



FINAL

**Climate Change Adaptation Tools and Resources
Stakeholder Engagement Report**

Submitted to:

**Government of Newfoundland and Labrador
Office of Climate Change and Energy Efficiency**

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29 March 2016

Amec Foster Wheeler Project #: TA1577601



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EXECUTIVE SUMMARY

Between December 2015 and February 2016, Amec Foster Wheeler met with stakeholders to discuss usage of climate change adaptation tools and resources developed by the Province of Newfoundland and Labrador and / or other agencies. These tools and resources include: the Climate Data Information Portal, Intensity-Duration-Frequency (IDF) Curves (2015 updated), “Projected Impacts of Climate Change for the Province of Newfoundland and Labrador” report, Flood Risk Mapping, the Hurricane Season Flood Alert System, Coastal Erosion monitoring studies, Sea-Level Rise predictions for the province and Community Climate Change Vulnerability Risk Assessments. It is intended that these tools and resources would be used for planning communities and development as well as designing, maintaining and / or protecting infrastructure, public facilities, natural and cultural heritage resources, private properties and economic assets.

This report includes the results of engagement with 69 representatives of municipalities, Nunatsiavut government, engineering consulting firms, regional health authorities, departments and agencies of the Provincial Government and Municipalities Newfoundland and Labrador. It presents the findings from meetings with representatives of municipalities, consulting firms, Provincial Government / regional agencies and other organizations in that order. A second report will provide additional information on potential training opportunities for identified stakeholders.

Municipalities

Municipalities own and manage a variety of infrastructure for drinking water supply, sewerage and sewage treatment, storm water management and roads. Various infrastructure may be affected by climate change but municipalities are mainly concerned with preventing flooding that causes property damage and public safety issues, erosion and loss of infrastructure in storms. This is true for large and small municipalities but the larger ones are more involved in strategic planning, community sustainability planning and asset management planning.

Municipal representatives were generally unaware of many of the climate change adaptation tools and resources, with the exception of Flood Risk Mapping and Flood Alerts. Their most likely sources of relevant data and information were Environment Canada and the Gander Weather Office. Some were aware of other tools and resources but the majority interviewed lacked the in-house expertise and resources to use them. Many municipal representatives consider the tools and resources to be valuable but do not ask consultants to use them. Rather they assume that engineering consultants are aware of and use the available tools and resources.

Municipalities in general use a limited number of the available tools and resources and particularly rely on weather forecasts to understand when to take maintenance measures that prevent flooding. Municipal representatives want more accurate weather forecasting and historical data to verify their observations and to anticipate issues more accurately. They feel that better direction from the Province is required to address development in flood prone areas and on-site storm water management. The main conflict related to climate change adaptation appears to be with development standards and

regulations as urban municipalities have differences with neighbouring communities where development best practices do not exist or are not enforced. Also, municipal representatives felt that developers see municipal policies and regulations as interfering with development and adding costs to projects.

Consulting Firms

The consulting firms interviewed are engaged by municipalities, Provincial agencies and private developers for infrastructure design and development services. Consultants use data and information to design infrastructure such as storm water sewers, culverts and bridges. Specialized consultants, generally with larger companies, use data for hydrological modelling for on-site storm water management. Consultants use historical precipitation data that they mainly access from Environment Canada or the Gander Weather Office. Some use precipitation data from the Provincial Government website, the Newfoundland and Labrador Water Atlas and the City of St. John's when working within the municipality. As most clients do not have data or information, consultants use local observations about historical weather events.

All of the consultants were aware of Flood Risk Mapping and most had used the information. Some consultants were aware of the 2015 IDF Curves and 2013 Climate Change Projections but few had used them. Consultants usually obtain IDF curves from Environment Canada and the City of St. John's but some have created their own. The level of awareness of the other tools and resources presented was low and they were not used by the consultants.

Generally clients do not request that consultants address climate change or extreme weather events with the exception of larger municipalities that have storm water management regulations. Municipalities may ask to have infrastructure made larger to address a particular issue but developers seek the lowest cost solution to meet minimum regulations. Where specific direction is not given, consultants are at risk of under designing or overdesigning infrastructure and some include a climate change factor as a default.

Consultants that work on storm water management plans stated that municipal regulations and oversight are inconsistent as is the approach to storm water modelling used by the Province and the City of St. John's which has the most comprehensive storm water management policy and regulations. Consultants stated that developers are concerned about increasing costs of installing underground systems or detention ponds that consume building lots or parking lot space. Adverse weather events include combinations of snowfall, melt and rainfall, which are difficult to model based on historical climate data. Consultants expressed interest in better data for stream flow rates, design storms and localized snow loads and wind speeds. They would like to have projections for precipitation separated for snow and rain, future storm surges and wave height, anticipated hydrographs and to understand the confidence levels for flows to justify increased costs of infrastructure. They also asked for general guidance on flood risk mapping, storm water management, storm water design details and the cost of incorporating new design guidelines for climate change.

Provincial Officials

Provincial officials that participated in stakeholder consultation were those responsible for local government, emergency response, natural resource development, natural and cultural heritage asset management and construction and management of public infrastructure, facilities and properties. These groups may want to use weather forecasts and other predictive information when planning and managing infrastructure and facilities but responses to issues are often reactive rather than proactive. While climate change can be incorporated into the planning and design of new infrastructure, management has to be reactive with regard to weather related issues such as snow loading, flooding and wind damage for existing buildings and infrastructure. Some decisions related to adverse weather events must be made during the event and dealt with through communications.

As with the two other participant groups, Provincial officials were most familiar with Flood Risk Mapping and Flood Alerts and the latter were used by most of the individuals who knew of them. Some participants were aware of the Climate Portal, 2013 Climate Change Projections, Coastal Erosion and Vulnerability Risk Assessments and Environment Canada was a key source of climate data and IDF Curves.

Provincial officials generally do not receive direction on incorporating climate change into operations with the exception of broad policy initiatives such as the "Climate Change Action Plan 2011" and "greening government". Some direction has been given within the Departments of Environment and Conservation, Transportation and Works, Municipal Affairs and Education and Early Childhood Development for design of roads and enhancing energy efficiency and environmental performance for new buildings. Provincial officials noted the differences in municipal and provincial infrastructure design standards and regulations as being a potential issue for climate change adaptation.

Responses from the three types of stakeholders who would address issues related to climate change adaptation indicate that the user groups may need different tools and resources or information. Engineering consultants along with particular groups or individuals from Provincial Government may analyse data to seek answers. However most municipalities, with perhaps the exception of the City of St. John's, may only need the results of data interpretation or analyses in their work. Provincial Government also has a role in establishing consistent approaches to strategic planning initiatives that help communities to avoid problems. To achieve this the Province might also ask: what are the issues, how should they be dealt with and what are the tools and resources needed to support these efforts.

Recommendations

Based on the stakeholder engagement process, Amec Foster Wheeler has developed a set of recommendations aimed at increasing the uptake of CCEE's climate change adaptation tools and resources. While the full set is presented in the report, the following categories, in descending order of priority, capture the main themes of the recommendations.

- ▶ Increase awareness – Stakeholders’ knowledge of CCEE and the resources they provide was identified as the largest gap.
- ▶ Develop regulations and common understanding – Feedback indicated that the lack of consistent requirements for infrastructure design and a “level playing field” is a major barrier to utilization of the tools. Lack of communication, on climate change adaptation, between municipalities and consultants has contributed to this issue.
- ▶ Develop training – For those stakeholders who were aware of and wanted to use the tools, there was a general lack of understanding of how the tools could be best used
- ▶ Improve tool and resource format and accessibility – Once users have the capability and desire to start using the tools, the focus should be on making the resources easier and less confusing to access
- ▶ Priorities for new tools and resources – Once stakeholders have begun developing experience with the resources and tools, there is opportunity to obtain effective feedback and enhance those resources.

Acknowledgements

Amec Foster Wheeler would like to express gratitude to our subject matter experts and advisors at Memorial University of Newfoundland for their guidance in preparing for this stakeholder engagement exercise and interpretation and presentation of the results:

- ▶ Trevor Bell, Ph.D. – Professor, Department of Geography;
- ▶ Joel Finnis, Ph.D. – Associate Professor, Department of Geography;
- ▶ Mark Stoddart, Ph.D. – Associate Professor, Department of Sociology; and
- ▶ Ken Snelgrove, Ph.D., P.Eng. – Associate Professor, Department of Civil Engineering.

Acronyms and Abbreviations

ACEC-Canada: The Association of Consulting Engineering Companies

ACAP: Atlantic Coastal Action Program

ACWWA: Atlantic Canada Water Works Association

API: Atlantic Planners Institute

CCEE: Office of Climate Change and Energy Efficiency

CENL: Consulting Engineers of Newfoundland and Labrador

CIP: Canadian Institute of Planners

CIM: Canadian Institute of Mining, Metallurgy and Petroleum

CPWA: Canadian Public Works Association

DBTCRD: Department of Business Tourism Culture and Rural Development

DBTCRD-HD: Department of Business Tourism Culture and Rural Development, Heritage Division

DEC: Department of Environment and Conservation

DEC-PNAD: Department of Environment and Conservation, Parks and Natural Areas Division

DEC-WRMD: Department of Environment and Conservation, Water Resources Management Division

DEC-WD: Department of Environment and Conservation, Wildlife Division

DEECD: Department of Education and Early Childhood Development

DNR: Department of Natural Resources

DNR-AB: Department of Natural Resources, Agrifoods Branch

DNR-GS: Department of Natural Resources, Geological Survey

DNR-MB: Department of Natural Resources, Mining Branch

DMA: Department of Municipal Affairs

DMA-ES: Department of Municipal Affairs, Engineering Services

DTW: Department of Transportation and Works

DTW-AS: Department of Transportation and Works, Air Services

DTW-BD: Department of Transportation and Works, Building Design and Construction

DTW-TD: Department of Transportation and Works, Transportation Division

FES - NL: Fire and Emergency Services – Newfoundland and Labrador

IPCC: International Panel on Climate Change

MNL: Municipalities Newfoundland and Labrador

MUN: Memorial University of Newfoundland

NAACAP: Northeast Avalon Coastal Action Program

NEIA: Newfoundland and Labrador Environmental Industry Association

NLCA: Newfoundland and Labrador Construction Association

NOAA: United States National Oceanic and Atmospheric Administration

PEGNL: Professional Engineers and Geoscientists Newfoundland and Labrador

PIEVC: Public Infrastructure Engineering Vulnerability Committee

PMANL: Professional Municipal Administrators Newfoundland and Labrador

RFP: Request for Proposal

7 Steps Assessment: “7 Steps to Assess Climate Change Vulnerability in Your Community”

2013 Climate Change Projections: “Projected Impacts of Climate Change for the Province of Newfoundland and Labrador”

2015 IDF Curves: Intensity-Duration-Frequency Curves

Amec Foster Wheeler: Amec Foster Wheeler Environment & Infrastructure

Climate Portal: Climate Data Information Portal

Flood Alerts: Hurricane Season Flood Alert / System

Vulnerability Risk Assessments: Community Climate Change Vulnerability Risk Assessments

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1.0 INTRODUCTION

In its 2011 Climate Change Action Plan, the Government of Newfoundland and Labrador stated that "climate change is one of the most pressing issues facing Newfoundland and Labrador". Government anticipates that climate change will affect the Province in a variety of ways, including more extreme weather, increased temperatures, increased precipitation, higher sea-level and storm surges. Depending on the location, this could result in more flooding in flood prone areas, flooding in new areas, greater coastal erosion, reduced ice conditions and unstable / thawing permafrost.

Government has developed various tools and resources aimed at stakeholders such as municipalities, Provincial departments responsible for infrastructure and planning, private sector companies and industry associations. The aim is that the agencies would improve their capability to incorporate climate change into decision-making processes with a view to mitigating risks to infrastructure, economic activity and communities as much as possible and enhancing resilience to adverse climate change effects.

While these tools and resources are valuable assets for informing decision-making in the province, the extent to which they are being used by stakeholders is unclear. As the maximum benefit of these tools and resources rests with their widespread use by decision-makers, it is important to assess the extent to which they are used, understand any barriers to their utilization, determine ways to increase uptake, identify any gaps in provision and to assess how best to raise awareness and build capacity among key stakeholders. To gain a higher level of understanding of how these tools and resources are used, the Office of Climate Change and Energy Efficiency (CCEE) issued a "Request for Proposals: Climate Change Adaptation Tools and Resources" on September 8, 2015.

In October 2015, Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) was engaged to consult with stakeholders on the tools and resources that have been developed to assist with climate change adaptation. The overarching goal of this work is to understand use of the climate change adaptation information products and tools made available by CCEE while identifying gaps in stakeholder needs. The stakeholder engagement process had the following objectives:

1. Improve understanding of the uptake of existing climate change adaptation information products and tools with key stakeholder groups, including reasons for uptake, barriers to uptake and gaps in provisions;
2. Identify ways in which Government can increase the province's resilience to climate impacts by influencing stakeholder decision-making, including through increasing the uptake of climate change information products and tools; and
3. Understand the training needs and requirements for identified stakeholders on climate change adaptation information products and tools to meet their needs and enhance their capacity to understand and adapt to climate change, through the development of a detailed syllabus of the content, duration and structure of a training program.

This report describes the stakeholder consultation process and the results of discussions about relevant tools and resources: usage, awareness, access, application, availability, reliability, direction, collaboration and conflict as well as recommendations on enhancing uptake, improving accessibility and climate change adaptation information gaps. A second report will refer to this content as well as provide additional insight into training opportunities.

