

Applying Public Sector Resources to Climate Change Adaptation in Canada Discussion Paper - Version 2.0

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ABSTRACT: This Discussion Paper suggests ways to improve the quality of public sector participation in climate change adaptation applications. An Executive Summary initially identifies their context. Suggestions are summarized with respect to Administration, Applied Policy, Basic Science and Applied Science for Federal and Provincial governments. Summarized suggestions are also presented for Municipal governments and Academic activities supported by public sector resources. An elaborate discussion of these then follows. It is suggested that the most effective application of public sector resources with respect to climate change adaptation in Canada would focus on a fundamental commitment to reducing the uncertainties of the basic science and making it available in the most useful of formats; supporting the development of relevant, practical decision making tools that can be used in regular real world projects; and supporting the use and application of these on some relatively sensitive (i.e. financial) public sector based and public sector supported decision making by public sector end users, as public domain pilot examples for others. Along term public policy goal is anticipated to have the automatic incorporation of climate change adaptation in public sector decision making. Public sector science is encouraged to next be applied to some significant regular public sector projects and decisions, where weather and climate information are influences to be taken into account, as useful experiences for others, and to develop decision making tools. Broad based teams, including researchers, scientists, end users, construction and operations people will form in cooperative team like responses to infrastructure projects with budgets.

Key words: Climate change adaptation, public sector resources, infrastructure, policy, administration, science

Executive Summary

This Discussion Paper suggests ways to improve the quality of public sector participation in climate change adaptation applications. The context for the suggestions offered are based on:

- administrative effectiveness with clear goals, resource allocations, accountability and reporting,
- in these early days for climate change adaptation applications, building capacity would occur most effectively through real world example projects with budgets to focus the efforts of broad based teams.
- over time, scientific uncertainties tend to decrease and quality of assumptions increase. and
- climate change adaptation includes accounting for natural changes and human activities.

Suggestions regarding activities of the **Federal** Government of Canada on Administration include:

- Have an Executive - Cabinet level mandate with goals, available resources, and accountability,
- based on such a mandate, establish an "Office" organization linking departments, and charge it to coordinate the preparation, implementation and documentation of an action plan, and
- screen federal activities and identify the most relevant climate vulnerable projects and decision making that involve primarily significant federal public sector resources, especially financial ones;

on *Applied Policy* include:

- support efforts resulting in learning opportunities for multiple governments,
- provide a communications focus for all Canadian public sector adaptation activities, and
- take climate change adaptation into account in public sector environmental impact assessments, environmental management systems, disaster preparedness, financial loans, and infrastructure;

on *“Basic Science”* include:

- support Atlantic Climate Centre and others in responding effectively to growth in “prediction” requests,
- make best efforts to package climate change values in format that is most useful for end user,
- in these early days, develop package of “standard predictions” for major urban areas, and
- improve capacities for making more applicable regional values from global climate values;

on *“Applied Science”* include:

- support and maintain most useful data sets of current conditions (i.e. weather, tidal),
- support efforts to “translate” basic science information into useful formats for end users,
- support development of project applicable decision making tools by groups that bring together basic science, applied science, and interests of end users or decision makers (i.e. case studies), and
- give preference to current research (i.e. AESN) onto which adaptation can best be later applied.

Suggestions regarding activities of the **Provincial** Government (i.e. Nova Scotia)

on *Administration* include:

- have an Executive - Cabinet mandate with goals, available resources, and accountability,
- based on mandate, establish an “Office” organization linking departments, and charged to coordinate the preparation, implementation and documentation of action plan,
- prepare provincial action plan to execute goals in mandate and “Office” documents implementation, and
- atmosphere of communication, support within provincial government and with other governments;

on *Applied Policy and Science* include:

- take climate change adaptation into account in public sector environmental impact assessments, environmental management systems, disaster preparedness, financial loans, and infrastructure,
- survey provincial and municipal activities and identify potential case study projects based on the types of major projects and decision making that is considered to be more climate sensitive,
- motivate public sector decision makers to want adaptation applications included in their projects,
- have adaptation applications made to a series of public sector case study projects (i.e. regional planning, flood plain management, watershed management, natural resources management, coastal infrastructure, and (storm damaged?) infrastructure repair or replacement), and
- have public sector experiences be a learning opportunity for other public sector decision makers.

Suggestions regarding activities of **Municipal** Government (i.e. Halifax Regional Municipality or HRM) include:

- they be a partner in the communication and coordination of public sector adaptation activities, adaptation at this level be first focused on planning and infrastructure,
- use some municipal (i.e. financially effective) projects for early example adaptation applications, and
- support development and improving use of decision making tools (i.e. HRM Climate SMART Project).

Suggestions regarding **Academic** activities supported by public sector resources include:

- encourage the most relevant research on background natural conditions in the region that are not yet understood, as a useful basis for later climate change adaption applications (i.e. watershed resources),
- encourage research on better understanding natural climate change, variability and human activities, and
- encourage research efforts with promising opportunities to reduce significant uncertainties.

The **private sector** already has a role in public sector projects, in bridging science with the interests of the end use decision maker (i.e. engineering, science, and planning consultants for various governments). They are a logical means for incorporating climate change adaptation into this type of public sector supported decision making where weather and climate related information is already being used. They are also a logical contributor to the public sector supported development of decision making tools.

