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Item No. 14.1.7
Halifax Regional Council
February 7, 2017

TO: Mayor Savage and Members of Halifax Regional Council

SUBMITTED BY: Original Signed by

Jacques Dubé, Chief Administrative Officer

Original Signed by

Jane Fraser, Acting Deputy Chief Administrative Officer

DATE: January 10, 2017

SUBJECT: LiDAR Data Acquisition – Advanced Capital Funding

ORIGIN

Approved 2016-17 Planning and Development Business Plan - Regional Planning Deliverables, Healthy Communities, Watershed / Water Quality Program Work Plan Development:

> To support detailed planning, develop a 3-year watershed / water quality work plan, based on outcomes of the corporate watershed studies and water quality monitoring programs. This will include opportunities for collaboration with the Province for LiDAR and other information sources.

December 14, 2016, Proposed 2017-18 Capital Program Budget and 10-Year Capital Plan

Halifax Regional Council ratified motion to:

1. Direct staff to prepare the ten-year capital plan, approve the capital budget for 2017-18, and schedule of reserve withdrawals, and approve in principal the 2018-19 capital budget as presented to Committee of the Whole as per Attachments 1a, 1b and 1c of the staff report dated December 5, 2016.
2. Approve the list of 2017-18 advanced capital funding as per Attachment 2 of the staff report dated December 5, 2016.
3. Approve the list of multi-year projects as per Attachment 3 of the staff report dated December 5, 2016.
4. Request staff to look at options to retain the funding levels established in the 2016/17 capital budget for Street Recapitalization and report back to Council.

LEGISLATIVE AUTHORITY

Halifax Regional Municipality Charter, subsection 74 (1) and clauses 74(2)(a)(b), as follows:

> (1) The Municipality may agree with….the Government of the Province or of Canada or a department or agency of either…to provide or administer municipal or village services.
>
> (2) An agreement made by the Municipality pursuant to subsection may…

RECOMMENDATION ON PAGE 2

(a) include any service provided by the Municipality;
(b) include the provision of services within or outside the Municipality;
…

Halifax Regional Municipality Charter, clauses 79(1)(p)(al), as follows:

The Council may expend money required by the Municipality

(p) preventing or decreasing flooding;
(al) wastewater facilities and stormwater systems;

Procedures of the Council Administrative Order, subsection 4(2) "Notwithstanding subsection (1), any one or more of the rules of procedures contained herein except for section 5 and subsections 12(5) and 59(3) may be suspended by Council, Committee of the Whole, Community Council or a Standing Committee by the affirmative vote of two-thirds (2/3rds) of the Members present and voting."

Procedures of the Council Administrative Order, Schedule 2, Audit and Finance Standing Committee Terms of Reference, as follows:

8. The Audit and Finance Standing Committee shall review and make recommendations on proposals coming to the Council outside of the annual budget or tender process including:
(a) new programs or services not yet approved or funded;
(b) programs or services that are being substantially altered;
(c) proposed changes in any operating or project budget items;
(d) the commitment of funds where there is insufficient approved budget;
(e) new or increased capital projects not within the approved budget;
(f) increases in project budget due to cost sharing; and
(g) the creation or modification of reserves and withdrawals not approved in the approved budget.

RECOMMENDATION

It is recommended that Halifax Regional Council:

1. suspend the Terms of Reference of the Audit and Finance Standing Committee requiring the Committee to review and make a report and recommendation to Regional Council; and

2. approve advanced funding for the Project CI000020 – LIDAR Data Acquisition in the amount of $2,400,000, as per the financial implication section of this report.

BACKGROUND

The proposed LiDAR Data Acquisition project follows the direction of policy E-25 of HRM's 2014 Regional Municipal Planning Strategy (RMPS). The policy states: "The recommendations of the Climate Change Risk Management Strategy for Halifax Regional Municipality, approved in principle by HRM in 2008, shall provide guidance for corporate priority actions to manage the risks associated with climate change". It calls for the acquisition of LiDAR coverage for all of HRM. The proposed project is consistent with this direction.

LiDAR – Light Detection and Ranging – is a remote sensing method used to examine the surface of the Earth. LiDAR systems allow scientists and mapping professionals to examine both natural and manmade environments with accuracy, precision, and flexibility.

LiDAR technology can provide accurate data (+/- 15 cm) for the development of elevation models that can be used to create maps depicting potential risks and vulnerabilities associated with coastal and inland flooding. With the exception of LiDAR data gathered in 2007 for the Halifax Harbour drainage basin and the lands surrounding East Petpeswick, current elevation mapping for the majority of HRM has a significant margin of error (+/- 2.5 m) preventing accurate hazard prediction related to flooding.

On December 14th Council approved the proposed 2017-18 capital program budget and 10-year capital plan. This included the LiDAR Data Acquisition Project (# BT4) under the proposed 2017-18 capital budget in the amount of $2,400,000, including 50% federal cost-sharing secured through the National Disaster Mitigation Program (NDMP). Details of the cost sharing are shown in the NDMP project proposal (Attachment A).

The NDMP is a five-year program of the federal government that provides funding to address significant recurring flood risks. The program allocates approximately $200 million over 5 years focusing on risk assessments, flood mapping, mitigation planning, and small-scale mitigation projects. It is designed to build a foundation for informed mitigation investments that can reduce the effects of flood events in the future. Through this program, the Government of Canada welcomed collaboration between Provincial and Municipal governments and proposed to cost-share up to 50% of eligible project costs. With Nova Scotia Emergency Management Office support, HRM submitted an NDMP funding application in June 2016 and in October 2016, received notification that the Government of Canada had approved project funding in the amount of $1,247,430 – the full amount requested.

The project's success now depends on timely data collection and processing in order to meet the conditions and timelines of the federal funding program.

DISCUSSION

On December 14th Committee of the Whole (COW) also approved a list of projects for Advanced Capital funding. The purpose of advanced capital funding is to allow tenders for projects that are time sensitive – generally due to a short construction season or the need to meet a critical opening date – to be awarded in time to take advantage of the construction season. The LiDAR Acquisition project meets the criteria for advanced capital funding however, it was not included on the list approved by Council.

The project is time-sensitive. To ensure data quality (data-gathering) flights must take place in the spring of the year (April to mid-June), during "leaf-off" and snow-free conditions. Leaf-off conditions conclude when deciduous trees achieve full foliage. To facilitate the start of this work in April 2017, the tenders must go out in January or February. The next scheduled meeting of the Audit and Finance Standing Committee is not until March 8th, 2017. Accordingly, unless a special meeting of this Standing Committee is scheduled, this will be too late to meet this timeline. Therefore, staff are recommending that the terms of reference of this Standing Committee be suspended allowing Regional Council to consider this matter without a recommendation from it. This requires a two-third vote of the Members present and voting.

Not meeting this tendering timeframe not only compromises the data quality, but impacts agreements with our funding partners on this cost-shared project. If the data collection contract is not awarded early enough to allow spring data collection, the data collection would need to be delayed until the fall of 2017, when "leaf-off" conditions again exist. This half-year delay would not allow the proposed coastal flood risk mapping to be completed by the agreed project completion date of March 2018. NDMP terms and conditions do not specify the consequence of a delay in project completion, however this uncertainty would add to the overall risk of the project.

Advanced tendering would enable the procurement process to commence in the winter months, so contracts can be awarded for spring 2017 (data-collection) flights during "leaf-off" conditions.

Project Benefits

The LiDAR project presents a significant opportunity and cost benefits to advance Regional Plan policies intended to address the Municipality's resilience to climate change while protecting citizens from its potential adverse effects.