2.0 CLIMATE CHANGE TOOLS AND RESOURCES

The Government of Newfoundland and Labrador has developed climate change adaptation tools and resources and tailored other data and information for the province. These include improved access to historical local climate data, precipitation intensity-duration-frequency (IDF) curves, climate change projections, climate change flood risk mapping, hurricane flood alert system, information on coastal erosion, sea level rise projections and tools to assist communities to assess their vulnerability to climate change. These tools and resources, which were the subject of this study, are summarized below.

2.1 Climate Data Information Portal

The Climate Data Information Portal (Climate Portal) provides historical climate data and charts: annual, quarterly, monthly and daily air temperature, precipitation and maximum wind gust (daily only), for more than 70 Environment Canada weather stations throughout Newfoundland and Labrador (NLSA-CA 2013). It includes several station comparisons (e.g. Newfoundland and Labrador airports).

2.2 Intensity-Duration-Frequency Curves (2015 update)

Intensity-duration-frequency curves characterize the relationship between the intensity (in mm/hr) of precipitation, over a specified duration of time (e.g. 5 minutes, 1, 6, 24 hours, etc.), and the frequency of occurrence or return period (e.g. 50, 100 years). IDF curves provide estimated precipitation intensity to support design of bridges, culverts, dams, spillways, storm sewerage systems and other hydraulic structures or infrastructure. Extreme precipitation events also affect storm surges and coastal flooding and are critical in city planning and land allocation. The 2015 report includes historical data and future IDF curves (2015 IDF Curves) with climate change projections (CCEE 2015).

2.3 Projected Impacts of Climate Change for the Province of Newfoundland and Labrador

“Projected Impacts of Climate Change for the Province of Newfoundland and Labrador” (2013 Climate Change Projections) is a regional climate change predictions study prepared for the Province of Newfoundland and Labrador (Finnis 2013). It includes eight temperature and 11 precipitation variables. Example variables include 6, 12 and 24 hr duration extreme precipitation amounts for select locations for 2, 5, 20, 25, 50 and 100-year return periods for both the current climate and mid-century projections, and projected change in seasonal daily mean air temperature for mid-century (2038-2070).

2.4 Flood Risk Mapping

Flood risk mapping, which has been prepared for 38 Newfoundland and Labrador communities, are used for management and planning in flood plains and minimizing the impact of floods (DEC-WRMD 2015 A). Provided by the Department of Environment and Conservation, Water Resources Management Division (DEC-WRMD) and sometimes in collaboration with municipalities, flood risk maps are developed using climate change projections and are based on flood events associated with a return period of 20 and 100 years and recent mapping includes climate change projections.

2.5 Hurricane Season Flood Alert System

Hurricane season flood alert system reports (Flood Alerts) are provided by Amec Foster Wheeler to Fire and Emergency Services – Newfoundland and Labrador (FES-NL) during hurricane season (from July to December) at 48 hours and 24 hours prior to a weather system that will potentially result in flooding. Once notified, FES provides daily alerts to municipalities, communities, Municipalities Newfoundland and Labrador (MNL) and Provincial departments and agencies (DEC-WRMD 2015 B). These reports include projected daily rainfall, 20 and 100-year flood risk levels and estimated peak precipitation time, for about 25 areas with flood risk mapping and precipitation-induced flooding and 16 other areas with IDF curves. The Flood Alert system is designed to support emergency response planning to prepare for storms and avoid high-cost expenditures in repairs and damages.

2.6 Coastal Erosion Monitoring

Coastal erosion studies are part of a multi-year Department of Natural Resources, Geological Survey (DNR-GS) coastal monitoring program with goals to: a) delineate coastal areas at risk from hazards including flooding, erosion and mass movement; b) assess rates of shoreline erosion; c) determine changes in beach profiles; and d) identify physical processes that cause coastal change. To date, 104 sites have been surveyed on the Island of Newfoundland and in Southern Labrador (Irvine 2014).

2.7 Sea-Level Rise Projections

The DNR-GS has also prepared projections of sea-level rise to 2049 and 2099 relative to 1990 levels for four zones in Newfoundland and Labrador (Batterson and Liverman 2010). This study was prepared to assist with coastal planning and the potential increased frequency and intensity of storms for which ocean defences or flood plains may no longer be sufficient. This work is based on International Panel on Climate Change (IPCC) predicted global sea level rises (~30 mm by 2049; ~59 mm by 2099), potential accelerated ice melt (~20 mm by 2099) and regional trends of crustal rebound (uplift or subsidence) ranging from 1 to 2 mm / year.

2.8 Community Climate Change Vulnerability Risk Assessments

Several agencies have prepared tools and resources for assessing community vulnerability to climate change (Vulnerability Risk Assessments). These include “7 Steps to Assess Climate Change Vulnerability in Your Community” (7 Steps Assessment), which is a step-by-step guide to help communities assess vulnerability and establish actions to be more prepared for climate change as part of future planning and development processes (DEC-WRMD 2015 C). The tool is designed for communities with limited resources and does not require technical expertise to use. It can serve as a guide for community leaders and decision-makers, providing a means for a quick analysis of local climate change impacts and potential adaptation options. Government has developed other vulnerability assessment tools such as “Managing Municipal Infrastructure in a Changing Climate Workbook” and relevant case studies are also available through CCEE (MNL 2015; PIEVC 2014).

3.0 STAKEHOLDER ENGAGEMENT

This section discusses the stakeholder engagement program which was intended to capture a range of information and opinions about climate change adaptation with a primary focus on the use of tools and resources developed by the Provincial Government. To gain a range of opinions and to facilitate a more meaningful discussion, CCEE requested face-to-face consultation (as much as possible) in various regions of the province with the following intended primary users of the climate change adaptation tools and resources:

- ▶ Government of Newfoundland and Labrador departments that are responsible for infrastructure decisions and planning;
- ▶ Municipalities particularly those that have the capacity for infrastructure asset management planning; and
- ▶ Private consulting firms that engage in infrastructure, land-use planning and development decision-making processes.

3.1 Stakeholder Engagement Approach

CCEE had determined that the preferred approach to this study would be a qualitative rather than quantitative analysis as there was a need to engage in a discussion that would lead to better understanding of if, how and why or why not participants use available tools and resources in the design, development and management land resources, facilities and infrastructure in Newfoundland and Labrador. Qualitative analysis is also better suited to smaller and non-random samples and allows exploration to gain additional insight into participants' perceptions and experiences.

Amec Foster Wheeler met with 69 representatives from nine municipalities, Nunatsiavut government, 10 engineering consulting firms, four regional health authorities, 14 departments and agencies of the provincial government and MNL. This broad sampling of stakeholders provides an overview of how the tools and resources are used by target stakeholder groups. Thus some information may be inconsistent as the report summarizes the views and opinions expressed by a group of participants.

3.2 Stakeholder Engagement Method

The engagement program was aimed at the three stakeholder participant groups discussed in Section 3.0 and also included the Nunatsiavut Government and MNL. To prepare for stakeholder engagement with these groups, Amec Foster Wheeler developed a semi-structured interview format with variations for municipal representatives, consultants and other stakeholders (interview questions are provided in Appendix A). Face-to-face meetings were organized with municipal representatives and consultants in Bay Roberts, Placentia, Gander, Corner Brook, Stephenville, Happy Valley-Goose Bay, St. Johns, Mount Pearl and Conception Bay South.

Provincial Government meetings were held at Government facilities in St. John's. Officials in Central / Western Newfoundland and Labrador participated by teleconference and received meeting materials by

email. Due to the potentially larger number of participants in these sessions, Amec Foster Wheeler adapted the interview format to facilitate a similar discussion which still included the Provincial tools and resources, usage, other tools, collaboration, conflict, awareness, format, information gaps and training opportunities. Also in the interest of time, these participants were asked to provide some of their responses in a short survey that was submitted at the meeting or sent via email.

3.2.1 Municipalities

The locations for municipal engagement were selected by Amec Foster Wheeler, and approved by CCEE, to best strike a balance between those with the largest populations and capacities for infrastructure and asset management, ensuring various areas of the province were represented, inclusion of towns with targeted adaptation tools and those that experience damage from extreme weather events. In addition to these municipalities, Amec Foster Wheeler was also asked to interview a representative of the Nunatsiavut Government.

3.2.2 Consulting Firms

To ensure that the insight of consulting firms was captured, Amec Foster Wheeler contacted 44 planning / engineering companies and determined that 19 were engaged in municipal work but some had no appropriate staff located in the province. Ten of these consulting firms agreed to be involved in stakeholder engagement.

3.2.3 Provincial Government Officials

Four engagement sessions with Provincial officials were organized by CCEE. While there was a priority to meet with departments responsible for local government and transportation infrastructure, other agencies were included as they are affected by climate change in various ways. These stakeholders included those that construct and manage government buildings, infrastructure and properties and are responsible for resource development.

3.3 Stakeholder Engagement Program

From early December 2015 to early February 2016, Amec Foster Wheeler met with 69 representatives from nine municipalities, Nunatsiavut government, 10 engineering consulting firms, four regional health authorities, 14 departments and agencies of the Provincial Government and MNL (Table 3-1).

The engagement activity included municipalities that manage land or infrastructure, engineering consultants that work with municipalities and Provincial Government department and agencies involved in management of community infrastructure related to drinking water, storm and wastewater management; transportation; business and economic activity; infrastructure for government, health and educational services; emergency response; natural resource development and management, management of heritage resources and parks and natural areas; and those with particular interest in climate change, extreme weather issues and adaptation in Newfoundland and Labrador.

Table 3-1: Participating Organizations

Date	Agencies
December 1, 2015	Town of Bay Roberts
December 2, 2015	Town of Gander
December 2, 2015	Cecon Engineering, Gander
December 2, 2015	DMG Consulting, Gander
December 15, 2015	Pinnacle Engineering, St. John's
December 16, 2015	Stantec, St. John's
December 17, 2015	Town of Placentia
December 18, 2015	City of St. John's
December 21, 2015	CBCL Limited, St. John's
January 4, 2016	Harris and Associates, Carbonear
January 5, 2016	City of Corner Brook
January 5, 2016	Amec Foster Wheeler, Corner Brook
January 5, 2016	Anderson Engineering, Corner Brook
January 6, 2016	Town of Stephenville
January 6, 2016	Atlantic Engineering, Corner Brook
January 7, 2016	Town of Happy Valley-Goose Bay
January 8, 2016	Town of Conception Bay South
January 12, 2016	City of Mount Pearl
January 13, 2016	Department of Justice and Public Safety, Fire and Emergency Services Department of Municipal Affairs, Engineering
January 13, 2016	Central Newfoundland Regional Health Authority Department of Education and Early Childhood Development, Design and Construction Department of Environment and Conservation, Policy and Planning Division Department of Environment and Conservation, Water Resources Management Division Department of Transportation and Works, Building Design and Construction Department of Transportation and Works, Western Region Eastern Newfoundland Regional Health Authority Labrador Grenfell Regional Health Authority Western Regional Health Authority
January 14, 2016	BaeNewplan / SNC Lavalin
January 14, 2015	Municipalities Newfoundland and Labrador
January 15, 2016	Department of Environment and Conservation, Parks and Natural Areas Division Department of Environment and Conservation, Wildlife Division Department of Fisheries and Aquaculture, Aquaculture Development Division Department of Fisheries and Aquaculture, Aquatic Animal Health Division Department of Fisheries and Aquaculture, Regional Services – Western / Central Department of Fisheries and Aquaculture, Regional Services – Northern Department of Fisheries and Aquaculture, Sustainable Fisheries and Oceans Policy Division Department of Natural Resources, Agrifoods Department of Natural Resources, Agrifoods - Land Resource Stewardship Department of Natural Resources, Mines - Geological Survey Department of Natural Resources, Mines - Mineral Development
January 15, 2016	Department of Business, Tourism, Culture and Rural Development, Heritage

Date	Agencies
	Department of Business, Tourism, Culture and Rural Development, Ocean Technology and Arctic Opportunities Branch Department of Municipal Affairs, Engineering Services Department of Transportation and Works, Air Services Department of Transportation and Works, Marine Services Executive Council - Labrador and Aboriginal Affairs, Labrador Affairs
February 2, 2016	Government of Nunatsiavut

4.0 RESULTS OF STAKEHOLDER ENGAGEMENT

This section provides information on: if and how participants incorporate climate change considerations into their work; whether (or not) the participants use the tools and resources provided by the Province or other tools; why they use these or other tools and resources; how the Provincial tools and resources compared to others; how participants learn about the tools they use; and where they access climate change data and information. It also provides summaries of the responses to questions around climate change direction, collaboration and conflict as well as recommendations from participants on how to enhance uptake of tools and resources, formats that may improve accessibility and information gaps that may exist.

4.1 Results of Engagement with Municipal Stakeholders

Representatives (21) of a selected group of municipalities and Nunatsiavut government were asked a number of questions to facilitate a detailed discussion around climate change tools and resources. The following sections outline the results of these exchanges with an attempt to provide anonymity but supply appropriate examples for illustrative purposes.

4.1.1 Use of Climate Change Adaptation Tools and Resources

Municipal representatives were asked if, how and why (or why not) they use particular data, tools and resources related to extreme weather and climate change. These participants were asked how they learn about the tools they use and if they have ready access to potentially relevant resources. Responses varied but there were some common themes throughout. The following paragraphs summarize these responses and percentages used to illustrate the analysis of usage (Table 4-1).

At least some of the municipal representatives were aware of each tool and resource that was presented in the interviews. The participants were most aware of Flood Risk Mapping, which has existed for a long time, and Flood Alerts which are sent directly to individuals within municipal government. About half of the participants were aware of the 2013 Climate Change Projections, Climate Portal, 2015 IDF Curves, Coastal Erosion and Sea-Level Rise resources. A smaller number were aware of at least one of the vulnerability assessment tools discussed in Section 2.8. Municipal representatives stated that in some cases, the tools are not relevant to them (e.g. Coastal Erosion and Sea-Level Rise in Gander or Mount Pearl) or were not available for their region (e.g. flood risk mapping for Conception Bay South). They also acknowledged that the tools and resources may be used by others within the organization or by consulting firms they engage. In a number of instances, participants were not sure if they had previously seen the information presented.