1.0 PROPOSED PRIORITIES IN PUBLIC SECTOR FINANCIAL RESOURCES

1.1 General Approach

This Discussion Paper suggests ways to improve the quality of public sector participation in climate change adaptation applications. The context for the suggestions offered are based on:

- administrative effectiveness with clear goals, resource allocations, accountability and reporting
- in these early days for climate change adaptation applications, building long term capacity would occur most effectively through real world example projects with budgets to focus efforts of broad based teams
- over time scientific uncertainties tend to decrease and quality of assumptions increase
- climate change adaptation includes accounting for natural changes and human activities

This paper presents suggestions specific to the federal, provincial, and municipal portions of the public sector, as well as suggestions regarding academic research and non-governmental organizations, with respect to climate change adaptation. These suggestions are made within the context of what might improve the quality and effectiveness of public sector resources in Canada that are being applied to climate change adaptation.

The suggestions for the federal government activities are grouped with respect to administration, applied policy, what is arbitrarily termed as "basic science" for the purposes of this discussion paper, and by extension what is termed "applied science." The provincial level, the suggestions are grouped with respect to administration, applied policy and science.

Federal and provincial jurisdictions are encouraged to have a mandated, accountable "office" with appropriate resources for achieving the applicable policy goals. Some naturally occurring cooperation, communication and coordination between these offices is anticipated. Atlantic Canada may well be the most philosophically accommodating and supportive region in Canada with respect to federal - provincial

cooperation. This may also reflect the relative availability of resources to the various jurisdictions. Public sector science is encouraged to next be applied to some significant regular public sector projects and decisions, where weather and climate information are influences to be taken into account, as useful experiences for others, and to develop decision making tools.

1.2 Government of Canada

This paper seeks a future where the most effective use of public sector resources is made, that supports improvements to the most relevant science-based knowledge, and its application, in the management of changing risks from change in the climate, other influences, and related environmental systems.

This paper anticipated that the long term public policy goal is to have the automatic incorporation of climate change adaptation in public sector decision making. If so, then a medium term goal might be to cost share the implementation of a recently developed approach. If that is so, the short term goal may be to take the lead in supporting the development and application of climate change adaptation evaluations to the more relatively sensitive and influential aspects of public sector decision making.

This paper anticipates that a public policy goal will be the creation and application of basic science knowledge of the regional environment through research, observations, decision support, and communication. As well, it is anticipated that public policy will be to facilitate the initial, useful, practical application of this knowledge to relatively sensitive (i.e. financial) public sector based, and public sector supported decision making.

A potential strategy for initial progress in achieving this Mission could include:

- a political mandate, with resources, organization, goals, and public accountability
- a public sector "Office" responsible for executing the political mandate
- public sector policies that encourage climate change adaptation applications
- continuous improvement in quality, relevance, and availability of "basic science"
- continuous improvement in knowledge observations and measurements of the most relevant natural baseline conditions

- encouragement and practical support in development of relevant decision support tools
- early application of climate change adaptation on most relevant projects and decisions
- communications with local and other scientific and stakeholder communities, stressing openness and transparency, and broad based ability to learn from early experiences and communicate results

It is suggested that for Government of Canada activities, the preparation, improvement, and execution of a functional climate change adaptation policy, or equivalent, be based on clear direction, an appropriate provision of resources, and unambiguous accountability for meeting program goals with respect to the political executive.

Suggestions on Federal Administration Activities

Suggested specific federal regional activities related to a political mandate are:

- an executive or cabinet level mandated management structure for program goals, priority setting, management review and processes, and institutional accountability, such that it focuses efforts and resources,
- based on mandate, establish an "Office" organization linking departments, and charged to coordinate the preparation, implementation and documentation of action plan,
- prepare a federal climate change adaptation framework which defines roles and responsibilities for different departments and organizations, and seeks to execute a comprehensive and coherent approach to adaptation in priority sectors action plans to execute goals in mandate,
- an expectation that new versions or generations of plan in 3 - 5 year cycles,
- establish clear links between tasks of Office and program budgets,
- on-going provision of appropriate resources to reflect changing or evolving roles,
- include responsible regular program reporting to executive or cabinet level of authority,
- include independent program oversight and reporting copied to Cabinet ministers,

- external interactions (i.e. provinces) anticipated for guidance, evaluation and feedback, and
- screen federal activities and identify most relevant climate vulnerable projects and decision making that involve primarily significant federal resources, especially financial ones.

Suggested specific activities related to an "Office" are:

- create, establish, identify, or modify an existing organization to be the actual or functional equivalent of a "Climate Change Adaptation Office" for federal activities,
- "Office" receives official mandate, resources, goals and accountability responsibilities from some Canada wide cabinet level authority,
- "Office" links mandate to program being implemented by participating departments and agencies,
- "Office" to regularly review and best address gaps with respect to climate change adaptation framework, by coordinating ongoing capacity building efforts with participating departments and agencies,
- "Office" to involve selected non-government stakeholders in an advisory capacity,
- "Office" to involve selected senior level persons in a Steering Committee capacity, coordinated planning and program implementation through inter-agency or interdepartmental working groups,
- coordination and management support from an inter-agency office accountable to the programs governing committee,
- directly and indirectly influence research science and applications funding, coordination, and integration, with some external input or review by others,
- development, coordination and integration of decision making support tools,
- integration of observation, monitoring and data management programs,
- development and implementation of inter-departmental communications plan,
- support associated working groups,
- consideration of climate change adaptation policy within Canada, and
- have the setting of priorities and sequencing of public sector resources, including financial investments by the "problem solving" or project oriented program influenced by an

option's or proposal's:

- scientific or technical quality,
- relevance to reducing uncertainties and improving decision support tools in priority areas,
- track record of consistently good past performance and identified metrics for evaluating future progress, and
- cost and value.

political commitment to start incorporating climate change adaptation into their current and long range policies and decision making.