Advanced tendering is necessary to full-fill the obligations of the cost-sharing agreement and the completion of project deliverables by March 2018 including:

1. Acquisition of LiDAR data for the entire landmass of the municipality, including coastal areas and overlapping watersheds;
2. Processing of LiDAR data and Digital Elevation Modelling at 1m, 2m, and 5m resolution, and a Digital Surface Model; and
3. Using the models along with sea level rise projections from the Intergovernmental Panel on Climate Change, development of coastal flooding and land-use vulnerability maps for the entire coastline of the Municipality. Flood vulnerability mapping for inland areas will also be produced following the completion of the LiDAR acquisition project through future business plans and budgets.
4. Collaboration with, and assistance from, identified project partners through provision of in-kind services by government agencies with experience in LiDAR project management including:
    a. Canadian Hydrographic Service (CHS) will provide nearshore coastal bathymetry data;
    b. Geological Survey of Canada (GSC) can assist with storm surge modeling, which will contribute to hazard and risk modeling for coastal communities across the Municipality;
    c. Additional partnership opportunities will exist for data processing and storage through collaboration with provincial and federal agencies as well as academic institutions.

A summary of the project is provided in the LiDAR Data Acquisition Project Supplemental Report (Attachment B). Also, a comprehensive list of LiDAR data uses is provided for reference (Attachment C).

The LiDAR data and data products are proposed to be shared broadly through publication in the Municipal Open Data Catalogue. This will extend the benefits to other sectors, governments, industry, academia, and the public at large thereby enhancing evidence-based decision-making at multiple levels.

FINANCIAL IMPLICATIONS

The $2,400,000 LiDAR Data Acquisition project was approved by Regional Council on December 14, 2016, as part of the 2017-18 capital budget. The National Disaster Mitigation Program is contributing $1,247,430 to the project. The advanced tendering is not expected to impact the cost of the project, but will significantly improve the quality of the data collected, increasing its value.

The project will be managed by Planning and Development staff in the Energy and Environment program area.

Budget Summary: Project Account No. CI000020 – LiDAR Data Acquisition

Cumulative unspent Budget	$ 0
Add: Advanced Capital Funding	$ 2,400,000
Balance	$ 2,400,000

RISK CONSIDERATION

There are no significant risks associated with the recommendations in this Report, rather the risk in not advancing capital to initiate the project are high. The cost of acquiring LiDAR data needed for HRM's planning and risk management efforts would be significantly reduced through the federal cost-sharing

program in the amount of $1,247,430. Without advanced capital to initiate early tendering of flights for data collection, there is significant risk in not completing the project as per the NDMP agreement.

COMMUNITY ENGAGEMENT

No community engagement was conducted in the preparation of the NDMP application but community engagement was conducted prior to the development of the 2014 RMPS (Regional Plan) climate change policy referenced in this report.

ENVIRONMENTAL IMPLICATIONS

Indirect (positive) environmental implications of the project are extensive, as the LiDAR data and its derivative products will enable municipal staff to identify communities and facilities at high risk from coastal flooding and develop priorities for risk mitigation planning. In addition, the data will support a large suite of projects that may directly and/or indirectly affect the environment. These include watershed studies, floodplain studies, hazard and risk mapping, emergency response planning, geological and hydrogeological studies, stormwater planning, infrastructure planning, and water resources management.

ALTERNATIVES

1. Council could choose to defer a decision on this matter pending a review and recommendation from the Audit and Finance Standing Committee.

2. Halifax Regional Council could choose not to approve advanced capital funding for the acquisition and processing of LiDAR data.

Neither alternative is recommended as the LiDAR data collection would be delayed until Fall 2017 putting the data processing and mapping component of the project at significant risk for required completion by March 2018.

ATTACHMENTS

Attachment A – National Disaster Mitigation Program Project Proposal Form
Attachment B – LiDAR Data Acquisition Project Supplemental Report
Attachment C – Halifax Regional Municipality - Bathymetric and Terrestrial Lidar Use Cases

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A copy of this report can be obtained online at http://www.halifax.ca/commcoun/index.php then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

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Attachment A

National Disaster Mitigation Program

Project Proposal Form

A) Applicant Contact Information

i) Province/Territory

Note: If more than one province/territory is involved in this proposed project, please identify the province/territory that will be leading this project.

1) Name:	2) Title:	
Paul MacNeil	Manager Disaster Assistance Nova Scotia	
3) Organization (i.e. Province/Territory):	**4) Telephone Number:**	**5) Facsimile Number:**
Province of Nova Scotia	(902) 424-8104	(902) 424-5376
6) Email Address:		**7) Date (dd/mm/yyyy):**
Paul.MacNeil@novascotia.ca		15/06/2016

ii) Original Applicant(s) (i.e. "the entity/ies", if applicable)

1) Name:	2) Title:	
Shannon Miedema	Energy & Environment Program Manager	
3) Organization:	**4) Telephone Number:**	**5) Facsimile Number:**
Halifax Regional Municipality (HRM)	(902) 490-3665	(902) 490-5950
6) Email Address:		**7) Date (dd/mm/yyyy):**
miedems@halifax.ca		22/06/2016

B) Project Details and Attestations

8) Project Stream

Identify the NDMP Project Stream relative to this project submission.

Note: Each project stream has different requirements and merit criteria.

See **Section C** for specifics on each stream.

- ☐ Stream 1: Risk Assessment(s)
- ☒ Stream 2: Flood Mapping
- ☐ Stream 3: Mitigation Planning
- ☐ Stream 4: Investment in Non-Structural or Small Scale Structural Mitigation

9) Project Title:

HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)

10) Project Timeline:

a) Duration of Project:		b) Projected Start Date or proposed project: (dd/mm/yyyy)	c) Projected End Date of proposed project: (dd/mm/yyyy)
Months:	Years:		
24		05/09/2016	31/08/2018

11) Estimated Total Cost of Project

(Please complete the **Budget Template [Section D]**).

a) Total of non-federal costs:	$1,247,430.00
b) Total federal costs:	$1,247,430.00
c) Total Project cost (i.e. a + b):	$2,494,860.00

12) Project Description

a) Provide a brief description of your proposed project.

HRM currently has accurate elevation data for approximately 25% of the municipality. The proposed lidar data acquisition project would provide full coverage for HRM. The flight area for the project is approximately 5,900 sq. km.

A key tool to enable HRM to develop appropriate plans, policies and by-laws to manage risks from climate change impacts is the development of LiDAR-based mapping that would be used to quantify flood inundation in all HRM communities. While some high resolution information is available for the Halifax Harbour Drainage Basin, mapping for the remainder of HRM with levels of accuracy sufficient to inform policy and decision making is currently not available. The use of LiDAR-based mapping coupled with coastal inundation modelling can improve the basis for planning decisions such as coastal set backs in vulnerable or high risks areas. Likewise LiDAR-based mapping can be utilized to establish flood protection zones for inland areas at risk of overland flooding. Acquiring and processing LiDAR data is costly and to this point sufficient funds have not been available to map the entire municipality. The scope of the proposed project is to acquire and process airborne LiDAR data for the entire municipality, including both land and water features. The municipality proposes to contract qualified providers of LiDAR services to acquire

LiDAR data that meets the municipality's requirements. HRM commits to updating coastal flood scenario maps accounting for climate change as well as the land use vulnerability assessment of coastal properties as the final piece of this project.

b) Describe how this project addresses one or more high risk communities and/or a flood mapping activity.

Note: b) is not applicable for Stream 1: Risk Assessment(s). Risk Assessments will help identify areas that may be at risk, as well as help to determine the level of risk.