While municipal representatives are aware of some of the tools and resources, they were less likely to have used them though some used them regularly. Nearly one third of representatives stated that they have used Flood Risk Mapping and Flood Alerts. The other climate change tools and resources presented had been used by few or none of the participants. The most likely sources of relevant data and information were Environment Canada and the Gander Weather Office.

Table 4-1: Municipal Use of Climate Change Tools and Resources

Tools and Resources	Use of Tools and Resources		Other Sources Used
	Aware of (Approximate)	Used (Approximate)	
Climate Portal	~48%	~5%	Environment Canada, Gander Weather Office
2015 IDF Curves	~43%	0%	Environment Canada, Municipal Affairs, Creates own
2013 Climate Change Projections	~62%	~10%	-
Flood Risk Mapping	~86%	~29%	-
Flood Alerts	~81%	~29%	Gander Weather Office
Coastal Erosion	~48%	~5%	-
Sea-Level Rise	~48%	0%	-
Vulnerability Risk Assessments	~29%	0%	-
Total Participants = 21			

4.1.2 Awareness of and Access to Data and Information

In many cases, municipal representatives stated that they are generally unaware of the climate change adaptation tools and resources, provided by Provincial agencies, or only familiar with them on a superficial level. While participants may be aware of some of the tools and resources, those that use particular information such as historical precipitation data and IDF curves seem most likely to access them through Environment Canada’s website or from Gander Weather Office because these sources are familiar or the representatives have effective contacts within an agency. The heads of municipal public works departments and others are aware of the Flood Alerts as they receive them directly via email.

Municipal representatives learn about tools and resources in various ways. Several noted emails from FES-NL and MNL. Some representatives noted that they receive information at conferences provided by groups such as the Canadian Public Works Association (CPWA). They also participate in continuing education activities such as seminars, workshops and webinars and some had attended the Public Infrastructure Engineering Vulnerability Committee (PIEVC) workshop. Representatives also obtain information from books on storm water management that often include a discussion of climate change effects and adaptation.

Municipal representatives use information such as weather forecasts from Environment Canada, the Weather Network and European weather services as well as hurricane tracking from the US National Oceanic and Atmospheric Administration (NOAA). These resources have been discovered through general knowledge, the Internet or by word-of-mouth.

Professional staff such as municipal engineers, who participated in this consultation, have learned about specific resources through their university education, academic contacts, Provincial government reports

online, from other engineering studies and from the 2013 Climate Change Projections. Some municipal planners stated that they access information and approaches to climate change adaptation from Federation of Canadian Municipalities Partners for Climate Protection program. Some have also done independent research on national and international best practices for sustainability and applied relevant information to municipal planning.

4.1.3 Application of Climate Change Adaptation Tools and Resources

Municipal representatives were asked to discuss why (or why not) they use particular climate change tools and resources. A number of participants stated that not knowing the tools and resources are available is the main barrier. Some stated that they understand the need for climate change adaptation and would be interested in having more data and information but lack the necessary human and financial resources and technical knowledge to use them. For instance, one municipal representative stated that they do not have in-house digital mapping capability (i.e. skill sets, computer software and hardware to access shape files) that would be useful for spatial analyses. Some municipalities stated that the Provincial Government, and other agencies, have informed them of available tools and resources but awareness does not mean that they are able to understand them or know who should use them.

A number of municipalities in the province have Flood Risk Mapping which is prepared by the DEC-WRMD and municipalities. These maps are important tools for those communities that have them. Municipalities incorporate Flood Risk Mapping into their Municipal Plans by adopting relevant policies and establishing prohibitive environmental hazard areas in land use bylaws. While the municipalities interviewed were aware of Flood Risk Mapping, not all knew that the new mapping includes climate change projections. Development applications within flood zones are directed to the DEC-WRMD for review under the “Newfoundland and Labrador Provincial Land Use Policy: Flood Risk Areas”. While municipalities have included flood risk areas in their plan and follow Government recommendations, one municipality stated that this policy is inflexible.

For larger municipalities that have professional planning, engineering and technical staff, climate change adaptation may involve strategic planning and management of land use and infrastructure through policies and regulations. Representatives of municipalities of all sizes stated that they assume that their consulting engineers would access and use appropriate tools and resources including climate change adaptation information but they generally do not give direction on what should be used. Some municipalities were aware that their consulting engineers design for the 100-year storm.

Most municipal representatives are overwhelmed with day-to-day operations and thus issues are mainly addressed in a reactive rather than a proactive manner. The majority of municipalities have worked under the direction of FES-NL to develop Regional Emergency Response Plans and participate in training that emphasizes practical, on-the-ground measures for addressing flood damage before, during and following storms. The heads of municipal public works departments receive storm alerts and hurricane flood risk warnings from FES-NL and MNL. Storm / flood warnings and weather forecasts are used to understand when the municipality is at risk and if so, to engage in monitoring and preventative maintenance. Storm preparation includes additional staffing, regular monitoring (especially in areas of

known flood risk), as well as clearing culverts, storm sewers, catch basins and drainage ditches of debris to permit water to flow more freely through the infrastructure as intended.

A participant from a smaller municipality commented that he considers climate change to be long term (i.e. change over 10 years) whereas the municipal government is consumed with addressing short term needs. Ongoing replacement of existing municipal infrastructure (e.g. curb and gutter, storm sewer, sanitary sewer) is managed incrementally with a portion of infrastructure being replaced annually within two to three year budgeting cycles. When replacing existing infrastructure, the municipality adjusts according to any new understanding gained during recent flooding events rather than using long term climate data and future precipitation projections.

4.1.4 Data and Information Availability and Reliability

Municipalities use various data and information, as well as their own experience and knowledge of an area, to plan for adverse weather events. To do this, they mainly access weather forecasts, and in some cases tidal information, from a variety of sources as they find that weather forecasting can be inconsistent and they have more confidence in making judgements based on multiple sources of information. Most of the municipal representatives interviewed use adverse weather warnings issued by Environment Canada's Gander Weather Office. These are considered relevant for short term details, such as when (during a winter event) snow will turn to rain.

Some municipalities stated that there is not much specific information for their community and that where data exists, coverage may be inadequate. Some municipal representatives commented that due to local conditions and the distance between climate data stations, that they may not receive accurate weather forecasts and or / weather data for their particular area. For example, as weather stations are located in Deer Lake and Stephenville, Corner Brook has to interpolate between the two data sets and the results may not be applicable to the local microclimate. Representatives of the Town of Gander noted seeing a DEC-WRMD presentation that showed future predictions of extreme weather but the Town already experiences precipitation exceeding the future level shown. Therefore, these data are often considered irrelevant and may not be used. Flood Risk Mapping for Stephenville is spatially incomplete as one area has not been mapped, and some municipalities that experience flooding have yet to be mapped.

Data and information are sometimes considered to be inaccurate or insufficient. For example, a representative of a municipality that experiences flooding feels that Environment Canada tends to be conservative in their estimates and the town would like to have more accurate information to avoid unnecessary usage of financial and human resources to prepare for evacuations, which are required in about one in ten of instances where flooding is predicted. In some cases, municipalities consider long-term projections to be for an insufficient time frame for infrastructure development. One municipality is considering a new sewage treatment plant that would be placed on the coast and needs to understand what sea-level will be in 100 years to coincide with the lifecycle of the facility.

Most representatives stated that they have limited capacity to collect or use data and information and depend on the Province for tools and resources. Data acquisition is expensive and the cost of conducting

local studies would be prohibitive as weather has so many variables and specialized expertise would be required. The Province shares water quality and flow data with municipalities and Environment Canada's historical climate data is available on their website (though they do charge a fee for custom dataset requests). The City of St. John's charges developers for precipitation data.

Some municipalities and other local agencies collect data but this was limited to several municipalities and in some cases to specific areas within a municipality. The Town of Gander collects data at the Gander Lake water supply pump house. Corner Brook Pulp and Paper provides the City with flow data for Corner Brook Stream but this is for one watercourse so is not relevant for the municipality as a whole. The City of St. John's collects weather data through a network of high-frequency rainfall gauges throughout the municipality. The City has also installed flow monitors on rivers and sanitary sewers and uses portable storm water monitoring stations to collect data on flow and groundwater infiltration. St. John's also uses a meteorological station at Windsor Lake to collect input parameters and uses water supply monitoring to examine water usage levels. All relevant environmental data collected by the City are inputted into XP SWIM for urban hydrologic modeling.

While, most municipalities do not have the financial resources to collect data, they wish to have specific information to understand local issues so that they can be more effectively addressed. For instance, the Town of Placentia stated that the lack a tide meter on the lift bridge is a limitation to understanding the relationship between tide levels and flooding. The most recent Flood Risk Mapping study for Corner Brook used data collected in Stephenville as a baseline but recommended local data collection to facilitate better planning.

When designing infrastructure, municipalities or consultants may use IDF curves but the observation periods are for every four or six hours whereas intense precipitation often occurs within shorter, sub-hourly, time periods. The quantity of precipitation within an hour is most important and excessive rain events (which may not be hurricanes) need to be better understood. The City of St. John's is more confident in its own IDF curves as it has collected and inputted about 20 years (since 1997) of precipitation data into the modelling. The City also uses external data to compare and check its own information. Some municipal representatives felt that as the 10-year storm is inadequate for current conditions, that the 2015 IDF Curves should be incorporated into the "Newfoundland and Labrador Municipal Master Specifications" with information by location.

The 2013 Climate Change Projections was among the better known of the tools and resources. Some municipalities indicated that they assume that their consulting engineers use this information and one municipality discussed using it themselves. The City of St. John's representatives stated that they use these models as they are tailored to St. John's, easy to use and adapted for the future.

Local knowledge is also a valuable and often dominant source of information. The Town of Conception Bay South has created a hazard map using information inputs based on historical data and local knowledge as well as the Provincial Geological Survey. Local people make observations that are effective in short term management. For instance, when heavy rain falls in the mountains, Town of

Stephenville representatives stated that it will take only three to four hours for the storm water runoff to reach the Town.

4.1.5 Provincial and Local Direction on Climate Change Adaptation

Municipal representatives were asked if they receive any direction on addressing climate change. Most stated that municipal councils have given no official direction on climate change mitigation or adaptation. In many cases climate change is not discussed at Council meetings and thus is not a priority. One participant stated that Council sees flooding as a localized issue or a singular event and better understands addressing items with immediate needs rather than long-term improvements.

Municipal representatives stated that they do not receive enough support to address climate change adaptation and improve development practices. A number of municipal representatives felt that climate change is not a municipal issue but rather a provincial matter. They stated that the Provincial Government should provide financial support to build municipal capacity and technical knowledge for climate change adaptation and long term planning. Some stated that accessing funding for climate change adaptation should be contingent upon following best practices.

Participants felt that while there is a lack of Provincial direction on climate change adaptation if direction was given they would follow it as they do with existing direction. For instance, the Province required municipalities to prepare an integrated community sustainability plan in order to qualify for Gas Tax Refund money and the municipalities did so. Provincial direction is followed on standards and guidelines for infrastructure design. Municipalities are not required to follow LEED standards for new buildings but some have chosen to incorporate these and other environmental building standards promoted by the Provincial Government. One municipality stated that Municipalities can collaborate on best practices but they need consistent policies such as a Provincial land-use policy to improve development practices. They would like the Province to establish a directive on planning and infrastructure standards for climate change adaptation, showing the municipalities what needs to be done and how to do it.

Some municipalities expressed concern over a lack of coordination or communication between groups such as municipalities, Department of Municipal Affairs (DMA), DEC-WRMD and DNR (for forestry harvesting) that make decisions and share information about development control in flood risk areas. For instance, municipal representatives felt that the DMA and DEC provide inconsistent Flood Risk Mapping information on their webpages. One municipality feels that its Flood Risk Mapping needs more frequent adjustment as changes have been made to control flooding but DEC-WRMD says that in order to change the maps, they need to review the entire watersheds.

In order to determine if municipal proposal and tendering processes may help or hinder municipalities to undertake climate change adaptation measures, municipal representatives were asked to discuss these processes. Participants indicated that professional staff involved in engineering and planning in larger municipalities, and management or technical public works staff in smaller municipalities, develop requests for proposals (RFP) and tender documents with consultants sometimes engaged to prepare the latter. In both large and small municipalities, RFPs and tender documents are prepared

independently with Council approval to engage consultants and contractors. One participant stated that municipalities feel that they do not have enough control over the procurement process due to DMA oversight.

4.1.6 Climate Change Collaboration and Conflict

Municipalities work with a variety of organizations around climate change. Municipal representatives consider Environment Canada's Gander Weather Office to be a collaborator. A number stated that this group is an important source of timely and up-to-date information. During extreme weather events, municipal operations crews often engage in open dialogue with Gander Weather Office.

Many municipal representatives mentioned a similar set of organizations including the Federation of Canadian Municipalities Partners for Climate Protection, MNL, Provincial Government agencies such as DJ-FES, DNR-GS (e.g. Melanie Irvine and Martin Batterson), DEC-WRMD (e.g. Ali Khan), DMA and CCEE. Other participants indicated the Homebuilders Association, the Bedford Institute of Oceanography, Memorial University of Newfoundland (e.g. Norm Catto, Joel Finnis and the Harris Centre) and the Atlantic Canada Regional Climate Change Advisory Committee. The City of St. John's noted Provincial Government collaborations including a cooperative arrangement with DEC-WRMD on Flood Risk Mapping. The City also works with CCEE on energy efficiency for commercial, industrial and institutional building code changes. Nunatsiavut Government works closely with MUN on its SMART Ice project as well as other academic institutions through University of Manitoba, Trent University, Harvard University and University of Guelph. Nunatsiavut Government also engages with Federal government agencies such as Parks Canada, Aboriginal Affairs and Northern Development Canada and Environment Canada.

