

The Impact of Canada's Regional Adaptation Collaboratives on Climate Adaptation

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Contents

1. Introduction.....	2
2. What results were expected	4
2.1. Program goals and expected results.....	4
2.2. Areas of change	7
3. What results were achieved.....	9
3.1. Awareness and understanding	9
Case 1: Drought and excess moisture preparedness plan implemented in Swift Current Creek Watershed (Saskatchewan).....	10
3.2. Planning and practical decisions to build resilience to climate change.....	11
Case 2: Guidelines for parking lot design to reduce urban heat islands and improve stormwater management adopted and made standard (Quebec).....	12
Case 3: Municipal climate change action planning completed province wide (Nova Scotia)	13
Case 4: Drinking water safeguarded through climate change consideration in source protection plans (Ontario)	14
Case 5: Provincial Flood Plain Management Policy updated and flood risk mapping enhanced to include climate change (Newfoundland and Labrador)	15
3.3. Expanded networks and regional spin-offs	16
Case 6: Regional approach to adaptation planning by 14 municipalities and rural communities of the Acadian Peninsula adopted (New Brunswick)	17
Case 7: Capacity to manage flood risks in British Columbia’s Lower Mainland and protect communities along the Fraser River and coast strengthened (British Columbia)	18
4. What does that say about adaptation	21
5. Conclusions.....	24
References	25
Endnotes.....	27

1. Introduction

The climate is changing and will continue to affect communities and sectors globally and in Canada; that's why we have to adapt. However, the impacts of climate change and responsibilities to adapt to related risks and opportunities often transcend political and sectoral boundaries. As a result, adaptation decision-making can be complex. Collaborative initiatives that bring together diverse groups to tackle climate adaptation challenges are gaining ground as an alternative policy response to top-down approaches (Bauer and Steurer, 2014).

In 2007 the Climate Change Impacts and Adaptation Division at Natural Resources Canada (NRCan) shifted its program focus and delivery, with collaboration as a guiding principle. After nearly ten years of research programs to build a knowledge foundation on the potential impacts of climate change and on engineering, institutional and behavioural options to adapt, the Division targeted turning science into action. Delivered over three years, the Regional Adaptation Collaboratives and Tools Program was a \$35 million federal investment (2007-2011) to advance adaptation decision-making in communities and sectors across Canada.

Core to this iteration of adaptation programs were the six Regional Adaptation Collaboratives (RACs) established starting 2009 across Canada (Atlantic, Quebec, Ontario, Prairies, British Columbia and North). NRCan supplied 50 percent of project funding and worked with regional and local partners to facilitate practical adaptation. Each RAC identified adaptation priorities, based on science information and policy relevance, with common themes including water resource management, municipal planning and infrastructure. Each RAC comprised a network of decision-makers in government and industry, practitioners and researchers. Together, RAC partners defined and delivered the information, decision support and policy-guidance tools, and cultivated the relationships needed to accelerate climate adaptation in their region. Activities of over 125 partner organizations have generated over 470 knowledge products, including guidebooks, technical studies, vulnerability assessments, workshop reports and case studies.¹

This report summarizes research on the RAC program's impact and is intended for adaptation practitioners and policymakers across Canada. Climate adaptation is a long-term process. Learning from programs is made difficult by the time lags that exist between analysis, planning and action on-the-ground. Three years have elapsed since the intensive phase of RAC activities. This presents an opportunity to reflect on lessons and results (intended and unintended) arising from the RAC program, both to recognize achievements and to inform future programs fostering collaborative approaches to adaptation.

The report addresses two main questions:

1. What was the immediate effect of the RACs in encouraging collaboration and adaptation decision-making and,
2. What was the influence of the RACs beyond program timelines and scope?

Two approaches shaped this report. One involved the review of program documents, including final reports from RAC partners. The other involved qualitative research reliant on key-informant interviews. To independently document the RAC's contribution to climate adaptation in Canada the research team employed a method called outcome harvesting (Wilson-Grau and Britt, 2012). It is a method suited to examining program impact on issues defying traceability, as is climate adaptation. (For example, decisions

to adapt to climate change are often in support of other objectives, such as water resource management.) The outcome harvest involved three steps (1) hearing from stakeholders on notable achievements in adaptation; (2) determining whether and how the RAC initiative contributed to these achievements; and (3) interpreting the significance of achievements and program contributions.²

Box 1: Key definitions

Adaptation is any activity that reduces harm or exploits benefits from the impacts of climate change. **Adaptation decision-making** is a continuous process promoting the progression from awareness, engagement, understanding or risks and opportunities through the use of climate change information, decision-making and learning. **Collaboration** has emerged as a key principle adopted by Canadian governments to advance knowledge and action on adaptation. Collaboration involves working with others on a common goal that exceeds what any one person or group can accomplish.

Other concepts used in this report:

Program design involves clarifying the chain of results that can be expected over time, from input to impact. **Inputs** are the raw materials required to complete program activities. **Activities** are what program implementers do, that is, the tasks that transform inputs into outputs. **Outputs** are the immediate, tangible results of a program, such as reports and training manuals. **Outcomes** are short to medium-term effects of a program, resulting from, for example, uptake or use of outputs. **Impacts** are the long-term effects –the overall objectives – of a program.

Participation of program stakeholders in monitoring and evaluating (M&E) program performance is often valuable. **Participatory M&E** can include involving program stakeholders (e.g., funding recipients and users of program outputs), in coming up with qualitative judgements on the program’s performance, in discussing and learning from results as well as in identifying corrective actions while still under implementation.

Sources: IPCC (2007); Eyzaguirre and Warren (2014); Forest, C. (2003); DfID (2009); Estrella (2000)

The report’s structure is as follows. Chapter 2 establishes the basic parameters against which to measure the RAC program’s contribution. Chapter 3 summarizes results achieved in practice both within and beyond program timelines. It also includes analysis of these results. Chapter 4 presents conclusions and implications for future adaptation programs.