In the short term, to motivate those currently unknown public sector decision makers involved with decisions that are relatively sensitive to climate change adaptation and influential, and that are within this supportive atmosphere, this discussion paper suggests the following:

Suggestions on Federal Applied Policy Activities

Suggested activities with respect to public sector policy are:

- have different government departments conduct internal assessments of the potential impacts of climate change on their assets and policies,
- have climate change adaptation considered in public sector funded activities and policy development,
- a public policy goal of communicating within the public sector to encourage the incorporation of climate change adaptation in public sector decision making, and supporting the development and application of rational, logical, justifiable solutions,
- a public sector goal of sharing on the technical and financial support in the incorporation of climate change adaptation into a limited series of public sector decisions involving \$xxx dollars,
- a public policy goal of having regional municipal plans document that climate change adaptation has been taken into account (i.e. federal financial support of infrastructure),
- a public policy goal of having public sector funding for future infrastructure investments, or storm repair work, document that climate change adaptation has been taken into account,
- a public policy goal of having environmental impact assessments document that climate change adaptation has been taken into account,
- a public policy goal of having major environmental management system plans document that climate change adaptation has been taken into account, and
- relevant public sector jurisdictions make a

- public sector decision maker end user initially notes that \$xxx dollars or other resources may be spent on something or available where climate change adaptation may be useful,
- have end users be aware that if a good case is put forward, there might be support for making that project or decision an example climate change adaptation application,
- have the end user be aware that this can help preserve existing or provide additional resources to the end user for the particular project or decision,
- have the end user be aware that they would be involved in the climate change adaptation example in a similar way as their hiring of a contractor to accomplish something for them,
- have the end user be aware that they remain in control and responsible for their decision or project, and
- have end user be aware that as a condition for acceptance, they would be expected to communicate the process and results of the climate change adaptation example of their project or decision to others by various means, and that this would be tangibly supported.

Suggestions on Federal "Basic Science" Activities

Suggested activities that are common to "basic science," the observations and measurement of natural baseline conditions, and for "applied science" are:

- plan, sponsor, and conduct research on changes in climate and related systems to improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and change,

- improve quantification of the forces bringing about changes in the Earth's climate and related systems,
- reduce uncertainty in projections of how the Earth's climate and related systems may change in the future,
- improve the understanding of the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related changes at the local, regional and global level,
- explore the uses and identify the limits of evolving knowledge to manage risks and opportunity related to climate variability and change, and
- study areas of uncertainty where investments can make a difference

Additional suggested activities with respect to "basic science" are:

- encourage Environment Canada on a national scale to seek the development and use of new, more realistic, input assumption scenarios with respect to the social - economic - energy use scenarios (i.e. SRES),
- encourage Environment Canada on improving international scientific and policy collaboration and cooperation,
- reduce scientific and technical uncertainties,
- improve availability of data, charts, graphs,
- clarify atmospheric composition,
- improve understanding of climate variability and change, including modelling,
- improve understanding of sea level rise estimates based on geological reasons, and
- increase regional climate modelling capability.

As a performance goal, the Atlantic Climate Center and other equivalent organizations, could continuously strive to be the best possible source of information for what is most likely to happen with respect to climate change.

Additional suggested research on the natural baseline conditions could be focussed on:

- enhancing the observations and data management systems for the most significant variables used in climate-related research,
- natural vulnerability,
- ecosystems,

- water cycle and water resources,
- land use / land cover change, and
- associated human contributions and responses.

Suggestions on Federal "Applied Science" Activities

Suggested activities with respect to decision making support tools are:

- involve interested technical specialists from various levels and forms of public sector, as well as some private sector involvement in some of the development and beta testing of decision making support tools,
- prepare scientific background paper to support informed discussion of climate variability and change and associated issues by decision makers, stakeholders, the media, and the general public,
- develop resources to support adaptive management and planning for responding to climate variability and climate change, initially as research and later as operational applications,
- develop and evaluate methods (scenario evaluations, integrated analysis, and alternative analytical approaches) to support climate change policymaking and demonstrate these methods with case studies,
- support and encourage the incorporation of climate change adaptation in planning, adaptive management and policy making,
- create maps for water quality, urban planning and crop management, and
- the expected outcomes from investments made in developing such decision making support resources are:
 - improved scientific basis for informing public discussion of climate change issues,
 - an improved adaptive management capacity that accounts for climate variability and change,
 - assessment information for evaluating options for adaptation to climate variability and change, and
 - identification of information needed to guide the evolution of the programs science agenda.

Suggested activities for the early application of climate change adaptation by case studies are to:

- include relevant examples such as flood plains and coastal flooding,
- have case studies that involve various levels and forms of public sector, as well as some private sector involvement in some of the “applied science,”
- present case study outcomes at a useful, practical level of detail that is not oversimplified, and
- potentially prepare case studies involving NGO and private sector “end users.”

Suggested activities with respect to communications and broad based learning opportunities are:

- establish a case study database as a website,
- improve public sector awareness of climate change adaptation activities,
- coordinate adaptation activities as required to avoid duplication,
- establish regional climate change partnerships as a focus of adaptation activity, that involve various levels of the public sector and a range of wider stakeholders,
- inter-departmental communications within the federal government,
- inter-jurisdictional communications within Canada,
- inter-governmental communications (i.e. representatives to the Intergovernmental Working Group in Climate Change Impacts and Adaptation, which prepared the document “A National Climate Change Adaptation Framework.”),
- specialized public sector workshops, professional and scientific meetings, prepare published papers, and information forums including online versions,
- communications involving representatives of government, academia (i.e. Atlantic Earth Science Network (AESN) or equivalents, Canadian Climate Impacts and Adaptation Network (C-CIARN) or replacement, consultants (i.e. professional associations for engineers, planners, scientists, ClimAdapt / Climate Canada Atlantic, PARC, Ouranos), and
- if the focus of initial activity was broader, to include private sector projects, then consider including representatives from farmer or forestry groups, or property owning, managing, developing and other similar

industry groups.