The neighbouring municipalities of Mount Pearl, St. John's and Paradise that share the Waterford River Valley watershed work together to address flood reduction and water quality issues. The City of Mount Pearl has also worked with groups such as the Conservation Corps on water quality studies and cleanup projects along the Waterford River.

Fewer conflicts were described and these included the challenge to provide enough funding and technical capacity to deal with climate change adaptation and infrastructure upgrades. Some municipalities have come into conflict with residents whose basements have flooded and see the issue as having more to do with municipal mismanagement than the effects of climate change and extreme weather.

The main conflict appears to be related to development standards and regulations. Consistent regional approaches to development are important but regional planning initiatives are challenged by political conflict and competition for development. Urban municipalities also run into conflict with neighbouring communities where development best practices do not exist or are not enforced. As neighbouring municipalities may share portions of watersheds, lack of storm water management regulations in one municipality can result in flooding in another. Also, developers often see storm water management measures (e.g. lot grading, landscaping) and infrastructure improvements as unnecessary red tape that

interferes with development and add costs to their projects. The result is that new developments may establish in communities that do not follow best practices and where low taxes artificially disable progress on storm water management. This can result in loss of Council support for staff to implement change in municipal policies and regulations.

4.2 Results of Engagement with Consulting Firms

Amec Foster Wheeler met with 10 planning / engineering firms located in Gander, Corner Brook and the Northeast Avalon to discuss use of climate change adaptation tools and resources. The following sections provide a summary of the results of these exchanges.

4.2.1 Use of Climate Change Adaptation Tools and Resources

Consultants who participated in stakeholder engagement were asked if, how and why (or why not) they use particular data, tools and resources related to extreme weather and climate change. These participants were asked how they learn about the tools they use and if they have ready access to potentially relevant tools. The results of this discussion are illustrated in Table 4-2. Again, the percentages are used to illustrate the usage of tools and resources.

All of the consultants interviewed were aware of Flood Risk Mapping as they work with municipalities that have mapping and most have used this information. Between one third and one half of the participants were aware of the 2015 IDF Curves and 2013 Climate Change Projections but less than half had used them. Consultants usually obtain IDF curves from Environment Canada, the City of St. John's (when working in that municipality) and some have created their own. The level of awareness of the other tools and resources presented was between zero and 40% and they were generally not used by the consultants.

Table 4-2: Consultant Use of Climate Change Tools and Resources

Tools and Resources	Use of Tools and Resources		Other Sources Used
	Aware of (Approximate)	Used (Approximate)	
Climate Portal	~21%	~7%	Environment Canada
2015 IDF Curves	~43%	~21%	Environment Canada, Gander Weather Office, City of St. John's, create own
2013 Climate Change Projections	~36%	~7%	-
Flood Risk Mapping	~100%	~71%	-
Flood Alerts	~14%	0%	-
Coastal Erosion	~21%	~7%	-
Sea-Level Rise	~0%	0%	-
Vulnerability Risk Assessments	~29%	0%	-
Total Participants = 20			

4.2.2 Awareness of and Access to Data and Information

Consultants use IDF Curves for infrastructure design and about half of the firms interviewed use those provided by Environment Canada as they have known about them for a long time. Some of the consultants were unaware that Environment Canada IDF Curves are available for a number of sites in the province and that these are updated periodically. Some are already using the 2015 IDF Curves or have accessed information from the 2013 Climate Change Projections. When working for the City of St. John's, consultants use the City's IDF Curves. Two consultants mentioned developing their own design storms using existing data. In larger companies, consultants may access the expertise of specialists such as hydrologists.

Consultants discussed accessing historical precipitation data mainly from Environment Canada or Gander Weather Office and noted that data are only available for specific sites and may not apply to a given study area. One participant noted learning about Environment Canada data when he was studying civil engineering. Some consulting engineers develop flow rates based on these data. Consultants indicated that they also use precipitation data from the Provincial Government website and the "Water Resources Atlas of Newfoundland" (includes rainfall distribution in NL). The City of St. John's provides precipitation data that are considered by some consultants to be more conservative than other sources.

Consultants indicated using various other resources including stream gauge data from the Water Survey of Canada and using flood frequency analysis. They also noted gaining insight from flow characteristics of different pipes and culverts and from DEC culvert guidelines for environmental approvals.

4.2.3 Application of Climate Change Adaptation Tools and Resources

Consultants were asked to comment on how they use climate change tools and resources, the advantages of, and barriers to, using particular sources of information. Various participants stated that they use data to calculate drainage areas, develop runoff factors and input into hydrological models. Information such as precipitation data, flow data, catchment area, surface permeability and Lidar are also used in modelling.

Consultants referred to various software programs into which they input data for analysis and design. These included WaterCAD, StormCAD, Civil 3D, XPSTORM and XPSWMM. If working with the City of St. John's, a particular hydrological model (i.e. XPSWMM) must be used.

The 2013 Climate Change Projections are preferred by at least two consultants (with larger firms) as it was developed for the Provincial government and is customized for Newfoundland and Labrador. These participants noted that this information includes climate change projections and return periods for rainfall and is incorporated in the same way as any other IDF curve.

One consultant stated that they prepare streamflow modeling for smaller ponds for water supply development. Two mentioned using flood frequency analysis but one stated that the Provincial information is approximately 20 years old.

When asked why they use the tools and resources that they choose, several consultants stated that they use well established and reliable data sources such as Environment Canada. One stated that historical Environment Canada data is considered credible for expert witness testimony.

Consultants that work on storm water management plans stated that municipal regulations and oversight are inconsistent. St. John's is conservative (e.g. it assumes saturation) and makes ongoing changes to the standards it has adopted. Mount Pearl is not as stringent as St. John's, potentially due to limited staff. A consultant noted that these issues will eventually resolve but developers are concerned about increasing costs of installing underground systems or detention ponds that consume building lots or parking lot space. One consultant talked about a school development project where the Province asked for 100-year design storm or greater with 50-year floodplains, and required incorporation of climate change projections to 2050. This meant large culverts, various compromises, addition of berms and relocation of a water course which all increase costs and require additional regulatory input.

Another consultant felt that storm water detention is challenging as it is difficult to understand what storm events will be like and each consultant's analysis may have different results. Various resources give direction such as to design pipes using the Rational Method for a 10-year event but IDF Curves are static. In this province, adverse weather events include combinations of snowfall, melt and rainfall which together is too much flow for infrastructure and further issues arise when infrastructure is blocked with snow. The "Regional Rainfall Frequency Analysis" does not include rain on snow events (related to the minor / major system).

The City of St. John's approach to storm water management differs from the Province of Newfoundland and Labrador. A consultant stated that working on storm water management projects for Provincial assets within the City of St. John's can be challenging. For hydrological modelling, the City of St. John's uses XPSWMM and the DEC-WRMD uses HEC-HMS which produce different results in floodplains. Also, HEC-HMS cannot incorporate Lidar. The City collects and uses its own precipitation data in which it has more confidence than in external information.

Consultants noted that it can be difficult to incorporate climate change and extreme weather events into design projects when clients do not ask for it. If the regulations and standards do not require changes, it may be challenging to propose them to clients. Municipalities generally do not have the financial resources to increase the size of infrastructure. Also, the Federal Government has been reluctant to fund replacement of assets lost in extreme events with larger infrastructure for frequent larger storms.

4.2.4 Data and Information Availability and Reliability

Consultants noted obtaining detailed historical weather data (e.g. snow, rain, melt, temperature) and information from the Internet including Environment Canada's website. A number stated that they call Gander Weather Office for information but some stated that the meteorologists are sometimes not as receptive to assisting. One consultant on the west coast of Newfoundland noted occasionally contacting an Environment Canada Weather Office in New Brunswick seeking information about weather in the Gulf of St. Lawrence.

Several consultants stated that if they were looking for climate change information they would go to the webpages of the Provincial Government, CCEE, the DEC or call a particular contact in the department. Others get information from the Federation of Canadian Municipalities InfraGuide, best management practices from sources such as the LEED guidelines and by checking Federal government regulations that may apply to a project. Information is also gained through contacts at MUN.

Several consultants noted learning about climate change at conferences and seminars. They stated that these events may have been provided by Professional Engineers and Geoscientists Newfoundland and Labrador (PEGNL), the Atlantic Canada Water Works Association (ACWWA), Atlantic Planners Institute (API) and the CCEE. One noted learning about the 2013 Climate Change Projections from a local event when the project was released.

The consultants interviewed for this study use data and professional judgement supplemented by their own observations and local knowledge to understand an area. They look at flood lines on watercourses and erosion in the landscape. One stated that local knowledge is more useful in small watersheds than resources developed for larger areas. Some noted that while local knowledge is valuable, it cannot be accepted as empirical and judgement must be used based on one's own experience.

Consultants stated that most clients do not have much data or information to offer. Consultants stated that they ask municipalities questions about historical weather events and observations including where basements have flooded or roofs have been damaged by storms.

A minimal number of municipalities may have access to data such as flow measurements. One consultant expressed concern of the confidence levels of flow data as a high degree of uncertainty is difficult to quantify and communicate with clients. The available tools are not effective for different sizes of storms and the results are inaccurate, variable and uncertain. This makes it difficult to justify increased infrastructure costs to municipal clients. Another consultant stated that the climate data is often not applicable to the specific site and standards such as the National Building Code do not account for various microclimates as snow deposition also depends on topographical features.

4.2.5 Client Direction on Climate Change Adaptation

Participating consultants were asked if they receive direction from clients (government and private industry) on planning or designing for climate change or extreme weather events. Generally municipal clients do not request that consultants consider climate change in infrastructure design. The exception would be larger municipalities such as Corner Brook or those on the Northeast Avalon that have storm water management policies and regulations. The City of St. John's asks consultants to incorporate the results of the 2013 Climate Change Projections into infrastructure and storm water management projects. This has also been requested for provincially funded studies in Flatrock and Logy Bay-Middle Cove-Outer Cove.

As a result of lack of direction, municipal infrastructure may be designed to meet minimum standards unless a consultant determines that it should be otherwise and if involved in this decision, the

municipality may accept the consultant's suggestion. Consultants stated that small municipalities do not have the financial resources or professional staff to deal with climate change matters and rely upon consultants to take appropriate initiative when designing infrastructure. Consultants may be asked to generally make infrastructure larger to address a particular issue with a culvert, bridge or in a residential area. Nonetheless, municipalities experience issues with access to sufficient funding to increase the capacity of the replacement infrastructure following major events. Consultants generally felt that if it was financially feasible to incorporate climate change, municipalities would be interested in the long term benefits of installing larger infrastructure so that they could focus on replacement of infrastructure due to ageing rather than flooding and washouts. Currently, there is an implied acceptance of risk of loss of infrastructure as a trade-off for lower costs for infrastructure replacement on an annual or short-term basis.

Some requests for proposals for regional planning studies have addressed climate change but these documents are generally policy driven. Provincial government clients have asked for storm water detention ponds for LEED projects and 100-year design storms or greater for flood plains at schools near watercourses. Industry generally wishes to have the lowest cost solution to meet the minimum regulatory requirements. There are exceptions where engineers have recommended increasing the design storm and private clients have been amenable to suggestion. Others are mindful that if their responsibility for infrastructure is temporary, they are not interested in over-designing for long-term use and loss prevention.

In the absence of direction from municipal clients, consultants may use their own discretion to design for climate change or extreme weather events. Consultants are potentially at risk of under designing or overdesigning infrastructure in these cases. One stated that they design for the minimum regulations unless requested to do otherwise. Another stated that overdesign is not the best approach as a rule but a reasonable factor of safety is required for infrastructure design. One consultant stated that the firm currently designs storm sewers and bridges for the 100-year storm or larger and subdivisions for the 50-year storm. Another usually adds a factor of 25% to 50% above the 100-year storm to accommodate extreme events and noted installing an 18 ft culvert in an area with ongoing flooding. . In the context of these varied approaches, multiple consultants discussed the need for guidance for designing under the uncertainty of climate change.

One consultant indicated that for due diligence, they always use a climate change factor in municipal infrastructure work even when not requested by clients. They also noted that for water supply studies, it is also important to consider potential drought years and lack of water conservation. Another stated that they often look at extreme weather for municipal design even if the client is not aware of it.

4.2.6 Climate Change Collaboration and Conflict

When asked about whether or not they collaborate with other agencies, or experience conflicts about climate change, consultants generally stated that neither is applicable to them. Some noted that their clients may collaborate with others. One stated that the environmental assessment process is collaborative between a project proponent, consultants and regulators. Conflict has sometimes arisen

between agencies within a watershed in an urban environment when there is a perception of moving problems from one location to another.

4.3 Results of Engagement with Provincial Officials

Amec Foster Wheeler met with 34 Provincial officials in four sessions. Because of the potential number of participants in Provincial sessions, official from Government agencies were asked a similar set of questions as those posed to the municipalities and consultants but in a slightly shortened format. The results of an interview with MNL is also included in this section. This agency, which does not own or operate facilities or infrastructure, uses climate data to develop resources for municipalities and acts as an information broker for sharing information.

4.3.1 Use of Climate Change Adaptation Tools and Resources

As was the case with other participant groups, Flood Risk Mapping and Flood Alerts were the best known resources and the latter were used by most of the individuals who knew about them (Table 4-3). This is not surprising as both of these resources are critical to protecting infrastructure and resources from flood damage and ensuring human safety.