(Please provide your responses in bullet form.)

- The 2007 Climate Change Risk Management Strategy for Halifax Regional Municipality calls for HRM to develop accurate flood inundation mapping for all coastal and inland area communities in the Municipality.
- Policy E-25 of the Regional Municipal Planning Strategy (2014) directs that corporate priority actions to manage the risks associated with climate change be guided by the recommendations of the 2007 Climate Change Risk Management Strategy.
- This project allows for the improved identification of high risk communities, as the Digital Elevation Models form the basis for our flood scenarios and land use vulnerability assessments.

13)

a) How will this project benefit the defined geographical area and the surrounding communities?

(Please provide your response in bullet-form.)

- Halifax is a regional municipality, covering more than 5,900 sq. km, formed in 1996 by the amalgamation of the Cities of Dartmouth and Halifax, the Town of Bedford, and the County of Halifax.
- HRM's population is approximately 415,000. More than 75% of the population is located in areas that could be affected by coastal or inland flooding.
- This project will acquire and process LiDAR data necessary to carry out the development of coastal and inland watershed flooding maps to ensure the health and safety of HRM residents.
- The municipality will share the processed LiDAR data with surrounding communities and with the public through its Open Data Catalogue, which can be used for a large and growing list of applications, such as academic research, riparian studies, erosion studies, evacuation planning, site suitability analysis for renewable energy technologies, hydrological studies, forest management, and coastal planning.

b) Were surrounding communities informed of this projected proposal? ☐ Yes ☒ No

Comments:

- In addition to communities located throughout the Halifax Regional Municipality, Halifax will share the data and mapping produced through this project with all neighbouring municipalities to inform their own flood mitigation strategies.

14) Affected Community(ies)

Notes: a) Identify all communities that are affected by this project.
b) Indicate the population of all identified communities.
c) Indicate if each identified community has been engaged in relation to this proposed project (E); and
d) Indicate if each identified community has commited to support this proposed project (C).

Name:	Population:	(E)	(C)
Halifax Regional Municipality, ≥200 distinct communities.	415,000	☒	☒

15) How will this project contribute to the following?

(please provide your responses in bullet-form)

a) Reducing impacts of disasters on Canadians?

(i.e. Describe, in bullet form, how the proposed mitigation project will reduce or negate the impact and/or likelihood of disasters)

- The final outcome of the proposed project is processed LiDAR data in many formats, including but not necessarily limited to: point clouds, intensity images, Digital Elevation Model, Digital Surface Model, Digital Terrain Model, and Contour maps. These data products will enable flood simulations, which in turn will enable the municipality to identify areas and assets at risk of flooding. Flood risk assessments will enable the municipality to identify and pursue appropriate risk responses. Adaptive responses, such as changing building elevation standards, may decrease the likelihood of disasters. Mitigation responses, such as educating residents and other property owners of flood risks and regulating land use in flood-prone areas, will reduce the impact of flood events.
- LiDAR data also supports a number of other applications that could be used to reduce the impact of flood events. These applications include inundation and storm surge mapping , shoreline mapping, emergency response planning, and coastal vulnerability analysis.

b) Reducing disaster related financial liabilities for all levels of government?

- LiDAR data will enable mapping that will support vulnerability assessments for municipal, provincial and federal assets, such as highways, local roads, bridges, culverts, wharves and buildings, along with other community infrastructure and private property. Regulations that prevent or control development in flood-prone areas may reduce the impact of flooding events by directing development into other locations.
- Educating property owners about their vulnerabilities to flood risks may result in the transfer of risk through private insurance,

or mitigation of risk through floodproofing measures.
• An increase in proactive steps such as these should lead to reduced claims for the restoration, replacement and repairs to dwellings or other essential property that could be impacted by flood events.

c) Reducing risk, developing capacity and/or enhancing resilience?
• The municipality only has accurate elevation data for approximately 25% of its total area. The absence or inaccuracy of elevation data for the remaining 75% represents a risk to residents and property owners in our community. Planning, developing, and building public and private infrastructure without accurate elevation data may result in siting facilities in locations vulnerable to flooding and/or in areas inaccessible to emergency responders.
• Processed LiDAR data used for flood simulations may identify flood risks in areas not previously considered at risk, or identify higher levels of risk than currently perceived. Effective communication of flood risk to affected communities is anticipated to result in greater preparedness by community members and a reduction in overall impacts.

16) Prioritized List of all project proposals in this Project Stream:

a) Provide your prioritized list of all proposed projects (E.g. #1 equals the highest priority project, #2 equals the second highest priority, etc.)

Number:	Project Title:
1	HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)
Number:	Project Title:
2	Fundy Agricultural Marshland Flood Maps

b) Indicate the priority ranking of this proposed project. # : 1

17) Provide a rationale/justification for implementing this mitigation activity instead of the other mitigation projects on the prioritized project list. (500 characters max.)

HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition) is a two year project which Halifax wants to start in 2016/17. The Fundy Agricultural Marshland Flood Maps project will not start until 2017/18.

18) Work Plan:

The proposed project's work plan should clearly articulate all activities (i.e. tasks, deliverables, resources, timelines, etc.) for which the financial contribution is being requested for each fiscal year.
The work plan should include all products, methods, information materials, protocols, agreements, etc. that will be created to support the completion of this proposed project.

Please complete the **Work Plan Template (Section D)**.

19) Stakeholders:

a) Identify all stakeholders/partnerships and describe their current and/or potential level of engagement, as applicable.
b) Identify those stakeholders/partners who have committed support, either in-cash or in-kind, for the proposed project.
c) Provide a description/summary of the stakeholder list, and how this information provides a rationale/justification for implementing this mitigation activity.

Please provide your answers in the **Stakeholders Template (Section D)**.

20) Project Implementation Risks (Please provide your response in bullet-form):

a) Identify any project implementation risks that may impact your ability to deliver the project as planned/scheduled
• Project authorization delays
• Staff availability
• Scheduling delays
• Quality of procured data could be less than required
• Permit delays

b) Outline the mitigation measures that you will take to minimize and/or address your project's implementation risks
• Project administration will be conducted in accordance with Project Management Institute standards. Identified known risks will be identified, classified, prioritized, and risk responses developed and confirmed prior to execution. Contingencies will be created for unknown risks. The Project Management Plan will include a Quality Management Plan.
• The Municipality will seek pre-authorization for execution of the project upon the award of project funding through NDMP
• The Municipality will pre-assign and authorize staff responsible for leading and supporting the project. Project team planning will include the identification of backup team members in the event that primary members become unavailable.
• The municipality will identify detailed data standard requirements to be achieved prior to procurement solicitation.

• Project scheduling will accommodate an appropriate time period for the selected vendor to achieve all required permits.

21) Monitoring and Performance Management (Please provide your response in bullet-form):

Describe the internal measures that you will implement to monitor your project and manage performance.

• The proposed project will be conducted in accordance with standards of the Project Management Institute and the corporation's Risk Management Strategy.

• Accordingly, cost, schedule, procurement, and risk controls, including risk reassessment, risk audits, variance analysis, and technical performance measurement, will be used to assess project performance.

22) Official Languages

In order to support Public Safety Canada's obligations under Part VII of the Official Languages Act, the applicant must indicate whether the needs of official language minority communities were considered, where appropriate (such as for stakeholder engagement activities)

a) Have the needs of official language minority communities been considered? ☒ Yes ☐ No

b) What will the (lead) province or territory do to address official languages requirements for linguistic minorities, as per the Official Languages Act, with respect to this project?