Some potential (Atlantic Canadian) examples for the application of public sector resources are:

- regional planning (i.e. HRM, St. John’s, Charlottetown PEI, and in New Brunswick),
- flood plain management (i.e. Truro NS, Fredericton NB),
- watershed management (i.e. Annapolis Valley NS),
- forest management (i.e. NS, NB and NL),
- agriculture crop selection (i.e. grape growing by Northumberland Strait, NS),
- coastal infrastructure (i.e. Charlottetown PEI), and
- municipal infrastructure (i.e. Halifax NS)

A documented self screening mechanism by applicable public sector end user decision makers could be an effective means to both draw additional attention and evaluation to those projects or decisions that may be particularly vulnerable to climate change impacts.

There are a variety of potential public sector end users in these potential examples. The basic science component could be provided by Environment Canada. The applied science component could be provided by a number of technical specialists within government (i.e. Geological Survey Canada), Atlantic Earth Science Network (AESN) or other equivalents, Canadian Climate Impacts and Adaptation Network (C-CIARN) or replacement, university researchers, and private sector consultants (i.e. Climate Canada Atlantic members).

Improve the collection of relevant local weather measurements. To an outsider, more stations may seem logical while Environment Canada appears to place a preference on long term objective measurements from a select group of locations. Hondas and Toyotas did not become the best selling cars in Canada because of a new gadget. A relentless, ongoing, pursuit of relevant weather information that reduces the uncertainty about what is happening, will provide the most useful basic science information for others to apply the multitude of decision makers.

What is the most useful format for Environment Canada information? A general answer is something that can be translated by applied science people into

formats that are already being used for the end user representatives. A suggested starting point is to review how current information ultimately is expressed in the Climate Information Appendix to the National Building Code of Canada, and then work with the appropriate persons to develop a tool to adjust these table values for those people choosing to take climate change adaptation into account in their decision making.

If such thinking seems a little too novel for general use, then consider applying this approach to some public sector projects as an example. If it is a good, useful example, then others in their private sector decision making will pick it up when these questions become more urgent. A project with a budget is a useful approach to motivate a team of technical and other people, to effectively pool their talents, skills, abilities and resources.

Some potentially interesting Environment Canada science projects might be:

- Provide climate change assumption data for a group of specific locations that others might use or reference later (i.e. Halifax, Montreal, Toronto, Winnipeg, Calgary, Vancouver),
- More down scaling of climate change modeling information, and
- Limitation of input scenario / model use. Work with interested persons on how results change if input model assumptions change (i.e. if model has 10% less GHG producing energy use, what adjustments to model output may be reasonably inferred).

1.3 Provincial Government (Nova Scotia as example)

This paper seeks a future where the most effective use of public sector resources is made, that supports improvements to the most relevant science-based knowledge, and its application, in the management of changing risks from change in the climate, other influences, and related environmental systems.

This paper anticipated that the long term public policy goal is to have the automatic incorporation of climate change adaptation in public sector decision making. If so, then a medium term goal might be to costshare the implementation of a recently developed approach. If that is so, the short term goal may be to share with the rest of the regional public sector in a common effort in the development and application of climate

change adaptation evaluations to the more relatively sensitive and influential aspects of public sector decision making.

This paper anticipates that a provincial public policy goal will be the creation and application of basic science knowledge of the regional environment through research, observations, decision support, and communication. As well, it is anticipated that public policy will be to facilitate the initial, useful, practical application of this knowledge to relatively sensitive (i.e. financial) public sector based, and public sector supported decision making.

A potential strategy for initial progress in achieving this Mission could include:

- a political mandate, with resources, organization, goals, and public accountability,
- a public sector "Office" responsible for executing the political mandate,
- public sector policies that encourage climate change adaptation applications,
- continuous improvement in quality, relevance, and availability of "basic science,"
- continuous improvement in knowledge observations and measurements of the most relevant natural baseline conditions,
- encouragement and practical support in development or relevant decision support tools,
- early application of climate change adaptation on most relevant projects and decisions, and
- communications with local and other scientific and stakeholder communities, stressing openness and transparency, and broad based ability to learn from early experiences and communicate results

It is suggested that for a provincial government, the preparation, improvement, and execution of a climate change adaptation policy, be based on clear direction, an appropriate provision of resources, and unambiguous accountability for meeting program goals with respect to the political executive.

Suggestions on Provincial Administration Activities

Suggested specific activities related to a political mandate are:

- an executive or cabinet level mandated management structure for program goals,

- priority setting, management review and processes, and institutional accountability, such that it focuses efforts and resources,
 - based on mandate, establish an “Office” organization linking departments, and charged to coordinate the preparation, implementation and documentation of action plan,
 - prepare a provincial climate change adaptation framework for the applicable jurisdiction which defines roles and responsibilities for different departments and organizations, and seeks to execute a comprehensive and coherent approach to adaptation in priority sectors action plans to execute goals in mandate,
 - establish clear links between tasks of Office and program budgets,
 - on-going provision of appropriate resources to reflect changing or evolving roles,
 - an expectation that new versions or generations of plan in 3 - 5 year cycles,
 - include responsible regular program reporting to executive or cabinet level authority,
 - include independent program oversight and reporting to legislative authority,
 - external interactions (i.e. federal / provincial / municipal) anticipated for guidance, evaluation and feedback, and
 - atmosphere of communication, support within provincial government and with other governments.
- “Office” to involve selected senior level persons in a Steering Committee capacity,
 - coordinated planning and program implementation through inter-agency or interdepartmental working groups,
 - coordination and management support from an inter-agency office accountable to the programs governing committee,
 - directly and indirectly influence research science and applications funding, coordination, and integration, with some external input or review by others,
 - development, coordination and integration of decision making support tools,
 - integration of observation, monitoring and data management programs,
 - development and implementation of interdepartmental communications plan, support associated working groups,
 - consideration of climate change policy within the jurisdiction, and
 - the setting of priorities and sequencing public sector resources, including financial investments by the “problem solving” or project oriented program, is influenced by an option’s or proposal’s:
 - scientific or technical quality,
 - relevance to reducing uncertainties and improving decision support tools in priority areas,
 - track record of consistently good past performance, and
 - cost and value.

Suggested specific activities related to an “Office” are:

- create, establish, identify, or modify an existing organization to be the functional equivalent of a Climate Change Adaptation Office for a jurisdiction,
- “Office” receives official mandate, resources, goals and accountability responsibilities from executive or cabinet level authority,
- “Office” links mandate to program being implemented by participating departments and agencies,
- “Office” to regularly review and best address gaps with respect to climate change adaptation framework, by coordinating ongoing capacity building efforts with participating departments and agencies,
- “Office” to involve selected non-government stakeholders in an advisory capacity,

Suggestions on Provincial Applied Policy Activities

Suggested activities with respect to provincial public sector policy are:

- have different government departments conduct internal assessments of the potential impacts of climate change on their assets and policies,
- have climate change adaptation considered in public sector funded activities and policy development,
- a public policy goal of communicating within the public sector to encourage the incorporation of climate change adaptation in public sector decision making, and supporting the development and application of rational, logical, justifiable solutions,
- a public sector goal of sharing the technical

and financial support in the incorporation of climate change adaptation into a limited series of public sector decisions involving \$xxx dollars,

- a public policy goal of having regional municipal plans document that climate change adaptation has been taken into account,
- a public policy goal of having public sector funding for future infrastructure investments, or storm repair work, document that climate change adaptation has been taken into account,
- a public policy goal of having environmental impact assessments document that climate change adaptation has been taken into account,
- a public policy goal of having major environmental management system plans document that climate change adaptation has been taken into account,
- relevant public sector jurisdictions make a political commitment to start incorporating climate change adaptation into their current and long range policies and decision making,
- take climate change adaptation into account in public sector environmental impact assessments, environmental management systems, disaster preparedness, financial loans, and infrastructure,
- survey provincial and municipal activities and identify potential case study projects based on the types of major projects and decision making that is considered to be more climate sensitive,
- motivate public sector decision makers to want adaptation applications included in their projects,
- have adaptation applications made to a series of public sector case study projects (i.e. regional planning, flood plain management, watershed management, natural resources management, coastal infrastructure, and (storm damaged?) infrastructure repair or replacement), and
- have public sector experiences be a learning opportunity for other public sector decision makers.

In the short term, to motivate those currently unknown public sector decision makers involved with decisions

that are relatively sensitive to climate change adaptation and influential, within this supportive atmosphere, this discussion paper suggests the following:

- public sector decision maker end user initially notes that \$xxx dollars or other resources maybe spent on something or are available where climate change adaptation may be useful,
- have end users be aware that if a good case is put forward, there might be support for making that project or decision an example climate change adaptation application,
- have the end user be aware that this can help preserve existing or provides additional resources to the end user for the particular project or decision,
- have the end user be aware that they would be involved in the climate change adaptation example in a similar way as their hiring of a contractor to accomplish something for them,
- have the end user be aware that they remain in control and responsible for their decision or project, and
- have end user be aware that as a condition for acceptance, they would be expected to communicate the process and results of the climate change adaptation example of their project or decision to others by various means, and that this would be tangibly supported.

Suggestions on Provincial Science Activities

Suggested activities related to provincial science activities are to focus on:

- improving the availability of provincial data, charts, graphs,
- monitoring atmospheric quality and composition,
- natural climate change cycles and vulnerability (i.e. erosion),
- ecosystems sensitivity and adaptability to climate variability and change,
- water resources management,
- land use / land cover change, and
- associated human contributions and responses.

Suggested activities with respect to decision making support tools are:

- involve interested technical specialists from

various levels and forms of public sector, as well as some private sector involvement in some of the development and beta testing of decision making support tools,

- prepare scientific background paper to support informed discussion of climate variability and change and associated issues by decision makers, stakeholders, the media, and the general public,
- develop resources to support adaptive management and planning for responding to climate variability and climate change, initially as research and later as operational applications,
- develop methods to support climate change policymaking and demonstrate these methods with case studies,
- support and encourage the incorporation of climate change adaptation in planning, adaptive management and policy making,
- create maps for water quality, urban planning and crop management, and
- the expected outcomes from investments made in developing such decision making support resources are:
 - improved scientific basis for informing public discussion of climate change issues,
 - an adaptive management capacity that accounts for climate variability and change,
 - assessment information for evaluating options for adaptation to climate variability and change, and
 - identification of information needed to guide the evolution of the programs science agenda.

Suggested activities regarding the early application of climate change adaptation by case studies are to:

- include relevant examples such as flood plains and coastal flooding,
- have case studies that involve various levels and forms of public sector, as well as some private sector involvement in some of the “applied science,”
- present case study outcomes at a useful, practical level of detail that is not oversimplified, and
- potentially prepare case studies involving NGO and private sector “end users.”

