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Item No. 14.1.7
Halifax Regional Council
March 6, 2018

TO: Mayor Savage and Members of Halifax Regional Council

SUBMITTED BY: Original Signed by
Jacques Dubé, Chief Administrative Officer

DATE: February 9, 2018

SUBJECT: Science Advising

ORIGIN

August 15, 2017 – Regional Council Motion:

> THAT Halifax Regional Council request a staff report to consider the implementation of a 'science advisor' position on staff to advise council on science issues. This report should include consultations with our universities, various science based institutes and of course HRM council and staff. It should answer issues related to what the requirements of such a position might be, the type of person(s), (qualifications, area of expertise etc.), association with outside institutes, remuneration, and whether it is a full time or part time position.

LEGISLATIVE AUTHORITY

Halifax Regional Municipality Charter, section 34:

> (1) The Chief Administrative Officer is the head of the administrative branch of the government of the Municipality and is responsible to the Council for the proper administration of the affairs of the Municipality in accordance with the by-laws of the Municipality and the policies adopted by the Council.
>
> (3) The Council shall provide direction of the administration, plans, policies and programs of the Municipality to the Chief Administrative Officer.

RECOMMENDATION

It is recommended that Halifax Regional Council:

1. Consider using, where appropriate, the procedures outlined in the HRM Public Appointment Policy[1] to increase science advisory capacity on municipal agencies, boards and committees (through competency-based recruitment and nomination of citizens for appointment).

[1] https://www.halifax.ca/city-hall/boards-committees-commissions/volunteer-boards-committees/public-appointment-policy

2. Direct the CAO to draft a corporate operational policy concerning scientific advising principles and guidelines.

3. Direct the CAO to conduct an annual horizon scanning exercise as described in the Discussion section of this report.

BACKGROUND

As noted in the Origin section in this report, Halifax Regional Council requested a staff report to consider creating a 'science advisor' position to advise council on science issues. This report provides an overview of various science advising approaches, HRM's current capacity as relates to science advice and options for going forward.

Structures and institutions providing science advice: Throughout the policy-making process, science-advisory structures, including Chief Science Advisors/Officers, act as intermediaries between scientific communities and policy-makers. Their task is to aggregate and synthesize scientific evidence and frame it in a way that is both accessible and useful to policy-makers. The approach to providing science advice varies depending on the advisory body or mechanism's degree of separation from government, its structure and its composition. The structures, institutions and individuals providing scientific advice can be broadly grouped as external, mandated or internal (see Table 1).[2]

Table 1 – Structures and institutions providing science advice

Science advice entity	Advisory role	Examples
External	Independent bodies that conduct research on a range of scientific matters.	Academies, learned societies, think-tanks, consultants and research organizations
Mandated	Independent (ad hoc or permanent) advisory structures established and mandated by government bodies to provide scientific advice.	Regulatory agencies, advisory boards and science councils
Internal	In-house advisory structures or positions that provide formal or informal science advice.	Government employed science advisors and practicing scientists

International approach to science advice: Across national governments and international bodies, there are many different approaches to scientific advising (see Attachment 4). These reflect distinctive cultures and traditions of decision-making (through which expert claims are constructed or challenged).[3] Science advisory systems are typically made up from a mix of external, mandated and internal scientific advising mechanisms that co-exist in most countries.

Canada's approach to science advice: Canada had a federal chief science adviser between 2003 and 2008. After a nine-year hiatus, the federal government reappointed a science advisor in 2017.[4] Canada's federal government has access to a mix of internal, external and mandated science advisory mechanisms

[2] See Scientific advice for policy-makers in the European Union http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/589777/EPRS_BRI(2016)589777_EN.pdf
[3] See Science Advice to Governments: Diverse systems, common challenges http://ingsa.org/wp-content/uploads/2014/08/Science_Advice_to_Governments_Briefing_Paper_25-August.pdf
[4] http://www.pm.gc.ca/eng/news/2017/09/26/prime-minister-introduces-canadas-new-top-scientist

(see Attachment 5). Quebec was the first province to institute a chief science advisor role (2011). Quebec's Chief Science Officer fulfills an advisory role to government on matters of science and innovation and acts as executive officer for Quebec's three main research funding councils. Ontario is currently developing a chief science advisor position, following stakeholder consultations conducted in 2016/2017.[5] None of Canada's ten most populated cities (Ottawa, Edmonton, Toronto, Montreal, Vancouver, Calgary, Mississauga, Winnipeg, Brampton, Hamilton) have a chief science advisor position.

Halifax's hybrid science advising approach: Halifax's approach to scientific advising, not unlike other jurisdictions, is a hybrid of internal, external and mandated advisory mechanisms:

- **Internal:** Municipal staff across the organization play a variety of internal scientific advising roles, including: (a) review of existing data and research sources; (b) collection and analysis of new scientific data; (c) interpretation of research from different sources; (d) application of expert judgement where data is lacking or inconclusive; (e) identification of policy options based on data and research evidence; and (f) providing expert scientific and engineering advice on policy options.[6] These activities are consistent with the range of activities typically undertaken by science advisors in other jurisdictions.

  Business-unit-specific tables are attached to this report (see Attachment 8) to provide Regional Council with an overview of current internal scientific/technical advising practices. As detailed in the attached tables (Tables 8-16), staff engage in a variety of activities to maintain/enhance the municipality's internal scientific advising capacity, including:

  - subscribing to e-lists, newsletters, webinars and periodicals;
  - participating in scientific/technical conferences, seminars and webinars;
  - reviewing and synthesizing peer-reviewed and grey literature[7] related to specific topics;
  - engaging directly in, liaising with and/or observing multilateral forums focused on scientific/technical themes;
  - participating in national and international scientific/technical organizations, committees and professional associations;
  - consulting with scientific/technical experts to assist the development of staff reports, policy pieces or procurement documents;
  - engaging directly or indirectly in scientific/technical consultations related to federal/provincial government policy;
  - actively seeking federal or provincial funding to conduct municipal studies or research projects of a scientific/technical nature;
  - working with governmental and non-governmental agencies/bodies to optimize alignment between their policies/practices/regulations and municipal policies/practices/regulations;
  - proposing and advising on academic research projects, and developing working relationships with post-secondary institutions and (external) research groups;
  - drawing on external (academic) scientific expertise to guide internal research projects; and
  - supporting access to municipally owned/generated scientific or technical data (by external researchers).

- **External:** Municipal staff access scientific expertise in a range of contexts on a (largely) ad hoc basis. Outside scientific/technical expertise may be brought to bear at any stage in the municipal

[5] https://www.ontario.ca/page/recruiting-ontarios-first-chief-science-officer
[6] See HSE Statement for the Implementation of the Chief Scientific Adviser's Guidelines for a discussion of science advisory functions http://www.hse.gov.uk/research/content/gl2005.htm
[7] Grey literature are materials and research produced by organizations outside of the traditional commercial or academic publishing and distribution channels. Common grey literature publication types include reports (annual, research, technical, project, etc.), working papers, government documents, white papers and evaluations. See https://en.wikipedia.org/wiki/Grey_literature

policy-making cycle, although different forms of external expertise may be needed at different stages. Typically, external science advice is sought when:

- there is significant scientific uncertainty;
- the policy problem raises scientific questions that exceed the expertise of in-house staff;
- there is a range of scientific opinion;
- the issue is horizontal – it cuts across disciplines or lines of responsibility or jurisdiction;
- independent scientific analyses can strengthen public confidence; and/or
- there are potentially significant implications for sensitive areas of public policy.[8]

Historically, the municipality has engaged consultants with scientific/technical expertise to conduct research and analysis to inform municipal operations, staff reports and policy documents. Sources of externally commissioned research and advice may include science advisory councils, think tanks, scientific advisory committees, the broad science and engineering community, and academics from universities and community colleges.

Examples of (municipal) collaborative or consultative relationships with external scientific advisors are included in the attached municipal advisory practices tables (see Attachment 8). Contracting out specialized or urgent analytical work to scientific advisors/consultants is most frequently done where the scientific questions raised by a policy issue exceed the expertise of in-house staff or staff lacks the time to do the research/analysis due to competing priorities.

- **Mandated:** Scientific advisory expertise is currently imbedded in several existing municipal standing committees and advisory bodies. Bodies that require, by way of terms of reference, science advising capacity include the following: Community Design Advisory Committee[9], Design Review Committee[10], Halifax Explosion 100th Anniversary Advisory Committee[11], Investment Policy Advisory Committee[12], Advisory Committee on the Western Common[13] and the Regional Watersheds Advisory Board[14]. Technical and/or scientific advisory expertise differs from body-to-body, but includes professional accreditation and/or expert knowledge in the following fields: architecture, urban design, city planning, public health, structural engineering, (applied) ecological sciences, history, finance and investment. The Regional Watersheds Advisory Board specifically mandates the inclusion of faculty members at post-secondary institutions and/or research scientists with doctoral training.

Relative advantages of internal, external and mandated approaches: Responding to the different rhythms of policymaking, and striking the right balance between formal and informal inputs, are crucial aspects of effective scientific advice.[15] Table 17 (see Attachment 9) highlights the relative strengths and weaknesses of internal, external and mandated approaches to scientific advising. All approaches are imperfect. Some structures are better suited to providing formal advice against a longer time horizon, by

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[8] This is the approach to seeking external scientific expertise recommended by the Government of Canada. See A Framework for Science and Technology Advice http://publications.gc.ca/collections/Collection/C2-500-2000E.pdf

[9] https://www.halifax.ca/sites/default/files/documents/city-hall/boards-committees/CDAC-TermsofReference.pdf

[10] https://www.halifax.ca/sites/default/files/documents/about-the-city/regional-community-planning/DowntownHalifax_LUB.pdf#page=15

[11] https://www.halifax.ca/sites/default/files/documents/city-hall/legislation-by-laws/AO-2014-005-GOV.pdf

[12] https://www.halifax.ca/sites/default/files/documents/city-hall/boards-committees/IPAC-TermsofReference.pdf

[13] https://www.halifax.ca/sites/default/files/documents/city-hall/legislation-by-laws/AO-2016-001-GOV.pdf

[14] https://www.halifax.ca/sites/default/files/documents/city-hall/boards-committees/RWAB-TermsofReference.pdf

[15] See Future Directions for Scientific Advice in Europe http://www.csap.cam.ac.uk/media/uploads/files/1/future-directions-for-scientific-advice-in-europe-v10.pdf

convening expert panels and producing detailed reports. Others may be better able to provide rapid, informal advice in emergencies, by gathering inputs from a range of sources. Likewise, the approaches to scientific advising differ in terms of the level of advisory independence, plurality of opinion, degree of scientific credibility and their tendency to openness and transparency. Halifax`s hybrid approach allows the municipality to draw on the strengths of internal, external and mandated science advisory mechanisms to improve municipal decision-making.

Understanding the limitations of science: Typically, scientific investigation is often thought of as linear, leading to simple and predictable outcomes and bringing precision to a problem or question. Increasingly, however, science is being applied to systems that are complex, non-linear and dynamic. These include, for example, questions about climate, the environment, society and human behaviour. This type of science almost never produces absolute answers. Instead science serves to describe interactions, reduce uncertainty and offer an assessment of probabilities. In this context, there are limits to how, and where, scientific advice can be applied usefully by decision makers.[16] Difficult policy decisions must sometimes be made on contentious issues in the face of significant uncertainty. Many decisions that governments must make are developed in an environment of limited available information or where the use of science is unable to help decide between competing policy options.[17] These limitations of science are acknowledged in Saint Mary's University's science advising submission (see Attachment 3).