As for the remaining tools and resources, more than 20% of participants were aware of the Climate Portal, 2013 Climate Change Projections, Coastal Erosion and Vulnerability Risk Assessments. Fewer than half of the individuals, who were aware of most of the tools and resources, had used them and this may be because it is not within the scope of their work to address relevant issues. As was typical with the other participant groups, Environment Canada was a key source of climate data and IDF Curves. Also, some of the developers of these tools and resources attended Provincial Government sessions which resulted in a higher level of awareness and usage among the participants.

Table 4-3: Provincial Officials Use of Climate Change Tools and Resources

Tools and Resources	Use of Tools and Resources		Other Sources Used
	Aware of (Approximate)	Used (Approximate)	
Climate Portal	~24%	~9%	Environment Canada, Water Resources Portal, NAV Canada
2015 IDF Curves	~12%	~12%	Environment Canada, Gander Weather Office
2013 Climate Change Projections	~21%	~12%	-
Flood Risk Mapping	~44%	~21%	-
Flood Alerts	~50%	~47%	-
Coastal Erosion	~21%	~9%	-
Sea-Level Rise	~18%	~15%	-
Vulnerability Risk Assessments	~21%	~18%	-
Total Participants = 34			

4.3.2 Application of Climate Change Adaptation Tools and Resources

Provincial officials were asked to discuss their usage of the eight climate change adaptation tools and resources offered by Provincial Government in their work. The following paragraphs discuss the results of these meetings and are arranged by the tools and resources.

Climate Change Information Portal

Information found on the Climate Portal and other historical climate data are used by the DEC-PNAD and Eastern Newfoundland Regional Health Authority. The Department of Transportation and Works (DTW) stated that consultants may use this information. The DNR-AB uses historical climate data for agricultural land suitability analysis. Some officials stated that other staff members within their departments may use this information. The Labrador Affairs Office (LAO) stated that historical climate data has been used for Labrador Winter Trails grooming subsidy evaluations. Participants from the Department of Business, Tourism, Culture and Rural Development (DBTCRD) stated that local businesses use climate and environmental data to develop information products such as SmartBay.

Provincial officials noted that there are various other sources of historical climate data. These include Environment Canada and Natural Resources Canada. The DMA-ES assumes that Climate Portal data are used by consulting engineers. Some agencies stated that they use real-time climate information rather than historical data and get this from Environment Canada and NAV Canada.

Intensity-Duration-Frequency (IDF) Curves (2015 Update)

Various officials from DMA, DNR and DTW use IDF Curves in infrastructure design and maintenance. Participants stated that IDF Curves are available from other sources such as Environment Canada and the Gander Weather Office. Several stated that they assume that their colleagues and / or consultants are aware of the 2015 IDF Curves and use them.

Projected Impacts of Climate Change for the Province of Newfoundland and Labrador

Provincial officials use climate change projections in their work. The DEC-WRMD and the DNR-GS use the 2013 Climate Change Projections and other sources of information. One participant stated that if they were looking for climate change projection information they would search on the Internet. An official from FES-NL stated that the Climate Change Projections might be useful to municipalities if the information was presented in clear terms so that they could understand it.

Flood Risk Mapping

Provincial officials use Flood Risk Mapping in various ways such as in design and engineering of roads, bridges, wharves and mine tailings impoundments, depending on the location. Fire and Emergency Services – Newfoundland and Labrador uses Flood Risk Mapping in the development of emergency response plans. Facility managers such as DTW-BD and regional health authorities use this information

for development and management of buildings and sites. The DMA-ES uses Flood Risk Mapping for disaster mitigation as the basis of infrastructure planning for those communities that have the mapping.

Hurricane Season Flood Alert System

The FES-NL sends these to contacts in all applicable agencies including communities, parks management and DMA. Provincial Government participants who are aware of Flood Alerts generally either receive them directly as they are relevant to their work in protecting infrastructure or they send them to other agencies so that they can prepare for potential storm damage.

Coastal Erosion Monitoring

Coastal erosion is an issue and roads, municipal infrastructure, residential properties, harbour infrastructure and aquaculture facilities may be vulnerable. Coastal erosion is also considered in emergency response planning for FES-NL and communities. Officials of the DTW Transportation Division (DTW-TD) and DBTCRD-HD indicated that it is likely that staff in their departments use this information to assess the vulnerability of infrastructure and archaeological sites along the coast. Participants stated that they believe this information was presented at a PIEVC workshop and it is likely that engineering consultants would use it.

Sea-Level Rise Projections

Information on potential sea-level rise is used by Provincial Government departments and agencies. The DNR-GS uses it in its coastal erosion work. Sea-level rise is a concern for municipalities as it may result in inundation of sea water into sewer systems and is also potential issue when working with orphaned and abandoned mine tailings facilities if they are on the coast. The information was used in a World Heritage Site Nomination application for Mistaken Point. Government officials stated that they assume that consulting engineers working with agencies on development and protection of infrastructure would understand and use this information.

Vulnerability Risk Assessments

Some Provincial officials such as those from FES-NL provided input into development of this toolkit which was developed through MNL. One participant stated that they use this information to inform stakeholders. Participants seemed to be better aware of other similar tools such as those prepared by Engineers Canada and some had attended a PIEVC workshop on the topic. The DMA-ES uses other vulnerability and risk assessments to advise communities on asset management. The FES-NL uses two other models (depending on the officer or manager) in the Emergency Management Planning process to identify hazards in communities.

4.3.3 Data and Information Availability and Reliability

Provincial officials were asked to comment on the availability and reliability of data and information. As with other participant groups there is concern about the reliability of weather forecasts and other

predictive information. One participant noted that there are differences between the hurricane and flood alerts provided by Amec Foster Wheeler and Environment Canada but they both indicate the same communities as having a potential problem. For long-term planning, Environment Canada climate data is not always accurate, depending on the location of climate stations, and accurate data and information are required to understand freshwater input when planning and managing aquaculture facilities.

Provincial officials noted that responses to issues are often reactive rather than proactive. For instance the DTW Air Services (DTW-AS) fights forest fires but is not involved in evaluating whether or not they are likely to occur. A DMA-ES official stated that climate change can be incorporated into the planning and design of new infrastructure but management has to be reactive with regard to flooding and wind damage for existing buildings and infrastructure. Participants noted that decisions related to adverse weather events must often be made in the present. For instance, during high wind events, decisions for ferry sailings are the call of the ship's captain. Various services in coastal Labrador are also subject to weather issues and the best the program managers can do is to communicate with communities.

Provincial officials were asked to compare the Provincial climate change tools and resources to others they have used. An official from Water Resources Management Division stated that particular resources (e.g. "Water Resources Atlas") that have been developed by the Provincial Government, are envied by other Atlantic Provinces. The participant also stated that Quebec is the most advanced province in the development of resources and that Environment Canada provides a lot of good data. For coastal changes, other jurisdictions such as the United States have more funding and better data and are able to make more confident predictions than those in Newfoundland and Labrador. A Provincial official stated that Provincial and Federal (i.e. NRCAN website) information on climate change projections are similar to those presented in the Climate Change projections report.

4.3.4 Provincial Direction on Climate Change Adaptation

Provincial officials stated that they generally do not receive direction on incorporating climate change into operations. They noted broader policy initiatives such as the "Climate Change Action Plan 2011" and the establishment of the CCEE as indications of direction on climate change. One official noted that Department of Environment and Conservation staff has been given Departmental direction. In addition, Provincial officials stated that they have received general awareness notifications around "greening government" and it is possible that directors or managers have been instructed on climate change adaptation.

Provincial officials have experienced changes to policy and practice for design of roads and buildings. The Department of Transportation and Works determined that culverts have to be a minimum of 1000 mm and that extreme weather events need to be incorporated into design. The DMA-ES has also adopted this practice. Addressing climate change mitigation and adaptation is inherent in policy direction such as the "Build Better Buildings" policy and LEED Silver certification targets for new Government facilities. Perhaps it is not an official policy but the Department of Education and Early Childhood Development (DEECD) has requested use of best available modelling data in school design.

4.3.5 Climate Change Collaboration and Conflict

Collaborations were described such as that between FES-NL and the agencies (Amec Foster Wheeler and Environment Canada) that provide potential flood risk alerts. The DEC-WRMD works with a number of groups. Flood Risk Mapping is a joint effort of DEC-WRMD and other departments as well as municipalities. Water Resources Management Division also collaborates with C-CORE at MUN, Public Services Canada, the US and Canadian Space Agencies and Amec Foster Wheeler, Met Ocean Group.

Memorial University is an important collaborator as a number of officials identified initiatives involving MUN. The DBTCRD-HD is involved in a project with MUN, Parks Canada and DEC to develop mapping and monitoring tools and remediation methods for archaeology sites at risk from coastal erosion. An official from the DEC Wildlife Division (DEC-WD) has worked with MUN on a project regarding potential changes in species distribution of wild fish. The DNR-GS works with MUN, Atlantic Coastal Action Program (ACAP), Northeast Avalon Coastal Action Program (NAACAP) and other agencies in its work on coastal erosion. The DNR Agrifoods Branch (DNR-AB) has worked with MUN in Corner Brook on an agricultural study related to drainage and greenhouse gases.

Other officials, especially those involved in infrastructure development and management, noted working with all government departments and agencies but mainly with FES-NL on emergency response planning and CCEE on energy efficiency. The DMA-ES works with other organizations on changes to infrastructure design guidelines and standards. Within Government, there are a number of collaborative initiatives including integrated coastal management where climate change and adaptation are discussed. The LAO works with academia, the Federal and Provincial Governments and the not-for-profit sector on issues such as food security, housing and climate change in Labrador.

Provincial officials stated that they generally do not come into conflict around climate change. Some noted that ministers have received letters from groups and individuals questioning the value of pursuing adaptation rather than mitigation. Participants described municipal challenges in terms of dealing with the current situation as well as accessing funding related to infrastructure replacement and renewal.

Some officials noted conflicts related to the differences in municipal and provincial infrastructure design standards and regulations. There is also a time lag between acceptance of policies and implementation with regard to issues such as runoff, design of infrastructure and tendering of construction work.

5.0 SUMMARY AND CONCLUSIONS

This section presents a summary and conclusions from the climate change adaptation tools and resources stakeholder consultation program with municipalities, consulting firms and Provincial Government officials.

5.1 Municipalities

Municipalities own and manage a variety of infrastructure for drinking water supply, sewerage and sewage treatment, storm water management and roads. Various infrastructure may be affected by climate change but municipalities are mainly concerned with flooding causing property damage and public safety issues, erosion and loss of infrastructure assets in storms and prevention of damage.

Municipal representatives (21 individuals from 10 organizations) were aware of Flood Risk Mapping, which has existed for a long time, and Flood Alerts, which are sent directly to individuals within municipal governments. About half of the participants were aware of the 2013 Climate Change Projections, Climate Portal, 2015 IDF Curves, Coastal Erosion and Sea-Level Rise resources and a smaller number were aware of one of the vulnerability assessment tools. Nearly one third of representatives had used Flood Risk Mapping and Flood Alerts but the other climate change tools and resources had been used by few or none of the participants.

Municipal representatives were generally unaware of the climate change adaptation tools and resources and the most likely sources of relevant data and information were Environment Canada and the Gander Weather Office. They are aware of tools and resources that are sent directly to them via email. Municipal representatives also learn about tools and resources through continuing education conferences, seminars and workshops offered in person and through webinars.

Flooding and subsequent erosion can also result in risks to human safety. Municipalities that have professional planners and engineers are more likely to be engaged in initiatives such as Federation of Canadian Municipalities Partners for Climate Protection, which advocates climate change mitigation plans and community sustainability.

Municipalities use weather forecasts for anticipating issues with storm water management which potentially causes flooding and damage to property as well as loss of infrastructure assets. The majority of municipalities interviewed (with the exception of the City of St. John's) lacked the in-house expertise and resources to use most of the tools and resources. It is more likely that they can access and use the results of relevant analyses prepared by outside agencies and presented in an applicable format. Many municipal representatives assumed that engineering consultants are aware of and use the best available tools and resources.

Small municipalities spend most of their time and resources engaged in responding to maintenance issues, whereas large and medium sized municipalities have more capacity to engage in long term planning and strategic replacement of infrastructure. Most municipalities stated that their work is

generally reactive as opposed to proactive. All municipalities interviewed were engaged in provincially mandated emergency response planning and use Flooding Alerts to initiate preventative maintenance to avoid flooding issues as much as possible. Those with Flood Risk Mapping incorporate this information into municipal plans to prevent vulnerable infrastructure and buildings from being constructed in flood prone areas.

Municipal representatives want more accurate weather forecasting especially for those areas without local climate stations. Municipalities would like to have more accurate flood forecasting to prevent implementing emergency measures when they are not required. Some municipalities experience flooding but have not yet had Flood Risk Mapping prepared. In some areas with Flood Risk Mapping, the information requires updating or is spatially incomplete. Some information such as sea-level rise predictions are needed for longer time frames for development of long-term infrastructure on the coast.

Most municipalities do not have the resources to collect their own data as studies are expensive and require specialized expertise. Purchasing existing data can also be costly. Some municipalities collect and use their own data for specialized work such as hydrologic modelling. Generally, most of the municipalities would not have a use for raw data given their current resources and skill sets.

Municipalities have specific information needs and stated that they want to know how much rain will fall within an hour as it is extreme rainfall within short periods that is most damaging. They wish to have information such as when during a winter event, snow will turn to rain as this will result in flooding if not addressed. They have local understanding of where flooding occurs, how much rainfall in a given period will cause flooding in a particular area, how long it takes for precipitation to move through an area, the relationship between rainfall and tides in coastal flooding of low lying areas. Municipalities would like better information to verify their observations and to anticipate issues more accurately.