Suggested activities with respect to communications and broad based learning opportunities are:

- establish a case study database as a website,
- improve public sector awareness of climate change adaptation activities,
- a greater coordination of adaptation activities is required to avoid duplication,
- establish regional climate change partnerships as a focus of adaptation activity, that involve various levels of the public sector and a range of wider stakeholders,
- inter-departmental communications within a jurisdiction,
- inter-jurisdictional communications within the applicable region,
- inter-governmental communications within the applicable region (i.e. regional representatives to the Intergovernmental Working Group in Climate Change Impacts and Adaptation, which prepared the document “A National Climate Change Adaptation Framework.”)
- specialized public sector workshops, professional and scientific meetings, prepare published papers, and information forums including online ones,
- communications involving representatives of government, academia (i.e. Atlantic Earth Science Network (AESN) and other regional equivalents, Canadian Climate Impacts and Adaptation Network (C-CIARN) or replacement, consultants (i.e. professional associations for engineers, planners, scientists, ClimAdapt / Climate Canada Atlantic, PARC, Ouranos), and
- if the focus of initial activity was broader to include private sector projects, then consider including representatives from farmer or forestry groups, or property owning, managing, developing and industry groups.

Some potential (Atlantic Canadian) examples for the application of public sector resources are:

- regional planning (i.e. HRM, St. John's, Charlottetown PEI, and in New Brunswick),
- flood plain management (i.e. Truro NS, Fredericton NB),
- watershed management (i.e. Annapolis Valley NS),
- forest management (i.e. NS, NB and NL),
- agriculture crop selection (i.e. grape growing)

- by Northumberland Strait, NS),
- coastal infrastructure (i.e. Charlottetown PEI), and
- municipal infrastructure (i.e. Halifax NS).

There are a variety of potential public sector end users in these potential examples. A documented self screening mechanism by applicable public sector end user decision makers could be an effective means to both draw additional attention and evaluation to those projects or decisions that may be particularly vulnerable to climate change impacts.

The basic science component could be provided by Environment Canada (Atlantic).

The applied science component could be provided by a number of technical specialists within government (i.e. Geological Survey Canada), Atlantic Earth Science Network (AESN) or equivalent, Canadian Climate Impacts and Adaptation Network (C-CIARN) or replacement, university researchers, and private sector consultants (i.e. Climate Canada Atlantic members).

1.4 Municipal Government (Halifax Region as Example)

Given their available resources, it is suggested that in general municipalities will be most effective with public sector resources when they are initially focused on incorporating climate change adaptation into their decision making regarding:

- their communication and coordination with other public sector adaptation activities,
- communicating with the provincial climate change "Office" and others,
- municipal planning,
- new infrastructure,
- infrastructure repairs, upgrades, and replacement that would be happening in any event, and
- use some municipal (i.e. financially effective) projects for early example adaptation applications.

The Halifax Regional Municipality has received funding for a Climate SMART project which includes the development of some decision making tools for the benefit of their own end use decision makers, and as a potentially useful public domain example for others.

1.5 Public Sector Supported Activities

It is suggested that public sector supported activities involving non-civil servants can take several forms, with respect to climate change adaptation applications.

With respect to the "basic science" activities, a small portion of the work might be contracted out on behalf of the public sector (i.e. private sector members of the Canadian Meteorological and Oceanographic Society).

It is suggested that a group of example or developmental climate change adaptation applications be executed, using current public sector projects or decision making. Funding for this might originate from the existing project revenue streams or by incremental or supplemental project funding applied for this purpose. A favorable series of events would include a public sector decision maker being aware that something potentially significant in their project or decision could be influenced under alternative climate conditions. This decision maker might cost share with a development fund managed by or through the appropriate provincial or federal "Offices" who have their own cooperation agreements between them. If the expression of interest from the end user decision maker becomes an accepted proposal by the "Office," or on behalf of them, then an example project could begin. Between the "Office" and the end use decision maker, a project team would start to form, especially around the applied science portion of first identifying and then "translating" the climate change information available from Environment Canada, into a format that is more useful to the end user.

The basic science component could be provided by Environment Canada. The applied science component could be provided by a number of technical specialists within government (i.e. Geological Survey Canada), Atlantic Earth Science Network (AESN) or equivalent, Canadian Climate Impacts and Adaptation Network (C-CIARN) or replacement, university researchers, and private sector consultants (i.e. Climate Canada Atlantic members). The discipline of a project with budget should bring out the most effective efforts of the team members.

The AESN is the Atlantic Earth Sciences Network and is a regional network of universities, federal and

provincial governments, environmental industry associations, and non-governmental organizations. C-CIARN was a federally sponsored Canadian Climate Impacts and Adaptation Research Network (www.c-ciarn.ca) program. It was composed mainly of academic researchers, public sector scientists, and some public sector members, community based or non-governmental organizations, students, and private sector consultants. While intended to link researchers with decision makers (i.e. those who have a capacity to fund and make practical use of researchers knowledge), the latter were not so prominent at C-CIARN events in Atlantic Canada.

Some potential (Atlantic Canadian) examples for the application of public sector resources are:

- regional planning (i.e. HRM, St. John's, Charlottetown PEI, and in New Brunswick),
- flood plain management (i.e. Truro NS, Fredericton NB),
- watershed management (i.e. Annapolis Valley NS),
- forest management (i.e. NS, NB and NL),
- agriculture crop selection (i.e. grape growing by Northumberland Strait, NS),
- coastal infrastructure (i.e. Charlottetown PEI), and
- municipal infrastructure (i.e. Halifax NS).

There are a variety of potential public sector end users in these potential examples.

