

PRINCE EDWARD ISLAND **Climate Change Adaptation**

**RECOMMENDATIONS REPORT
—SUMMARY**



**University of Prince Edward Island
Climate Research Lab**



**UNIVERSITY
of Prince Edward
ISLAND**



Acknowledgements

This work was supported by the Government of Prince Edward Island Department of Communities, Land and Environment.

This Report was developed by Stephanie Arnold of the University of Prince Edward Island Climate Research Lab with the input of many individuals and organizations. We would like to thank them for their expertise and time. Please note that their participation does not imply their endorsement of this Report and the information presented does not necessarily reflect the views of the participants or the organizations they represent.

Dr. Bishnu Acharya	Melanie Griffin	Ken Mayhew	Corinne Rowsell
Peter Boswall	Dr. Daryl Guignon	Dan McAskill	Peter Rukavina
Dr. Laura Braden	Dr. Helen Gurney-Smith	Kim McBurney	Dawn Runighan
Jessica Brown	Dr. Matthew Hall	Matthew McCarville	Dr. Marina Silva-Opps
Darren Chaisson	Janice Harper	Dr. Lyndsay Moffat	Brenda Simmons
John Cuniffe	Scott Harper	Kevin Moufler	Ritchie Simpson
Rosemary Curley	Amber Jadis	Tanya Mullally	Shirley Smedley Jay
Andrew Daggett	Don Jardine	Samantha Murphy	Ira Smith
Alex Dalziel	Jim Jenkins	Tom O'Handley	Kyra Stiles
John Dewey	Dr. Yefang Jiang	Angus Orford	Dr. Andrew Swingler
Greg Donald	Bill Kendrick	Hope Parnham	Barry Thompson
Brian Dunn	Pooja Kumar	Dr. Heather Pringle	Brian Thompson
Darrell Evans	Evan MacDonald	Mike Proud	Julie Vasseur
Dr. Aitazaz Farooque	James MacDonald	Betty Pryor	Jonathan Veinot
Kelley Farrar	Rosanne MacFarlane	Aaron Ramsay	Ron Waite
Shaman Ferraro	Bob MacGregor	Matt Ramsay	Peter Warris
Mary Finch	Heather MacLeod	Bruce Raymond	
Alex Forbes	Shaun MacNeill	Brad Romaniuk	
Bill Glen	John MacQuarrie	John Rowe	

Recommended citation:

Arnold, S. and A. Fenech. (2017, October). Prince Edward Island Climate Change Adaptation Recommendations Report. University of Prince Edward Island Climate Lab. Charlottetown, Canada. Report submitted to the Department of Communities, Land and Environment, Government of Prince Edward Island, 25p.

Photo Credits:

All photographs in this publication were used with permission from: Don Jardine and Government of Prince Edward Island.

©2017 University of Prince Edward Island
ISBN 978-1-988692-14-2

COVER PHOTOS: Top left photo: Government of PEI; Three remaining photos: Don Jardine (all used with permission)
DESIGNED BY: Graphically Speaking PEI (www.gspeak.ca)



October 31, 2017

Dear Islanders,

The UPEI Climate Research Lab was commissioned by the Government of Prince Edward Island to develop the *Prince Edward Island Climate Change Adaptation Recommendations Report*. This report studies the impacts of climate change on ten sectors across the Island and recommends a total of 97 adaptation actions to address those impacts. The sectors are: Agriculture, Education and Outreach, Energy, Fish and Aquaculture, Forestry and Biodiversity, Insurance, Properties and Infrastructure, Public Health and Safety, Tourism, and Water. Please refer to the main report for an in-depth analysis and full list of references.

The recommended adaptation actions were developed in five stages. First, the public and sector stakeholders were consulted on their concerns regarding climate change and adaptation. Second, anticipated climate change impacts and adaptation approaches used in other jurisdictions regionally, nationally and internationally were reviewed to prepare a discussion document for each sector. Third, roundtable discussions with sector stakeholders were held to review the relevance and practicality of the proposed approaches and to develop additional recommendations. Fourth, the sectors' input was incorporated in the discussion documents, which form the sector chapters of the draft report. Last, the public's input on the draft report was sought via online submissions and consultation meetings and incorporated in this final report.

Throughout this process, the focus was on suggesting adaptation actions that are science-based, relevant to the needs of the Island, and practical to implement. The needs of the Island will change as the climate and the environment, society, and economy of the Island change. Therefore, the intention was to make the recommendations as robust as possible without being overly prescriptive. The leads will need to gauge the state and needs of the Island and the data available at the time the decisions are made and consult with collaborators to determine the best way forward.

Climate change is a shared problem that requires shared responsibility from everyone – individuals, businesses, research institutions, non-governmental organizations, sectors, different levels of government, etc. Planned adaptation takes time and the work to develop an informed, forward-looking, comprehensive adaptation strategy must begin immediately. Concerted effort from every Islander will be required for Prince Edward Island to successfully minimize the impacts that climate change will invariably bring.