Municipal representatives generally felt that municipal councils do not see climate change adaptation as a priority. Potential problems are not averted but addressed when issues occur. The municipal representatives felt that they need better direction from the Province in terms of a more comprehensive provincial land-use policy to address inconsistencies in how municipalities deal with issues such as development in flood prone areas and on-site storm water management. They also felt that there needs to be more consistency and coordination between Provincial agencies that provide assistance with local issues.

The main conflict related to climate change adaptation appears to be related to development standards and regulations. Urban municipalities run into conflict with neighbouring communities where development best practices do not exist or are not enforced. As municipalities may share portions of watersheds, lack of storm water management regulations in one municipality can result in flooding in another. Also, developers see storm water management measures (e.g. lot grading, landscaping) and infrastructure improvements as interfering with development and add costs to their projects. The result is that new developments may establish in communities that do not follow best practices and where low taxes artificially disable progress on storm water management. This can result in loss of Council support for staff to implement change in municipal policies and regulations.

5.2 Consulting Firms

The consulting firms interviewed (20 individuals from 10 firms) were mainly engaged by municipalities for infrastructure design and development services. Some are involved in providing a full range of services to municipalities and other clients while others are strongly focused on particular areas such as drinking water treatment and distribution, sewage collection and storm water collection. Several of those interviewed were engaged in specialized services such as sewage treatment and hydrologic modelling for storm water management.

All of the consultants were aware of Flood Risk Mapping and most have used this information. Between one third and one half of the participants were aware of the 2015 IDF Curves and 2013 Climate Change Projections but less than half had used them. Consultants usually obtain IDF curves from Environment Canada (though they were not always aware of the spatial and temporal scope of this resource), the City of St. John's have created their own. The level of awareness of the other tools and resources presented was between zero and 40% and they were generally not used by the consultants. Generally, more technically complex approaches and application of innovative methods were seen in larger regional, national and international firms with access to professional specialists and technical tools and with recently graduated and / or specialized engineers.

Consultants use historical precipitation data which they mainly access from Environment Canada or Gander Weather Office. Consultants, like municipalities, noted that data are only available for specific sites and may not apply to a given study area. Some consultants indicated that they also use precipitation data from the Provincial Government website and the Newfoundland and Labrador Water Atlas. The City of St. John's provides consultants with precipitation data from its own data collection program. Consultants use precipitation data, flow data, catchment area, surface permeability and Lidar to calculate drainage areas, develop runoff factors and input into hydrological models.

Consultants that work on storm water management plans stated that municipal regulations and oversight are inconsistent as is the approach to storm water modelling used by the Province and the City of St. John's which has the most comprehensive storm water management policy and regulations. Developers are concerned about increasing costs of installing underground systems or detention ponds that consume building lots or parking lot space. Adverse weather events include combinations of snowfall, melt and rainfall, which are difficult to model based on historical climate data.

Consultants stated that they obtain climate change information from the webpages of the Provincial Government, CCEE, the DEC or contacts within the department. Others get information from the Federation of Canadian Municipalities InfraGuide, LEED guidelines and through contacts at MUN. Consultants noted learning about climate change at conferences and seminars.

The consultants interviewed for this study use data and professional judgement supplemented by their own observations and local knowledge but stated that the latter cannot be accepted as empirical. As most clients do not have data or information, consultants ask municipalities questions about historical weather events and other observations.

Generally clients do not request that consultants address climate change in infrastructure design. The exception would be larger municipalities that have storm water management policies and regulations or in special studies such as Flood Risk Mapping. Consultants may be asked to generally make infrastructure larger to address a particular issue with a culvert, bridge or in a residential area. Where direction on incorporation of climate change is not given, consultants are potentially at risk of under designing or overdesigning infrastructure. Some consultants design for the minimum regulations. Some use a factor of safety. Some include consideration of climate change and extreme weather events with or without clients' knowledge. Industry generally wishes to have the lowest cost solution to meet the minimum regulatory requirements so climate change is not introduced.

5.3 Provincial Government Officials

Provincial officials (34 individuals from 18 agencies) invited to participate in stakeholder consultation were those with departments responsible for local government and transportation infrastructure. Other selected agencies included those that construct and manage government buildings, infrastructure and properties and are responsible for resource development.

As with the two other participant groups, Flood Risk Mapping and Flood Alerts were the best known to Provincial officials and the latter were used by most of the individuals who knew about them. As for the remaining tools and resources, more than 20% of participants were aware of the Climate Portal, 2013 Climate Change Projections, Coastal Erosion and Vulnerability Risk Assessments. Environment Canada was a key source of climate data and IDF Curves.

Provincial officials were also concerned about the reliability of weather forecasts and other predictive information and the distances between climate stations as accurate data and information are required when planning and managing infrastructure and facilities. Provincial officials noted that responses to issues are often reactive rather than proactive. While climate change can be incorporated into the planning and design of new infrastructure, management has to be reactive with regard to flooding and wind damage for existing buildings and infrastructure. Some decisions related to adverse weather events must often be made in the present and dealt with through communications.

Newfoundland and Labrador tools and resources are sometimes similar or may be better or worse than those in other jurisdictions. Some water management resources developed by the Provincial Government, are envied by other Atlantic Provinces. However, researchers of coastal change are not as confident in their predictions as those in areas with more funding and better data than in Newfoundland and Labrador. Provincial and Federal information on climate change projections are similar to those presented in the 2013 Climate Change projections report.

Provincial officials generally do not receive direction on incorporating climate change into operations. They noted broader policy initiatives such as the "Climate Change Action Plan 2011" and the establishment of the CCEE as well as general notifications around "greening government". A limited number of Provincial Government Officials stated that Department of Environment and Conservation has given direction to staff. The Departments of Transportation and Works and Municipal Affairs have

amended policies and practices for design of roads and buildings. Government has also adopted policies for reducing energy consumption and enhancing environmental performance for new buildings.

Provincial officials are engaged in a variety of collaborative efforts that address climate change both within and external to Government. They generally do not come into conflict around climate change but noted, like consultants, the differences in municipal and provincial infrastructure design standards and regulations.

Based on the responses from the three types of stakeholders who would address issues related to climate change adaptation, the user groups may need different types of tools and resources or levels of information. Engineering consultants along with particular groups or individuals from Provincial Government may analyse data and use the results. However most municipalities, with perhaps the exception of the City of St. John's, may only need the results of data interpretation or analyses to make policy decisions or set direction. The Provincial Government needs to take a leadership role on consistent approaches to collecting data, providing tools and resources and leading strategic planning initiatives that help communities avoid issues related to climate change and extreme weather events. To do this the Province might ask: what are the issues, how should they be dealt with and what are the tools and resources needed to support these efforts.

6.0 RESPONDENT RECOMMENDATIONS

As part of the engagement process, participants were asked for suggestions on how to increase the uptake of the climate change adaptation tools and resources. While there were common responses within and across stakeholder groups, the most prevalent suggestion, by far, given by all three groups of stakeholders was to increase awareness of the various tools and resources. As discussed in Section 4, some tools and resources were well known (e.g. Flood Risk Mapping), while others were known only to a few (e.g. vulnerability risk assessment tools). Participants were also asked for suggestions regarding which format of CCEE tools and resources would help ensure greater accessibility and usability.

Participant suggestions were categorized into awareness and communication, regulation and incentives, education and training, and format and accessibility, all of which are discussed below. The responses are not divided into municipality, consulting firm and provincial government as many of the recommendations were given by respondents from multiple groups.

6.1 Awareness and Communication

Distribute information through industry and professional organizations such as: PEGNL, Consulting Engineers of Newfoundland and Labrador (CENL), Association of Consulting Engineering Companies, Canada (ACEC), CPWA, Professional Municipal Administrators of Newfoundland and Labrador (PMANL), Newfoundland and Labrador Construction Association (NLCA), Canadian Institute of Mining, Metallurgy and Petroleum Minerals (CIM), Canadian Institute of Planners-Atlantic Planners Institute (CIP-API); provincial government departments and agencies communications systems (e.g. DMA circular, FES-NL email); and MNL. Include brief regular updates on state of information and suggestions for how to incorporate tools and resources. There was some concern that information tends to get lost when emailed via list-serve, especially those that send a lot of communications. Phone calls, faxes and regular mail may be a better option for direct contact from CCEE. One respondent also suggested having a dedicated mailing list setup for climate change adaptation stakeholders, who would have to sign themselves up. Face-to-face meetings (such as those that occurred during the engagement process) have the biggest impact, while presentations at relevant conferences, seminars and workshops are a good way to reach many people.

One participant noted that there are a limited number of people who actually need to use the tools, most just need to be aware of them. Elected municipal officials (or those creating and approving tenders and RFPs) and Provincial Government department executives only need to be aware of tools, while staff need a more technical knowledge. In many cases, municipalities need to give direction to consultants on using tools and resources to achieve desired outcomes rather than use the tools themselves.

When looking for this type of information some tend to think of other agencies such as Department of Natural Resources and Department of Environment and Conservation rather than CCEE. CCEE is relatively new and not as well-known as other agencies so people may not look to CCEE for information. To be effective CCEE needs to be promoted through a communications strategy aimed at the relevant

Provincial Government departments, municipalities and consulting firms and through industry and professional associations.

The CCEE's Turn Back the Tide public education campaign on climate change mitigation was well known to some participants but not to others. There were some who suggested that public education and awareness needs to focus on the impacts of climate change adaptation and not just mitigation. This would be a potential vehicle to direct people to the tools and resources.

6.2 Regulations and Incentives

Many participants (and nearly all of the consultants) said that making use of these tools and resources mandatory and enforceable would be required to create a level playing field for all intended users. Some recommended including them in design standards. For example, Transportation and Works has a design manual to which it can add a climate change guide for consultants (with appropriate links and contacts). Others were careful to note that when such policies are implemented, lead time is required.

1. Many consultants who have heard of the various tools and resources have never had the need or opportunity to use them. Consultants will not likely volunteer to use the tools and resources if they are not asked to do so, if it increases their costs and decreases their chances of winning a project due to a higher bid. If incorporation of climate change using appropriate tools and resources were explicitly requested in an RFP or Tender Call, they would be used.
2. A common recommendation from municipal participants was to provide some kind of (financial) incentive. This might include financial support for specific projects or building capacity for professionals (in larger municipalities). Others suggested connecting the use of the tools to a funding requirement, such as the Gas Tax Agreement, or to make climate change adaptation a Provincial requirement for municipal plans or regional plans otherwise they will not be used consistently.

Provincial participants said that Government must set the example, as it is doing with LEED certified and other methods of achieving energy efficient buildings. This will create a demand for relevant skills to be developed and bring awareness to the tools and resources that are available. Municipalities would become accustomed to regulations once they are instituted (as in the case of the Accessibility Act).

6.3 Education and Training

Several participants recommended various training, education and hands-on practice using the tools and resources, including case studies and examples of how other Newfoundland and Labrador communities use them. They felt such examples are important for determining how each tool or resource is applicable or relevant to municipal operations. One person suggested a layman's guide on how to use the tools and resources, including a flow chart on processes.

One participant noted that tools and resources that only provide awareness of an issue are not much more than interesting. There needs to be an explicit methodology for implementation. Another respondent gave the example of instructions on how to develop a land-use plan based on future flood risks. One municipal respondent said that if a certain tool or resource is not available for a given municipality, Government should provide information and guidance on a standardized approach of how to adapt these for the specific location.

This report describes recommendations provided by those who participated in stakeholder consultation. Additional information regarding education and training suggestions was collected during the engagement process and will be presented in a separate report.

6.4 Format and Accessibility

Several participants suggested making all tools and resources available on one simple and clear online portal or a portal with links to other webpages that provide relevant information. Many have stated that the Provincial Government website is not user friendly as there is too much content for easy navigation. One suggestion for the website was to include more pictures and visuals.

Others suggested that an information package (such as an expanded version of summary sheet given out during these engagements) would be a useful starting point. One participant noted that Internet access may be an issue in some areas of the Province and a pamphlet may be best for certain communities or regions.

It was mentioned several times that different users have different needs. For instance, CCEE should keep it simple for the municipalities while providing technical tools and information for the engineers and consultants. Similarly, it was noted that the language of tools and resources needs to be appropriate for target audience. Municipal employees, for instance, want to be able to quickly access and use information (e.g. evidence in point form and / or graphically) for efficient and timely analysis and communication to council.

There were also recommendations for methods of two-way communication with CCEE. For example, one person suggested phone support for those who do not have the appropriate skills, technology or Internet access but have questions about the tools and resources. Another respondent emphasized the need for a feedback mechanism to CCEE, to ensure information and tools are updated as needed.

Two municipalities recommended making tools and resources ready for incorporation into GIS systems. Some Provincial Government participants expressed an interest in using Smartphone apps for flood risk mapping (and flood alerts), historical climate data, wind data and flood data.

Participants from one municipality requested having historical climate data exportable to Excel (i.e. they would like access to the data and not just the outputs) as this would facilitate making tables / charts for communicating with council. Participants recommended graphical representation of uncertainty ranges

along with general discussions, which would help with justification and comprehension by elected officials and senior bureaucrats.

6.5 Gaps in Existing Tools and Resources

Many of the recommendations received during the engagement sessions were made by only one or two participants. There were, however, a few that came up several times, including resources related to wind, rain on snow events and localized coastal information. Suggestions for new tools and resources are listed below organized by monitoring, future projections and other tools and information.