Project Attestations

23) The province or territory responsible for the implementation of this project agrees to share information with the government of Canada, including risk information/data, including the completed risk assessment information template; flood maps and associated data, based on the criteria established by PS, for inclusion in a national flood database; and all other relevant project information, such as lessons learned.

☒ I agree

24) The province or territory responsible for the implementation of this project agrees to report, in accordance with its contribution agreement, on topics such as the project implementation status, measures for successful implementation, project risk mitigation measures, and financial expenditures.

☒ I agree

25) The province or territory responsible for the implementation of this project agrees to publicly recognize the federal government's contribution in any announcement

☒ I agree

26) The province or territory responsible for the implementation of this project agrees to ensure that it takes all necessary steps to prevent the risk of conflicts of interest, including:

- Disclosure of any apparent, actual or potential conflict of interest in compliance with Canada or the Province's laws, regulations or policies, as the case may be, and disclosure of the involvement of any former public servants or public office holders subject to the *Values and Ethics Code for the Public Sector*, the *Conflict of Interest Act*, and the conditions of the *Parliament of Canada Act*;
- Registrant as lobbyists as required under the Lobbying Act (applicants shall provide assurance that, where lobbyists are utilized, they are registered in accordance with the Lobbying Act and that no actual or potential conflict of interest exists nor any contingency fee arrangement);
- Role of any Government of Canada official, if a Government of Canada official is to participate on an advisory committee or board. Such involvement must not be seen to be exercising control on the committee or board on the use of funds.

☒ I agree

27) NDMP contributions may be provided for the following types of mitigation projects:

a) new projects or existing projects that have been developed but have not been identified for funding; and

b) non-structural or small scale structural projects.

Does your proposed NDMP meet this description? ☒ Yes ☐ No

C) Additional Required Information for Each NDMP Stream (1-4)

Stream 2: Flood Mapping

1) Was a copy of your completed and up-to-date NDMP risk assessment information template (RAIT) covering the geographic area related to this proposed project provided to PS?

☐ Yes, Previously - File #: _____ ☒ Yes, Attached ☐ No

2) Provide a description/summary of your risk assessment findings. (500 characters max.)

HRM conducted a risk assessment based on Hurricane Juan. The likelihood and impacts of another category 2 hurricane with 2m storm surge was contemplated in the risk assessment to be highly likely (rating of 5) with severe impacts, such as 50+ fatalities, more than 15% of the local population displaced for 1-4 weeks, and more than 15% of the local economy impacted. High risks to transportation, energy and utilities, information and communication technologies, health and safety were identified.

3) **Project Description**

a) Check the activities that apply for this project

Note: Flood maps that are updated or newly created must be produced in digital format.

- ☐ Updating Exisiting Flood Map(s)
- ☐ Creating New Flood Map(s)
- ☒ Acquisition of elevation data and mapping data
- ☐ Plotting of historical data and inundation mapping
- ☐ Modelling of hydrological and hydrometric data
- ☒ Other geospatial, mapping and modelling activities (include details in the "comments" section)

Comments:
Coastal Flood Risk Vulnerability Mapping, for the entire HRM coastline.

b) Describe the final output(s) that will be created as a result of this project.
(500 characters max.)

The final outputs will be data files in the following formats:
- LiDAR Digital Elevation Model (DEM) 5m raster
- LiDAR DEM 2m raster
- LIDAR DEM 1m raster
- LiDAR DEM 5m Metadata
- LiDAR DEM 2m Metadata
- LiDAR DEM 1m Metadata
- Lidar Digital Surface Model (DSM) raster

Based on the designated DEM file, the Municipality will conduct coastal flood risk vulnerability mapping for its coastline. The output will be a map that depicts flooding vulnerability based on predefined classifications.

c) Identify and describe the methodology/ies that you will use for this project.

Methodology/ies:
- Procure Data Acquisition Services
- Flight Operations Plan
- Data Acquisition
- Data Preparation
- Data Processing
- Data Post-Processing
- Delivery of Data Products

Description:
- Procure Data Acquisition Services: Define specification level requirements and associated specifications for all parameters. Define scope of work, standards, deliverables, and project controls.
- Flight Operations Plan: includes aircraft type selection, sensor selection, control setup (the preparation for groundtruthing and control surface), flight plans and system configuration.
- Data Acquisition: executing the flight plan.
- Data Preparation: includes point integration, cleaning and alignment.
- Data Processing: includes: flightline matching, scanner matching, ground control correction, and geoid correction.
- Data Post Processing: includes bare earth editing, detailed classification, hydro flattening, and 2D/3D feature extraction.
- Delivery of data products: DEM & DSM raster files and associated metadata documents at designated resolution(s).

4) Area Covered by Flood Mapping Activity (km^2)

5900 km^2

5) Watershed(s) related to the flood mapping activity/ies (km^2)

Please identify the watershed(s) where the project activity/ies will take place, and indicate the total square kilometres of the area(s) covered by the watershed(s).

Watershed Name(s):
Thirty-seven named subwatersheds lie, in full or in part, within the Halifax Regional Municipality. These include the Avon River, Chezzetcook River, Dartmouth Lakes, East River, East River Chester, East River Sheet Harbour, Ecum Secum River, Fish River - Lake Charlotte, Grand Lake, Halfway Brook, Indian River, Kearney Run, Little River, Little Salmon River, McIntosh Run, Musquodoboit River, Moser River, Newcombe Brook, Nine Mile River, Northeast River, Partridge River - Lawrencetown Lake, Pennant River, Prospect River, Quoddy River, Sackville River, Salmon River, Salmon River (Halifax County), Shubenacadie River, Smith Brook, St. Croix River, Tangier River, Unnamed tributary to Blind Bay, West River - Sheet Harbour, West Taylor Bay Brook, Woodens River, and Wrights Brook.

Watershed Area(s) (total):
8094 km^2

6) **Type of Flood Mapping**

What type of of flood mapping will this project be undertaking?

☒ Riverine ☒ Urban ☒ Coastal ☐ Other: _____

☐ Not Applicable (Please provide details in the "comments" section, below.

Comments:

7) How does this project address the impacts of climate change?

Explain, in bullet form.

- Digital Elevation Models serve as the basis for flood risk maps. Surface elevations are used in association with hydraulic and hydrologic models to estimate flood risks. Currently the municipality only has low-resolution (20m DEM) data for the majority of its spatial area, exclusive of the two areas for which LiDAR data was collected in 2007. This project proposes to generate high-resolution elevation data, with 1m, 2m, and 5m data products. These high resolution DEMs would dramatically increase certainty in the results of modeling outputs, flood risk mapping products, and the results of associated data analysis for risk assessment for those areas currently only served by low-resolution data. In addition, the new data and mapping products would provide much-needed updates to the areas previously surveyed by LiDAR, which have undergone significant development since 2007.
- The primary flooding-associated impacts of climate change are the increased frequency and intensity of storm events. Engineering professionals and researchers have developed a suite of tools that can analyze the impacts of different climate models based on different climate scenarios on the area under study. The municipality will be able to carefully tailor its responses to the impacts of climate change to different locations based on accurate, current, and reliable data, and associated quantitative analyses.
- Applying the International Panel on Climate Change, Assessment Report 5 (IPCC AR5) scenarios to high resolution DEMs will enable the development of high level coastal flooding vulnerability maps to the municipality's 2000 km of coastal shoreline. These maps will allow the municipality to identify, classify, and communicate risks, and prioritize risk responses to affected communities and assets.

8) Have copies of all existing flood maps that cover some or all parts of the area related to this project proposal been provided to Public Safety Canada?