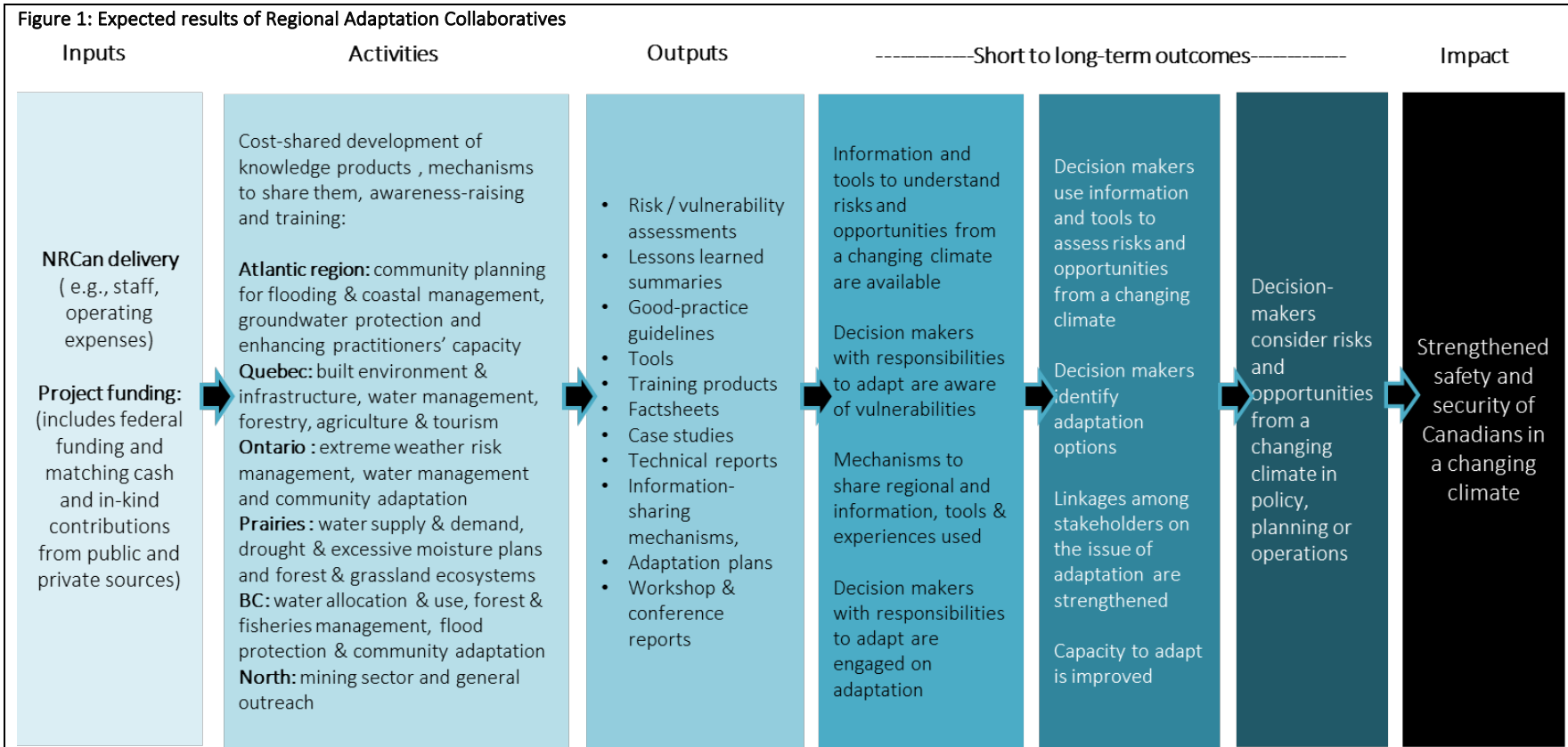
2. What results were expected

This chapter summarizes NRCan's expectations for the RAC program prior to its implementation. It identifies areas of change that the initiative aimed to influence, by design.

2.1. Program goals and expected results

The goal of the RACs and Tools program was *"to catalyze coordinated and sustained adaptation planning, decision-making and action, across Canada's diverse regions"*.³ For NRCan to secure program funds from federal coffers the department had to identify the need for the program and its goals, as well as describe expectations about how the program would contribute to change and yield results. The results chain in Figure 1 depicts just that – the expected chain of results for the RAC program.

Figure 1: Expected results of Regional Adaptation Collaboratives



The assumptions inherent in the program’s logic were that (1) identifying regional adaptation priorities jointly and generating information and tools to address them and (2) sharing information and lessons learned would help raise awareness among key decision-makers of the need and options to adapt, engage those with responsibility to adapt and facilitate uptake of information and tools to assess risks and identify adaptation options. As a result, RAC activities would ultimately help integrate adaptation into decision-making (i.e., “mainstreaming”), thereby safeguarding Canadians’ safety and security in a changing climate.

Results chains such as the one above are useful to clarify what should be monitored to help demonstrate accountability to tax payers and to inform conclusions on a program’s merit. To help learn about the adaptation process in practice and the potential to make gains over the course of delivering the three-year RAC program, NRCan devised an “Adaptation Decision-Making Continuum” (Figure 2).

This continuum is a conceptual model that explains an organization’s trajectory from unawareness of climate change impacts and adaptation as way to address risks and vulnerabilities through to the point of deciding whether and how to adapt. It also depicts the types of activities and behaviours expected in transitioning from one level to another. For example, an organization that understands the current and future risks and opportunities of changing climate for its operations would likely seek detailed information to decide on a course of action (e.g., a cost-benefit analysis, quantitative risk assessment or a policy review), particularly if the stakes of making the wrong decision were high. At the outset of the program, NRCan asked funding recipients to track RAC stakeholders’ progress along this continuum.

Figure 2: NRCan's Adaptation Decision-Making Continuum

Position on the Continuum	Examples of indicators
<p>1. Unawareness The organization has very limited understanding about how it may be affected by the impacts of changing climate</p>	<ul style="list-style-type: none"> Climate impacts are not discussed at the management level There is often confusion distinguishing between climate change mitigation and adaptation measures
<i>Raising awareness</i>	
<p>2. General awareness Organization is aware that climate change is affecting, or is likely to affect, the organization and is interested in learning about how to reduce risks and take advantage of opportunities</p>	<ul style="list-style-type: none"> Management is generally aware of how changing climate may affect the organization, but haven't identified the broad implications for plans, policies, programs and operations The media and ad hoc presentations (e.g. a lecture or conference session) are the primary source of climate change impacts and adaptation information
↓ <i>Engaging decision-makers</i>	
<p>3. Active awareness Organization is actively engaged in investigating how a changing climate affects the organization</p>	<ul style="list-style-type: none"> Established management support for adaptation Reviewed reputable climate change impacts and adaptation sources such as government reports, professional publications and peer reviewed articles Assembled an adaptation team, committee or working group and have defined its mandate
↓ <i>Applying knowledge to identify risks and opportunities</i>	
<p>4. Focused awareness Organization clearly understands the risks and opportunities that a changing climate presents to the organization now and into the future</p>	<ul style="list-style-type: none"> Undertaken research into how changing climate may affect the organization Conducted a risk and opportunity assessment, either internally or with outside assistance, using available impacts and adaptation-related material Developed a preliminary action plan or road map
↓ <i>Conducting in-depth analysis</i>	
<p>5. Comprehensive understanding Organization has identified possible changes to plans, policies, programs and operations to help adapt to a changing climate</p>	<ul style="list-style-type: none"> Identified potential adaptation actions to address risks, vulnerabilities and opportunities Conducted in-depth analysis of possible adaptation actions - could include consideration of drivers and constraints and a cost/benefit analysis Identified where adaptation could be integrated into new or existing plans, policies, programs and operations
↓ <i>Making decisions</i>	
<p>6. Decision point</p>	<ul style="list-style-type: none"> Decision made whether or not to implement adaptation action
<i>Monitoring and lessons learned</i>	

Source: Climate Change Impacts and Adaptation Division (CCIAD), Regional Adaptation Collaboratives Program, Final Report (2010)

2.2. Areas of change

Taken together, the RAC results chain and Adaptation Decision-Making Continuum discussed above point to five areas of change that NRCan should track to both demonstrate accountability and to learn from program implementation:

Awareness. Decision-makers (strategic or operational) accept that the effects of a changing climate may present threats or opportunities to an organization. They are able to distinguish between greenhouse gas mitigation and adaptation to a changing climate.

Engagement. Decision-makers seek information and allocate organizational resources to clarify the magnitude of the problem and scope of adaptation as a solution. They primarily rely on existing sources of climate change impacts and adaptation knowledge, such as government science publications, practitioner sources and journal articles.