One participant stated the Government should increase the awareness and use of existing tools and resources before developing anything new. Another suggested that communities need fewer tools and more support, such as regional coordination (planners) who could use the data and help municipalities make informed decisions. There were also comments about not duplicating existing resources, as it would be a better use of time and effort to simply provide a link to an outside resource.

6.5.1 Monitoring

Participants asked for more localized information for high risk areas. In many areas, climate monitoring stations are too far apart to deal with the microclimates of various communities. Participants suggested more coverage with climate stations for accurate weather forecasting and historical climate data. This data could also be used for snow mapping and wind mapping.

Participants requested more oceanographic data in areas of concern or opportunity. One community said they would benefit greatly from a tide gauge warning system to monitor and anticipate ocean flooding. A participant from within Provincial Government requested increased monitoring (e.g. oceanographic data such as currents, temperature profiles, ice profiles and historical ice data) for planning and maintaining aquaculture facilities.

Northern communities would like to see more information and tools on sea ice (especially on critical travel routes), which is relied upon for winter transportation needs. They noted that the times of year that ice may not be suitable for travel is changing and support for initiatives such as SmartICE is important to ensure public safety and access to resources.

6.5.2 Weather Forecasting and Climate Projections

Communities monitor weather forecasts and weather warnings to anticipate and prepare for issues such as flooding. Several participants suggested investigating rain-on-snow events, which is often a source of flooding. One person said that precipitation projections should be separated into snow and rainfall accumulations. Participants wanted better weather forecasting of when during winter events, snow will turn to rain.

Snow loads (not just snowfall accumulation) on buildings are of concern to some engineers particularly for designing new buildings and for protection of existing building based on anticipated snow loads. The

National Building Code has increased the minimum snow load design criteria in its past several updates for multiple locations around the province and consulting firms would like information on how snow loads will evolve in the future.

Intense wind storms are of concern for protecting infrastructure and property especially on construction sites. Several participants requested information regarding changes in predominant wind direction. Similarly, others would like wind mapping of prevailing winds and corridors showing which particular areas are more vulnerable to high winds. One municipal representative suggested a wind warning system for when winds are expected to be above a certain threshold.

Hydrological modelling is important for flooding prevention including storm water detention design, which is required by some urban municipalities. Several respondents were interested in information that would be useful for hydrological modeling, including projected changes in the water table and frost lines (as well as various other soil data).

Coastal infrastructure and facilities could be affected by sea-level rise, coastal erosion and intense storms. Participants suggested continuing to invest in coastal erosion studies for additional areas and with longer range predictions for infrastructure placement. Multiple respondents felt it would be important to know the impact of future storm surges, tidal height and wave height on the design of fishing and port infrastructure. Others felt that understanding sea ice coverage predictions are also important for marine shipping and aquaculture facilities.

Much of the focus in these engagement activities was on effects of flooding from intense storms and watercourses but climate change and variability of weather conditions could at times have the opposite effect. One consultant suggested that information on projected droughts would be useful for water supply planning.

6.5.3 Tools and Information

Several consultants noted the need for general storm water guidelines and flood risk mapping guidelines. There is a lot of guidance available for water and sewer but nothing for storm water. Participants noted a need for more complete Flood Risk Mapping for all affected communities (e.g. CBS) and more complete studies and updates in areas that have Mapping. Flood Risk Mapping would also be useful for smaller basins especially, where local flooding is not currently captured. Several other tools or resources were suggested by various respondents. These are listed below:

- ▶ A resource that indicates which design storms (e.g. 100-year 24-hour event) for which situations would help to clear up some confusion and ambiguity;
- ▶ Best practice guidance for incorporating extreme weather and climate change information into activities such as replacing culverts;
- ▶ Case studies so that users can select a similar situation and see how to use the tools and resources for a particular situation;

- ▶ A package of climate change adaptation information geared toward a specific industry (e.g. the existing environmental farm plan workbook for the agricultural industry);
- ▶ A general analysis on the costs of incorporating climate change projections into new design guidelines compared to the long term benefits (e.g. avoiding issues and repeated replacements and potential positive effects on insurance rates);
- ▶ A checklist, for site development, of factors that should be considered before developing road access and site drainage for new facilities;
- ▶ Information on the design life of infrastructure compared to when flows are expected to change; and
- ▶ An emergency response and preparedness plan for abandoned and orphaned mining sites based on predicted climate change.

7.0 AMEC FOSTER WHEELER RECOMMENDATIONS

Amec Foster Wheeler suggests the following as recommendations to improve the uptake of CCEE's climate change adaptation tools and resources and to further climate change adaptation as an operational practice in planning and infrastructure in Newfoundland and Labrador. Note, that as many of the tools and resources have not been used extensively by participants, it was difficult for stakeholders to make recommendations on how to adapt them to be more relevant or useful. Detailed information on the efficacy of these tools and resources may not be available until they are well used and this may not occur until the various stakeholders accept climate change adaptation as an important part of management or land, infrastructure, facilities and other resources in the province.

The following sections are ordered according to their priority.

- ▶ Awareness – Stakeholders' knowledge of CCEE and the resources they provide was identified as the largest gap.
- ▶ Regulations and Common Understanding – Feedback indicated that the lack of consistent requirements and a “level playing field” is a major barrier to utilization of the tools. Lack of communication, on climate change adaptation, between municipalities and consultants has contributed to this issue.
- ▶ Training – For those stakeholders who were aware of and wanted to use the tools, there was a general lack of understanding of how the tools could be best used
- ▶ Format and Accessibility – Once users have the capability and desire to start using the tools, the focus should be on making the resources easier and less confusing to access
- ▶ Priorities for Tools and Resources – Once stakeholders have begun developing experience with the resources and tools, there is opportunity to obtain effective feedback and enhance those resources.

7.1 Awareness

First and foremost, CCEE should increase awareness of the agency and the climate change adaptation tools and resources using a multi-pronged approach. This includes increasing awareness of:

- ▶ The CCEE's mandate and role in supporting climate change adaptation;
- ▶ The existence of the tools and resources themselves;
- ▶ The need for adaptation to the impacts of climate change (including when use of the various tools and resources would be an appropriate part of the approach);
- ▶ How municipalities, and other agencies, involved in land-use planning and infrastructure / economic asset management, can use the tools and resources (i.e. knowing how it is possible for an analysis or action to have measurable long-term benefit to the community);
- ▶ Training opportunities; and
- ▶ Updates to the tools and resources.

The most straightforward method of reaching intended users is via professional organizations (e.g. PEGNL, API), associations such as Newfoundland and Labrador Construction Association (NLCA), Newfoundland and Labrador Environmental Industry Association (NEIA), CPWA, PMANL and MNL as well as FES-NL. CCEE should ask these organizations to share information with their memberships through their mailing lists and by continuing to present at related conferences, seminars and workshops. When increasing awareness among municipalities, CCEE should focus on MNL's Urban Caucus as well as FES-NL. Regular updates on new information, updated tools and resources, case studies, conferences, and workshops should also be shared through these networks.

The following recommended measures would also serve to improve knowledge of CCEE and climate change adaptation. It is also possible that climate change adaptation awareness in Newfoundland and Labrador will be driven by insurance, litigation and liability issues related to damage to and / or loss of property and infrastructure due to extreme weather events.

7.2 Regulations and Common Understanding

Climate change adaptation is important to municipalities as a number of those interviewed expressed concerns over potential issues. In particular, the effects of increased frequency and intensity of precipitation events on the capacity of infrastructure to accommodate increased flow and runoff, resulting in flooding. Yet, consulting engineers state that they are rarely, if ever, instructed by clients to incorporate a climate change factor into infrastructure design. While some municipalities have introduced storm water runoff control regulations, approaches are inconsistent among consultants, municipalities and the Provincial Government. In addition, the development community is putting pressure upon municipalities to reduce regulations. Varying approaches in neighbouring municipalities, have also resulted in situations where flooding in one community has been caused by development practices in another.

The uptake of CCEE climate change adaptation tools and resources will increase if consulting engineers and planners are asked to use them by their municipal and Provincial clients. As the consulting industry is competitive in nature, a level playing field must be provided by including the use of these tools in RFPs for planning and infrastructure work.

To address these issues, CCEE should work with the Department of Municipal Affairs to incorporate climate change adaptation into the Municipal Master Specifications and into processes such as Asset Management Planning (importantly, tying it to funding from the Gas Tax Agreement) or Municipal Planning. Specifically, the Province should prioritize the inclusion of storm water management specifications into the Municipal Master Specification (to accompany the existing municipal water, sewer and roads specifications). Further to this, climate change adaptation considerations should be incorporated into RFPs for design consultants as well as the Prime Consultant Agreements used by DMA and DTW.

CCEE should also develop a situation-based climate change adaptation checklist for Government departments, municipalities and consultants to use in project planning to identify the particular climate

change challenges related to a project (e.g. coastal transportation infrastructure would be impacted by rising sea-levels and more severe storm surges) and identify the appropriate climate change adaptation tools and resources to address the anticipated issues. These measures would help to create a common understanding and approach to climate change adaptation (or a level playing field as suggested by consultants) for municipal and Provincial infrastructure development.

A provincial land use planning policy could address differences in development approaches among municipalities. This may not be relevant in all areas of the province but is an important consideration in areas with increasing urban density. The Department of Municipal Affairs has been engaged in regional planning exercises in particular areas of the province. These exercises should be supported by CCEE as they can be used to address consistent development approaches for matters such as infrastructure design and land use planning. Consideration should be given to regional watershed area planning to address storm water management based on natural rather than political divisions. It is important for natural asset management and wetland stewardship policies to be included in this process.

Other Provincial Government departments (particularly Transportation and Works and Municipal Affairs) should lead by example by incorporating the use of the climate change adaptation tools and resources into their designs and operations.

7.3 Training

Amec Foster Wheeler recommends that CCEE develop a training program to ensure intended users are able to effectively apply the climate change adaptation tools and resources. This recommendation will be covered comprehensively in a follow-up report. The training program will contribute to several of the recommendations discussed in this section. In addition to increasing awareness, training will provide consistent information to all stakeholders regarding the effective application of adaptation tools and resources as well as the benefits of increasing climate change resiliency.

There could be a clear distinction made between those stakeholders who need to be aware of the tools and their utility (e.g. elected officials, relevant staff in various municipalities and Provincial Government agencies and other organizations) and those who need to apply the tools for technical purposes (e.g. consultants and other staff such as professional engineers in municipalities and Government).

7.4 Format and Accessibility

The most important recommendation that would increase accessibility of CCEE's climate change adaptation tools and resources is to create one simple, clear, easy to find online portal that can provide data and information or links to all relevant tools and resources. Currently CCEE has two web interfaces: one as a Government agency and one as a public education portal. Finding the climate change adaptation tools and resources is not obvious on either, even when an individual knows what they are looking for. For instance, none of the climate change adaptation tools and resources are found under the "Tools and Resources" tab on the "Turn Back the Tide" webpage. Information can be found under

“In Your Community” and then “Adapting to Climate Change”. The CCEE Agency webpage has internal information and links to external sources but a user would have to click “Climate Data” in order to find the climate change adaptation tools and resources. These sites should also include straightforward information for non-technical users (e.g. municipal elected officials), such as a one-page non-technical brief highlighting the potential impacts of climate change in a specific region of the province.

Internet issues were identified in stakeholder consultation. The Provincial Government website is difficult to navigate and if the user is not aware of CCEE, they would be looking elsewhere on the website for a climate change adaptation webpage. Search Engine Optimization (SEO) should be considered to facilitate the search for those who Google (e.g.) “climate change impacts Newfoundland and Labrador” as their starting point. As Internet access is inconsistent across the province, a hard copy of an information / summary package about the tools and resources could be distributed to all intended users. The package could also provide users with information on where to find additional support.

To facilitate broader understanding and uptake of the climate change adaptation tools and resources, CCEE could improve its Internet presence by creating an easy-to-find, straightforward information source that municipal staff and consultants can use to find resources. One of the most important changes would be creating a tab called “Climate Change Adaptation Tools and Resources” with information and links on the following webpages: “Turn Back the Tide”, Office of Climate Change and Energy Efficiency, Community Accounts, Department of Environment and Conservation: Water Resources Management Division, Department of Municipal Affairs, Department of Transportation and Works, Fire and Emergency Services Newfoundland and Labrador and possibly others engaged in development of public facilities such as schools and hospitals and management of natural resources. Likewise, CCEE may be able to place a general link on the websites of other agencies such as PEGNL, MNL, NEIA, API and CPWA so that regular users of these websites will also find a link to relevant information. These links from external websites would also contribute to SEO efforts. Smaller organizations are also useful for distributing timely information as their ability to update their websites may be more efficient than for Government.

CCEE’s web presence(s) should include a graphic representation of the availability of climate change adaptation tools and resources. An interactive map of the province could be used to illustrate the locations and regions for which particular data and information is available. In this way, municipalities, consultants, Provincial Government employees and other users would be able to easily identify all of the relevant climate change adaptation tools and resources available in any location of the province, including the non-technical briefs mentioned above. Such a map may also be a way of analysing areas where information may be required. The map could also show areas where information (e.g. flood risk mapping) will be available.

7.5 Priorities for Tools and Resources

During stakeholder engagement, participants were asked to comment on the usefulness of the climate change adaptation tools and resources including potential changes to existing tools and resources and suggestions for additional resources. Changes to existing tools and resources and development of new

information is both time consuming and costly. The CCEE and other agencies are aware of these limitations when considering and undertaking new initiatives. While the recommendations in Section 7.1 through 7.4 should be prioritized, Amec Foster Wheeler also recommends addressing the following:

- ▶ Increase the density of climate monitoring stations across the province, with a focus on populated areas that currently are not well serviced, as these stations are valuable for producing accurate weather forecasts and analysing historical events and trends;
- ▶ Continue with the ongoing flood risk mapping program by the Department of Environment and Conservation to include areas of concern that are currently unmapped and to reduce the time between renewals if required; and
- ▶ Develop projections for future storm surge levels, possibly in combination with sea level rise, for managing existing, and planning new, coastal infrastructure and communities.