DISCUSSION

Evidence-based decision making: Evidence-based policy development refers to an approach that uses the best available objective evidence to identify and understand issues so that effective policies can be crafted. The goal of evidence-based policy development is to ensure that the experience, expertise and judgment of decision-makers is supported by the best available objective evidence and systematic research.[18] Scientific advising facilitates evidence-based decision-making by providing accurate, reliable and credible information, knowledge and analysis to inform public policy. Scientific evidence and research helps decision-makers craft policies that deliver desired outcomes effectively, with a minimal margin of error and reduced risk of unintended consequences. Evidence-Based decision making is one of the values in Halifax Regional Council's 2017-2021 Strategic Plan.

Connection to Council Priority Area: Governance and Engagement is one of six Council priority outcome areas outlined in the municipality's 2017-21 Strategic Plan. The priority outcome calls for governance structures and communications which provide maximum opportunity for public engagement and enable appropriate stewardship of municipal affairs.

Municipal policy-makers need to be able to draw on high quality scientific evidence to enable informed decision-making. Policies based on independent, objective science are more likely to be resilient over the long term and more effective than policies developed without such advice. Halifax can benefit from science advice that leads to sound government decisions, minimizes crises and capitalizes on opportunities.

An effective advisory process brings the best science advice to bear on key issues, and ensures that: (a) Council and senior management is confident that a rigorous and objective assessment of all available science was made in providing the advice; (b) credible science advice is considered (where appropriate) by decision makers; and (c) the public and politicians are confident that municipal government is using science in the best interests of all residents. These aspects of science advising are consistent with a "science for policy" approach[19], and are in line with the municipal role suggested by Saint Mary's University

[16] Decision-makers should ensure that scientific uncertainty is given appropriate weight in policy decisions and should not press experts to come to firm conclusions that cannot be justified by the evidence available.
[17] See Towards Better use of Evidence in Policy Formation http://www.pmcsa.org.nz/wp-content/uploads/Towards-better-use-of-evidence-in-policy-formation.pdf
[18] See http://www.horizons.gc.ca/en/content/case-evidence-based-policy
[19] See the discussion of 'science for policy' and 'policy for science' in Attachment 3.

(see Attachment 2).

GO FORWARD OPTIONS

Chief Science Advisor/Officer: Staff have researched Chief Science Advisor/Officer roles in other jurisdictions. Findings and recommendations concerning: (a) knowledge, skills, education and experience; (b) employment on a part-time or full-time basis; (c) term of employment; (d) mandate; and (e) remuneration are set out in Attachment 2. Commonly held Chief Science Advisor/Officer roles include:[20]

- offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation;
- undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat;
- building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally);
- increasing public support for, and understanding of, the role that science and technology play in the delivery of services and in policy development;
- participating in strategic planning for emergencies/crises;
- soliciting scientific research/advice to inform decision making;
- stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries;
- helping to coordinate scientific research by linking governmental data collection and research with academics/researchers;
- providing leadership on relevant regional, national and/or international science and engineering issues;
- advising the government on the appropriate balance between basic and applied research; and
- increasing the impact and competitiveness of governmental research programs.

Staff's capacity to fill these internal science advisory roles is illustrated by Tables 8-16 (see Attachment 8).

In staff's view, the creation of a Chief Scientific Advisor/Officer position is not advisable. There is adequate in-house expertise to meet the municipality's needs and to allow HRM to act as an 'intelligent customer' of external scientific advice. Municipal staff currently serve as an effective link between decision makers and the scientific community. In-house scientific expertise has historically helped the municipality mobilize and exploit the most appropriate external scientific expertise, with a view to establishing a sound knowledge base for better policies.

Although hiring a Chief Science Advisor/Officer would create a single point of contact, it would not appreciably enhance the municipality's ability to tap into scientific expertise.[21] Chief Science Advisors/Officers do not act as a sole source of scientific advice. Instead, Chief Science Advisors/Officers typically formulate questions, recruit scientific experts, and oversee the advisory process. These advisory functions are being fulfilled within HRM, albeit in a diffused fashion. The internal advisory role is spread throughout the organization.

RECOMMENDATION 1: Consider using, where appropriate, the procedures outlined in the HRM Public

[20] See Attachment 6 for papers discussing the role of science advisors in other jurisdictions.
[21] Creating a separate and distinct scientific advisory position also gives the impression that someone else is responsible, enabling staff to defer their responsibilities to a central unit/position rather than developing a sense of ownership necessary for the desired scientific advisory culture.

Appointment Policy[22] to increase science advisory capacity on municipal agencies, boards and committees (through competency-based recruitment and nomination of citizens for appointment).

Stand-alone science advisory body: The creation of a new standing municipal scientific advising structure/body may be problematic. Given the substantive administrative burden of forming and coordinating formal advisory bodies/standing committees, staff maintain that the advisory function would be better served by continuing to secure/access scientific expertise through existing standing committees/advisory bodies.[23] This position is consistent with the municipality's recent attempts to limit the proliferation of advisory bodies/standing committees and eliminate these bodies wherever possible. It is also consistent with Regional Council's direction regarding reducing red tape, making the delivery of municipal programs and services more efficient, and improving customer service.

RECOMMENDATION 2: Direct the CAO to draft a corporate operational policy concerning scientific advising principles and guidelines.

Principles and guidelines for science advice: Despite the diversity of advisory mechanisms, common challenges persist across all advisory systems: (a) how to protect the independence of advice while ensuring that science advice is listened to; (b) how to develop a trusted relationship with policymakers, while maintaining transparency and accountability in the eyes of the public and the science community alike; and (c) how to undertake appropriate quality assurance.[24]

Emerging science advisory principles cover the collection of advice though ad hoc and permanent expert groups; external consultants (individuals, groups or companies); and in-house expertise. The advisory principles apply to all stages in the policy-making cycle, including framing the question, selecting the advisors, producing the advice and communicating and using the advice. Although variations exist in how the principles are articulated and applied, they typically include: (1) capacity and capability; (2) timeliness; (3) role clarity; (4) independence; (5) plurality; (6) credibility; (7) proportionality; (8) uncertainty; (9) openness; and (10) transparency.

The scientific advising principles and guidelines outlined in this report have been drawn from a variety of national and international discussion papers and governmental policies (see Attachment 7). They set out a framework that encapsulates and promotes good advisory practices. The principles and guidelines could help to establish a more coherent approach to scientific advising and lay the groundwork for better policies.

RECOMMENDATION 3: Direct the CAO to conduct an annual horizon scanning exercise.

Horizon scanning: A solid scan of the horizon can help policy makers to take a longer-term strategic approach, and make present policy more resilient to future uncertainty. In contingency planning, horizon scanning helps to manage risk by planning for unlikely, but potentially high impact events. Horizon scanning involves techniques for detecting early signs of potentially important developments through a systematic examination of potential threats and opportunities. It explores novel and unexpected issues as well as persistent problems and trends (including matters at the margins of current thinking that challenge past assumptions). It is not about making predictions, but systematically investigating evidence about future trends.[25]

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[22] https://www.halifax.ca/city-hall/boards-committees-commissions/volunteer-boards-committees/public-appointment-policy

[23] Where a standing committee or advisory body with an appropriate mandate does not exist, staff can resort to securing external science advisory input on an ad hoc basis.

[24] See Science Advice to Governments: Diverse systems, common challenges http://ingsa.org/wp-content/uploads/2014/08/Science_Advice_to_Governments_Briefing_Paper_25-August.pdf

[25] See OECD Overview of Future-Oriented Methodologies https://www.oecd.org/site/schoolingfortomorrowknowledgebase/futuresthinking/overviewofmethodologies.htm

Municipal horizon scanning is currently largely based on desk research[26], used to develop the big picture behind the issues to be examined. Staff recommend an annual municipal horizon scanning exercise involving small groups of experts who are at the forefront of an identified area of municipal concern. Experts could be invited to share with the municipality their perspectives and knowledge – to 'scan' how new phenomena might influence the future. The intent of the municipal scanning exercise would be to:

- coordinate work between business units around specific topics;
- improve horizon scanning work by using a wide range of expertise to obtain new insights and challenge current thinking;
- develop/strengthen scientific advising networks to gather and share information and to gain new insights; and
- bring emerging issues to a senior-level audience.[27]

Areas of interest for a horizon scanning exercise could be identified by senior management, with the advice and input of staff, Regional Council and members of the scientific/technical community. Areas of municipal interest suited to a horizon scanning exercise include, but are not limited to**:**

- climate change and the environment (extreme weather events, sea level rise, etc.);
- the digital future (smart grid, intelligent communities, next gen telecom networks, etc.);
- the impacts of disruptive technologies (artificial intelligence, big data, robotics, block chain technology, nanotechnology, the Internet of Things[28] etc.); and
- disaster management and preparedness (radicalization,[29] terrorism, natural disasters, etc.).

Periodic horizon scanning exercises have the advantage of being time-limited, tightly-focused and guided by municipal interests. No additional burden would be put on the Municipal Clerk's Office (since the horizon scanning approach does not necessitate a standing body that would require ongoing administrative support). Needed scientific/technical expertise could be identified for each scanning exercise and experts could be invited to participate. Given the limited commitment, the scientific experts' involvement could be on a voluntary basis or be supported by a modest consultancy fee.

FINANCIAL IMPLICATIONS

There are no financial implications relating to recommendations 1 and 2. Costs associated with recommendation 3 are unknown, with no allocation in the 2018-19 budget.

Financial implications relating to Alternative 3, are subject to a full scoping of position responsibilities, required competencies and experience. A labour market assessment will be required to determine the wage rates needed to attract a qualified candidate given the scope. A full analysis by Human Resources accompanied by a labour market assessment would then allow Finance to allocate appropriate funding for the position, pending Regional Council direction. These processes would occur during the 2019-20 budget cycle.

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[26] Desk research may involve a wide variety of sources, such as the Internet, government ministries and agencies, non-governmental organizations, international organizations and companies, research communities, and on-line and off-line databases and journals.

[27] These objectives are consistent with those laid out for the UK Government's horizon scanning programme team. See https://www.gov.uk/government/groups/horizon-scanning-programme-team

[28] The Internet of Things describes a world in which everyday objects are connected to a network so that data can be shared. See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409774/14-1230-internet-of-things-review.pdf

[29] Radicalization is a process by which an individual, or group comes to adopt increasingly extreme political, social, or religious ideals and aspirations that reject or undermine the status quo or undermine contemporary ideas and expressions of the nation.

RISK CONSIDERATION

Recommendation 1: Direct the CAO to consider using, where appropriate, the procedures outlined in the HRM Public Appointment Policy to increase science advisory capacity on municipal agencies, boards and committees.

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	2	2	L	N/A
People	–	–	–	N/A
Reputation	1	1	L	
Legal and Compliance	2	2	L	N/A

Recommendation 2: Direct the CAO to draft a corporate operational policy concerning scientific advising principles and guidelines.

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	–	–	–	N/A
People	–	–	–	N/A
Reputation	1	1	L	
Legal and Compliance	–	–	–	N/A

Recommendation 3: Direct the CAO to conduct an annual horizon scanning exercise.