Sincerely,

Dr. Adam Fenech
Director, Climate Research Lab
University of Prince Edward Island
upei.ca/climate

1 INTRODUCTION

WHAT IS CLIMATE CHANGE?

Climate is not weather. Weather is short-term changes (hours, days) in temperature, cloud cover, precipitation (e.g., rain, snow, sleet), humidity or wind at the local or regional scale. Climate, on the other hand, is long-term changes (months, seasons, years, decades) in these variables at the global, regional or local scale. Changes in our climate are often so small as to take decades, centuries, or millennia to be observable. These small changes in climate, however, can have significant impacts on the environment, society, and economy of Prince Edward Island.

WHAT IS CLIMATE CHANGE ADAPTATION?

There are two ways to address climate change: mitigation (reducing greenhouse gas emissions to slow down climate change) and adaptation (preparing for and dealing with unavoidable climate change impacts) (see Figure 1). *This summary report focuses solely on climate change adaptation.*

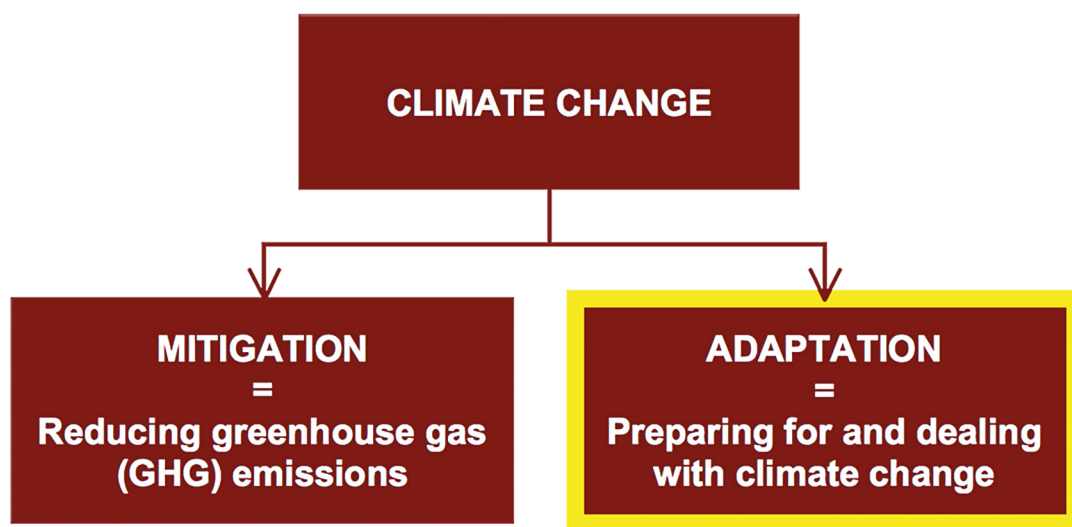


Figure 1: Climate change mitigation versus climate change adaptation.

Climate change adaptation is necessary for the environment, society, and economy of Prince Edward Island to survive and thrive under a changing climate. Unlike coping, which is mainly reacting to immediate damages as they occur, adaptation requires developing a planned, informed, forward-looking, and thorough approach. For adaptation to be effective, everyone—individuals, businesses, non-governmental organizations, sectors, research institutions, different levels of governments, etc.—must work together. Joint action has the added benefit of combining resources, experiences, perspectives, and expertise from different groups to tackle a shared problem. Therefore, the recommended adaptation actions are the shared responsibilities of different groups, with many of them requiring a collaborative effort from two or more groups.

2 PRINCE EDWARD ISLAND'S CHANGING CLIMATE

HOW WILL CLIMATE CHANGE AFFECT PRINCE EDWARD ISLAND?

- Warmer temperatures will lead to more frost free days, milder winter seasons, reduced snow cover, fewer extreme cold days ($<-20^{\circ}\text{C}$) and more extreme hot days ($>27.5^{\circ}\text{C}$).
- Warmer air temperatures could also deteriorate air quality, even if emission levels stay the same.
- Warmer water temperatures in the Gulf of St. Lawrence will reduce sea-ice cover.
- A decrease in precipitation from today's normal is expected in the medium-term, making it drier and more susceptible to drought conditions.
- Precipitation events will occur less frequently but each event will be more intense.
- Extreme weather events such as storms are expected to be more intense and frequent.
- Global mean sea-level could rise in the range of 2.0 to 2.7 m by 2100, worsening coastal flooding and coastal erosion.