☐ Yes, Previously - File #: _____ ☒ Yes, Attached ☐ No

9) Provide a description/summary of your risk assessment findings.
(500 characters max.)

See question 2. The attached maps demonstrate our current understanding of flooding scenarios based on our current quantity and quality of data. This information is limited in geographic scope and is dated.

10) Describe how the information in your Risk Assessment(s) and flood map(s) provide(s) a rationale/justification for implementing this mitigation activity.

(500 characters max.)

Currently the municipality has only mapped approximately 250km (~12%) of the municipality's 2000 km shoreline, as measured accurately using GIS. Based on historic weather events, current IPCC AR5 climate change scenarios and modeled local climate change impacts, including increased precipitation frequency and intensity, this project is critical to enable proactive, evidence-based decision making and increased community resiliency.

11) Project Output Attestation:

a) NDMP-funded flood maps must be compliant with relevant Treasury Board standards and guidelines.
b) All Stream 2 projects, upon completion, must provide a copy of the flood map(s) to Public Safety Canada in the appropriate format and associated data as outlined in the contribution agreement.
c) All Stream 2 projects must provide Public Safety Canada with an updated NDMP risk assessment information template (RAIT), which includes the newly-created flood mapping information resulting from this project.
d) This project will respect the applicable guidelines, standards and/or methodologies of the province/territory in which it is being undertaken.

☒ I agree

D) Templates

1. Budget Template	Add Template	Remove Template

Project Budget
Revenues for Fiscal Year (April 1 - March 31)
2016 - 2017

Project Title: HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)

Government Funding: Cash (Municipal, provincial, territorial, and federal) (**Note:** For federal funding, please specify the federal government department)	**Amount**
	$0.00
Subtotal – Cash	$0.00
Government Funding: In-Kind (Municipal, provincial, territorial, and federal) (**Note:** For federal funding, please specify the federal government department)	**Amount**
Halifax Regional Municipality - LiDAR Acquisition. Work conducted by municipality and project partners to initiate and develop the project plan, acquire internal and procured resources and prepare for execution.	$72,350.00
Subtotal – In-Kind	$72,350.00
Total Government Funding (subtotal of Cash + subtotal of In-Kind from municipal, provincial, territorial, and federal government sources)	$72,350.00
Total Federal Government Funding (subtotal of Cash + subtotal of In-Kind from all federal government sources)	$0.00
Proportion of Federal Government Contribution *(Note: The maximum Federal Contribution is **50%** for Provinces and **75%** for Territories)*	0 %
Non-government Funding and other: Cash	**Amount**
Subtotal – Cash	$0.00
Non-government Funding and other: In-Kind	**Amount**
Subtotal – In-Kind	$0.00
Total Non-government Funding and other (subtotal of Cash + subtotal of In-Kind from non-government funding and other sources)	$0.00
Total Government Funding (Total of government funding + total of non-government funding and other)	$72,350.00

1) Cash: actual dollar value or revenues/funding received
2) In-Kind: non-cash input which is given a cash value.

Project Budget
Revenues for Fiscal Year (April 1 - March 31)
2017 - 2018

Project Title: HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)

Government Funding: Cash (Municipal, provincial, territorial, and federal) (Note: For federal funding, please specify the federal government department)	**Amount**
National Disaster Mitigation Program - LiDAR Acquisition	$832,480.00
Halifax Regional Municipality - LiDAR Acquisition	$716,320.00
National Disaster Mitigation Program - Data Processing of LiDAR	$414,950.00
Halifax Regional Municipality - Data Processing of LiDAR	$357,050.00
Subtotal – Cash	$2,320,800.00
Government Funding: In-Kind (Municipal, provincial, territorial, and federal) (Note: For federal funding, please specify the federal government department)	**Amount**
Halifax Regional Municipality - once the LiDAR data is processed, municipal staff will update flood scenario maps and land use vulnerability assessment for the entire municipality - staff time.	$174,060.00
Subtotal – In-Kind	$174,060.00
Total Government Funding (subtotal of Cash + subtotal of In-Kind from municipal, provincial, territorial, and federal government sources)	$2,494,860.00
Total Federal Government Funding (subtotal of Cash + subtotal of In-Kind from all federal government sources)	$414,950.00
Proportion of Federal Government Contribution *(Note: The maximum Federal Contribution is **50%** for Provinces and **75%** for Territories)*	50 %
Non-government Funding and other: Cash	**Amount**
Subtotal – Cash	$0.00
Non-government Funding and other: In-Kind	**Amount**
Subtotal – In-Kind	$0.00
Total Non-government Funding and other (subtotal of Cash + subtotal of In-Kind from non-government funding and other sources)	$0.00
Total Government Funding (Total of government funding + total of non-government funding and other)	$2,494,860.00

1) Cash: actual dollar value or revenues/funding received
2) In-Kind: non-cash input which is given a cash value.

Project Budget
Eligible Expenses for Fiscal Year (April 1 - March 31)
2016 - 2017

Project Title: HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)

Eligible Costs (i.e. Categories of work)	Details	Eligible Expenditures: Cash			
		Public Safety Canada Funding (NDMP Funds)	Other Government Funding	Non-Government Funding and Other	Total
					$0.00
					$0.00
					$0.00
Subtotal – Cash		$0.00	$0.00	$0.00	$0.00
Eligible Costs (i.e. Categories of work)	**Details**	**Eligible Expenditures: In-Kind**			
		Public Safety Canada Funding (NDMP Funds)	Other Government Funding	Non-Government Funding and Other	Total
1. New research and data collection	LiDAR acquisition		$72,350.00		$72,350.00
					$0.00
					$0.00
Subtotal – In-Kind		$0.00	$72,350.00	$0.00	$72,350.00
Total Expenditures: (Subtotal of Cash + subtotal of In-Kind)		$0.00	$72,350.00	$0.00	$72,350.00

1) Cash: actual dollar value or revenues/funding received
2) In-Kind: non-cash input which is given a cash value.

Project Budget
Eligible Expenses for Fiscal Year (April 1 - March 31)
2017 - 2018

Project Title: HRM - Coastal and Inland Flood Mapping (LiDAR Acquisition)

Eligible Costs (i.e. Categories of work)	Details	Eligible Expenditures: Cash			
		Public Safety Canada Funding (NDMP Funds)	Other Government Funding	Non-Government Funding and Other	Total
1. New data collection	LiDAR data acquisition	$832,480.00	$716,320.00		$1,548,800.00
2. Professional Services Support	LiDAR data processing	$414,950.00	$357,050.00		$772,000.00
					$0.00
Subtotal – Cash		$1,247,430.00	$1,073,370.00	$0.00	$2,320,800.00
Eligible Costs (i.e. Categories of work)	**Details**	**Eligible Expenditures: In-Kind**			
		Public Safety Canada Funding (NDMP Funds)	Other Government Funding	Non-Government Funding and Other	Total
3. Flood mapping and forecasting	HRM staff will create flood scenario maps and do a land use vulnerability assessment		$174,060.00		$174,060.00
					$0.00
					$0.00
Subtotal – In-Kind		$0.00	$174,060.00	$0.00	$174,060.00
Total Expenditures: (Subtotal of Cash + subtotal of In-Kind)		$1,247,430.00	$1,247,430.00	$0.00	$2,494,860.00

1) Cash: actual dollar value or revenues/funding received
2) In-Kind: non-cash input which is given a cash value.