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	–	–	–	N/A
People	–	–	–	N/A
Reputation	1	1	L	
Legal and Compliance	–	–	–	N/A

Alternative 1: Status Quo

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	–	–	–	N/A
People	–	–	–	N/A
Reputation	2	2	L	N/A
Legal and Compliance	–	–	–	N/A

Alternative 2: Form Standing Science Advisory Body

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	2	2	L	N/A
People	–	–	–	N/A
Reputation	2	2	L	N/A
Legal and Compliance	2	2	L	N/A

Alternative 3: Create Chief Science Advisor/Officer Position.

Risk	Likelihood (1-5)	Impact (1-5)	Risk Level (I/L/M/H/VH)	Mitigation
Financial	–	–	–	N/A
Environmental	–	–	–	N/A
Service Delivery	2	2	L	N/A
People	–	–	–	N/A
Reputation	2	2	L	N/A
Legal and Compliance	2	2	L	N/A

COMMUNITY ENGAGEMENT

In preparing this report, staff met with Councilors who expressed an interest in discussing the creation of a Chief Science Advisor position. Staff also invited feedback at a meeting of the Halifax Higher Education Partnership.[30] Post-secondary institutions were asked to comment on the best use of their respective institution's scientific advising expertise. Saint Mary's University's written responses is attached to this report (see Attachment 3). Saint Mary's University recommended against the creation of a Chief Science Advisor position and instead supported the formation of a generalist scientific advising advisory body. Internal feedback was solicited on current internal science advising practices/activities. Internal responses are included in the report in business-unit-specific scientific advising tables (see Attachment 8).

[30] All post-secondary institutions in the municipality are represented on the Halifax Higher Education Partnership.

ENVIRONMENTAL IMPLICATIONS

There are no environmental implications to this report.

ALTERNATIVES

1. Status quo. Staff do not recommend the status quo for the reasons outlined in the Discussion section of this staff report.

2. Regional Council could direct the CAO to return to Council with a report to create a standing scientific advisory body to advise the municipality on matters of science. Staff do not recommend the creation of a standing scientific advisory body for the reasons outlined in the Discussion section of this staff report.

3. Reginal Council could direct the CAO to include funding for a Chief Science Advisor/Officer position within the municipality in the 2018/2019 budget. Staff do not recommend that Chief Science Advisor/Officer position be created for the reasons outlined in the Discussion section of this staff report.

Staff's findings concerning Alternative 3 are articulated in Attachment 2. As requested in the originating Regional Council motion, staff have addressed the following: (a) knowledge, skills, education and experience; (b) employment on a part-time or full-time basis; (c) term of employment; (d) mandate; and (e) remuneration.

ATTACHMENTS

1. Principles and guidelines for the effective use of science and technology advice in municipal decision making (Table 2)
2. Chief Science Advisor/Officer position – education, experience, remuneration, mandate term and part-time versus full time status (Tables 3-5)
3. Science advising submission (Saint Mary's University)
4. International science advisory structures (Table 6)
5. Canadian science academies and advisory bodies (Table 7)
6. Roles and responsibilities for science advisors – National and International
7. Science advisory principles and guidelines – National and International
8. Current municipal scientific advising practices (Tables 8-16**)**
9. Comparative advantages and disadvantages of science advising mechanisms (Table 17)

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

Report Prepared by: Scott Sheffield, Government Relations and External Affairs, 902.490.3941

Attachment 1

Principles and Guidelines for the Effective Use of Science and Technology Advice in Municipal Decision Making

Table 2 – Science advising principles and guidelines

Principle I – Capacity and capability *Leverage existing scientific advising capacity and coordinate advisory activities.*	
I-1	In-house scientific expertise should be maintained to allow government to act as an 'intelligent customer' when soliciting, and acting on, external science expertise.
I-2	Existing advisory mechanisms and bodies should be used in preference to creating new (ad hoc or permanent) advisory mechanisms.[31]
I-3	Research priorities should be established to form a knowledge base that will support future science-based decision making.
I-4	In the case of cross-cutting policy issues, business units should co-ordinate efforts to solicit expert input relevant to the issue (to avoid unnecessary duplication).
Principle II – Early issue identification and timeliness *Anticipate, as early as possible, those issues for which science advice will be required*	
II-1	Policy issues that require expert advice should be identified as early as possible in the policy cycle.
II-2	Horizon scanning should look broadly, beyond current areas of interest, and should address opportunities as well as risks.
II-3	The timing of the government's response to scientific advice should allow for proper consideration of that advice.
II-4	The need to anticipate future research and policy needs is as important as shorter term reactive research requirements.[32]
II-5	How scientific advice is provided in an emergency should be clearly understood prior to the crisis (including clear designation of responsibility, processes to be employed and sources of advice).
Principle III – Inclusiveness *Draw advice from a variety of scientific sources and from experts in relevant disciplines*	
III-1	Questions (that scientific experts need to address) should be framed to cover the interests and concerns of all relevant partners, including consumers and citizens.
III-2	Advice should be drawn from a variety of scientific sources and from experts in multiple disciplines to capture diverse scientific schools of thought and opinion.[33]

[31] Informal science advisory contacts may provide rapid results, and are often appropriate at very early stages in the policy process, and for non-sensitive questions.
[32] Where research is needed to answer key questions important to policy formulation and/or its implementation, significant lead time may be necessary.
[33] This diversity may result from differences in scientific approach, different types of expertise, different institutional affiliations, or contrasting opinions over the fundamental assumptions underlying the issue. Depending on the issue (and the stage in the policy cycle) pluralism also entails taking account of minority and non-conformist views, multi-disciplinary expertise and multi-sectoral expertise. Other factors may also be important, such as geographical, cultural and gender perspectives.

III-3	The advisory process should include those with practical knowledge gained from day-to-day involvement in an activity.
III-3	Scientific advisors (on permanent advisory bodies) should be regularly rotated, with replacements chosen to preserve balance of representation.

Principle IV – Proportionality *Collect and use science expertise in proportion to the task at hand*	
IV-1	Science expertise should be solicited and used in proportion to the task at hand (considering the sector concerned, the issue in question, and the stage in the policy cycle).[34]
IV-2	The way science experts are involved (in-house, consultancy, expert group, etc.) should be determined by the urgency, complexity and sensitivity of the policy issue.[35]
IV-3	A scoping exercise should determine the profile of expertise required. The nature of the issue in question should determine the optimum mix.

Principle V – Independence *Employ measures to ensure the independence and integrity of scientific advice.*	
V-1	Scientists and science advisors should have the flexibility, within the issue being examined, to explore the range of conclusions and interpretations that the scientific findings might suggest.
V-2	As far as possible, experts should be expected to act in an independent manner. The aim is to minimize the risk of vested interests distorting the advice offered.[36]
V-3	Scientific advisers should be free to publish/present their research/advice, including when it appears to be inconsistent with governmental policy (subject to normal confidentiality restrictions).
V-4	The academic freedom, professional status and expertise of independent scientific advisers should be respected.
V-5	Decision-makers should be conscious of possible biases among the science advisors and in the science advice received.

Principle VI – Credibility *Employ measures to ensure the quality of scientific advice.*	
VI-1	Experts should clearly highlight the evidence (sources, references, etc.) upon which they base their advice, as well as any persisting divergent views.
VI-2	All evidence, analyses, finding and recommendations should be subject to critical evaluation; however, this can take different forms and needs to be proportionate to the nature of the evidence and its use.[37]

Principle VII – Uncertainty *Consider the degree and nature of scientific uncertainty when reaching decisions and making policies.*

[34] Methods suitable for minor policy changes will probably be inadequate in sensitive cases, when the underlying science may be highly uncertain and when also the 'stakes are high' in terms of the political, social, economic or environmental consequences of an eventual policy decision.
[35] The relative merits and drawbacks of external, mandated and internal approaches to science advising should be weighed on a case-by-case basis (see Table 17).
[36] By establishing practices that promote integrity, by making dependencies explicit, and by recognizing that some dependencies – varying from issue to issue – could impinge on the policy process more than others
[37] Consideration should be given to: (a) novelty and complexity of the information; (b) importance of the information to the decision making; (c) extent of prior peer reviews; and (d) expected benefits and costs of critical evaluation.

VII-1	Science advisors should ensure that scientific uncertainty is weighted fairly, is explicitly and fully identified in scientific results, and is communicated directly in plain language to decision makers.
VII-2	Decision-makers should not press experts to come to firm conclusions that cannot be justified by the evidence available.
VII-3	The level of confidence and appropriate caveats should be stated where analysis/advice has been done/provided over a short time-frame.[38]
VII-4	Decision-makers should ensure that scientific uncertainty is given appropriate weight in decisions.
VII-5	Policy-makers should state clearly what precautionary approaches are being taken in response to scientific uncertainties identified during the advisory process.

Principle VIII – Role Clarity
Define the remit, roles and responsibilities of advisory bodies and advisory positions.

VIII-1	What role(s) experts are being asked to perform and the boundary of their role(s) should be made clear.[39]
VIII-2	Boundaries should be reasonable and agreed to at the start to avoid any misunderstanding later in the advisory process.[40]
VIII-3	Scientific advisers should respect the democratic mandate of municipal government to take decisions based on a wide range of factors and recognize that science is only part of the evidence that the municipality must consider in developing policy.

Principle IX – Openness
Employ decision-making processes that are open to stakeholders and the public.

IX-1	Early warning of significant (science-related) policy and regulatory initiatives should be given to stakeholders and the public.
IX-2	Where possible, there should be public involvement in framing the questions that experts and policy makers need to address.
IX-3	Decision-makers should be open to both solicited and unsolicited advice from external advisory sources, stakeholders and the public.[41]
IX-4	The level of expected risk and controversy, and the need for timely decisions, should guide the nature and extent of consultation undertaken.
IX-5	Decision-makers should remain open to revisiting issues and policy decisions in the light of new or changing evidence.

[38] There will inevitably be occasions where advice is required within a few days, or even within hours. Decision makers should therefore also be made aware of the period of notice which policy makers and specialists have had to prepare advice.
[39] These roles can include: (a) review of existing data and research sources; (b) collection and analysis of new scientific data; (c) interpretation of research from different sources; (d) application of expert judgement where data is lacking or inconclusive; (e) identification of policy options based on data and research evidence; and (f) providing expert scientific and engineering advice on policy options.
[40] The municipality may wish to consult interested parties on the framing of the questions and underlying assumptions, particularly on sensitive issues. A determination should be made whether the available expertise covers the topics to be addressed and whether sufficient pertinent background information and data are available to ensure that there is a clear understanding of the advisory tasks assigned.
[41] Inclusiveness enhances the debate and draws in scientific findings which may not otherwise be considered; sound science thrives on the competition of ideas facilitated by the open publication of data and analyses.

Principle X – Transparency
Present policies in open fora, and grant public access to the findings and advice of scientists.

X-1	How scientific advising issues are framed and experts are selected should be communicated to stakeholders and the public
X-2	The scientific evidence should be published in a way that is meaningful to the non-expert.
X-3	The scientific analysis and judgement that went into it, and any important omissions in the data, should be clearly identified and made available to stakeholders and the public.[42]
X-4	The reasons for policy decisions should be explained publicly, particularly when the decision appears to be inconsistent with scientific advice (in doing so, the evidence should be accurately represented).
X-5	When responding to public concerns over emerging findings, government should communicate the level of quality assurance and peer review which has been carried out,

[42] This guideline does not override existing municipal policies regarding limitations on the release of information (for example, for the protection of privacy, proprietary information, intellectual property, etc.)