These changes are expected to benefit and challenge various parts of the Island's environment, society, and economy differently. The impacts of climate change were studied for each of the ten sectors below and a total of 97 adaptation actions were recommended. The sectors are:

- Agriculture
- Education
- Energy
- Fish and Aquaculture
- Forestry and Biodiversity
- Insurance
- Properties and Infrastructure
- Public Health and safety
- Tourism
- Water

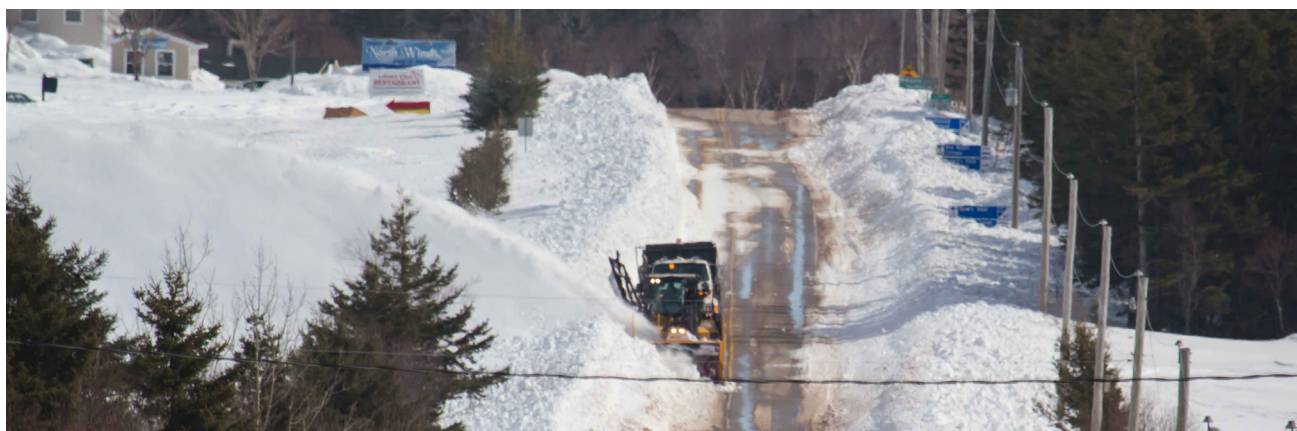


PHOTO CREDIT: DON JARDINE

3 AGRICULTURE SECTOR

Warmer temperatures could benefit the sector by:

- enabling double harvest for short season crops (e.g., soy beans followed by peas);
- increasing yields for longer season crops;
- supporting planting of new and possibly more profitable crops that require more heat units (e.g., pulses such as lentils and chickpeas);
- increasing winter survival of pollinators and encouraging build-up of colonies in the spring;
- providing more opportunities for livestock to graze and be fattened outdoors;
- reducing the heating needs for livestock;
- lowering feed requirements; and,
- increasing survival rate of young.

Warmer temperatures, changes in precipitation patterns, more intense and frequent extreme weather events, and rising sea levels could challenge the sector by:

- introducing new pests and pathogens and increasing the severity and frequency of pest and pathogen infestations;
- limiting the breadth and quality of diet for pollinators;
- increasing water stress in crops;
- increasing winter bud kill;
- increasing the growth of weeds;
- increasing the winter survival of “volunteers” (potatoes that remain in the field after harvest), thereby increasing the risk of disease to neighbouring fields;
- decreasing milk production, beef cattle weight gain, and reproduction in the dairy industry;
- increasing water requirement for crops;
- increasing bank erosion and runoff; and,
- decreasing the availability of pasture.