List: Eligible Costs

#	**Eligible Costs**
1	New research and data collection.
2	Flood mapping and forecasting.
3	Flood resistant construction techniques.
4	Hazard mapping and forecasting.
5	Professional services support
6	Purchase of equipment used to undertake mitigation and/or support the implementation of permanent structural mitigation measures
7	Building community partnerships for the purpose of disaster risk reduction.
8	Consultant fees.
9	Hazard, impact, risk, vulnerability and assessments.
10	Development of disaster mitigation plans.
11	Public awareness and education.
12	Building standards and enforcement.
13	Non-structural retrofitting.
14	Land use planning controls.
15	Planning and feasibility activities for structural mitigation investments
16	Land purchases
17	Non-structural measures that will enhance proactive whole-of-community flood mitigation measures and resilience to associated hazards and risks
18	Small-scale structural flood mitigation measures
19	Construction of new permanent structural measures designated to mitigate the impacts of flooding
20	Improvement or modernization of existing permanent structural measures.
21	Post-flood finishing costs for measures undertaken within the eligible period.
22	Measures taken to protect primary residences only.
23	Other permanent structural flood mitigation measures and costs related to post-flood finishing measures
24	Exceptional salary costs, benefits and incidentals.
25	Exceptional administrative costs.
26	Materials.
27	Facilities.
28	Exceptional transportation costs.
29	Other incurred costs that are directly attributed to the implementation of permanent structural and non-structural flood mitigation measures.

List: Ineligible Costs

#	**Ineligible Costs**
1	Costs relating to events and equipment which are considered to be the routine responsibility of provincial ministries or first responder agencies such as police, fire and ambulance.
2	Ongoing operating and maintenance costs for NDMP initiatives following completion of the project.
3	The value assigned to data that was procured or collected prior to the establishment of the project Contribution Agreement.
4	Administrative costs which are not directly related to a specific NDMP project. Each recipient is expected to absorb the routine costs of doing business. Examples such as regular salaries and benefits, audit costs, office furniture, equipment, office supplies, committee work, administration and supervision of NDMP, are not to be cost-shared. It is recognized that certain proposals incur extraordinary administrative expenses, which are incremental to the routine costs of providing government services; these expenses can be considered for cost-sharing and shall be clearly identified in detail at the proposal stage.
5	Hospitality costs.
6	Mitigation project that would yield only temporary measures (e.g., use of sandbags).
7	Mitigation projects that would create ongoing need for funds from the federal government or from its recipient that cannot be absorbed in their current budget.
8	Any expenditures related to a project already started prior to application for funding and prior to approval.
9	Any expenditures related to a project already started prior toDamages and interests resulting from any action or omission causing harm to a third party for which the Recipient is held civilly liable by a Court and has to pay; or fines under any municipal, provincial, territorial or federal legislation resulting from a transgression by the Recipient, or any amount resulting from any settlement entered into by the Recipient, or imposed by a Court, including an Arbiter, to the Recipient in relation with the funded NDMP project. application for funding and prior to approval.
10	Taxes other than the PST or provincial part of the HST.
11	Projects that address needs that are not related to prevention/mitigation.
12	Costs reimbursed under another Government of Canada program.

2) Work Plan Template

Activities	Tasks	Deliverable(s)/ Product(s)	Resources	Timelines (Start and End Dates)	Considerations/ Comments
New research and data collection	1. Authorize project charter. 2.Secure project funding. 3. Formally establish technical committee. 4. Develop project management plan, including a detailed Scope of Work. 5. Collect relevant background materials, complementary datasets from adjacent jurisdictions, research, etc., with technical committee. 6. Select appropriate LiDAR standard specifications per best practices reflected in Service Nova Scotia LiDAR Data Acquisition and Quality Assurance Specifications and GeoBC Specifications for LiDAR Version 2.0. 7. Develop and award Request For Proposals for work to be initiated and completed in FY 2017-2018.	Interim deliverables: Project charter, project funding, technical committee, project plan, data and research repository, contract with secured vendor.	Municipal personnel (project manager, support staff) Technical Committee, including Research Scientists from federal and provincial agencies, environmental planner, academics, and others).	Start Date: 03/04/2017 End Date: 30/03/2018	

Obtain a new, complete LiDAR data set for all watersheds and coastlines of HRM.	1. Conduct project kickoff meeting with technical team and contractor to ensure that all parties have a shared and accurate understanding of the project scope, activities, deliverables, requirements, standards & processes. 2. Engage the contractor to conduct their flights and acquire LiDAR data. 3. Conduct third party QA/QC to validate contractor QC results. 4. Accept validated deliverables. 5. Acquire all required project documentation and close contract.	- Acquisition Deliverables, such as Accuracy Calculation, Estimations for Point Density and Point Spacing, Flight Operations Plan, - Production Deliverables, such as Calibration Reports, Adjustment Report, Control Reports, GPS Base Station Information, GPS Processing Summary, Flight Logs, Hardware Settings, Metadata, Data verification QC , Trajectories, flight maps (trajectories, control points, GPS base station information, shapefile), LAS files.	Municipal personnel (project manager, support staff) Technical Committee, including Research Scientists from federal and provincial agencies, environmental planner, academics, and others).	Start Date: 03/04/2017 End Date: 30/03/2018	Project will adhere to best practices reflected in Service Nova Scotia LiDAR Data Acquisition and Quality Assurance Specifications and GeoBC Specifications for LiDAR Version 2.0.
Have LiDAR data processed and analyzed into useable formats.	1. Develop and execute research agreements with universities and government agencies for post-processing of LiDAR data. 2. Confirm agreement deliverables. 3. Conduct data processing. 4. Validate processing results. 5. Accept deliverables. 6. Distribute LAS files and all processing deliverables to federal and provincial agencies, neighboring municipalities, and the public as Open Data.	1. Research Agreement with selected universities and government agencies. 2. Processed deliverables - 1m DEM, 2m DEM, 5m DEM, corresponding metadata documents, and DSM. 3. HRM Open Data Set available for all data products.	Municipal personnel (project manager, support staff) Technical Committee, including Research Scientists from federal and provincial agencies, environmental planner, academics, and others).	Start Date: 03/04/2017 End Date: 30/03/2018	

Update coastal flooding and land use vulnerability maps based on new LiDAR and IPCC AR5 sea level rise predictions.	1. Identify GIS software best suited to conduct analysis. 2. Use GIS software to develop and run flood models. 3. Define flood vulnerability characteristics	1. Coastal flooding vulnerability maps for entire municipal coastal shoreline. 2. Land use vulnerability maps for areas landward of municipal coastal shoreline.	Municipal personnel (project manager, support staff) Technical Committee, including Research Scientists from federal and provincial agencies, environmental planner, academics, and others).	Start Date: 03/04/2017 End Date: 30/03/2018	

3) Stakeholder Template

Notes:

a) Identify all stakeholders/partnerships and describe their current and/or potential level of engagement, as applicable.

b) Identify those stakeholders/partners who have committed, in-cash or in-kind, support for the proposed project.

c) Provide a description/summary of the stakeholder list, and how this information provides a rationale/justification for implementing this mitigation activity.