The execution of some applied examples could stimulate the creation of useful decision making tools. This could involve contributions from university based researchers, in house technical specialists from the public sector, and private sector consultants familiar with the projects.

Another area of activity for public sector scientists and university researchers relates to an improved knowledge of current natural conditions, before additional climate change is included. An improved understanding with respect to current water resources would be particularly helpful when one considers the public sector end user decision making that is particularly sensitive to climate change.

With respect to climate change adaptation and the academic community, public sector resources may be most effective when they are used to:

- encourage the most relevant research on

background natural conditions in the region that is not yet understood, as a useful basis for later climate change adaptation applications (i.e. watershed resources),

- encourage research on better understanding of natural climate change, variability, and the influences of various human activities, and
- encourage research efforts with promising opportunities to reduce significant uncertainties.

In Atlantic Canada the C-CIARN network mandate appeared to have become a catalyst for communication between university and public sector scientists. In that respect, the organization accomplished this goal. Since April 2006, due to federal funding decisions, C-CIARN activities across Canada ceased and what happens next is uncertain. However, some of the more recent C-CIARN activities may not have significantly influenced how often its various members have ended up working together on a project with a budget.

Involvement in C-CIARN events was consistently pleasant socially, and useful at maintaining some technical or professional contacts. For the more experienced members, there are only so many new people to meet. For people who are new to the climate change adaptation field, their activities provided a useful means to improve one's developing technical knowledge. For experienced university based or professional public sector based researchers, the case became somewhat less than compelling for investing "marketing" time at C-CIARN events with respect to the potential opportunity for a resulting increased amount of research revenue.

For such people, with respect to increasing their opportunities to being awarded research contracts, or from another perspective maintaining a sustainable, developed regional scientific capacity, it may become more useful to bypass the next C-CIARN event, and instead attempt to "follow the money" of potential projects.

The money being followed may well originate from the public sector. It is suggested that over the long term, public sector resources being used for university or similar type research will be relatively more effective, if the research efforts are not so much on stand alone studies, but on topics or themes that are useful to end use decision makers such as public sector

representatives involved with infrastructure decisions..

There is a time and place for the use of public sector resources.

Public sector resources may be used directly, or by indirect funding support, for a variety of purposes, or criteria. The goals for using resources in these ways may be based on a desire of having the results or process draw public attention or raise awareness of a particular item. The goals may be in part to encourage the general development of research capacities in a particular field, and not specific investigations. The goals may also be quite specific in conducting investigations that are particularly relevant or influential to targeted ongoing operational activities.

Over the effective long term life cycle of a topic, there is a time and place for different goals to be applied. What might start out as "Can kiwis help your live longer?" may later be based more on building research capacity as "A Kiwi Tree Grows in Brooklyn . . . Hants County, Nova Scotia" but not in St. John's, but it should do well in Charlottetown, but does not survive Fredericton winters. As the "life cycle of interest" in kiwis matures, the initially built up research capacity may shift to Prince Edward Island and the Annapolis Valley, close to where all the really serious "kiwi money" is being spent. Research topics then may be similar to "Improving Charlottetown Kiwi Growing Conditions." This paper suggests that resources applied on research are most effectively used at this stage of the "life cycle of interest" after the developmental work of the early days has occurred. As research becomes more applicable and useful for the every day operations and decision making in "kiwi country," there will be a trend in the potential sources of funding from a mixture of the public and private sector, towards the latter becoming the most significant. The history of apple and wild blueberry research in Atlantic Canada has followed these "kiwi country" type stages.

Natural resources management, especially with respect to water quality and watershed areas, municipal government regional planning, and infrastructure associated with all levels of government are areas where "kiwi country" resides within the public sector, and the equivalent to the "really serious kiwi money" being used are public sector resources.

There are many ways and there can be many reasons

for which public sector resources can be used, with respect to research associated with climate change adaptation applications. This paper suggests that at this stage, the most effective use of public sector resources is in improving the quality of public sector decision making where the really serious "kiwi money" is already being spent in the essentially exclusively public sector "kiwi country" activities related to natural resources, municipal planning, and infrastructure. Accomplishing this first on some example public sector projects and decisions, would be anticipated to also result in improved decision making tools being developed, an improved understanding of the environment, and through good communications, an improved set of experiences that is useful for other potential decision makers in the public and private sectors.

Some potentially useful, relevant, example projects, with budgets, that involve the end use decision maker, in this case the public sector, and where the results are of practical benefit to the end use decision maker, would be of serious interest to, and merit "marketing" efforts by potential researchers and others.

If something like this is the future, and this is what will be attracting the attention of researchers seeking a long term use for their developed capacities, then this may have some implications to those involved in the potential renewal of the C-CIARN mandate. Their mandate and funding was not renewed at the beginning of this financial year. Perhaps C-CIARN, or C-CIARN 2, or whatever maybe the appropriate name will be involved as part of a link between different federal, provincial, and municipal governments, along with the public sector end users and their projects, and the researchers, be they technical specialists internal to the public sector, in the universities, or in the private sector.

Such "new C-CIARN" type activities and responsibilities across Canada, might be coordinated through, be a part of, or be directly sub-contracted to a federal "Office" for Climate Change Adaptation in Canada.

If we have come through a period of researchers meeting potential collaborators, then the next phase of development would be to facilitate their connection to clients, projects, budgets, and these may involve different groups or project teams of fellow researchers as collaborators. It is suggested that there are

decisions being regularly made, in regular public sector activities, that could merit a climate change adaptation application or review. This paper also suggests that in the long run, what is likely to be more effective for the public sector is to have those applications made to those projects that had the initiative to take climate change adaptation into account.