Uptake of climate change information. Decision-makers undertake or fund their own analysis, using information, datasets and tools to assess risks and opportunities from a changing climate and evaluate alternative options to adapt.

Adaptation mainstreaming: Decision-makers integrate risks and opportunities from a changing climate in policy, planning or operations.

Relationships: Levels of joint activity and trust among stakeholders facing shared adaptation issues, as well as the diversity of stakeholders represented, increase.

All areas of change and the types of situations they describe amount to “process” indicators. That is, achievements in these areas can reasonably be expected to lead to tangible impacts over time, although this can’t be assured (Bours et al. 2014). Examples of program impacts include: costs savings accrued to municipalities by designing infrastructure to withstand future climate extremes and coastal flooding, avoided health impacts from the use of fire-smart practices in urban-wildland interface zones and the avoided costs to homeowners from flood-proofing their basements.

3. What results were achieved

This chapter summarizes evidence on results achieved, in part, due to the RAC program. It draws on two sources. The first is information reported by RAC funding recipients on changes they observed among their stakeholders over the course of implementing RAC activities, at two snapshots in time. The second is a series of case examples developed for NRCan between November 2014 and April 2015.

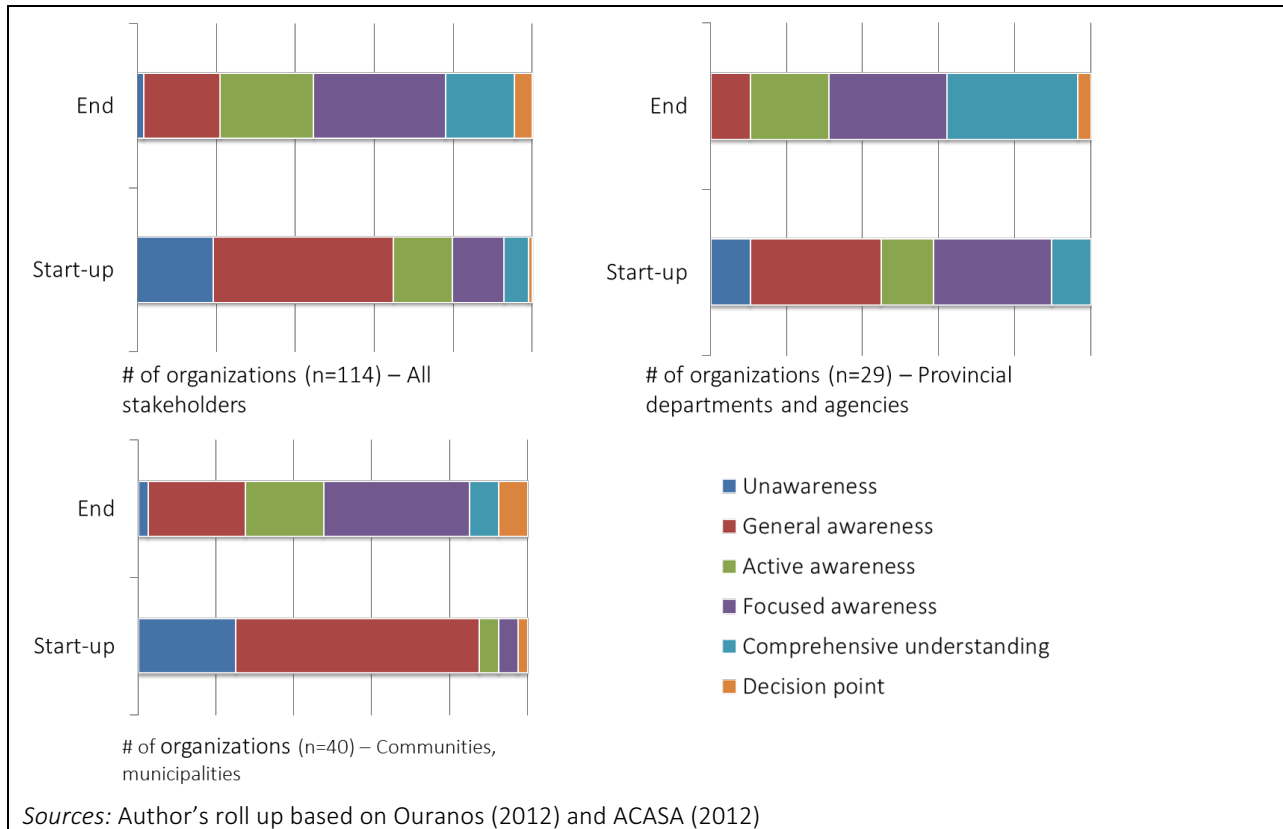
Based on these data sources alone we conclude that the RAC program strongly contributed to the changes we would expect from a program designed to build capabilities to adapt: increased levels of awareness and understanding of vulnerabilities and adaptation options and integration of climate change information in planning and decision-making. The RAC program grew the network of people working on adaptation issues. It was also a catalyst of adaptation and other sustainability initiatives unfolding today. Although examples do exist, implementation of tangible changes to reduce people's and assets' exposure or sensitivity to climate change risks is not yet widespread. A discussion of what the RAC program contributed to and how follows.

3.1. Awareness and understanding

The RAC program contributed consistently to the short-term outcomes mapped out for the program prior to its implementation. As measured by progress along the Adaptation Decision-Making Continuum for three of six RACs, virtually all RAC partners' engagement levels grew over the course of the program. Municipalities, communities and provincial agencies showed most progress. Figure 3 shows the combined results for the Atlantic and Quebec RACs, at the start and end of the initiative (1) across all stakeholders, (2) municipalities and communities and (3) provincial departments and agencies.⁴ We draw attention to these regions because both the Atlantic and Quebec RACs scored partners in a way that made a roll up of results possible.⁵ At start-up, most stakeholders were generally aware or unaware of the potential effects of climate on their organizations. Two years later, awareness levels had heightened, many had a clear understanding of risks and some had started to plan for them.

Although the Adaptation Decision-Making Continuum is a useful, simple heuristic to track progress, adaptation is not always linear. Experience from the BC Regional Adaptation Collaborative suggests that obtaining comprehensive information does not always precede reaching a decision point. However, when economic stakes are high, decisions to take proactive steps are unlikely to be made without obtaining as accurate information as possible (Fraser Basin Council and BC Ministry of Environment, 2012).

Figure 3: RAC participants' progress along adaptation decision-making continuum at start-up (2010) and end (2012), Atlantic and Quebec



One of the ways the RAC program helped boost awareness and understanding of climate change risks and adaptation options was in linking scientific and local knowledge to work on a natural resource problem of broad concern. The following case describes just that.

Case 1: Drought and excess moisture preparedness plan implemented in Swift Current Creek Watershed (Saskatchewan)

The challenge: Saskatchewan is a land of extremes; climate conditions can switch quickly from too wet to too dry. Located in the southwest part of the Province, the Swift Current Creek Watershed comprises 5,592 km² of land and is home to about 54,000 residents of small communities and two major cities. The Swift Current Creek Watershed is among the driest areas in the Canadian Prairies. Residents, including homeowners, farmers, ranchers and recreationists, are concerned about the sustainability of the amount and quality of their water. Water resources and the populations they serve are at risk from the pressures of growth in water demand, climate change and the potential for more frequent and intense extreme climate conditions.