Suggestions from stakeholder engagement that Amec Foster Wheeler considers to be of interest for investigation and potential development of tools and resources include:

- ▶ Increase oceanographic monitoring (including sea ice) that would be beneficial to northern and coastal communities, as well as the ocean based industries;
- ▶ Develop wind maps of the existing wind regime and projections of how it will change as this would be beneficial for managing future urban and industrial development;
- ▶ Produce climate projections of what to expect for the timing and magnitude of storm water runoff as rain-on-snow events can lead to significant flooding during such events;
- ▶ Develop projections of future snow loads (not simply snow accumulation), which is valuable information for structural designers and building maintenance managers; and

Where other entities are providing data and information, it may not be necessary for CCEE and other Provincial Government agencies to replicate. An example of this that was mentioned by stakeholders is the Climate Data Information Portal, which presents information that may be obtained from Environment Canada. This information could be easily accessible through a web link on the CCEE webpages.

8.0 CLOSURE

This report has been prepared for the exclusive use of the Office of Climate Change and Energy Efficiency. The study was conducted in accordance with the terms of reference and verbal and written requests from the client. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our proposal. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. Amec Foster Wheeler accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this report meets your needs and are available to discuss upon request of the client.

Yours sincerely,

**Amec Foster Wheeler Environment & Infrastructure,
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APPENDIX A: INTERVIEW QUESTIONS

Climate Change Adaptation Tools and Resources: Interview Questions

Municipality: _____ Date/Time: _____

Municipal Officials in Attendance:

No.	Name	Role
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1. What infrastructure and services are provided by the municipality?

<input type="checkbox"/> <i>Drinking water treatment,</i> <input type="checkbox"/> <i>Drinking water supply,</i> <input type="checkbox"/> <i>Sewage collection,</i> <input type="checkbox"/> <i>Sewage treatment,</i>	<input type="checkbox"/> <i>Road development,</i> <input type="checkbox"/> <i>Road maintenance,</i> <input type="checkbox"/> <i>Other: _____</i>
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2. What planning services are provided by the municipality?

<input type="checkbox"/> <i>Production of municipal plans,</i> <input type="checkbox"/> <i>Urban design,</i>	<input type="checkbox"/> <i>Development control services,</i> <input type="checkbox"/> <i>Other: _____</i>
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3. What challenges has the municipality experienced related to land-use planning or services and infrastructure?
4. Has the municipality experienced any particular issues related to extreme weather events or flooding?
5. What other environmental hazards are you concerned about?

After the initial general discussion of infrastructure and planning challenges, the questions will focus more on **tools and resources** used to address those mentioned.

6. How are each of these weather-related challenges addressed?
7. Are adaptation measures a possible solution to your weather concerns?
8. In preventing or coping with these hazards, do you include potential impacts from climate change?
9. Do you use any data, tools and resources related to weather and climate change?

Tools not being used

10. If not, why not?
 - a. Do you have ready access to potentially relevant tools?
11. What are the specific barriers?
 - a. *Depending on the responses to this question there will likely be **follow-up questions** that further investigate the barriers to uptake.*
12. How do local expert knowledge and observations compare to external “expert” resources?
13. Have municipal officials been directed by any policy, or received any instruction or guidance (e.g., in municipal plans, design specs or guidelines) related to adapting to climate change in their operations?
 - a. Do these directions mention any specific tools or resources?
14. If time and resources were not an issue, do you have any interest in accessing and applying available adaptation tools and resources?

Tools being used

15. Which data/tools/resources do you use?
16. How did you hear about the data/tools/resources?
17. Through what channels are you accessing these data/tools/resources?
18. What’s attractive about those particular data/tools/resources? (i.e., why use these tools and not others?)
19. How do you incorporate them into your operations?
 - a. Are they used in combination with any other tools and resources?
20. Who is responsible for development of tenders and RFPs related to planning and engineering?

* Handout information sheet with CCEE Tools and Resources

21. For each of the tools and resources on the sheet, can you tell us if you’ve:
 - a. Heard of them
 - b. Tried them
 - c. Use them regularly
 - d. Heard of / tried / use a similar tool from another source

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The **line of questioning will be more explicitly related to climate change**, including questions about attitudes and opinions with respect to climate change.

22. Do you collaborate with any other organizations (industry, government, not-for-profit) around climate change adaptation?
 - a. Are there any organizations you've come into conflict with around climate change adaptation?
23. Do you believe that climate change is an issue in planning and infrastructure design in Newfoundland and Labrador municipalities?
24. Do you believe that climate change is occurring in general?
25. Does the municipality (e.g., council and departments such as planning and engineering) have consistent views on municipal climate change adaptation?
26. In general, do you believe climate change will be beneficial or harmful to Newfoundland and Labrador?
27. Should we put a high priority in responding to climate change?
28. In responding to climate change, should the main focus be on mitigation (lowering our greenhouse gas emissions) or adaptation (making adjustments to live with a changing climate)?

Request Suggestions and Advice

29. *(If tools are used)* What are the main challenges or barriers you've encountered in using climate change adaptation tools and resources?
 - a. From the Government of NL? From other sources?
30. *(If CCEE tools are used)* Can you compare climate change tools and resources produced by the Government of NL to other tools and resources that you use?
31. *(If CCEE tools are used)* How do Government of NL adaptation tools and resources compare to local knowledge and observations?
32. What would increase the use of the climate change adaptation tools and resources that are currently available from the Government of NL?
33. Do you have suggestions for the format of Government of NL climate change adaptation tools and resources that would ensure their greater accessibility and usability?
34. What kind of climate change adaptation tools and resources would be helpful for planning and design, but are not currently available?
 - a. What would be needed to generate uptake for such tools?
35. What kind of training would you like to see offered by the provincial government around climate change impacts tools and resources?

Climate Change Adaptation Tools and Resources: Interview Questions

Municipalities NL Date/Time: _____

Officials in Attendance:

No.	Name	Role
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11. What support services do you provide municipalities?
 12. What challenges do municipalities experienced related to land-use planning or services and infrastructure?
 13. What particular issues related to extreme weather events or flooding have municipalities experienced?
 14. What other environmental hazards are municipalities concerned about?
 15. How are these weather-related challenges addressed by municipalities?
 16. In preventing or coping with these hazards, do municipalities consider potential impacts from climate change?
 17. What tools, data or resources related to extreme weather and climate change **do you provide to your members?**
 - a. Were they requested by members or an MNL initiative?
 - b. Developed in-house or externally?
 - c. If externally, where did you find them and how did you learn about them?
 - d. What is attractive about those particular tools/resources?
 - e. Have you received feedback on any from your membership?
 - f. What is the uptake like by members?
 - g. How do you create awareness around your tools/resources?
 - h. Do you direct members to any external resources?
 - i. Is there anything that has been requested but isn't readily available?
 - j. How do municipalities incorporate your tools into your operations?
 - k. Are they used in combination with any other tools and resources?
 18. What are the specific barriers to municipalities using climate change tools and resources?
 19. How do local expert knowledge and observations compare to external "expert" resources?
 20. Do you know of any municipalities that give direction, instruction or guidance (e.g., in municipal plans, design specs or guidelines) related to adapting to climate change in their operations?
 - a. Do these directions mention any specific tools or resources?
 21. Do municipalities seem to have an interest in accessing and applying available adaptation tools and resources?
- * **Handout information sheet with CCEE Tools and Resources**
22. For each of the tools and resources on the sheet, can you tell us if you've:
 - a. Heard of them
 - b. Referred members to them
 - c. Provide direct access to them for membership
 - d. Heard of / provide a similar tool from another source

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Attitudes and Opinions with respect to climate change.

23. Do you collaborate with any other organizations (industry, government, not-for-profit) around climate change adaptation?
 - e. Are there any organizations you've come into conflict with around climate change adaptation?
24. Do you believe that climate change is an issue in planning and infrastructure design in Newfoundland and Labrador municipalities?
25. Do you believe that climate change is occurring in general?
26. Do you find the municipalities internally have consistent views on municipal climate change adaptation (e.g., council and departments such as planning and engineering)?
27. In general, do you believe climate change will be beneficial or harmful to Newfoundland and Labrador?
28. Should we put a high priority in responding to climate change?
29. In responding to climate change, should the main focus be on mitigation (lowering our greenhouse gas emissions) or adaptation (making adjustments to live with a changing climate)?

Request Suggestions and Advice

30. Can you compare climate change tools and resources produced by the Government of NL to other tools and resources that you've seen?
31. How do Government of NL adaptation tools and resources compare to local knowledge and observations?
32. What would increase the use of the climate change adaptation tools and resources that are currently available from the Government of NL?
33. Do you have suggestions for the format of Government of NL climate change adaptation tools and resources that would ensure their greater accessibility and usability?
34. What kind of climate change adaptation tools and resources would be helpful for planning and design, but are not currently available?
 - a. What would be needed to generate uptake for such tools?
35. What kind of training would you like to see offered by the provincial government around climate change impacts tools and resources?

Climate Change Adaptation Tools and Resources: Interview Questions

Consulting Firm: _____ Date/Time: _____

Firm Employees in Attendance:

No.	Name	Role
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1. What engineering design and construction services do you offer to municipalities?
 - Drinking water treatment,*
 - Drinking water supply,*
 - Sewage collection,*
 - Sewage treatment,*
 - Roads,*
 - Other: _____*

2. What planning services do you offer to municipalities?
 - Preparation of municipal plans and by-laws,*
 - Plan and zoning amendments,*
 - Urban design,*
 - Other: _____*

3. What challenges do municipalities experience related to services and infrastructure?
 - a. Clients from private industry?
4. Are any particular issues related to extreme weather events, flooding or climate change?
5. Do municipal clients (and those from industry) ask you to incorporate extreme weather and climate change adaptation information into planning and design services?
 - a. Why or why not?
 - b. How often?
 - c. What sized municipalities?
6. Do municipal clients (and those from industry) ask you to incorporate measures to help prevent hazards caused by extreme weather effects or climate change effects in the municipality's plan and land use bylaws?
 - a. Why or why not?
 - b. How often?
 - c. What sized municipalities?
7. Do municipal clients (and those from industry) ask you to incorporate measures to help to prevent hazards caused by extreme weather and climate change effects in the design and construction of infrastructure?
 - a. Why or why not?
 - b. How often?
 - c. What sized municipalities?
8. When addressing the above client requests, do you use any external data, tools or resources?

Tools not being used or clients not requesting climate change considerations.

9. If clients were to make such a request, where might you look for tools and resources?
10. Do you have ready access to potentially relevant tools?
11. What are the specific barriers?
 - a. *Depending on the responses to this question there will likely be follow-up questions that further investigate the barriers to uptake.*
12. How do local expert knowledge and observations compare to external “expert” resources?

Tools being used

13. Which data/tools/resources do you use?
14. How did you hear about the data/tools/resources?
15. Through what channels are you accessing these data/tools/resources?
16. What is attractive about those particular data/tools/resources? (i.e., why use these tools and not others?)
17. How do you incorporate them into your operations?
 - a. Are they used in combination with any other tools and resources?

*** Handout information sheet with CCEE Tools and Resources**

18. For each of the tools and resources on the sheet, can you tell us if you’ve:
 - a. Heard of them
 - b. Tried them
 - c. Use them regularly
 - d. Heard of / tried / use a similar tool from another source

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Attitudes, Opinions & CCEE Tools

19. Do you, or the municipalities you work for, collaborate with any other organizations (industry, government, not-for-profit) around climate change adaptation?
 - a. Are there any organizations you've come into conflict with around climate change adaptation?
20. Do you believe that climate change is an issue in planning and infrastructure design in Newfoundland and Labrador municipalities?
21. Do you believe that climate change is occurring in general?
22. In general, do you believe climate change will be beneficial or harmful to Newfoundland and Labrador?
23. Should we put a high priority in responding to climate change?
24. In responding to climate change, should the main focus be on mitigation (lowering our greenhouse gas emissions) or adaptation (making adjustments to live with a changing climate)?

Request Suggestions and Advice

25. What are the main challenges or barriers you've encountered in using climate change adaptation tools and resources?
 - a. From the Government of NL? From other sources?
26. *(If CCEE tools used)* Can you compare climate change tools and resources produced by the Government of NL to other tools and resources that you use?
27. *(If CCEE tools used)* How do Government of NL adaptation tools and resources compare to local knowledge and observations?
28. Do you have suggestions that would help increase the use of the climate change adaptation tools and resources that are currently available from the Government of NL?
29. What kind of climate change adaptation tools and resources would be helpful for planning and design, but are not currently available?
30. What would be needed to generate uptake for such tools?
31. Are there gaps in the climate change adaptation tools and resources currently available from the Government of NL?
 - b. How could these gaps be addressed by the Government?
32. What kind of training would you like to see offered by the provincial government around climate change impacts tools and resources?

Name: _____ Date/Time: _____

Department: _____

1. Have you been directed to any policy, or received any instruction or guidance related to incorporating climate change projections on your operations?
 - a. From elected officials? If so, who?
 - b. From senior non-elected officials? If so, who?
 - c. From other provincial government departments or agencies? If so, which?
2. Do you believe that climate change is occurring?
3. In general, do you believe climate change will be beneficial or harmful to Newfoundland and Labrador?
4. Should we put a high priority in responding to climate change? Why or why not?
5. In responding to climate change, should the main focus be on mitigation (lowering our greenhouse gas emissions) or adaptation (making adjustments to live with a changing climate)?