Attachment 2

Chief Science Advisor/ Officer - education, experience, remuneration, mandate, term and part-time versus full time status

Chief Science Advisor/Officer – knowledge, skills, education and experience: The Ontario and Federal governments both recently announced the creation of science advisory positions. In the case of Ontario, consultations were conducted with the scientific community, and the public, to develop a science advisory mandate and establish the qualifications for the advisory position. The feedback received suggested that the science advisor should have the knowledge, skills and abilities set out in Table 3 (see below) and the education and experience set out in Table 4 (see below).

Table 3 – Knowledge, Skills and Abilities (CSO/CSA)

Knowledge of the government machinery and its decision-making process, as well as knowledge of science and technology policy.	Knowledge of the challenges and opportunities facing evidence-based policy-making within government.
Ability to provide scientific advice in support of policy decisions in an authoritative and independent manner, combining knowledge and experience and effectively addressing the limits of science, the insufficiency of evidence, and appropriately framing uncertainties.	Superior communication skills, both written and oral, including the ability to develop and maintain effective relationships and networks with internal and external stakeholders, including academia, industry and the wider public.
Knowledge of the state of current scientific evidence – including accepted theories, established findings and existing uncertainties – outside the candidate's field of specialization.	Ability to provide constructive scientific advice on contentious issues where considerations include, but are not limited to, science, and recognizing her/his advisory role in the context of decision-making.
Ability to think creatively, with a strategic vision for science that extends to the longer term.	Ability to work effectively within a committee or working group framework with various governmental actors.
Knowledge of scientific and non-scientific issues relevant to the government.	Ability to evaluate evidence and to weigh up conflicting evidence from a wide range of disciplines.
Proficiency in both official languages preferred.	

Table 4 – Education and experience (CSO/CSA)

A doctoral degree in natural sciences, mathematics, engineering sciences, health sciences or social sciences.	Demonstrated leadership and management experience within public or private research organizations
Significant experience as a scientific research practitioner and peer reviewer, with a strong record of peer-reviewed publications in a relevant field of specialization.	Experience participating in scientific advisory bodies established by government (e.g., expert panels, task forces, committees).
Involvement in scientific reviews within legislative or regulatory processes.	Experience promoting transparency and integrity in scientific research.
Experience evaluating scientific or research programs or projects.	

Chief Science Advisor/Officer – part-time or full-time basis: Science advisors should be employed part-time. Science advisors need to maintain and develop links with the scientific and industry communities. Continued research, for example, helps science advisors to keep their knowledge and networks up-to-date. Part-time employment ensures that science advisors maintain their useful external networks for the period of the appointment.[43]

Chief Science Advisor/Officer – term of appointment: Typically, Chief Science Advisor/Officer appointments are made on a term basis. Evidence from other jurisdictions suggests that science advisors require at least one year to become familiar with governmental processes and develop a working relationship with decision-makers. Long term science advisor appointments are uncommon. Shorter duration appointments minimize the risk that the Chief Science Advisor/ Officer becomes imbedded in the bureaucracy and loses the ability to provide independent and objective advice to decision-makers.[44]

Chief Science Advisor/Officer – mandate: An internal science advisor could potentially serve two different functions – a Chief Science Officer (CSO), providing 'policy for science' advice or a Chief Science Advisor (CSA), providing 'science for policy' advice. Given the differing nature of these two roles, it would be challenging to try and fulfill both functions within one position. Although distinct, the functions of CSAs and CSOs do overlap (as reflected in Table 5, below). Staff maintain that an advisory mandate focused on 'science for policy,' consistent with the Chief Science Advisor functions set out in Table 5 below, would be consistent with the advisory needs of the municipality

[43] For a detailed discussion of part-time versus full-time employment status (vis-à-vis science advisors), see https://publications.parliament.uk/pa/ld201012/ldselect/ldsctech/264/264.pdf
[44] For a detailed discussion of length of appointment (vis-à-vis science advisors), see https://publications.parliament.uk/pa/ld201012/ldselect/ldsctech/264/264.pdf

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Table 5 – CSO and CSA mandate

Science advice mandate	Chief Science Officer	Chief Science Advisor
Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	+	+++
Undertaking horizon scanning to raise scientific research/ developments that entail either an opportunity or a threat.	++	++
Building relationships with high-level advisory groups/ structures and other advisors (regionally, nationally and internationally).	+++	+++
Increasing public understanding, support and appreciation for the role that science and technology play in our society and in policy development.	+	++
Liaising with sectors outside of government to communicate and advocate for the scientific community.	++	
Determining future priorities and opportunities for governmental investments in science and research.	+++	
Participating in strategic planning for emergencies/crises.	+	+++
Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	+++	+
Providing leadership on relevant national and international science and engineering issues.	++	
Helping to coordinate scientific research by linking government research with that done by academics.	++	+
Advising the government on the appropriate balance between basic and applied research.	++	
Increasing the impact and competitiveness of governmental research programs.	++	
Protecting governmental science from inappropriate political interference.	++	

Table Legend: + existing feature ++ important feature +++ strong feature

Chief Science Advisor/Officer Remuneration: Because there is no municipal comparator, a labour market assessment will be required to determine the wage rates needed to attract a qualified candidate based on a full scoping of position responsibilities, required competencies and experience. Provisionally, the Chief Science Advisor/Officer hire would be classified as a P3 position. The salary band (on a full-time annual basis) would be $88,000 to $110,000.

Attachment 3
Science Advising Submission (Saint Mary's University)

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Response from Saint Mary's University on Halifax Regional Municipality Science Advisor Position

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Saint Mary's University would first like to applaud the Halifax Regional Municipality (HRM) for being forward looking, and considering the important issue of science advice to local government. As is widely known, science advisors are becoming prominent in policy making at the federal and provincial levels within Canada, at least partially in response to the increasingly technological and science-oriented nature of our world.

Focusing on our local concerns, there are many pressing issues for the HRM that require science advice. From sea-level rise and understanding the statistical implications of forecasts, through to operational issues such as "how much road salt will cause long-term damage to biota city lakes?", it is hard to imagine a day goes by without an issue in HRM operations and policy-making that does not require some scientific inputs. We thus reiterate strongly that we fully applaud this initiative, and it places the HRM at the forefront of municipalities on being proactive in evidence-based policy-making.

Before answering the questions asked in the charge, we would like to note the important difference in science advising at the federal and provincial levels, versus local government. At the federal and provincial levels, science funding portfolios often feature prominently in the mandate of science advisors; however, it should be emphasized there is a distinct difference between having advisors comment on *policy for science* versus *science-based inputs for policy*. At the local government level, the latter of these two issues is clearly the most prominent, although it is notable that some national governments (most notably New Zealand) are careful to make this distinction.

Ironically one of the most important aspects of science advice is ensuring that the limits of science are properly understood in the policy context. It is important that policy-makers be adequately informed about what is reasonable and practical to achieve by the scientific method. Removing the concept of

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science as providing certainty - it does not - and instead highlighting the role of probability is an important, if somewhat uncomfortable, aspect of providing meaningful science advice in the policy context.

With respect to the two questions specifically noted in the charge:

1) What role (if any) do you see your institution playing vis-à-vis scientific advising?

Saint Mary's University has a long tradition of community-engaged research, and it forms one of the five university-wide initiatives in our current strategic framework. A number of our faculty have contributed directly to important historical and social issues within the HRM (the Cornwallis issue being a notable recent example). Science, Arts, and Business faculty at SMU work on a wide variety of issues related to local and regional governance – with some examples being: coastal geomorphology, aquatic ecosystem health, invasive species, water monitoring (quality and pollution), atmospheric & light pollution, immigration policies and impacts, long-term care and care of an aging population. Importantly, almost all this research is carried out in association with students, and in some cases with HRM community volunteers ("citizen-science" projects). Looking to the future, many of these issues – which ultimately speak to sustainability – are set to become increasingly important.

Consequently, we view SMU as providing a resource of both expertise of established knowledge, as well as being a vehicle for addressing pressing questions in science-related local policy. Indeed the strategic framework of the university emphasizes that our mission is to serve governance from the local to international levels. Moreover, as constituents increasingly demand transparency of governance, open public institutions naturally fit into that framework as a function of their independence and accountability. In our view there is strong potential for a relationship between HRM policy-making and SMU to be of mutual benefit to all constituents in the HRM.

2) What option(s) would make the best use of your institutions scientific advising expertise?

We have considered this question from an operational perspective of what we view as best for the HRM. Solely from a policy-input perspective, it is likely that an in-house advisor would provide the most direct input into decision-making. There is little substitute for having an individual available on short notice (assuming of course that stakeholders in policy-making choose to make use of the advice mechanism). Such a position would essentially be one of knowledge brokerage, translating scientific issues into policy-relevant language, and rely upon a network of connections to inform decision making. However, a single individual: would potentially be hampered by conflict-of-interest issues (whether from the public or private sector); may find it challenging to maintain the trust of various stakeholders; may have their independence questioned (e.g. are they a broker or advocate?); and, have a capacity to address issues limited by (at least initially) the breadth of their personal network.

We thus view the idea of having a generalist advisory body to be the most practical solution. While the precise details of composition are a challenging optimization problem, it is our view that a suitable

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composition would be: an HRM staff member, two councillors to provide direct connection to council, representatives from the post-secondary institutions in the area with science-based research, and representatives from the private sector. The Chair of the committee would ultimately serve as the primary conduit for advice, and would clearly need to be well respected and have broad connections; but rather than relying on a single individual, having multiple members on the committee ensures that different stakeholders can interface through their preferred avenues. Additionally, a generalist body provides advantages over external advisories in that the representatives will have local knowledge that is important in the knowledge-translation process. External advisory bodies can be approached where necessary, and specialist committees could also be struck when circumstances warrant. An advisory body is also more distant from policy-making than an individual (although, depending on the point-of-view, this may or may not be an advantage of the panel). Lastly, such a body *must* have a strong initial mandate and be recognized as a part of policy-making by the governmental process.

Horizon scanning presumes that policy-making copes adequately with science questions on a short-term basis, and that the science primarily informs longer-term issues. While there obviously are issues that have longer-term cadences (e.g. sea level rise being one of the most obvious), problems with changes to local pollution, sudden influxes of invasive species, etc., can have short- and long-term impacts. Hence we view this particular mode of informing policy as limited.