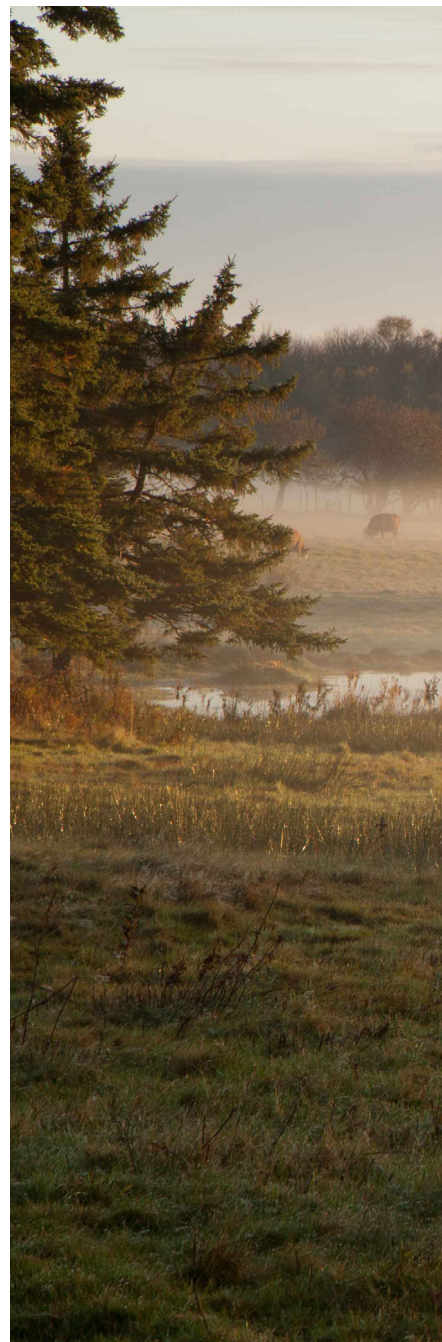


PHOTO CREDIT: DON JARDINE

Table 3: List of all adaptation actions recommended adaptation actions for the Agriculture sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
1. Commission a comprehensive study of crop opportunities and challenges under warming conditions over the next thirty years.	Leads: Sector, Provincial Government Collaborators: Experts	Fill knowledge gaps	Short-term (0 to 5 years)
2. Build an understanding of water requirements, anticipated drought conditions, and common methods used to address them.	Leads: Sector, Provincial Government Collaborators: Experts, Other sectors	Fill knowledge gaps; Reduce non-climatic factors	Short-term (0 to 5 years)
3. Reduce the amount of contaminated runoff reaching water bodies by managing stormwater onsite and reducing the amount of inputs used.	Leads: Sector, Farmers Collaborators: Experts, Other sectors	Increase resilience	Ongoing
4. Conduct on-farm demonstrations of best practices to showcase effective adaptation measures and provide producers with practical guidance.	Lead: Sector Collaborators: Farmers	Fill knowledge gaps; Engage in outreach	Medium-term (6 to 10 years)
5. Add and maintain 100 climate stations across the Island to improve the collection of climate data, including soil temperature, to develop a baseline for the analysis of climate trends at higher resolutions	Lead: Sector Collaborators: Farmers, Experts	Fill knowledge gaps; Increase collaboration	Short-term (0 to 5 years); Ongoing maintenance
6. Integrate climate change considerations in the agricultural insurance framework (e.g., offer insurance for new crop varieties expected to thrive and adjust the framework for exiting crops anticipated to struggle under a changing climate).	Lead: Agriculture Insurance Corporation Collaborators: Experts	Fill knowledge gaps; Mainstreaming climate change	Ongoing
7. Commission a comprehensive study of diseases and pathogens that could be introduced to the Island, the types of livestock at risk, and the common methods used in their management.	Leads: Sector, Provincial Government Collaborators: Experts	Fill knowledge gaps; Reduce non-climatic factors	Medium-term (6 to 10 years)



PHOTO CREDIT: GOVERNMENT OF PEI



PHOTO CREDIT: GOVERNMENT OF PEI

4 EDUCATION AND OUTREACH SECTOR

The multifaceted and complex nature of climate change gives students an opportunity to gain interdisciplinary experience and knowledge in new subject areas.

On the other hand, the nature of climate change and its spatial and temporal scales could challenge the sector by:

- increasing exposure among teachers to this relatively new field;
- finding resources to integrate climate change into the school curriculum;
- supporting holistic learning across individual subject areas;
- increasing scientific literacy;
- requiring improved communications from scientists;
- balancing medium- to long-term impacts of climate change with day-to-day needs; and,
- inspiring action.



PHOTO CREDIT: DON JARDINE

Table 4: List of all adaptation actions recommended adaptation actions for the Education and Outreach sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
8. Integrate climate change in the curriculum for lower grades where interdisciplinary and inquiry-based learning is already taking place (e.g., identify resources and activities).	Lead: Provincial Government Collaborators: Experts	Address knowledge gaps; Promote climate change mainstreaming	Short-term (0 to 5 years)
9. Integrate climate change in the curriculum for higher grades, focusing on increasing the skills, competencies, and knowledge of students across all subject areas.	Lead: Provincial Government Collaborators: Experts	Address knowledge gaps; Promote climate change mainstreaming	Short-term (0 to 5 years)
10. Support teachers by implementing small-scale initiatives to introduce climate change to the students in the near-term (e.g., host full-day workshop during PD days, provide inquiry-based activities to teachers).	Lead: Provincial Government Collaborators: Experts, Informal education providers	Address knowledge gaps; Promote climate change mainstreaming; Increase collaboration	Short-term (0 to 5 years)
11. Identify ways to increase experiential learning without leaving the school grounds (e.g. design and build a rain garden to manage stormwater onsite).	Lead: Provincial Government, Public Schools Branch, French Language School Board, Private Schools Collaborators: Experts, Home and School Federation	Address knowledge gaps; Engage in outreach	Ongoing
12. Increase exposure to climate change, interdisciplinary-learning, and inquiry-based learning at the post-secondary level.	Lead: Post-secondary institutions Collaborators: Experts	Address knowledge gaps	Short- to medium-term (0 to 10 years)
13. Increase awareness of opportunities to learn outside of the classroom.	Leads: Informal education providers, Provincial Government Collaborators: Parents and guardians	Engage in Outreach; Increase collaboration	Short-term (0 to 5 years)
14. Develop new informal education programming to expand the students' knowledge.	Leads: Informal education providers Collaborators: Parents	Address knowledge gaps; Engage in outreach	Short-term (0 to 5 years)
15. Place more emphasis on inspiring action and less on improving understanding of scientific knowledge when engaging the public.	Leads: All levels of government, All sectors	Engage in outreach	Ongoing
16. Encourage knowledgeable provincial government staff to communicate with colleagues (e.g., lunch and learns) and citizens (e.g., school workshops, roundtable discussions) about their areas of expertise.	Lead: Provincial Government Collaborators: Public	Address knowledge gaps; Engage in outreach	Ongoing
17. Identify different segments of the population (e.g., 'unconcerned and dismissive' versus 'most concerned and motivated') and generate public outreach approaches accordingly.	Leads and collaborators: All levels of government, All sectors	Engage in outreach	Ongoing
18. Create communication networks (e.g., websites, social media, flyers) and provide public forums for information sharing, roundtable discussions with experts, etc. on different themes to enhance public engagement.	Lead: Provincial Government Collaborators: Public, Experts	Engage in outreach	Ongoing
19. Leverage best practices in outreach from other sectors and jurisdictions (e.g., EMO is effective in educating the public of risks).	Leads and collaborators: All levels of government, All sectors	Engage in outreach; Increase collaboration	Ongoing