Non governmental organizations involved in climate change adaptation activities either through “applied science” or in working with “end users” are anticipated to include members of C-CIARN or C-CIARN 2 if there is a replacement. Professional associations for engineers, planners, and scientists, are potential venues to receive “outside” feedback with respect to the development of decision making tools. Trade associations such as the fruit growers, forestry, and others are potential partners in applied science research, as well as either direct or indirect representatives of end use decision makers.

For now it is suggested that some specific goals or projects be provided to a ClimAdapt or Climate Canada Atlantic type group of consultants and researchers, sitting at the same table with the relevant public policy people, Environment Canada as a basic science provider, C-CIARN type member or similar researchers, and some end user decision makers. This latter group would be anticipated to both be seeking to take into account climate change adaptation applications for their projects or decisions, and also be motivated to support part of the team efforts financially. Such end use decision makers may be municipal, provincial or federal public sector representatives involved in infrastructure or natural resources where weather and climate are already influential.

An initial group of end use decision makers might be the policy people involved in the development and implementation of their respective Climate Change Action Plans. The next group might be some public sector infrastructure representatives involved with some future investments and interested in how and where climate change adaptation will be taken into account on a pilot project basis. The basic science, policy, consultant and infrastructure could come up with a tool to help with decision making, or adapt an already existing one to their particular purposes. The universities may contribute specific research that has particular specific goals or purposes. The end result

would be the cooperative development of better Climate Change Action Plans (at least with respect to climate change adaptation); the development of climate change adaptation tools that are of specific use for some example public sector infrastructure projects, the possible application of these tools, and the most up to date basic science from Environment Canada for some real world public sector projects.

If the climate change adaptation applications are logical, rational, make sense, and appear to be reasonably cost effective if applied on a broader scale, then such public sector led examples will be voluntarily picked up by other public and private sector based decision makers. Assuming the interests of the general public shift somewhat and become more interested in applying climate change adaptations, having some real world public sector examples, with decision making tools and reports that are in the public domain, will be a catalyst for more climate change adaptation activity.

Some public sector efforts have been applied to communicating to others that climate change and climate change adaptation is important. If it is so self evidently important, then perhaps it is time to invest public sector resources on incorporating climate change adaptation on some regional public sector projects. The availability of information about such projects to the public would mean that they can be examples from which others can learn from.

It is suggested that the most effective application of public sector resources with respect to climate change adaptation in Canada would focus on:

- a fundamental commitment to reducing the uncertainties of the basic science and making it available in the most useful of formats,
- supporting the development of relevant, practical decision making tools that can be used in regular real world projects, and
- supporting the use and application of these on some specific public sector projects for public sector end users, as a pilot example from that others have the capacity to learn.

Broad based teams, including researchers, scientists, end users, construction and operations people will form in cooperative team like responses to projects with budgets.

1.6 An Atmosphere for Early Adaptation

An atmosphere that encourages the early adaptation of these types of suggestions would seek to include or incorporate climate change adaptation into regular potentially climate sensitive decision making. With respect to infrastructure, this would begin with a clear mandate to incorporate climate change adaptation from the applicable senior management or ownership representative of the infrastructure, otherwise project level technical decision makers may be reluctant to contemplate such an additional dimension to the decision making.

Those currently allocating resources with respect to infrastructure would seek to additionally account for climate change adaptation. Technical decision makers would have practical, useful mechanisms with which to execute the prescribed mandate. There would also be an availability or capacity to produce supporting baseline "natural science" science data (ie. applicable watershed studies) and "applied science" tools (ie. model projections) for applicable decision makers.

The public sector is the owner, steward, manager, operator of a significant portion of infrastructure, and it could take the lead by seeking to incorporate climate change adaptation into the regular decision making associated with infrastructure under its responsibility.

With a clear mandate from senior leadership, motivations and encouragement could be made, such that technical people would gradually incorporate it into future projects and decision making. A mechanism for this could be to develop example climate change adaptation applications for real municipal infrastructure decision making.

Support for the science could be provided on a per project basis through Environment Canada meteorology, and natural resources baseline type studies.

Support and encouragement could be provided for the development and application of decision making tool kits, through infrastructure project decision making.

There could be an effort to incorporate climate change adaptation into existing weather and climate sensitive decision making such as those using the national Building Code and InfraGuide type documents.

Introduction to Cameron Ells, P.Eng.

Cameron Ells, P.Eng., founded Cameron Consulting Incorporated in 2000 to profit from supporting the advancement of effectively applied practical science and policy solutions, to the goals, challenges, and responsibilities of our community environments. Clients include a range of Canadian and American engineering and environmental consultants as a subconsultant; industry as a technical and administrative auditor; legal and financial institutions as an expert opinion, and the public sector as a reviewer and provider of policy suggestions.

He has a civil engineering background, along with structural design and infrastructure construction experience. He began his involvement in contaminated site assessment, remediation, and brownfield redevelopment projects in the 1990's. He conducts human health risk assessment (Atlantic RBCA Application) short courses for Dalhousie University Continuing Education.

He has presented at respected international technical conferences in Canada, the United States and Europe.

Growing organic grapes as Summervine Inc. has become a sort of personal climate change adaptation.

In May 2006, he presented "Incorporating Climate Change Adaptation into InfraGuide (Municipal Infrastructure) type Decision Making" at the national Engineering Institute of Canada Climate Change Conference in Ottawa. He is a founding member of ClimAdapt, Climate Canada Atlantic, and lead author for the original and subsequent versions of "A Practitioner's Guide to Incorporating Climate Change Adaptation into Design, Development and Management Decision Making."