Attachment 4
International science advisory structures

Table 6 – International science advisory structures

Jurisdiction	National Science Advice Structure/s	Chief Advisors/Key institutions
Australia	National Academy	Australian Academy of Science
Australia	Chief Science Advisors	National: Ian Chubb NSW Chief Scientist and Engineer, Mary O'Kane QLD Chief Scientist, Geoff Garrett VIC Lead Scientist, Leonie Walsh Chief Scientist of WA, Peter Klinken
Australia	State Government Science Agency	The NSW Office Dr. Kate Wilson Western Australia Office of science
Austria	National Academy	Austrian Academy of Sciences
Canada	Advisory Council	Science, Technology and Innovation Council
Canada	National Academy	The Royal Society of Canada Council of Canadian Academies
Canada	Chief Science Advisors	National: Chief Science Advisor Quebec: Chief Science Advisor
China	National Academy	Chinese Academy of Sciences Chinese Academy of Social Sciences Chinese Academy of Engineering
Cuba	National Academy	Academia de Ciencias de Cuba
Cuba	Chief Science Advisor	Castro Díaz-Balart
Denmark	National Academy	Royal Danish Academy of Sciences and Letters
El Salvador	National Academy	Viceministerio de Ciencia y Tecnología
Finland	Advisory Council	The Council of Finnish Academies
France	National Academy	French Academy of Sciences
Germany	National Academy	German National Academy of Sciences Leopoldina Deutsche Forschungsgemeinschaft (DFG)
Greece	National Academy	Academy of Athens
India	National Academy	Indian National Science Academy
Ireland	National Academy	Royal Irish Academy
Ireland	Chief Science Advisor	Mark Ferguson
Italy	National Academy	L'Accademia Nazionale dei Lincei
Japan	Advisory Council	Council for Science Technology and Innovation (CSTI)
Kenya	National Academy	Kenya National Academy of Sciences
Malaysia	National Academy	Academy of Sciences Malaysia

Mongolia	National Academy	Mongolian Academy of Sciences
New Zealand	National Academy	Royal Society of New Zealand
New Zealand	Chief Science Advisor	Sir Peter Gluckman
Portugal	National Academy	Academia das Ciencias de Lisboa
South Africa	National Academy	Academy of Science of South Africa (ASSA)
South Korea	National Academy	National Academy of Sciences, Republic of Korea
Sweden	National Academy	Royal Swedish Academy of Sciences
Switzerland	National Academy	Swiss Academy of Sciences
Thailand	Advisory Council	National Research Council of Thailand
United Kingdom	National Academy	Royal Society
United Kingdom	Chief Science Advisors	National: Government Chief Scientific Adviser Departmental science advisors are listed online.
United States of America	National Academy	National Academy of Sciences
United States of America	Chief Science Advisor	Science Advisor to the President (Currently vacant)

Attachment 5
Canadian Science Academies and Advisory Bodies

Table 7 – Canadian Science Academies and Advisory Bodies

The Canadian Academy of Engineering (CAE)[45]	Established in 1987, the Canadian Academy of Engineering (CAE) is an independent, self-governing and non-profit organization. Members are nominated and elected to honorary fellowships by their peers, for their distinguished achievements and career-long service to the engineering profession. CAE provides advice to government, industry, academia and Canadians at large on issues where engineering considerations play a role. The Academy collaborates with like-minded national and international organizations in developing a common voice on emerging issues important to Canada and the world.
The Canadian Academy of Health Sciences (CAHS)[46]	Founded in 2004, the Canadian Academy of Health Sciences (CAHS) brings together Canada's top-ranked health and biomedical scientists and scholars (from all disciplines working in healthcare and research institutes and universities). Since 2006, CAHS has engaged the sponsorship of a wide variety of public and private organizations representing patients and families, professionals, health system leaders, policy-makers, and service and private industry providers. CAHS co-invests in independent assessments that address key health issues with outcomes that have shaped strategic policies and initiatives
The Council of Canadian Academies (CCA)[47]	Founded in 2005, the Council of Canadian Academies (CCA) is an independent, not-for-profit organization.[48] The CCA's work encompasses a broad definition of science, incorporating the natural, social and health sciences as well as engineering and the humanities. In 2015, CCA received a $15 million endowment from the Government of Canada to complete up to four assessments per year, over a five-year period.[49] The CCA may also conduct assessments outside of its agreement with the federal government. Potential questions for assessment can be referred to the CCA by foundations, non-governmental organizations, the private sector, or any level of government. Assessments may consider emerging issues, gaps in knowledge, Canadian strengths, and international trends and practices.

[45] https://www.cae-acg.ca/
[46] http://www.cahs-acss.ca/
[47] http://www.scienceadvice.ca/en.aspx
[48] The CCA draws upon the intellectual capital of its three member academies: the Royal Society of Canada (RSC); the Canadian Academy of Engineering (CAE); and the Canadian Academy of Health Sciences (CAHS).
[49] Assessments are conducted by multidisciplinary panels of experts from across Canada and abroad.

National Research Council (NRC) of Canada[50]	The National Research Council (NRC) is the Government of Canada's premier research organization supporting industrial innovation, the advancement of knowledge and technology development, and fulfilling government mandates. NRC is a Government of Canada organization. Its mandate is set out in the National Research Council Act. Under the Act, NRC is responsible for: (a) undertaking, assisting or promoting scientific and industrial research in fields of importance to Canada; (b) providing vital scientific and technological services to the research and industrial communities; (c) investigating standards and methods of measurement; (d) working on the standardization and certification of scientific and technical apparatus, instruments and materials used or usable by Canadian industry; (e) operating and administering any astronomical observatories established or maintained by the Government of Canada; (f) Establishing, operating and maintaining a national science library; and (g) publishing and selling or otherwise distributing such scientific and technical information as the Council deems necessary.
The Royal Society of Canada (RSC)[51]	Founded in 1883, The Royal Society of Canada (RSC) includes three bilingual Academies embracing a broad range of scholarly disciplines and artistic fields. The Society promotes learning and research in the arts, the humanities and the natural and social sciences. It undertakes a range of initiatives, including bestowing awards and honours, organizing and hosting symposia. In the early 2000s RSC launched an expert panel initiative with a mandate to carry out independent, authoritative, evidence-based expert panel assessments to inform public policy development. Expert panels bring together scholars and researchers from diverse disciplines to provide insight, advice and recommendations to Canadian governments, industry and NGOs.
The Science, Technology and Innovation Council (STIC)[52]	Established in 2007, the Science, Technology and Innovation Council (STIC) is an independent advisory body embedded within the Department of Industry, and mandated by the Government of Canada to provide confidential advice on science, technology and innovation (STI) policy issues. This advice helps inform government policy development and decision making. STIC is also mandated to produce biennial, public state of the nation reports that benchmark Canada's STI performance against international standards of excellence.

[50] https://www.nrc-cnrc.gc.ca/eng/
[51] http://rsc-src.ca/
[52] http://www.stic-csti.ca/

Attachment 6
Roles and Responsibilities and Science Advisors – National and International

- **Government of the United Kingdom (2012)** *The role and functions of departmental Chief Scientific Advisers*

  https://publications.parliament.uk/pa/ld201012/ldselect/ldsctech/264/264.pdf

- **European Parliament (2016).** *Scientific advice for policy-makers in the European Union*

  http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/589777/EPRS_BRI(2016)589777_EN.pdf

- **The Royal Society of Canada (RSC) (2015)** *Strengthening Government by Strengthening Scientific Advice: Fully realizing the value of science to Canadian society*

  https://www.rsc-src.ca/sites/default/files/pdf/PP_SA_EN.pdf

- **Ontario Bioscience Innovation Organization (2017)** *Ontario's First Chief Science Officer Feedback Submission*

  https://static1.squarespace.com/static/55bbf3f3e4b08b3622073685/t/58da81fcff7c500d7b47f080/1490715134498/Ontario%27s+First+Chief+Science+Officer.pdf

- **European Commission (2015)** *Future Directions for Scientific Advice in Europe*

  http://www.csap.cam.ac.uk/media/uploads/files/1/future-directions-for-scientific-advice-in-europe-v10.pdf

Attachment 7
Science Advisory Principles and Guidelines – National and International

- **Government of Canada (1999)** *Science Advice for Government Effectiveness (SAGE)*

  http://publications.gc.ca/collections/Collection/C2-445-1999E.pdf

- **Government of Canada (2001)** *Framework for Science and Technology Advice: Principles and Guidelines for the Effective Use of Science and Technology Advice in Government Decision Making.*

  http://publications.gc.ca/collections/Collection/C2-500-2000E.pdf

- **Government of the United Kingdom (2010)** *The Government Chief Scientific Adviser's guidelines on the use of scientific and engineering advice in policy making.*

  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293037/10-669-gcsa-guidelines-scientific-engineering-advice-policy-making.pdf

- **Government of the United Kingdom (2010)** *Principles of scientific advice to government.*

  http://www.bis.gov.uk/go-science/principles-of-scientific-advice-to-government

- **Government of the United Kingdom (2011)** *Code of Practice for Scientific Advisory Committees.*

  http://www.bis.gov.uk/assets/goscience/docs/c/11-1382-code-ofpractice-scientific-advisory-committees.pdf

- **The Commission of the European Communities (2002)** *Communication from the Commission on the Collection and Use of Expertise by the Commission: Principles and Guidelines – Improving the knowledge base for better policies.*

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2002:0713:FIN:EN:PDF

- **European Academies Science Advisory Council (2011)** *European Academies Science Advisory Council Guidelines – Good Practice in the Dialogue Between Science Academies and Policy Communities.*

  http://www.easac.eu/fileadmin/ppt/Science-Policy-Dialogue/Short_EASAC_Guidelines_PDF.pdf

- **European Commission (2010)** *Communicating research for evidence-based policy making: A practical guide for researchers in socio-economic sciences and humanities.*

  http://ec.europa.eu/research/socialsciences/pdf/guide-communicating-research_en.pdf

- **The Swiss Academies of Arts and Sciences (2011)**. *Scientific Policy Advice. Recommendations of the Swiss Academies of Arts and Sciences for Researchers.*

  http://www.swiss-academies.ch/en/index/Aktuell/News.html

Attachment 8
Current Municipal Science Advising Practices

Table 8 – Scientific Advising Practices | Energy and Environment Program (P&D)

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	Reviewing and synthesizing peer-reviewed and grey literature related to specific topics, as required, to inform staff reports; Researching peer-reviewed and grey literature related to specific topics, as required, to inform RFPs and other procurement processes; Participating in scientific/technical conferences, seminars and webinars to stay abreast of emerging issues relevant to Energy & Environment program themes. **OPERATIONAL EXAMPLE:** Energy & Environment has proposed a Contaminated Site Management policy to provide an efficient, consistent, accurate and effective contaminated sites management framework to support municipal operations and services in HRM, and to comply with the provincial Contaminated Sites Regulations, effective July 6, 2013.
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	Monitoring, reviewing and synthesizing emerging literature, both peer-reviewed and grey (e.g., subscribing to journal publication alerts) focused on energy, energy management, energy efficiency, renewable technology, transportation and fleet improvements such as electric vehicle, climate change mitigation and adaptation and other Energy & Environment thematic areas; Participating in scientific/technical conferences, seminars, workshops and webinars to stay abreast of emerging issues relevant to Energy & Environment program themes. **OPERATIONAL EXAMPLE:** Energy & Environment has completed a petroleum storage tank inventory for all tanks owned by HRM. The inventory contains information that will help plan and budget for tank decommissioning and replacement timelines and to ensure compliance with the NSE petroleum storage tank registry. This information will also aid to reduce risk and maintain insurance coverage.