5 ENERGY SECTOR

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events, and rising sea levels could challenge the sector by:

- causing a shift in the energy mix (e.g., higher reliance on electricity for air conditioning and lower reliance on heating oil for heating);
- increasing electricity demand in the summer;
- putting more energy assets and infrastructure at risk of coastal erosion and flooding;
- damaging wind turbines, power lines, and utility poles; and,
- managing changes in regulations.



PHOTO CREDIT: DON JARDINE

Table 5: List of all adaptation actions recommended adaptation actions for the Energy sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
20. Commission studies to form a foundation for evidence-based adaptation planning (e.g., climate forecasts, vulnerability assessments, cost-benefit analysis).	Leads: Utilities Collaborators: Experts	Fill knowledge gaps; Promote climate change mainstreaming	Short-term (0 to 5 years)
21. Relocate, retrofit, and/or protect critical energy infrastructure and equipment vulnerable to climate change impacts (e.g., move infrastructure located in areas vulnerable to erosion, add guying to utility poles to avoid cascades of falling poles).	Leads: Utilities Collaborators: Experts	Increase resilience	Ongoing
22. Lower energy demand as a complementary approach to addressing peak capacity (e.g., develop an alert system with suggested actions to reduce consumption when system is near peak capacity to avoid rolling brownouts).	Leads: Provincial Government, Utilities Collaborators: Public	Increase resilience; Reduce non-climatic factors; Engage in outreach; Leverage regulation	Short- to medium-term (0 to 10 years)
23. Decentralize, diversify, and develop redundancy in the sector to increase its capacity to cope with hazardous events and avoid large-scale system failures (e.g., solar panels, energy storage equipment, district energy systems).	Leads: Utilities, Provincial Government Collaborators: Public, Businesses, Municipal governments	Increase resilience; Engage in outreach; Address financial concerns	Medium-term (5 to 10 years)
24. Implement policies and regulations to foster climate change adaptation in areas such as design and safety standards, permitting, siting and zoning.	Lead: Provincial Government Collaborators: Utilities, Experts	Increase resilience; Promote climate change mainstreaming; Leverage regulation	Short- to medium-term (0 to 10 years)
25. Integrate climate change impacts into day-to-day operations as well as planning, risk assessment and management, and decision-making processes (e.g., load and demand forecasting, training, investment planning).	Leads: Utilities	Promote climate change mainstreaming	Ongoing
26. Plan new developments with climate change in mind (e.g., make buildings “solar ready”, site new developments in areas with low vulnerability to coastal erosion and flooding).	Leads: Utilities, Businesses, Individuals	Increase resilience; Promote climate change mainstreaming	Ongoing
27. Increase collaboration and communication among sector stakeholders (e.g., share information such as climate risks and best practices).	Leads: Utilities	Increase collaboration	Ongoing



PHOTO CREDIT: DON JARDINE

6 FISH AND AQUACULTURE SECTOR

Warming temperatures could benefit the sector by:

- accelerating the growth rate of some species;
- reducing winter natural mortality; and,
- increasing access to commercial fish species with product centres traditionally located south of Prince Edward Island.

Warming temperatures, changes in precipitation patterns, more intense and frequent extreme weather events, rising sea levels, decreasing sea-ice cover, and ocean acidification could challenge the sector by:

- limiting the growth rate of some species;
- increasing watercourse temperatures above the optimal temperature range and thermal tolerance limit;
- shifting the timing of species' lifecycle stages;
- introducing new invasive species;
- pushing existing commercially important species further north away from the Island;
- increasing the productivity of some parasites;
- reducing the availability of nutrients and dissolved oxygen in near-surface waters;
- making it more difficult for shellfish to develop hard shells;
- jeopardizing the health of fish and shellfish;
- diminishing stream flow thus increasing pollutant loading levels and estuary salinity;
- changing stream persistence and morphology;
- increasing the amounts of sediment and contaminants found in water bodies;
- increasing fish kills and anoxic events;
- damaging equipment and infrastructure.