Achievements during the RAC: In March 2011, Swift Current Creek Watershed Stewards Inc. in collaboration with the Saskatchewan Research Council and the Water Security Agency released a drought and excessive moisture preparedness plan for the Swift Current Creek watershed with 35 action items along three themes (municipalities, education and agriculture). Its development engaged close to 350 stakeholders and combined climate trends and projections with local knowledge to identify risks from extreme-climate events and priorities for future action. Participation in the planning process enhanced watershed residents' awareness of climate impacts and actions occurring across the region, and understanding of what others were facing grew as a result.

Status today: Implementation of the drought and excessive moisture preparedness plan is starting to take place. The Executive Director of Swift Current Creek Watershed Stewards consults the drought and excessive moisture plan often and highlights two action items that have progressed:

- The plan highlighted the need for municipalities' emergency response plans to incorporate landowners downstream of a major reservoir. A pilot project, led by the South West Public Safety Region, to bring together municipalities to discuss a regional response to hazards such as wildfires and drought, came as a result.
- Water supply planning was a high-priority action item in the plan. A moratorium on new water allocations has been in place since 1981 and watershed residents have questions concerning the continued relevance of this moratorium. Swift Current Creek Watershed Stewards have advocated for the Water Security Agency to examine the issue for some time. The Agency is undertaking a study for completion in 2015.

Minimizing risks from dry and wet conditions tends to be a shared concern among watershed residents but disagreements arise when it comes to how to do this and what values to prioritize. The drought and excessive moisture preparedness plan and the discussions it comprised can help minimize conflict among water users in times of droughts or floods and costly impacts like agricultural losses.

RAC contribution: The Prairies RAC provided funding and technical support from the Water Security Agency (at the time it was the Saskatchewan Watershed Authority) to complete the drought and excessive moisture planning process. Drought preparedness featured in the Swift Current Creek Watershed Stewards' 2009 watershed protection plan but they *"didn't know how to proceed"* until the Water Security Agency approached them to participate in this RAC initiative. According to the Executive Director of the SCCWS drought and excessive moisture planning would not have occurred without the RAC's support.

Key references:

1. Rowan, K., Pittman, J., Wittrock, V., and A. Unvoas. 2011. Drought and Excessive Moisture Preparedness Plan, Swift Current Creek Watershed. 44 pp.
2. Climate Change Adaptation Case Study: Drought and Excessive Moisture Preparedness Planning in Saskatchewan Watersheds. March 2014.
3. SaskAdapt (nd). Drought Preparedness: Success Story – Swift Current Creek Watershed Stewards.

3.2. Planning and practical decisions to build resilience to climate change

In our research, funding and the information resources created from RAC activities stand out as the contributions most valued by program participants. This is not surprising. Dedicated funding and information gaps commonly arise in discussions on barriers to adaptation (e.g., Eyzaguirre and Warren, 2014). Overcoming these barriers has a number of benefits, as the following statements from RAC partners and users of RAC-funded information resources attest to:

"You need money to drive initiatives that are new and to build capacity. Without RAC funding we would still be at superficial level, sharing results of scientific work on climate change impacts but not being able to get down to targeted actions." (Jenny Fraser, British Columbia Ministry of Environment)

“Data mapping and visualizations are very effective in explaining [climate change impacts] in way local officials understand it as well as the general public. Without this, people know there is a problem but they just don’t know how big the problem could be, like the extent of flooding for example.” (Colette Lemieux, New Brunswick Department of Environment and Local Government)

“Source [water] protection is an important policy initiative in Ontario. Through the RAC we were able to put together resources to help practitioners as they went into the next phase in source protection planning.” (Chandra Sharma, Toronto and Region Conservation)

“The water supply and demand project [of the Okanagan Basin Water Board in BC] was useful to inform demand growth projections for our Master Water Plan in 2012. We looked to the OBWB water supply and demand project for climate change scenario outputs, especially for projecting agricultural demand, which has a complex relationship with climate, population growth and economic development that our utility couldn’t have modeled without the support of the WSDP”. (Jennifer Miles, Regional District of North Okanagan)

The following four case examples illustrate different approaches that information on climate change impacts, risks and good practice can spread. Vectors include guidelines, planning requirements and policy changes. Collaboration across organizations representing diverse disciplines and sectors facilitates the process, in some cases.

Case 2: Guidelines for parking lot design to reduce urban heat islands and improve stormwater management adopted and made standard (Quebec)

The challenge: Average temperatures are rising, as are the number of hot days occurring annually. These trends will likely continue as the global climate changes. Hotter weather affects human health, giving rise, for example, to respiratory and heart problems. As a result of the 2010 heatwave in Quebec, 280 people died and 3,400 people were hospitalized over and above the deaths and hospital visits expected according to past records. Rising temperatures aggravate urban heat islands, a local phenomenon already of public health concern in many cities, including in Quebec. Because paved areas, such as surface parking lots, take up a lot of land surface, contribute to urban heat islands and increase storm water runoff they are good candidates for design and management improvements.

Achievements during the RAC: A project of the Quebec RAC led to guidelines to reduce the urban heat-island effect and manage stormwater by improving the design of surface parking lots. Several partners were involved: the Institut national de santé publique du Québec (INSPQ) initiated the project and commissioned the Bureau de normalisation du Québec (BNQ) – a nationally-accredited standards developer and certifier of environmental management systems— to lead it. To develop the guidelines, BNQ, with support from INSPQ and Ouranos, struck a technical standards committee, with members including municipalities, parking lot service providers, colleges and universities and landscaping professionals. The guidelines provide basic information on urban heat islands and outline a strategic approach to managing surface parking lots to counteract the urban heat island effect. This includes three important design criteria (1. increase shade cover, 2. increase the albedo – i.e., the reflectivity of a material— and 3. expand the proportion of permeable to impermeable surface) and practical advice on measures to implement.

Status today: Since the guidelines’ publication in February 2013, more than 3,000 individuals from 850 organizations have downloaded them. At least seven commercial and institutional development projects in Quebec have adopted practices it recommends. For example, design, architecture and landscaping consultants Groupe Rousseau-Lefebvre have incorporated recommendations on pavement colour,

greening and stormwater management in their redevelopment of the Centropolis in Laval. Local governments and provincial ministries reference the guidelines in their own policies and norms and promote their use by others. Notably, the City of Montreal passed a motion in 2014 to promote the guidelines' application. With this motion the City commits to adopt the guidelines' recommendations when rehabilitating or building surface parking lots in any of the city's nineteen boroughs. Health Canada, Ouranos and BNQ are now exploring options to further increase the guidelines' uptake, such as developing a standard to certify parking lots that meet minimum requirements.

RAC contribution: The Quebec RAC provided the \$74,000 in funding required to develop the guidelines. Natural Resources Canada's cash contribution was essential to leverage funds from provincial ministries. The project either would not have taken place or would have but not as quickly in the absence of RAC funding. As one among a portfolio of seven projects focused on the built environment in the south of Quebec, the parking lot guidelines benefitted from feedback and expertise of researchers and practitioners involved in other Quebec RAC projects.