3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	Engaging directly in multilateral forums focused on scientific/technical themes (e.g., Lidar Working Group, UFMP Working Group, QUEST Nova Scotia's Municipal Energy Learning Group, QUEST NS District Energy and Combined Heat and Power Working Group, QUEST NS Buildings Working Group, QUEST National for Community Energy Planning and District Energy Working Group, Efficiency Nova Scotia Demand Side Management Advisory Group); Liaising with and/or observing multilateral forums focused on scientific/technical themes (e.g., NRCan's Office of Energy Efficiency, QUEST NS Caucus); Monitoring scientific/technical listservs and other online forums to stay abreast of new information relevant to the program's objectives (e.g., Canadian Urban Foresters' listserv, Canadian Urban Sustainability Practitioners' Network, CleanTechnica, ASHRAE, Rocky Mountain Institute, Association of Energy Engineers, American Council for an Energy Efficient Economy); Engaging consultants with scientific/technical expertise to conduct research and analysis to inform municipal operations, staff reports and policy documents; Participating in national and international advisory organizations (e.g., Environment Canada's Road Salt Management Working Group and Salt Vulnerable Areas Subcommittee; North American Lakes Management Society (NALMS), QUEST National). **OPERATIONAL EXAMPLE:** Energy & Environment, acting on behalf of the department responsible for the contaminated sites, is responsible for the contaminated site with respect to the duty to notify Nova Scotia Environment. If, during an environmental assessment conducted by an environmental consultant, E&E becomes aware that the property has conditions requiring notification or from an accidental chemical release, then E&E must provide notification to the Minister in accordance with the Contaminated Sites Regulations using form FRM-100, Notification of Free Product or Contamination.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	Delivering guest lectures and invited presentations, and participating in panel discussions, focused on scientific/technical themes related to Energy & Environment program objectives (e.g., panel discussion on sea-level rise and flood risk in HRM, presentations related to HRM's Community Energy Plan, presentation and panel discussion on energy poverty, presentations on Solar City); Developing a white paper in conjunction with stakeholder with the QUEST DE Working group to understand best practices for district energy implementation through strong policy and planning; Developing an Open Data initiative to show the solar energy generation through participating property owners in the Solar City program; Participating in trade shows and similar public marketing forums related to Energy & Environment's program areas. **OPERATIONAL EXAMPLE:** Energy & Environment reviews permit requests for excavating within a HRM's right-of-way when a site has been reported as contaminated. E&E provides the necessary health and safety requirements for a contractor when excavating or handling contaminated material and for the proper transport and disposal requirements for contaminated materials.
5	Participating in strategic planning for emergencies/crises.	Monitoring, reviewing and synthesizing new research/literature related to disaster risk reduction; Participating in multilateral forums focused on climate change adaptation and risk reduction (e.g., Ecology Action Centre's Sea-level Rise Working Group). **OPERATIONAL EXAMPLE:** The proposed Management of Contaminated Sites policy will be implemented as a corporate policy of HRM. The objective of this policy is to provide clarification of the required roles and responsibilities of HRM staff regarding contaminated sites response, remediation, data management and notification. Where available, site specific emergency response plans are to be followed and will work in conjunction with this policy. E&E has made itself available to the EMO office if needed.

6	Soliciting scientific research/advice to inform municipal decision making.	Consulting with scientific/technical experts to assist the development of staff reports, policy pieces or procurement documents (e.g., consulting with NRCan scientists in the development of specs for the 2016-19 lidar data acquisition project); Participating in scientific/technical conferences, seminars and webinars to stay abreast of emerging issues relevant to Energy & Environment program themes. Consulting with scientific and engineering experts to help guide the Sackville River Floodplain study, including inclusion of reference to the impacts of climate change. **OPERATIONAL EXAMPLE:** Energy & Environment retains qualified environmental/engineering consultants to conduct Phase I and Phase II environmental site assessments, hazardous material surveys and remediation projects during site decommissioning, land transfers and site development projects.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	Providing property owners with information on local service providers offering solar PV, solar hot air and solar thermal technologies as renewable energy options; facilitating the expansion of the local solar energy industry through HRM-led property owner incentive programs; see above re Solar City's development to provide open data for solar electric generation through the program and relaying information from real time electrical generation from solar in 5 min intervals. **OPERATIONAL EXAMPLE:** Energy & Environment's successful Solar City Halifax program uses a Local Improvement Charge to offer Property Assessed Clean Energy (PACE) financing to property owners to pay for equipment and installation provided by local solar energy contractors. The program brings together local service providers and property owners in a mutually beneficial relationship that stimulates the local economy and promotes healthy, livable communities. We also allowed Solar City data from the pilot to be used in a Hackathon at Dalhousie University for a smart app for participants, focused on maximizing solar system installations and big data analysis.
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	Actively advising/supervising students conducting scientific/technical research related to program objectives. Collaborating and sharing municipal data with local academics to undertake mutually beneficial studies or empirical research (e.g., collaboration with Dalhousie University's School of Resource and Environmental Studies on the development and implementation of the UFMP); Providing feedback on the development of local government-focused academic research (e.g., advising researchers from the University of Waterloo on the development of municipal Communities of Practice around flood risk governance); **OPERATIONAL EXAMPLES:** The Solar City Halifax program provides solar PV & solar hot water generation data, water quality and other lake-related data to students and researchers at NSCC, Dalhousie University, and others in support of class projects and/or academic theses; in the early 2000s the Dalhousie Eco-efficiency group developed and maintained the 0 Colford Ave property through an agreement with HRM's then-Energy & Environment section. They were treating runoff from the former Dartmouth landfill (under the Don Bayer Sportsfield across the street), using a series of sedimentation ponds to treat the leachate. Once Dalhousie has completed their studies at this site HRM may be required to maintain this site as per ongoing NS Environment requirements.
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	Engaging with scientific/technical staff at the Province of Nova Scotia to advise on energy/renewables, climate change, water resources and contaminated sites matters overseen by the province; Engaging with scientific/technical experts at Efficiency Nova Scotia/Efficiency One, Clean Foundation and Solar Nova Scotia on thematic issues.

10	Advising the government on the appropriate balance between basic and applied research.	Engaging directly or indirectly in scientific/technical consultations related to government environmental policy (e.g., compiling HRM's submission for the 5-year review of the Nova Scotia Environmental Goals and Sustainable Prosperity Act; Solar Electricity for Community Building pilot program; Energy Planning); Participating in scientific/technical conferences, seminars and webinars to stay abreast of emerging issues relevant to Energy & Environment program themes; Liaising with relevant program staff at NS Department of Energy, NS Environment, NS Department of Natural Resources and NS Fisheries and Aquaculture. **OPERATIONAL EXAMPLE:** E&E is currently engaged in discussions with NS Environment and Halifax Water over the use and maintenance of retention ponds that currently serve both as municipal infrastructure and possibly as water courses. Provincial regulations address both surface water and sediment quality but it is not clear how water quality in HRM storm water infrastructure is treated, necessitating further research and discussion between all parties.
11	Increasing the impact and competitiveness of governmental research programs.	Actively seeking federal or provincial funding to conduct municipal studies or research projects of a scientific/technical nature (e.g., 2016-2019 lidar data acquisition project funding via the federal Natural Disaster Mitigation Program). **OPERATIONAL EXAMPLE:** Pending the results of the lidar data acquisition project, Energy & Environment will produce an updated digital elevation model for the municipality as well as maps of coastal flood vulnerability for HRM's entire 2,400 km coastline. These digital products will enhance the quality of HRM's maps for planning, emergency services, recreation and climate change preparedness, in addition to providing the public and the researchers with high-quality geospatial data via HRM's Open Data portal.

Table 9 – Scientific Advising Practices | Regional and Community Planning Program (P&D)

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	Regional and Community Planning obtains, synthesizes, analyzes and presents socioeconomic and geographic data to evaluate alternatives for policies and regulations guiding the conservation and development of land and buildings. We present our analysis using maps, diagrams, photos and text. We work with other Business Units and relevant agencies to understand how their proposals and recommendations interact with ours, and try to optimize alignment between their policies and ours for the benefit of municipal stakeholders including the public, with an emphasis on quality of life, affordability, social equity and long-term economic viability. Specialized or urgent analytical work is contracted out to consultants, but our internal staff typically do interdisciplinary, geographically oriented analysis with the assistance of Planning Technicians. We also design, conduct, tabulate and analyze public consultation, including surveys, questionnaires, focus groups and workshops. These enable us to gain local knowledge as well as a sense of local values from residents and other stakeholders.

2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	Regional and Community Planning staff subscribes to e-lists, newsletters, webinars and periodicals to keep up to date on best practices in community design, transportation modes, conservation, public policy, zoning methods and other relevant topics. Different staff members focus on different areas of interest, often combining more than one discipline. Our Nova Scotia Licensed Professional Planners are required to maintain Continuous Professional Learning credits through the Canadian Institute of Planners and Atlantic Planners Institute. Many of our staff are also involved with planning related research and advocacy, including involvement with the Dalhousie University's School of Planning as advisors, mentors or lecturers. Recent "horizon scanning" has included sea level rise, storm surge and freshwater inundation associated with climate change, the growing recognition of the need for Equitable Transit Oriented Development, and opportunities/ challenges anticipated from autonomous vehicles in relation to settlement patterns, public transit, parking and community design.
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	Regional and Community Planning participates in Dalhousie University School of Planning's annual student symposium, suggests research and project topics for students, and encourages program staff to attend relevant student research presentations. Staff is also encouraged to attend sessions of interest at the annual Nova Scotia Planning Directors Conference and other comparable events. We also anticipate working more closely with Saint Mary's University Geography Department, and some of our staff were involved in the Space-Time-Activity Research (STAR) household survey, which itself involved a partnership between Saint Marys and another university in southern Ontario. We are also keeping abreast of P&D's Strategic Transportation Planning partnership with the Dalhousie University Transport Collaboratory (DalTRAC) which is establishing an on-going transportation, time and activity study of HRM residents.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	Much of Regional and Community Planning's work involves questioning common assumptions about land use, transportation and socioeconomic issues, and providing data, analysis and examples of best practices to support innovative solutions with an emphasis on evidence-based decision making. We encourage the public, business interests and Council to look at problems differently, and to apply innovative solutions, some of which challenge conventional thinking. We communicate these ideas and research results not only through staff reports, but also through presentations designed both to inform and inspire creative action.
5	Participating in strategic planning for emergencies/crises.	Regional and Community Planning's mandate is oriented to longer-term issues, but we try to anticipate and mitigate potential future crises through cautionary planning, for example by specifying setbacks and minimum elevations for shorelines and watercourses. As and when the Municipality or Province embarks on emergency or crisis planning, through our Business Unit's technical staff we will be able to assist with providing data on households, employment and other factors relevant to evacuation or mitigation.
6	Soliciting scientific research/advice to inform municipal decision making.	This is an important part of Regional and Community Planning's work, especially where more in-depth expertise is required than we can provide in-house. We typically engage consultants for such tasks as watershed analysis, piped servicing strategies, population/household projections, employment projections and future growth modelling. We also submit suggestions to universities for research and project topics of interest to the Municipality.

7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	In accordance with the HRM Regional Plan and principles of Smart Growth, Regional and Community Planning seeks to educate the public and developers about the benefits of "Complete Communities" where people can live, work, study and play within a convenient walking distance and where high quality public transit is readily available. These types of communities are most likely to attract an innovative workforce which employers in knowledge-based and technology industries seek. As we embark on a suburban structure plan comparable to the recently approved Centre Plan, we aim to identify the most promising locations for Complete Communities oriented to strong public transit corridors, and rezone these strategic areas to facilitate mixed-use, pedestrian-supportive development attractive to a range of enterprises and a diversity of age groups and occupations.
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	Regional and Community Planning staff has a long history of proposing and advising on academic research projects, and has developed working relationships with faculty of the Dalhousie School of Planning and other departments, and the Saint Mary's University Department of Geography. Staff has drawn from this work for a range of municipal projects. As already noted, Planning & Development is partnering with the Dalhousie Transport Collaboratory household trip diary survey, which will provide ongoing measurements for evaluating the success of the Regional Plan and Integrated Mobility Plan, and will deepen our understanding of activities, origins, destinations and trip patterns of HRM residents.
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	Internationally, Regional and Community Planning staff has presented best practices and innovative projects to delegations from China and Jamaica, and has worked closely with an exchange planner from Sweden. Within Canada, we have provided input to Transport Canada's railway safety act review, and we send a delegate to the annual CMHC Housing Now conference. Our staff has delivered presentations at both national and provincial planning symposia, and interacts frequently with local students and faculty to exchange ideas and suggest future research.
10	Advising the government on the appropriate balance between basic and applied research.	As practising planners, Regional and Community Planning's emphasis is, of necessity, on applied research.
11	Increasing the impact and competitiveness of governmental research programs.	Regional and Community Planning's research and analysis often adds value to local data provided by Statistics Canada and the CMHC, by aggregating census geographies, noting trends and suggesting policy implications.