PHOTO CREDIT: GOVERNMENT OF PEI



PHOTO CREDIT: GOVERNMENT OF PEI



PHOTO CREDIT: DON JARDINE

Table 6: List of all adaptation actions recommended adaptation actions for the Fish and Aquaculture sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
28. Form a foundation for evidence-based adaptation planning by conducting research and collecting data (e.g., create an inventory and map habitats of significant marine species and environmental variables, study effective responses against invasive species).	Leads: Sector, Provincial Government, Federal Government Collaborators: Experts, Watershed groups	Fill knowledge gaps	Short-term (0 to 5 years)
29. Increase the ability of aquatic life to adapt to climate change impacts by reducing non-climatic stressors (e.g., widen the watercourse and wetland buffer zone, reduce runoff, restore coastal habitats).	Leads: Sector, Provincial Government, Federal Government Collaborator: Fishers, Experts, Public	Increase resilience; Reduce non-climatic factors; Engage in outreach	Medium-term (6 to 10 years)
30. Reduce stream water temperatures by reducing solar heating (e.g., increasing canopy cover in riparian zones) and improving water flow (e.g., limiting irrigation during times of high temperatures and low stream flows). Target areas where flow retention times are longer and large heat loads can accumulate in the absence of shade.	Leads: Sector, Provincial Government, Watershed Groups Collaborators: Private land owners, Experts	Increase resilience	Short-term (0 to 5 terms)
31. Increase support to watershed groups via funding for training, data collection and habitat improvement programs (see Recommended Adaptation Actions #27, #28, #29, and #30 and #36).	Leads: Provincial Government, Federal Government, Sector Collaborators: Watershed groups	Increase resilience; Reduce non-climatic factors; Fill knowledge gaps; Increase collaboration	Ongoing
32. Manage risks and adapt to increased variability in the sector via diversification (e.g., diversify livelihoods, decentralize and spread out locations of facilities).	Leads: Fishers, Sector Collaborators: Experts	Increase resilience	Medium-term (6 to 10 years)
33. Invite other jurisdictions to share best practices (e.g., seek ways to cope with green crab, share local methods of transferring mussel seed from an infested area to a new area).	Leads: Fishers, Sector Collaborators: Experts	Increase collaboration	Ongoing
34. Relocate, retrofit, and/or protect existing properties and infrastructure and design new properties and infrastructure to reduce flooding and erosion vulnerabilities.	Leads: Infrastructure owners Collaborators: Experts	Increase resilience	Medium- to long-term (6+ years)
35. Facilitate adaptation and harmonize adaptation objectives and approaches among different stakeholders that are reliant on the same resource by using regulatory measures (e.g., prioritize sustainability of the industry and the environment over short-term profit and yield).	Leads: Provincial Government, Federal Government Collaborators: Fishers, Sectors, Other sectors	Leverage regulation; Promote climate change mainstreaming; Increase collaboration	Short- to medium-term (0 to 10 years)
36. Identify and address gaps in tools, guidelines, training, and skills (e.g., habitat restoration, vulnerability and risk assessments, training materials).	Leads: Sector, Provincial Government	Increase resilience; Promote climate change mainstreaming	Ongoing
37. Limit business losses caused by climatic events by employing financial mechanisms such as insurance and other innovative instruments (e.g., create a co-operative that offers insurance against production losses).	Leads: Sector, Provincial Government Collaborators: Fishers, Experts	Address financial concerns; Increase collaboration	Medium-term (6 to 10 years)

7 FORESTRY AND BIODIVERSITY SECTOR

Warming temperatures could benefit the sector by:

- increasing forest productivity;
- lengthening the growing season;
- adding growing degree days for some hardwood species; and,
- expanding suitable habitat for other species.

Warming temperatures, changing precipitation patterns, and more intense and frequent extreme weather events could challenge the sector by:

- shifting the suitable range of cold-hard species further north away from the Island;
- eliminating habitat at stopover sites for migratory birds;
- increasing the severity of diseases and pest outbreaks;
- decoupling important ecological relationships;
- increasing frost exposure;
- shortening winter soil water recharge period;
- intensifying water stress;
- increasing the risk of forest fire; and,
- flooding and killing trees.