Key references:

1. Bureau de normalisation du Québec [BNQ]. (2013). Norme BNQ 2019-190/2013 : Lutte aux îlots de chaleur urbains – Aménagement des aires de stationnement – Guide à l'intention des concepteurs. Québec, Canada, 104 p. <http://www.bnq.qc.ca/fr/normalisation/environnement/lutte-aux-ilots-de-chaleur-urbains.html>
2. <http://www.monclimatmasante.qc.ca/norme-sur-l-amenagement-des-aires-de-stationnement.aspx>

Case 3: Municipal climate change action planning completed province wide (Nova Scotia)

The challenge: In recent years, municipalities in Nova Scotia have suffered damages and losses from coastal flooding and storm surges. Climate change adds to these risks; impacts from rising sea levels, more frequent extreme weather events, and changes in the quantity and quality of water resources are expected to occur. Municipalities need to adjust how they manage capital assets and operations to prevent costly damage to infrastructure and protect public safety – the \$100 million suffered in losses by municipal governments due to Hurricane Juan in 2003 highlights this. Municipal Climate Change Action Plans (MCCAPs) provide one avenue for all municipalities across the province to help finance their capacity and infrastructure needs in addressing climate risks (adaptation and mitigation) through gas tax revenues.

Achievements during the RAC: The Department of Municipal Affairs required municipalities in Nova Scotia, either individually or as regional clusters, to submit a plan outlining their response to climate change by December 2013. This MCCAP is an amendment to municipalities' Integrated Community Sustainability Plans, a requirement to gain access to project funding from gas tax revenues. To support preparation of MCCAPs "capacity-building" projects became eligible for gas tax funding. In addition, aware of capacity limitations, particularly in small municipalities, and gaps in information and knowledge, the senior planner at the Department of Municipal Affairs led the development of a guidebook and other resources so municipalities could comply with the climate change action planning process.

Status today: Nova Scotia has become the first Canadian jurisdiction to link mandatory municipal adaptation planning with financial incentives and guidance. The MCCAP process strengthened the Department of Municipal Affairs' capabilities to work with municipalities on adaptation planning, with marked success. The province has now received, reviewed and approved 43 municipal climate change action plans, covering all 54 municipal units that serve Nova Scotia's entire population and landmass. Municipalities have spent close to \$580,000 of gas tax funding on capacity building projects that include

LiDAR mapping, high resolution models and scenario-planning for river floodplains and storm surges that incorporate sea level rise projections, professional facilitation of stakeholder meetings and land-use bylaw reviews as a basis for recommending adaptation policies and provisions.

RAC contribution: The Atlantic RAC supported several aspects of the MCCAP process. With the MCCAP guidebook completed in late 2010, the Department of Municipal Affairs pilot tested the guidebook with RAC partners, namely the Municipality of the County of Cumberland, District of Lunenburg and Town of Yarmouth. The pilot identified the need for additional help. The RAC program funded the development of a companion document, providing definitions, worked examples and references to data sources for each of the six steps included in the MCCAP guidebook. Finally, several technical resources funded by the Atlantic RAC became inputs for municipalities in preparing their MCCAPs, such as climate scenarios; high-resolution flood risk maps; vulnerability assessments of coastal aquifers; coastal erosion scenarios; social vulnerability studies; and an inventory of physical infrastructure at risk of flooding.

Key references:

1. ACASA (2012). Developing Climate Change Capacity at the Municipal Level in Nova Scotia. By A. Patton, Service Nova Scotia and Municipal Relations, May 2012.
http://atlanticadaptation.ca/sites/discoveryspace.upei.ca/acasa/files/Developing%20Capacity%20in%20Nova%20Scotia's%20ACAS%20Municipalities_0.pdf
2. http://atlanticadaptation.ca/ns_projects

Case 4: Drinking water safeguarded through climate change consideration in source protection plans (Ontario)

The challenge: Ninety eight percent of Ontario's 13.6 million residents live in the Great Lakes and St. Lawrence River Basin and a majority get their drinking water from lakes. This basin supports much of Canada's manufacturing activity and a third of the country's employment in farming and food processing. Deaths and hospitalizations in 2000 due to contamination of source water in Walkerton highlighted the importance of protecting drinking water sources from contamination and overuse. Threats to water quality and quantity include natural contaminants, land uses that pollute or use too much water, development patterns that prevent water from soaking into the ground and replenishing groundwater sources, and air pollutants that fall on surface waters. A changing climate is an added pressure on sources of drinking water, affecting supplies and quality.

Achievements during the RAC: Regulations under Ontario's Clean Water Act require communities to develop watershed-based source protection plans for approval by the Province. Source protection plans are informed by technical studies, including water budgets and analyses of water quantity and quality threats and risks at the watershed level. By regulation, communities must integrate information on current and future climate in developing water budgets and examining threats to drinking water. Data and capacity gaps limited compliance with this requirement prior to 2012. Climate datasets, guides on climate change impact assessment and training modules are among the resources that were made available to source water practitioners, starting in 2010, to simplify the task of integrating climate change impacts into the analysis included in assessment reports. Several organizations played a role in delivering these resources, including the Ontario Ministry of Natural Resources, the Ministry of Environment, Credit Valley Conservation, Toronto and Region Conservation and York University.

Status today: Source water practitioners have gained access to information resources and learning modules to support detailed climate change impact assessment as a basis for source protection plans and water budgets. Over 160 water practitioners have registered to access the online learning modules

developed by York University and Toronto and Region Conservation. All assessment reports contain analysis, either qualitative or quantitative, of the climate change implications on water quality and supplies; or, in rare cases, they explain why climate change information has not been taken into account. Catalogues with risk management measures, including those compatible with climate adaptation are available. As a result, policies and measures outlined in source protection plans are more likely to be robust to changing climate conditions than they would have been without access to the information resources and learning modules. As of April 2015, the Province had approved twelve source protection plans, serving over three million residents.

RAC contribution: The Ontario RAC funded four initiatives to integrate climate impacts into the source protection framework, on a cost-shared basis, contributing to provincial water policy as a result. It's unclear whether the Province would have supported climate change work as part of source protection planning. Delivering the Ontario RAC's source water protection work and leading a national RAC project helped build Toronto and Region Conservation's leadership position on climate and water science. Program managers at Natural Resources Canada provided the support staff at Toronto and Region Conservation needed to grow their networks.

Key resources:

1. Ontario Ministry of Environment (2009). Technical Bulletin: Climate Change and the Director's Technical Rules, August 2009.
2. EBNFLO Environmental and AquaResource Inc. (EBNFLO) (2010). Guide for Assessment of Hydrologic Effects of Climate Change in Ontario. Prepared for the Ontario Ministry of Natural Resources and Ministry of the Environment in partnership with Credit Valley Conservation.
3. AquaResource Inc. and EBNFLO Environmental (2011). Future Climate Datasets Guide. Prepared for the Ontario Ministry of Natural Resources. <http://waterbudget.ca/futureclimatedata>
4. Status of source protection activities by source protection area. See: <http://www.conservation-ontario.on.ca/uncategorised/143-otherswpreregionsindex>

Case 5: Provincial Flood Plain Management Policy updated and flood risk mapping enhanced to include climate change (Newfoundland and Labrador)

The challenge: In Newfoundland and Labrador currently, nine in every ten flood events relate to intense rainfall and coastal flooding. Climate change is expected to continue to increase the frequency and intensity of both rainfall events and coastal storm surge, thus increasing flood risk, damage and subsequent costs to the province. Between 1950 and 2014, at least 267 communities suffered flood damage costing over \$250 million. Flood risk maps generated using historical flood data are no longer sufficient and must be updated to include climate change information (such as projected rainfall amounts and depth of flooding) if they are to reduce expensive payouts and costs of rebuilding.