Table 10 – Scientific Advising Practices | Infrastructure Planning Program (P&D)

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	Since engineering is applied science, engineers within Planning & Development currently fill a scientific advising role that touches upon issues of *applied* science, technology and innovation.
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	Engineering staff continuously stay abreast of and raise trends and developments related to infrastructure planning.

3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	N/A
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	N/A
5	Participating in strategic planning for emergencies/crises.	Engineering staff participate directly in strategic planning for emergencies/crises given the role of municipal infrastructure in mitigating and abating emergencies/crises.
6	Soliciting scientific research/advice to inform municipal decision making.	Engineering staff regularly solicit scientific/technical research/advice to inform municipal decision making. This includes retention of external consultants and collaborations with researchers.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	N/A
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	Engineering staff help to coordinate applied research by linking data collection and research done by academics/researchers. The Infrastructure Planning program's collaboration with the DalTRAC research group at Dalhousie is an example of this.
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	N/A
10	Advising the government on the appropriate balance between basic and applied research.	N/A
11	Increasing the impact and competitiveness of governmental research programs.	N/A

Table 11 – Scientific Advising Practices | Halifax Partnership

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	The Halifax Partnership (HP) does, when appropriate, analyse and opine on how policy proposals may affect the climate for innovation and productivity enhancement. HP is placing an increasing focus on innovation and commercialization. Our roles include: developing a better understanding of the extent to which Halifax businesses are innovating (in terms of products, processes, markets, etc.); promoting policies and programs that provide a supportive climate for firms to innovate; enhancing the connections among firms, entrepreneurs, and academic and research institutions that will spark and nurture innovation. Work on development of a Halifax Innovation District will be central to these efforts.

2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	HP seeks to do more in this vein in terms of assessing the extent to which Halifax firms are engaging in activities related to innovation and productivity enhancement. Furthermore, scanning efforts will encompass identifying global companies who may be able to invest and capitalize on Halifax's innovation assets.
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	As noted above, HP is seeking to better understand activities in academic and research institutions and then forge improved linkages with firms and entrepreneurs with the goal of accelerating and improving innovation and commercialization activities. HP recently hired a Sales Engineer to lead these efforts.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	HP's new Vice President of Innovation, who begins work on January 22, will be leading efforts to highlight the importance of innovation to the Halifax economy.
5	Participating in strategic planning for emergencies/crises.	This has not been an area of focus for HP.
6	Soliciting scientific research/ advice to inform municipal decision making.	There may be more activity in this area soon in terms of the development of a Halifax Innovation District.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	As noted above, HP is placing an increasing focus on innovation and an Innovation District. Our roles include: developing a better understanding of the extent to which Halifax businesses are innovating (in terms of products, processes, markets, etc.); promoting policies and programs that provide a supportive climate for firms to innovate; enhancing the connections among firms, entrepreneurs, and academic and research institutions that will spark and nurture innovation.
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	This has not been an area of focus for HP to date, but helping to forge connections with firms that could use municipal data is an area of interest.
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	HP continues to work on selling Halifax in terms of its role as leading city for science and research.
10	Advising the government on the appropriate balance between basic and applied research.	This has not been an area of focus for HP.
11	Increasing the impact and competitiveness of governmental research programs.	Through HP's SmartBusiness business retention and expansion (BRE) program, we gather feedback on business's experiences and satisfaction with government programs and report back to relevant government departments

Table 12 – Scientific Advising Practices | Transportation and Public Works

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	Solid Waste uses scientific subject matter experts for a variety of work such as Hydrogeologists, surface and well-water sampling analysis (Labs), Composting sampling (Labs), Engineering (all disciplines). Transportation Association of Canada. ROC participates on TAC - Road Salt Usage Working Group as well as maintains membership in American Public Works Association (APWA) - Clear Roads Best Practices report.
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	N/A
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	Solid Waste uses scientific subject matter experts for a variety of work such as Hydrogeologists, surface and well water sampling analysis (Labs), Composting sampling (Labs), Engineering (all disciplines). Participation at Transportation Association of Canada, Institute of Transportation Engineers, North American City Transportation Officials (NACTO), ProWalk, ProBike, ProPlace, Walk 21, Intelligent Transportation System Canada, US National Academics of Science, Engineering Medicine, Transportation – Research Board, Canadian Technical Asphalt Association, Nova Scotia User Producer Association, Nova Scotia Roadbuilders Association, Consulting Engineers of Nova Scotia, Nova Scotia Engineers, Land Surveyors of Nova Scotia, DalTRAC, Office of Sustainability for Dalhousie, Canadian Institute of Planners, Atlantic Planning Institute, License Professional Planners Association of NS, Project Management Institute, Tech Nova, Institute of Transportation Engineers, American Concrete Institute - Atlantic. See above per ROC involvement in TAC and APWA.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	HRM Website, Shape Your City Surveys, Public Engagements, Public Lectures, Media updates, 311.
5	Participating in strategic planning for emergencies/crises.	Incident Command System (ICS) Training Accreditation, Emergency Exercises. Solid Waste uses scientific subject matter experts for a variety of work such as Hydrogeologists, surface and well-water sampling analysis (Labs), Composting sampling (Labs), Engineering (all disciplines). ICS Training across management team at 100 Level with advanced certification for senior leaders within ROC.

6	Soliciting scientific research/ advice to inform municipal decision making.	Solid Waste uses scientific subject matter experts for a variety of work such as Hydrogeologists, surface and well-water sampling analysis (Labs), Composting sampling (Labs), Engineering (all disciplines). HRM Municipal Service System Guideline (Redbook), Standard Specifications for Municipal Services (Bluebook), HRM Asphalt Design Manual, HRM Standard Contract Specifications, Materials Testing requirements, Asphalt and Concrete Specifications, Asphalt and concrete testing requirements, Pavement Designs, High Speed Data Collection, GPS and Total Station Surveying processes, Civil 3D/CAD, Highway Pavement Management Application software, Recycling Methodologies Manual, HRM Construction Services Contract Administration Manual, Various publications from Transportation Association of Canada including - Geometric Design Guidelines, Roundabout Design, Pavement Designs as well as participation on a number of standing committees, Canadian Highway Bridge Design, Ontario Structure Bridge Manual, Canadian Standards Association (CSA), Ontario Traffic Manual, Book 18: Cycling Facilities, American Association of State and Highway Transportation Officials (AASHTO), American Society for Testing and Materials (ASTM), Canadian User Producer Group for Asphalt (CUPGA), International Slurry Surfacing Association (ISSA), Nova Scotia User Producer Association, Nova Scotia Roadbuilders Association, Consulting Engineers of Nova Scotia, Nova Scotia Engineers, Land Surveys of Nova Scotia, DalTRAC, Office of Sustainability for Dalhousie, Canadian Institute of Planners, Atlantic Planning Institute, License Professional Planners Association of NS, Project Management Institute, Tech Nova, Institute of Transportation Engineers, American Concrete Institute - Atlantic, ongoing technical training/webinars, collaboration with provincial and municipal partners, engagement of engineering consultants to perform strategic inspections/testing of varying road related infrastructure. ROC representatives participate on TAC - Road Salt Usage Working Group; American Public Works Association (APWA) - Clear Roads Best Practises.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	In 2005 the Council of Federation "identified Canada's transportation system as vital to promoting economic growth, international competitiveness, and the best standard of living for all Canadians". The outcome of the Council of Federation discussions included the use of recycling techniques. HRM has since created the Sustainable Pavement Recycling Practices Manual. Investment on various pavement rehabilitation strategies, investment in bike lanes which leads to innovations such as bike share systems, B-Line App through HRM Bike week, DalTRAC.
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	Participation in various Transportation Association of Canada standing committees and surveys; Canadian Technical Asphalt Association (CTAA); Nova Scotia User Producer Association (NSUPA), Municipal Benchmarking Network Canada (MBNC), DalTRAC, University of Waterloo, StatsCan, Simon Fraser University (Impacts of Cycling Infrastructure in Mid-sized Canadian Cities), collaboration with provincial and municipal partners.
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	Solid Waste uses scientific subject matter experts for a variety of work such as Hydrogeologists, surface and well water sampling analysis (Labs), Composting sampling (Labs), Engineering (all disciplines). Participation in various Transportation Association of Canada standing committees; Canadian Technical Asphalt Association (CTAA); Nova Scotia Users Producers Association (NSUPA), North American City Transportation Officials (NACTO).
10	Advising the government on the appropriate balance between basic and applied research.	N/A.
11	Increasing the impact and competitiveness of governmental research programs.	N/A

Table 13 – Scientific Advising Practices | Halifax Regional Fire and Emergency (HRFE)

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	HRFE is currently reviewing all previous practices / processes in comparison to industry best practices and looking to transition to a culture of continuous quality improvement and evidenced based decision making in the future where possible. In addition to making this paradigm shift HRFE is looking to be involved more significantly in research in the years ahead and partner with other municipal and non municipal partners wherever possible.
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	Utilization of census data assists HRFE in planning for station locations and volunteer recruitment. Census information also allows us to identify vulnerable populations that may require extra assistance during an event.
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	EMO utilizes meteorological weather analysis to keep track of major storms. EMO has also built a relationship with Ham Radio operators in the event of a widespread communication breakdown. HRFE routinely refers to National Fire Protection Association (NFPA) standards that are considered industry best practices and scientifically supported (where possible) through various studies, one being NIST that intensively investigated the impact of crew sizes on the fire ground.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	The use of GIS mapping and modelling as well as AVL and CAD data collection will be the how HRFE will determine whether it is meeting a service level standard. This method of data collection is expected to be rolled out this year and HRFE will need to increase public support, understanding and confidence in the way data is collected and reported . As well the collected data will inform decision making.
5	Participating in strategic planning for emergencies/crises.	EMO utilizes meteorological data for weather monitoring. Multiple connections with the scientific community have been made through universities and other government led departments to ensure HRFE has access to specialists when required. A relationship has been made with the Amateur Ham Radio groups to ensure continuation of communications should it be required. HRFE utilizes census information to track both population growth as well as identifying vulnerable populations. The use of drones in emergency situations is being piloted in HRFE it is a new technology to firefighting so there is also learning from outside experts to learn to fly and analyse the data
6	Soliciting scientific research/advice to inform municipal decision making.	EMO utilizes meteorological weather analysis to keep track of major storms.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	HRFE is currently exploring opportunities to be involved in research.
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	HRFE is currently exploring opportunities to be involved in research and with five universities in the region and a newly created national fire incident data base this is area that could yield significant benefits for HRM.

9	Providing leadership on relevant regional, national and/or international science and engineering issues.	HRFE was involved with the Fire Knowledge to Practice (FKTP) project for the last three years. It was a federal government grant project to develop a science based fire behavior curriculum for Canadian fire departments. The scope of the project was to develop lessons threat were scientifically correct and teach tactics developed from best practices supported by the science. It included theory lessons as well as firefighting techniques and props to use for training. The curriculum gives standard definitions and recommendations on how to identify fire behavior and tactics based on science for suppression. Halifax was one of the sponsors on the federal grant, along with Montreal, Calgary and Ottawa who was the lead agency.
10	Advising the government on the appropriate balance between basic and applied research.	HRFE is currently exploring opportunities to be involved in research.
11	Increasing the impact and competitiveness of governmental research programs.	HRFE is currently exploring opportunities to be involved in research.

