l'eau / Boat launch
- Marina / Marina
- Lieux de dépôt rapides - arrêt d'urgence / Safety harbour facility - emergency stop
- Parc riverain / Waterfront Park
- Belvédère / Lookout
- Halle routière / Rest Stop
- Port / Port
- Hydrobase / Water aerodrome

Usages / Uses

- Nautisme / Boating
- Baignade / Swimming
- Observation de la nature / Wildlife Observation
- Pêche sportive / Sports fishing
- Cyclisme et randonnées / Cycling and hiking

Intérêts / Interests

- Territoire protégé / Protected Area

Installations / Facilities

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