Achievements during the RAC: In 2010, the Department of Environment and Conservation of Newfoundland and Labrador updated their policy for Flood Plain Management to include climate change flood zones, thereby regulating development in flood zones impacted by climate change. To facilitate policy compliance, the Province has updated eight of 39 flood risk maps with climate projections.⁶ Another updated map is expected in June 2015 for a total of nine.⁷

Status today: Newfoundland and Labrador was the first province to integrate climate change into flood policy. In addition to the anticipated avoided costs from flood impacts for the province, the template for climate change flood risk mapping has attracted significant interest from other provincial and local governments seeking advice and technical support in the updating of their own flood risk maps. All flood

risk maps are available online for communities, decision-makers, first responders and researchers to use. Additionally, data from the three climate change flood risk studies completed between 2010 and 2012 have since improved the Province's Hurricane Season Flood Alert System. Communities and emergency professionals can better prepare for intense storms as a result.⁸

RAC contribution: The Atlantic RAC funded the Department of Environment and Conservation's Water Resources Management Division to complete a flood risk and vulnerability analysis that helped set priorities for updates to historical flood risk maps with climate change information. Funding from the Atlantic RAC also supported the Water Resources Management Division to complete three climate change flood risk studies. The Department of Environment and Conservation's Water Resources Management Division worked with engineering consulting firms (AMEC Environment & Infrastructure, HATCH, CBCL) to complete these studies.

Key references:

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3.3 Expanded networks and regional spin-offs

The RAC program strengthened existing relationships among stakeholders and created new ones. Relationships are an enabler to action; once they take root exchange of ideas, information, knowledge, even funding is made easier than without these linkages among individuals and organizations. Several examples point to the influence the RAC program has had in increasing the sheer number of people attuned to and working together on adaptation issues. For example, the number of Atlantic users of the Climate Change Adaptation Community of Practice – an online community with national reach—doubled between 2010 and 2015. Atlantic Provinces have also launched adaptation working groups and maintain formal and informal networks of interested individuals and experts. According to a water management practitioner in Ontario, *“If we had to graph progress on climate change adaptation we would see a huge jump once RAC funding came through. The RAC got a huge number of people involved that might not have been involved before”* (Harris Switzman, Toronto and Region Conservation).

The question is – will the RAC program contribute to lasting relationships to tackle adaptation problems or will enthusiasm wane over time? Some relationships could well be long-lived, especially since the motivation for working together emerged from the bottom up:

- Coordination and communication among partner organizations active under the Ontario RAC has sustained beyond the project. For example, Conservation Hamilton and the City of Hamilton has partnered with the consulting firm Matrix Solutions Inc. (formerly Aquaresource Inc.) to study climate change and hydrological impacts outside of the source protection framework. Partners jointly secured just under \$20,000 to retain a student researcher.
- The growing network of engaged people and organizations has already led to the creation of new entities with the potential for lasting influence on cross-border issues in the Atlantic region. The

Tantramar Climate Change Adaptation Collaborative supports climate change adaptation in the area of Sackville (New Brunswick) and Amherst (Nova Scotia) and brings together representatives from both provinces, plus municipalities, non-governmental organizations and researchers at Mount Allison University.

The following two case examples illustrate how relationships and collaborative approaches can scale out regionally starting from initial set of communities or organizations actively engaged during the RAC program or influenced by it.

Case 6: Regional approach to adaptation planning by 14 municipalities and rural communities of the Acadian Peninsula adopted (New Brunswick)

The challenge: Coastal flooding, erosion and property damage are long time concerns of residents of the Acadian Peninsula in northeast New Brunswick. Climate change adds to the threat by way of rising seas and increased risk of storm surges. The village of Le Goulet got the earliest start to climate adaptation planning, with options including building a 3.8km sea wall at a cost of \$3.3 million to protect community assets from the worst impacts of storm surges and relocation of the 30 or so households likely to be most affected by storm surges. Across the Province, demands to address infrastructure deficits exceed funds available and, in economically-depressed communities, the incentive to attract investors and accrue property taxes can outweigh the option of putting in place development restrictions. Communities in the Acadian Peninsula face tough choices and cannot afford specialists and land-use planners to help with climate adaptation.

Achievements during the RAC: Understanding of coastal flooding and erosion scenarios and related implications for infrastructure and land use grew between 2010 and 2012 with the *Acadian Peninsula Coastal Erosion and Sea Level Rise Project*. Using a high-resolution digital model of the land surface, this project modelled future sea level rise, storm surges and coastline advance and retreat to 2100 and developed a database of infrastructure at risk according to various flooding and erosion scenarios for three municipalities, Le Goulet, Shippagan and Bas-Caraquet. Consultants (R.J. Daigle Enviro) and university researchers from the Université de Moncton developed the scenarios and analysis of infrastructure. Using these detailed technical resources, technical staff from the Coastal Zones Research Institute and the Commission d'aménagement de la Péninsule acadienne guided citizen focus groups through a four-part exercise resulting in specific recommendations on zoning, protective structures, emergency planning and others, to their respective municipal councils. The provincial database containing coastal and climate information has tripled, *"to a large extent based on the information generated by the activities under the RAC."*

Status today: In March 2014, the Forum of Mayors of the Acadian Peninsula signed a five-year agreement with the Coastal Zones Research Institute to adopt a regional approach to adaptation planning on the Peninsula. Although it lacks political or administrative authority, the Forum is a venue for mayors to discuss issues of regional importance. The fourteen municipalities engaged in this Forum are part of one same Regional Service Commission (#4), which, among other shared services, delivers regional land use and emergency planning to communities. Since signing the memorandum of understanding, the Coastal Zones Research Institute has supported 27 community needs assessments and two feasibility studies - one for a relocation strategy for a high-risk coastal community and the other one on sand dune restoration as a buffer from storm surge flooding. Plans for 2016 include a cost-benefit analysis of different types of adaptation and risk reduction strategies to inform the development of a regional plan for the Peninsula.

RAC contribution: The Acadian Peninsula Coastal Erosion and Sea Level Rise Project was part of the Atlantic RAC's program of work. *"The inundation mapping and vulnerability assessment work and its intersection with infrastructure, was the basis for a lot of the work going forward in the Acadian Peninsula".*⁹ Additionally, through the Atlantic RAC's initial funding to generate ideas and interest in climate change adaptation, local researchers and grassroots organizations in the Peninsula are now better positioned to compete for project dollars from the Province's Environmental Trust Fund (ETF). Five climate change adaptation projects in the Towns of Tracadie-Sheila, Le Goulet, Ste-Marie-St-Raphaël plus one with a regional scope received \$230,000 in total funding awards in 2014. Projects include restoring sand dunes and developing planning tools to adapt to flood and erosion risks worsened by climate change. The partnership between the Forum and Coastal Zones Research Institute might not have happened in the absence of the RAC program since participation in the RAC-funded project equipped to respond to the Forum's request for technical assistance.