Table 14 – Scientific Advising Practices | Halifax Regional Police (HRP)

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	In most instances, the science advising process within HRP involves three components. - First, a question regarding a scientific development (e.g. a technological innovation, new policing strategy, or relevant research, including scientific and social scientific developments) needs to be identified as a priority for attention by HRP staff. This may come from any level of the organization from constables and civilian staff up to the Chief of Police, as well as the externally from the community or Board of Police Commissioners, but the decision to prioritize will generally come from members of the Executive Management Team. - Second, once a scientific or technological development has been identified and prioritized, one or more individuals from the relevant or affected unit or section in HRP is normally tasked with examining the implications of this development for police. So, for example, when HRP decided to look at Body-Worn Video (BWV), the Information Management Officer and the head of the Strategic Technology Integration Unit (STIU) examined the cost and operational implications of the technology. Similarly, as new tactical equipment is developed (for example, tactical vests that can be used in place of duty belts), such equipment may be reviewed and piloted by the Training section to understand the feasibility of deployment. This may involve discussions with colleagues internally as well as reaching out to other police services who have relevant experience or expertise, as well as review of literature and technical reports on the topic. - Third, alongside this operational review by relevant HRP staff, members of the Operational Planning unit (including the Research Coordinator and Policy staff) may be asked to examine wider literature and documentation, consider and implement evaluation of proposals and pilots of new technology, and consider policy and performance measurement implications of scientific developments. This may also involve reaching out to colleagues elsewhere in HRM, other police agencies, legal advisors, and academic contacts with relevant expertise.

2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	As above - the identification of issues requiring scientific advice and analysis may emanate from any level of the HRP organization as well as from external stakeholders such as the Board of Police Commissioners. However, there is no specific role or process dedicated to horizon scanning.
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	The Research Coordinator is the main organizational point of contact for external academic and scientific collaboration. However, many HRP members have roles that bring them into contact with advisory groups - for example, membership within organizations such as the Canadian Association of Chiefs of Police, the International Association of Chiefs of Police, the International Association of Crime Analysts, and related committees of these organizations. In turn, many members are responsible for being aware of the state of the art in their particular area of competence or specialization (for example, our polygraphists would stay up-to-date on developments in investigative interviewing through their own work, rather than working specifically through the research coordinator; similarly, members who are involved with the CACP drugs committee will have a responsibility to advise HRP on relevant trends and techniques in drug policing and investigation; our Diversity Equity Officer maintains their own network of community contacts to understand current thinking around the best ways to promote diversity and equity at HRP; the Wellness Coordinator acts as the point of expertise on workplace wellbeing; and so on).
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	The Research Coordinator has the lead responsibility for promoting evidence-based policing and research literacy within HRP, and works with external stakeholders to improve understanding of how research and scientific evidence are used in policing. Other members of the executive management team also have a role in promoting evidence-based decision-making within their area of responsibility and reflecting this in their public statements.
5	Participating in strategic planning for emergencies/crises.	The organizational lead in this area is the Operational Planning Officer. HRP's OPO is tasked to ensure HRP will continue to develop an all hazards-based and HRM-aligned approach to emergency response that will be informed by work accomplished to date on the Emergency Response Plan, mass notification system management, business continuity planning, Amber Alert protocols, established Incident Command System framework and Ground Search and Rescue.
6	Soliciting scientific research/advice to inform municipal decision making.	The Research Coordinator is the primary liaison between HRP and the scientific and academic community. However, as above, many individuals at HRP will have responsibility for soliciting advice specific to their area of specialization, and such advice may be (but does not have to be) sought in collaboration with the Research Coordinator, depending on context.
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	N/A
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	As above - the Research Coordinator is the primary liaison between HRP and the scientific and academic community. This involves developing collaborative projects and networks with university researchers as well as non-university-based research groups, drawing on academic expertise to guide internal research projects, and supporting access to data for external researchers seeking to understand policing and justice issues. All research coordination activities involve an internal approval process (following HRP's Research Policy) that requires review and approval by the Deputy Chief prior to HRP providing support to external researchers, and this process normally involves engagement with the management of relevant units to ensure that the research is well-informed and valuable to HRP.

9	Providing leadership on relevant regional, national and/or international science and engineering issues.	As above - the Research Coordinator has the organizational lead role in promoting and developing HRP's role in scientific research. However, also as above, many HRP officers and civilian staff are involved nationally and internationally in committees and professional associations that promote evidence-based policing and/or support the development of new policing technologies and strategies. For example, the Deputy Chief is the HRP representative on the Canadian Society of Evidence Based Policing, and members of our Victims Services unit have held leadership roles with research/academic groups such as the NS Criminal Justice Association.
10	Advising the government on the appropriate balance between basic and applied research.	N/A
11	Increasing the impact and competitiveness of governmental research programs.	N/A

Table 15 – Scientific Advising Practices | Halifax Transit

No.	Scientific Advising Role	Business Unit Activities / Practices
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	Halifax Transit works with affiliates, including the Federation of Municipalities; Canadian Urban Transit Association; Canadian Urban Transit Research and Innovation Consortium. These affiliates help ensure federal agencies invite Halifax to forums related to Climate Change; Fuel: Carbon Intensity; Battery operated vehicles (BEB's); Renewable Natural Gas (RNG) etc.
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	Halifax Transit is a member of the Canadian Urban Transit Association (CUTA) as well the Canadian Urban Transit Research and Innovation Consortium (CUTRIC). These member organizations work with the federal government on issues and trends and organize conference calls and focus groups discussions of any issues that may impact public transit.
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	Halifax Transit is currently working with CUTRIC on an electric bus study in partnership with Dalhousie and Nova Scotia Power. The pending feasibility study will determine the best battery technology and infrastructure configuration for Halifax Transit's network, topography and environment. CUTRIC organizes PHD to support research and works very closely with the National Research Council (NRC). In 2015, Halifax transit engaged Clean Energy Canada to review the capital cost implications, and building design implications associated with Halifax Transit moving to compressed natural gas (CNG) vehicles.
4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	Not Halifax Transit's mandate; role of CUTA and CUTRIC

5	Participating in strategic planning for emergencies/crises.	Incident Command System (ICS) protocols apply to Halifax Transit. Halifax Transit provides logistical support, including comfort buses for deployment by Halifax's Emergency Measure Organization (EMO). Halifax Transit is developing emergency measures for regions of the municipality not serviced by public transit. Halifax Transit is also currently engaged in planning relating to public transit's role in large scale evacuations (from Halifax to evacuation centres).
6	Soliciting scientific research/advice to inform municipal decision making.	Halifax Transit works through CUTRIC in areas of shared research interest and have partnered with Dalhousie on projects such as a power generation decision matrix
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	Not Halifax Transit's mandate; mandate of CUTRIC
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	Halifax Transit partners with CUTRIC and through professional relationships like Engineering. (CAPstone projects)
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	Halifax Transit advances scientific research through its research partners coordinated through CUTRIC or through academic relationships
10	Advising the government on the appropriate balance between basic and applied research.	Through research partners and lobbying through CUTA and FCM
11	Increasing the impact and competitiveness of governmental research programs.	N/A

Table 16 – Scientific Advising Practices | Communications

No.	**Scientific Advising Role**	**Business Unit Activities / Practices**
1	Offering analysis and opinion on policy proposals that touch upon issues of science, technology and innovation.	N/A
2	Undertaking 'horizon scanning' to raise trends/ developments that represent either an opportunity or a threat to the municipality.	N/A
3	Building relationships with scientific advisory groups/structures and/or science advisors (regionally, nationally or internationally).	N/A

4	Increasing public support for, and understanding of, the role that science and technology play in the delivery of municipal services and in municipal policy development.	Incorporating consultant's (Stantec) scientific analysis of the effectiveness of Solid Waste Resources operations and planning into public information campaigns. Many initiatives and files handled by Energy & Environment division within P&D BU, including: (a) diesel release at Transit depot; (b) 'sick buildings' like Khyber and St Pats A where asbestos and other impacts require remediation; (c) rationale for beach closures due to bacteria/ algae; and (d) impacts on planning and development (e.g. flood plains) by rises in sea level/ climate change.
5	Participating in strategic planning for emergencies/crises.	Collaboration with weather specialists at Environment Canada during storms. Working with HazMat specialists during gas leaks/ vehicle accidents involving trucks with flammable or noxious gases and with DND scientists in the event of nuclear threat.
6	Soliciting scientific research/advice to inform municipal decision making.	N/A
7	Stimulating innovation, entrepreneurship and economic growth in knowledge-based science and technology industries.	N/A
8	Helping to coordinate scientific research by linking municipal data collection and research with academics/researchers	N/A
9	Providing leadership on relevant regional, national and/or international science and engineering issues.	N/A
10	Advising the government on the appropriate balance between basic and applied research.	N/A
11	Increasing the impact and competitiveness of governmental research programs.	N/A

Attachment 9
Comparative advantages and disadvantages of science advisory structures (external, internal and mandated)

Table 17 – Comparative advantages and disadvantages of science advisory structures (external, internal and mandated)

Approach	Advantages	Disadvantages
Internal (Government employed science advisors and practicing scientists)	• Allows for rapid, informal science advice, including in emergency situations • Responsive to the differing rhythms of policymaking • Government body has significant control of the advisor's mandate • Unsolicited science advice comparatively easily integrated • Shared understanding of problem definition may be more easily achieved given the proximity to decision makers	• Science advisors only possess a portion of the knowledge that is relevant to complex scientific questions • Uncertainty of scientific results may not be consistently communicated given the pace and volume of advising • Credibility of advisor may be questioned given (limited) degree of subject matter expertise • Informal advisory mechanisms may lead to real/perceived non-disclosure • Advisor's employment relationship may undermine autonomy
Mandated (Regulatory agencies, advisory boards and science councils)	• Able to draw on a variety of scientific experts in diverse, relevant disciplines • Peer review measures help to ensure the quality, integrity and objectivity of the science advice • Flexibility of advisory approach supports increased receptivity to diverse inputs • Government has ability to set terms of refence and remits • Approach to presenting results tends to support explicit identification and communication of uncertainty • Shared understanding of problem definition better achieved given focused nature of mandated advisory body	• Requires moderate time horizon for soliciting and receiving feedback • Government control over composition of mandated body may undermine perceived/actual autonomy • Decision-making processes may only be semi-transparent, to stakeholders and to the public • Shorter time-frame for presenting results may undermine explicit identification and communication of uncertainty

External (Academies, learned societies, think-tanks, consultants and research organizations)	• Able to draw on a variety of scientific experts in diverse, relevant disciplines • Peer review measures help to ensure the quality, integrity and objectivity of the science advice • Approach to presenting results tends to support explicit identification and communication of uncertainty • Assessment conclusions are typically published/made public • Stand-alone nature of entity supports real and perceived autonomy	• Requires long time horizon for soliciting and receiving feedback • Assessments tend to be focused on macro-level issues • Mandate mismatch may exist • May rely on internal expertise of member scientists • Scope of assessment undertaken and objectives may be impacted by agency's own agenda/mandate