PHOTO CREDIT: GOVERNMENT OF PEI

Table 7: List of all adaptation actions recommended adaptation actions for the Forestry and Biodiversity sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
38. Form a foundation for evidence-based adaptation planning by conducting research and collecting data (e.g., forecast precipitation patterns, determine current state of biodiversity).	Leads: Sector, Provincial Government Collaborators: Environmental groups, Experts	Fill knowledge gaps; Increase collaboration	Short-term (0 to 5 years)
39. Keep forests healthy and productive and maintain biodiversity by reducing non-climatic stressors (e.g., reduce pollution, promote development of ground cover).	Leads: Sector, Provincial Government, Woodlot owners Collaborators: Environmental groups, Municipal governments	Reduce non-climatic stressors; Increase resilience	Short- to medium-term (0 to 10 years)
40. Increase natural connectivity among natural areas (e.g., preserve core habitat areas, increase hedgerows).	Lead: Provincial Government Collaborators: Sectors, Municipal governments, Public, Environmental groups	Increase resilience	Medium- to long-term (6+ years)
41. Increase natural areas to sustain enough suitable habitats for diverse and healthy populations, particularly where natural connectivity is lacking, biodiversity is under threat, and future species may thrive (e.g., restore abandoned agricultural fields, sell tree saplings as school fundraisers).	Leads: Provincial Government, Environmental groups Collaborators: Public	Increase resilience	Medium- to long-term (6+ years)
42. Promote needed adaptation where existing incentive is lacking by using regulatory frameworks (e.g., widen the watercourse and wetland buffer zone). Increase compliance with added enforcement efforts and stricter penalties.	Lead: Provincial Government Collaborators: Sectors	Leverage regulation; Reduce non-climatic factors	Short-term (0 to 5 years)
43. Demonstrate the importance of forestry and biodiversity conservation and enhancement initiatives by assigning an economic value to the ecosystem services they provide (e.g., pollination and carbon storage services). These benefits and their economic values should be highlighted when generating support for adaptation actions in the sector.	Lead: Provincial Government Collaborators: Experts	Address financial concerns	Short-term (0 to 5 years)
44. Generate additional support for adaptation actions by engaging in outreach (e.g., frame the benefits of forests and biodiversity in ways that resonate with the public).	Lead: Provincial Government Collaborators: Sector, Environmental groups, Experts	Engage in outreach; Increase collaboration; Fill knowledge gaps	Short-term (0 to 5 years)
45. Improve the efficiency and effectiveness of adaptation activities by connecting with other environmental groups, community groups, and sectors (e.g., coordinated habitat restoration for Fish and Aquaculture and Forestry and Biodiversity sectors).	Leads: Environmental groups, Sectors Collaborators: Provincial Government, Experts	Increase collaboration	Ongoing
46. Collaborate with local Indigenous groups to incorporate Traditional Ecological Knowledge.	Lead: Sector Collaborators: Indigenous groups, Provincial Government, Environmental groups	Increase collaboration; Fill knowledge gap	Short-term (0 to 5 years)
47. Increase capacity within the government (e.g., dedicate more staff to outreach)	Lead: Provincial Government	Fill knowledge gap; Engage in outreach	Short- to medium-term (0 to 10 years)
48. Develop a coordinated approach to implement the Recommended Adaptation Actions for the sector (#38 to #47) (e.g., stakeholder meetings, onsite demonstrations).	Leads: Provincial Government, Sector / Collaborators: Woodlot owners, Environmental groups, Outreach groups	Increase collaboration; Engage in outreach; Fill knowledge gaps	Ongoing

8 INSURANCE SECTOR

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events and rising sea levels could challenge the sector by:

- increasing the number and severity of inland and coastal flooding events;
- increasing the likelihood of car accidents; and,
- increasing demand for new insurance products.



PHOTO CREDIT: DON JARDINE

Table 8: List of all adaptation actions recommended adaptation actions for the Insurance sector.

Recommended Adaptation Actions	Responsibility	Themes	Suggested Timeline
49. Gather required data to address concerns of risk exposure (e.g., create and update flood risk maps).	Leads: Sector, Insurers Collaborators: Experts, Federal Government	Fill knowledge gaps; Increase collaboration	Short-term (0 to 5 years)
50. Improve public understanding on the different types of flooding, levels of risk, types of insurance coverage available, and circumstances under which government financial aid is available.	Leads: Sector, Insurers	Engage in outreach	Ongoing
51. Look for opportunities to develop new insurance products (e.g., insure against coastal flooding).	Lead: Sector Collaborators: Insurers, Experts	Fill knowledge gaps; Increase collaboration	Ongoing
52. Promote adaptation actions, especially where insurance coverage is limited or unavailable (e.g., use visualization techniques to inspire adaptation, encourage relocation from areas of high flood risk)	Leads: Sector, All levels of government Collaborators: Other sectors, Experts	Engage in outreach	Short- to medium-term (0 to 10 years)



PHOTO CREDIT: DON JARDINE

9 PROPERTIES AND INFRASTRUCTURE

Warming temperatures could benefit the sector by requiring less road salt and extending the construction season.

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events and rising sea levels could challenge the sector by:

- increasing damage from gully erosion, coastal erosion, coastal flooding, and wind;
- flooding and washing out infrastructure; and,
- causing road closures and flight delays.