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<http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/ETF Awards.pdf>

Case 7: Capacity to manage flood risks in British Columbia's Lower Mainland and protect communities along the Fraser River and coast strengthened (British Columbia)

The challenge: Encompassing Greater Vancouver and the Fraser Valley, British Columbia's Lower Mainland, is home to just over 2.5 million people, supports diverse wildlife and salmon populations, grows over half of the province's agricultural output in dollar terms, and is a major tourism destination and transportation corridor. About 220,000 residents are at or below current sea levels and protected by extensive diking systems.¹⁰ Major flood events of a regional scale have not occurred since 1948; flood hazards are changing, however. Combined with natural processes and choices in land use, sea level rise, storm surges and more intense rainfall brought on by climate change are likely to make flooding more frequent and intense than it is today. Further, much of the flood protection infrastructure in place does not meet the province's current design standards. Since legislative changes in 2003, local governments have gained authority to approve development of subdivisions on the floodplain as well as issue flood-related bylaws and so are responsible for taking action to minimize exposure to damage in flood-prone areas.

Achievements during the RAC: Understanding of sea-level rise and implications for flood protection grew between 2011 and 2013 with the publication and dissemination of a series of technical studies under the BC RAC:

- Updated provincial guidelines for sea dike design and coastal flood hazard land management to address climate change factors in coastal waters of BC. Included was a recommended sea-level rise curve to use as policy in BC (2011).

- A standardized methodology to generate floodplain maps that account for sea level rise for coastal communities (2011).
- Guidance for professionals undertaking flood assessments, including the need to account for climate change and land use changes (2012).
- A costing assessment of upgrading 250 km of diked shorelines and low-lying areas of Metro Vancouver to a one metre rise in sea levels to 2100, from 2000 levels (2012).
- A primer to help coastal managers identify, evaluate and compare options for adapting to the impacts of sea level rise and related coastal hazards, including the use of green infrastructure (2013).

Status today: In 2014, 41 partner organizations, including 25 local governments, provincial ministries, a federal department, six owners of major transportation infrastructure and five other organizations, set out to collaboratively fill knowledge gaps and develop a blue print to adapt to catastrophic river and coastal flooding in British Columbia's Lower Mainland. Interest in developing a Lower Mainland Flood Management Strategy was partly in reaction to the 2012 study on the Cost of Adaptation – Sea dikes and Alternative Strategies. This study pegged the costs of adapting shorelines and low-lying areas in twelve municipalities to a one-metre rise in sea levels at \$9.5 billion (including seismic upgrades).

The expected impact of the regional approach to flood management includes cost savings for local governments by pooling resources to fill information gaps. It also includes the avoided costs of loss and damage from flooding. Work to estimate these potential economic impacts that could be avoided or reduced by structural and non-structural options is underway, but previous analysis suggests the avoided costs could be substantial. For example, the City of Chilliwack's 2009 flood risk assessment found that damage and loss from a dike-breach scenario exceeded \$1 billion.

RAC contribution: The technical studies funded through the BC RAC were influential. In particular, the potential size of the investment highlighted in the sea-dike costing study triggered several reactions. For example, the City of Vancouver, City of Surrey, Richmond and Delta undertook their own flood vulnerability studies. The City of Vancouver amended their flood construction level. Fraser Basin Council's Joint Program Committee for Integrated Flood Hazard Management initiated a consultation process on a regional approach to prepare for catastrophic floods, which resulted in the Lower Mainland's Flood Management Strategy. Without the RAC's \$300,000 contribution, the Province's Flood Safety Section in the Ministry of Forests, Lands and Natural Resource Operations would not have been able to complete the suite of technical studies mentioned above. In the RAC's absence, local governments and major infrastructure owners and operators might have enhanced engagement on adaptation, but not as quickly and likely focused on their own narrow interests.

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4. What does that say about adaptation

This chapter discusses findings from the research on the RAC program's impact with applicability to other situations in Canada. Because our research focused on some of the more visible achievements in adaptation, while aiming to show a range of regional examples, these are observations, not hard and fast conclusions.

It's clear that many more organizations are taking action to adapt to the impacts of climate change today than was the case prior to 2009. Levels of engagement and activity are not uniquely attributable to the RAC program, itself a product of over ten years of federal investment. Nevertheless, many lines of

"The Regional Adaptation Collaborative has had a tremendous impact as an accelerator. People would have gotten around to thinking about sea level rise and climate change – but we are at least 5-10 years ahead of where we would have been."
(Thomas White, British Columbia Ministry of Environment)

evidence highlight the RAC program's contribution. Despite a short timeframe of implementation, the RAC program generated hundreds of valued knowledge products and increased levels of understanding of and

engagement on climate adaptation across all types of stakeholders. As was Natural Resources Canada's intention at the outset, the RAC Program did, indeed, accelerate adaptation initiatives across the country and nurture relationships to tackle adaptation problems in the long term. Although the impact of the RAC program is not measurable with aggregate numbers, stakeholder perspectives shed light on the kinds of impacts the RACs are contributing to (see Box 2).

Box 2:

Organizations involved with the RAC program are not tracking outcomes or impact related to RAC activities systematically, for the most part. Tracing cause and effect is difficult for this and other reasons. To capture the perceived impact of the RAC program we asked stakeholders to discuss the significance of their region's achievements. Their responses included the following economic and social impacts:

- Improved economies of scale and economic efficiencies
- Improved ability to mobilize funding
- Avoided costs / losses
- Strengthened networks of engagement
- Increased public awareness of climate change-related flood risks
- Increased provincial leadership and capacity
- Increased municipal preparedness
- Improved management of the natural and built environment

It's not surprising that many impacts are of a social nature. The RAC program aimed to build capacity to mainstream climate adaptation across Canada's regions and results related to this, at least in the timeframes of this research, are about interactions among people. The RAC program explicitly did not fund implementation of adaptation at an operational level and so results related to reduced sensitivity or exposure of people and assets should not be expected to be evident at this time.

Source: Eyzaguirre and Boardley (2015).

Adaptation implementation remains in early stages, though. Our research supports the conclusion in Warren and Lemmen (2014) on the overall status of adaptation implementation in Canada. Much of the follow-on work to the RACs aims to build capacity to adapt (e.g., generating specific information for decision-making, communications, dissemination, planning initiatives). Tangible examples of action, which we interpret as direct action to reduce exposure or sensitivity to future climate change effects, exist but they are few. They include cases where credible risk or economic costing information exists and significant development dollars are being spent. Our small set of data suggest that uptake of future climate information in risk assessments and other quantitative studies is not necessarily changing what

decisions are made but builds confidence in the robustness of those decisions. In this context, tracking adaptation becomes very difficult.

Four findings of potential applicability to future adaptation programs are worth sharing. None are particularly novel but they add to the evidence base of how and why climate adaptation is unfolding in Canada.