Part 1: Stakeholder Identification and Level or Engagement					
Name of Stakeholder	**Title, Organization**	**Level of Engagement/Commitment (current and/or potential in the future)**	**Financial Support**		
			In-Kind Contribution (Name of Items)	**Value of In-Kind Contribution ($)**	**In-Cash ($)**
	NRCan	Current member of LiDAR working group, potential member of technical steering committee, user of data	Professional expertise		
	Canadian Hydrographic Service	Current member of LiDAR working group, potential member of technical steering committee, user of data	Professional expertise		
	DFO	Current member of LiDAR working group, potential member of technical steering committee, user of data	Professional expertise		
	GeoNova	Current member of LiDAR working group, potential member of technical steering committee, user of data	Professional expertise		
	NS Fisheries and Aquaculture	Potential member of technical steering committee, user of data	Professional expertise		
	Dalhousie University	Potential member of technical steering committee, user of data	Professional expertise		
	Nova Scotia Community College	Potential member of technical steering committee, user of data	Professional expertise		
	Public	User of data	Partnership		
	Insurance industry	User of data	Partnership		
	Federal Department of Environment and Climate Change	User of data	Partnership		
	Provincial EMO	User of data	Partnership		
	Federal EMO	User of data	Partnership		
	Private Sector	User of data	Partnership		

All identified stakeholders have interest in, or will benefit from, the data and mapping that results from this project. HRM is willing and able to share all resulting data as Open Data, which is publicly available. HRM wishes to continue to create and enhance partnerships with key stakeholders as part of this project.					

Part 2: Description/Summary **How does the engagement of these stakeholders support and/or justify the implementation of this mitigation activity?**

2017/2018 Capital Budget Form

Project Name:	LIDAR Data Acquisitions
Project Number:	CI000020
Budget Category:	Business Tools
Project Type:	Service Improvements
Discrete/Bundled:	Discrete
Project Manager:	Bob Bjerke

Project Summary:

The LiDAR project will be carried out as three successive activities in 2017-18:

1. Flights will be conducted to create a complete LiDAR data set for HRM watersheds and coastlines;
2. LiDAR data will be processed and analyzed into useable high-resolution formats;
3. Coastal flooding and land use vulnerability maps will be developed.

This work will enable HRM to:
- Better manage environmental risks, including the impacts of climate change;
- Develop models for development planning, water resource management and open space management;
- Expand HRM's Open Data offering to build decision-making capacity among stakeholder partners and the broader public.

Total Capital Request: (5 Years) $ 2,400,000

Supports Outcome Area:

Project Status a) concept; b) design; c) tender ready; or d) permits and approvals secured N/A

How advanced are the budget estimates? Class D, C, B or A Class 'C'

CAPITAL COSTS - Cash Flow

Fiscal Year	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
Gross Budget:	2,400,000	-	-	-	-
Funding Source:					
Federal Cost Sharing	1,250,000	-	-	-	-
Other	1,150,000	-	-	-	-
Total Funding:	2,400,000	-	-	-	-
Net budget:	-	-	-	-	-

Fiscal Year	**2022/23**	**2023/24**	**2024/25**	**2025/26**	**2026/27**
Gross Budget:	-	-	-	-	-
Funding Source:					
	-	-	-	-	-
	-	-	-	-	-
Total Funding:	-	-	-	-	-
Net budget:	-	-	-	-	-

Ongoing Operating Costs	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
Annual Revenues:	-	-	-	-	-
Annual Operating Costs:	-	-	-	-	-
Net Annual Operating Costs:	-	-	-	-	-

Detailed Work Plan 2017/18:	**Estimate**
	-
Data Acquisition	1,600,000
Data Processing	800,000
	-
	-
	-
	-
	-
	-
	-
	-
	-
	-
Sum of Work Plan Items above (If cell is red it does not match Work Plan entered in Summary Sheet)	2,400,000
Total Estimated Work Plan 2017/18 (From Summary Sheet)	**2,400,000**
Less Projected Carry Forward from Previous Years	-
Gross Budget Request for 2017/18	**2,400,000**

Attachment C **Halifax Regional Municipality – Bathymetric and Terrestrial Lidar Use Cases**

Category	Use Case	Potential Collaborator (Agency, Business, Academic, NGO)
Agriculture	Precision Agriculture	NS Dept. Agri. (NSDA) Agriculture and Agri-Food Canada (AAFC) Dalhousie Agricultural Campus (DAC)
Agriculture	Storm Water Flow Mapping on Crop Land	NSDA (Land Protection), Environment & Climate Change Canada (EC3) AAFC
Agriculture	Erosion Assessment and Mitigation	NSDA (Land Protection), AAFC, DAC
Agriculture	Gully Detection	NSDA (Land Protection), AAFC, DAC
Agriculture	Riparian Buffer Mapping and Protection	NSDA (Land Protection), AAFC, DAC
Archeology & Paleontology	Archeological site identification	Communities, Culture & Heritage (CCH) Parks Canada (PC), Municipal
Archeology & Paleontology	Paleontological site identification	CCH PC, Municipal
Archeology & Paleontology	Shipwrecks	CCH PC, Municipal, PC
Conservation	Erosion Studies	NS-Enviro, Municipal, DAC, Geological Survey of Canada (GSC)
Conservation	Geomorphology	NS-Enviro, NS Dept. Natural Resources, GSC
Conservation	Groundwater Resource Availability, Management Protection	NS-Enviro, Municipal,GSC
Conservation	Invasive Species	NS-Enviro, DFA, NSDA (Land Protection), DNR (Wildlife) PC, AAFC, Canadian Food Inspection Agency (CFIA), DFO, NRCAN
Conservation	Land Conservation	NS-Enviro, NSDA (Land Protection), DNR (Wildlife) PC, Municipal
Conservation	Riparian Buffers	NS-Enviro, NSDA, DNR (Wildlife) Halifax Water Commission (HWC)
Conservation	Impervious Surfaces & Storm Water Analysis	NS-Enviro, NSDA (Land Protection), PC, HWC, Municipal
Conservation	Shoreline Erosion	NS-Enviro, DFA, NSDA (Land Protection), DNR PC, Municipal
Conservation	Wetland Inventory\Analysis	NS-Enviro, NSDA (Land Protection), DNR (Wildlife) PC, Municipal
Conservation	Wildlife Habitat Management and Protection	NS-Enviro, NSDA (Land Protection), DNR (Wildlife) PC
Conservation	Coastal Vegetation	NS-Enviro, DFA, NSDA (Land Protection), PC
Conservation	Upland, intertidal and subtidal delineation	NS-Enviro, DFA, NSDA (Land Protection), DFA,
Emergency Management	Dam Failure Site Analysis and Planning	NSDA (Land Protection), NS Energy, NS Power, HWC, Municipal
Emergency Management	Evacuation Planning	NS-EMO, Transportation & Infrastructure Renewal (TIR), Municipal
Emergency Management	Federal Disaster Relief applications	NS-EMO, Municipal
Emergency Management	Fire Prevention and Management, e.g., Fire Fuel Models	NS-EMO, Municipal

Category	Use Case	Potential Collaborator (Agency, Business, Academic, NGO)
Emergency Management	Flood Prevention and Management	NS-EMO, HWC
Emergency Management	Floodplain Mapping	NS-EMO, Municipal
Emergency Management	Hazardous Spill Analysis, Control and Remediation	NS-EMO, Municipal
Emergency Management	Ice Jam Studies	NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Emergency Management	Landslides and Landslide Prone Areas	NS-EMO, TIR, Municipal Governments
Emergency Management		NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Emergency Management	Shoreline Flooding	NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Emergency Management	Plume Modeling	NS-EMO, DFO (Science)
Emergency Management	Slope Stability	NS-EMO
Emergency Management	Storm forcing and wave modeling	NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Emergency Management	Coastal Erosion/change detection and monitoring	NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Emergency Management	Security Management, Line-of-Sight	Municipal
Energy	Biomass/Woody Biomass Fuel Estimates	DNR (Forestry), NS Energy, NS Power, DAC
Energy	Energy/Communications Planning	NS Energy, NS Power
Energy	Infrastructure Planning and Management	NS Energy, NS Power, Municipal
Energy	Solar Energy Site Suitability	NS Energy, NS Power, Municipal
Energy	Wind Energy Site Suitability	NS Energy, NS Power, DAC
Energy	Tidal Energy Site Suitability	Acadia Tidal Institute, FORCE, NS Energy, NS Power/Emera, various tidal energy companies
Energy	Wave	NRCAN
Energy	Hydrokinetics	NRCAN
Geology	Soil Modeling	DNR (Geoscience), DAC
Geology	Geologic Fault Mapping	DNR (Geoscience)
Geology	Surficial Geology	DNR (Geoscience), DAC
Geospatial Data	Improved Orthorectification Accuracy of Aerial Photos	GeoNova, DNR (Geoscience), NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments

Category	Use Case	Potential Collaborator (Agency, Business, Academic, NGO)
Geospatial Data	Cadastral	Most Provincial Dept.
Geospatial Data	Height Modeling	Most Provincial Dept.
Hydrology	Ditch/Depression, Improved Network Connectivity	NS-Enviro (Water), NSDA, HWC
Hydrology	Snow Pack and Water Runoff Modeling	NS-Enviro (Water), NSDA, DAC
Hydrology	Sub-watershed and Catchment Delineation	NS-Enviro (Water), NSDA
Hydrology	Bay/Inlet flushing	NS-Enviro (Water), DFA
Municipal	Property Valuation	Municipalities, NS Property Valuation Services, Consulting Engineers/Planners, Real Estate Companies
Natural Resource Management	Enhanced Soil Surveys	DNR (Geoscience), NSDA, DAC, Consulting Engineers/Planners
Natural Resource Management	Enhanced/Updated Hydrography	NS-Enviro (Water), NSDA, DNR (Geoscience), DFA, Consulting Engineers/Planners
Natural Resource Management	Forestry Uses & Management, e.g., Biomass, Timber Volume, Invasive Species	NS-Enviro, NSDA, DNR (Forestry) J. D. Irving, Limited, Louisiana Pacific Canada Ltd., Northern Pulp Nova Scotia Corporation, Wagner Forest NS Ltd., Nova Forest Alliance
Natural Resource Management	Habitat - Wildlife	NS-Enviro (Water), NSDA, DNR (Wildlife) PC, Nova Forest Alliance
Natural Resource Management	Headwater Stream Mapping	NS-Enviro (Water), DFA, DNR (Geoscience), Consulting Engineers/Planners
Natural Resource Management	Land Cover Mapping	NS-Enviro (Water), NSDA, DNR PC, Consulting Engineers/Planners
Natural Resource Management	Timber Volume	NSDA, DNR (Forestry), NS-Enviro) J. D. Irving, Limited, Louisiana Pacific Canada Ltd., Northern Pulp Nova Scotia Corporation, Wagner Forest NS Ltd. Nova Forest Alliance
Natural Resource Management	Water Quality Monitoring	NS-Enviro (Water), NSDA, DNR, Municipal, Consulting Engineers/Planners
Planning	3D Visualization: Building Extraction, Change Detection, Building Footprints	Various Municipal and Provincial, Consulting Engineers/Planners
Planning	Building Footprints	Various Municipal and Provincial, Consulting Engineers/Planners
Planning	Impervious Surfaces	Various Municipal and Provincial, Consulting Engineers/Planners
Planning	Resort Planning (viewsheds, golf courses, etc.)	Consulting Engineers/Planners
Planning	Trail planning and design, maintenance	Various Municipal and Provincial, TIR, PC, Consulting Engineers/Planners

Category	Use Case	Potential Collaborator (Agency, Business, Academic, NGO)
Planning	Urban Planning/Mapping	Various Municipal and Provincial, Consulting Engineers/Planners
Planning - Land Use	Forest Type and Density	NSDA, DNR (Forestry), NS-Enviro PC
Planning - Land Use	Forest/Farmland Fragmentation	NSDA, DNR (Forestry), NS-Enviro, Consulting Engineers/Planners
Planning - Land Use	Forest/Tree Canopy Analysis	DNR (Forestry), NS-Enviro
Pollution Mitigation	Non-point Source Pollution Analysis	DFA, DFO, NS- Enviro, EC3, HWC, Consulting Engineers/Planners
Pollution Mitigation	Plume Modeling	DFA, DFO, NS- Enviro, EC3, HWC, Consulting Engineers/Planners
Pollution Mitigation	Point Source Pollution Analysis	DFA, DFO, NS- Enviro, EC3, HWC, Consulting Engineers/Planners
Pollution Mitigation	Carbon Estimates	NS-Enviro, EC3, Consulting Engineers/Planners
Transportation	Bridge Scour Assessment	TIR, DFA, DFO, EC3, Municipal, Consulting Engineers/Planners
Transportation	Highway Design	TIR, Municipalities, Consulting Engineers/Planners
Transportation	Identify Old Road Alignments	TIR, Municipalities, Consulting Engineers/Planners
Transportation	Transportation Planning	TIR, Municipalities, Transport Canada (TC), Canadian National Railway (CNR)
Utilities	Broadband Services: Line-of-Sight & Viewshed Analysis	Municipal Governments, NSPI
Utilities	Cell Phone Tower Placement Analysis	NS-Emergency Management Office (NS-EMO), Industry Canada, Rogers, Eastlink, Bell Aliant
Utilities	Electrical Transmission Reliability & Planning	Municipal Governments, NSPI, Industry Canada
Utilities	Federal Safety Compliance Verification	Municipal Governments, TC
Coastal Planning	Emergency planning	NS-EMO, DFO (Oceans – Small Harbours), TIR, DFA, Municipal Governments
Coastal Planning	Hazards (Flooding, pollution, storm impacts, etc.)	PC, Halifax Port Authority(HPA), Dalhousie Marine Affairs (DMA)
Coastal Planning	Infrastructure Siting and Monitoring (Dykes, Wharves/launches, roads, utilities, etc.)	DFO (Oceans – Small Harbours), TIR, DFA, Municipal, HPA, Department of National Defense (DND), DMA
Coastal Planning	Risk and vulnerability assessment	DFA, EMO, Municipal, Consulting Engineers/Planners, DMA
Coastal Planning	Public access	TIR, Tourism NS, Environment, DNR (Crownland), PC, Municipal
Coastal Resource Development	Aquaculture siting	DFA, DFO (Science), DMA
Coastal Resource Development	Shoreline use/activity (combined with photos)	DFA, Municipal, Consulting Engineers/Planners, DMA
Coastal Resource	Rock weed volumes	DFA, Acadian Seaplants Ltd., AGRG Consulting Engineers/Planners,

Category	Use Case	Potential Collaborator (Agency, Business, Academic, NGO)
Development		DMA
Coastal Mapping	Shoreline delineation	DFO (CHS) PC, Municipal , DMA,
Coastal Mapping	Topography/Bathymetry	DFO (CHS) PC, DMA, Municipal, Consulting Engineers/Planners
Coastal Mapping	Shallow-water bathymetry/shoreline for nautical charts	DFO (CHS) DMA
Water surface, column and seafloor characterization	Benthic classifications	DFO (Science) DFA, DMA
Water surface, column and seafloor characterization	Pelagic classifications	
Water surface, column and seafloor characterization	Habitat mapping	DFO (Science), DFA, DMA
Water surface, column and seafloor characterization	Nearshore seabed characterization	DFO (Science) DMA
Water surface, column and seafloor characterization	Sediment plumes to study coastal currents	DFO (Science) DMA
Water surface, column and seafloor characterization	Erosion and Sedimentation analysis	DFO (Science) DMA