Finding #1: When it comes to adaptation, factors that enable social change include outreach, networking and pre-relationships; policy alignment; local champions; loss and damage; and access to experts and complementary information resources. Dedicated efforts to promote the use of good practices and to advance ideas from concept to reality, as well as pre-existing relationships and trust can boost participation rates in planning processes and the spread information through networks. The RAC program's focus on funding policy-relevant studies and other information resources attached adaptation to issues that mattered regionally and locally (e.g., source water protection, flood risk management, local development), increasing the odds of adaptation taking hold. The key role of champions or institutional entrepreneurs (individuals or organizations) often arises in discussions on enablers to adaptation. In this case, they included local politicians, a provincial senior planner with ideas and follow through to support municipal climate adaptation planning province-wide and a large conservation authority that exerted leadership to connect water and climate science to source protection practitioners. Direct local experience with flooding and storms, as well as regional exposure heightened risk awareness and public interest in at least two of the cases documented. Technical expertise, scientific outputs and other technical resources are inputs to vulnerability and risk assessments that inform decisions. The RAC program helped build these competencies and resources and also benefitted from results of previous work done by others.

Finding #2: Although some changes can happen quickly when the right conditions are in place, adaptation is a long-term process with many forms. The cases we examined included a few examples of changes in policy, plans or practices that occurred quickly (Newfoundland and Labrador's changes in flood plain management policy and related updates to flood risk mapping; local government reactions to coastal flooding and sea-level rise studies in British Columbia). We also documented cases where change occurred incrementally; the sequence of events dating back to five or more years. Our dataset is too small to draw conclusions on the most effective ways of enabling adaptation efficiently. However, it's sufficient to illustrate the range of ways of taking adaptation to scale. They include: direct action by government; mandatory assessment and reporting; informal regional collaborations made possible by political champions and access to local researchers; collaboration driven by shared interests at the watershed level; and, certification schemes to spread good practice. Timelines, issues of scale and the many types of "solutions" available make tracking adaptation and determining a program's impact that much more difficult.

Finding #3: To be effective in promoting engagement and uptake of climate change information and adaptation guidance it's important to understand the incentives and disincentives faced by the target audience. Reasons for deferring action on adaptation are increasingly documented. Whether promoting voluntary action or requiring organizations to consider climate change risks and opportunities in decision-making, addressing disincentives for action is critical. Funding, although important, is rarely the only impediment to action. A few examples of supports to action are as follows:

- The market for climate information and adaptation services is growing in Canada but under-resourced and geographically-remote organizations are unable to tap into it. To increase access to technical experts and local information on future coastal flooding, erosion and infrastructure risk

among small, isolated communities of the Acadian Peninsula, the Forum of Mayors in the region struck a formal partnership with a local research institute. Lower cost consultants (e.g., retired federal scientists) and academic institutions help fill a support gap for under-resourced and remote communities.

- Upon making it mandatory for municipalities to develop and implement adaptation plans, the province of Nova Scotia changed its framework agreement with the federal government so that gas tax funding could cover the cost of studies and facilitation needed to prepare the adaptation plans. Aware of capacity limitations, particularly in small municipalities, and gaps in information and knowledge, the province developed, tested and distributed a guidebook and other information resources so municipalities could readily comply with the climate change action planning process. Nova Scotia's decision to link mandatory municipal adaptation planning with financial incentives and guidance has worked well in practice.
- In British Columbia, a series of flood-related projects, starting with local scenarios of sea-level rise to a sea-dike costing study for Metro Vancouver, raised awareness within the professional community, local governments on the BC coast and the general public on the risks and vulnerabilities of climate change and rising seas. Local governments took action shortly after the Province issued these studies; including undertaking their own flood vulnerability studies and making policy changes on flood construction levels. Public awareness, credible information on risks, costs and response options and good timing (major development approvals) were all factors shaping local action.
- Centralized future climate data, guidelines, in person training, e-learning modules, and inventories of measures to reduce risks to drinking water are helping communities in Ontario to comply with the province's requirement to integrate information on current and future hydrological impacts of climate change in watershed plans.

Finding #4: Collaboration is important and useful but only if it's based on tackling a shared problem. Natural Resources Canada's currently leads "Enhancing Competitiveness in a Changing Climate" (2011-16) through the Adaptation Platform.¹¹ It builds on results of the RAC program and embraces collaboration as an approach to advance adaptation. Naturally, comparisons on levels of engagement between the RAC program and the Adaptation Platform arose in our research with stakeholders. These only represent three independent views on the issue, but they warrant further exploration. Their observations were that engagement levels, at least regionally, were higher during the RAC program than they are at present. The regional scale invites closer connections and informal interactions that cultivate trust and understanding. In contrast, working thematically on national issues is closer to information-sharing (or joint ventures) than true collaboration.

5. Conclusions

The climate is changing and will continue to affect Canadian communities and sectors. Warmer temperatures, shifting precipitation patterns, rising sea-levels, combined with changes in exposure to natural hazards, are risks to the integrity of infrastructure and assets that communities rely on, can threaten water availability and quality and affect our health.

Delivered over three years (2007 – 2011), Natural Resources Canada’s Regional Adaptation Collaborative (RAC) program set out to influence regional and local adaptation decision-making, planning and action. The program created an opportunity for regions to tackle self-identified adaptation priorities while generating collaborative networks. The RACs program demonstrated that important achievements can happen during a three-year program, particularly in the areas of awareness and engagement (organizations mobilizing their own resources to better understand problems and solutions). Three years was insufficient time to see widespread progress in uptake of climate change information for specific decisions or tangible impact on the lives of Canadians. These latter kinds of results are occurring now. The RAC program was a catalyst for adaptation action in Canada. The dedicated funding and other program features increased engagement and action on adaptation, by some accounts, five years earlier than would have happened otherwise.

Learning from innovative programs that address complex issues such as the RAC defies standard practices in monitoring and evaluation. Program benefits are difficult to characterize with aggregate, easy-to-understand metrics. The lag time between analysis, planning and action complicates attribution between program inputs and results down the road. Systematic approaches and techniques to help harness information on program results applicable to even the most complex and dynamic settings for climate adaptation, and learn from implementation experience, are available. Their use can support future adaptation programs discover not just what was achieved and who benefitted but also how and why.

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Endnotes

¹ Further information on these knowledge products is available at <https://www.nrcan.gc.ca/environnement/impacts-adaptation/initiatives-regionales/10632>

² For further information on the outcome harvest, see Eyzaguirre, J. and Boardley, S. 2015. Regional Adaptation Collaborative (RAC) Program Impacts Project. Research Report. Prepared by ESSA Technologies Ltd. April, 2015. This report is available on demand. Please inquire at Adaptation@NRCan-RNCan.gc.ca

³ <https://www.nrcan.gc.ca/environment/impacts-adaptation/regional-initiatives/10631>

⁴ Municipalities, communities, provincial departments and agencies comprise 60 percent of the sample.

⁵ One RAC supplied overall scores and observations for participants in its four activity areas (British Columbia), based on survey responses from project leads. On a thematic basis, the greatest gains in engagement were in flood protection and flood plain management (Fraser Basin Council and BC Ministry of Environment, 2012).

⁶ Flood risk maps have been updated for the Town of Stephenville, Stephenville Crossing and Black Duck Siding (2012), Shearstown / Bay Roberts area (2012), Logy Bay–Middle Cove–Outer Cove (2012), Goulds and Petty Harbour (2013) and Corner Brook Stream and Petries Brook (2013)

⁷ for Portugal Cove and St Phillips.

⁸ <http://www.env.gov.nl.ca/env/waterres/flooding/hurricane.html>

⁹ Telephone interview, Jeff Hoyt, Paul Jordan and Colette Lemieux (Department of Environment and Local Government), January 8, 2015.

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