PHOTO CREDIT: DON JARDINE

Table 9: List of all adaptation actions recommended adaptation actions for the Properties and Infrastructure sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
53. Relocate, retrofit, and/or protect properties and infrastructure vulnerable to climate change impacts (e.g., move infrastructure located in areas vulnerable to erosion, flood proof homes located in flood risk zones).	Leads: Property and infrastructure owners Collaborators: Experts	Increase resilience	Ongoing
54. Address budgetary constraints through financial planning (e.g., create an inventory of roads and bridges within the coastal zone area and perform a cost-benefit analysis to prioritize adaptation).	Leads: Property and infrastructure owners (e.g., individuals, businesses, governments)	Address financial concerns; Promote climate change mainstreaming	Ongoing
55. Make available erosion and coastal and inland flood risk maps accessible to all asset owners.	Lead: Provincial government Collaborators: Experts	Fill knowledge gaps	Ongoing
56. Set a future climate scenario to establish design standards (e.g., should roads be built to withstand 1-in-50 year or 1-in-100 year rain events and are the events taking place in 2020, 2050 or 2100?)	Lead: Provincial Government Collaborators: Experts	Promote climate change mainstreaming	Short-term (0 to 5 years)
57. Update coastal erosion rates continuously to inform horizontal setbacks (i.e., 60 times the annual rate of erosion or 75 feet from the coastline, whichever is greater). Given that erosion rates are expected to accelerate, updated rates are critical in protecting buildings and Islanders.	Lead: Provincial Government Collaborators: Experts	Fill knowledge gaps	Ongoing
58. Incorporate future climate considerations into land use and building regulations (e.g., increase horizontal and vertical setbacks, require additional information during the development permit process).	Leads: Provincial and municipal governments Collaborators: Other sectors, Experts	Leverage regulation; Promote climate change mainstreaming	Short-term (0 to 5 years)
59. Develop guidelines on shore stabilization and flood mitigation techniques as part of a comprehensive shoreline plan.	Lead: Provincial Government Collaborators: Experts, Public	Fill the knowledge gap	Short-term (0 to 5 years)
60. Explore the issue of liability surrounding developments and real estate transactions within flooding and erosion risk zones.	Lead: Provincial Government Collaborators: Experts	Fill the knowledge gaps	Short-term (0 to 5 years)
61. Utilize complementary green infrastructure when upgrading or designing stormwater management systems (e.g., rain gardens).	Leads: Stormwater management system managers and owners, Homeowners Collaborators: Experts, Other sectors	Increase resilience	Medium- to long-term (6+ years)
62. Encourage a bottom-up approach by making property and infrastructure owners and managers aware of projected climate change impacts, adaptation actions available to them, and how those actions should be implemented.	Lead: Provincial Government Collaborators: Educators, Other sectors	Engage in outreach; Fill knowledge gaps	Short-term (0 to 5 years)
63. Provide a forum for asset and infrastructure owners and managers to learn and share best practices.	Lead: Provincial Government Collaborators: Municipal governments, Sector, Public	Fill knowledge gaps; Engage in outreach; Increase collaboration	Ongoing

10 PUBLIC HEALTH AND SAFETY SECTOR

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events and rising sea levels could challenge the sector by:

- increasing the risk of vector-borne and zoonotic diseases (e.g., Lyme disease, West Nile virus);
- increasing concentrations of ground-level ozone;
- extending the pollen season and increasing the allergenicity of pollen;
- increasing exposure to ultraviolet radiation;
- decreasing air quality;
- increasing concentration of pathogens and contaminants in drinking and recreational waters;
- increasing the risk of waterborne diseases;
- causing physical injuries and post-traumatic stress disorders during storm events; and,
- increasing the risk of saltwater intrusion of drinking wells.



PHOTO CREDIT: DON JARDINE

Table 10: List of all adaptation actions recommended adaptation actions for the Public Health and Safety sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
64. Invite other jurisdictions to share best practices and innovative approaches (e.g., WHO developed a tool to estimate costs and benefits of adaptation decisions).	Lead: Provincial Government Collaborators: Experts	Fill knowledge gaps; Increase collaboration	Ongoing
65. Integrate climate change impacts in all existing vulnerability assessments, management activities, policies, programs, etc. (e.g., adjust the operating budget to allow for increased demand for services).	Lead: Provincial Government Collaborators: Experts	Promote climate change mainstreaming	Ongoing
66. Help the general public adapt to climate change by developing an outreach strategy. The information should be practical and relevant on a personal level and does not have to discuss climate change.	Lead: Provincial Government Collaborators: Educators	Engage in outreach, Fill knowledge gaps	Short-term (0 to 5 years)
67. Evaluate the knowledge gaps in the existing system and identify data, skills, or expertise required to address climate change impacts; develop multidisciplinary partnerships; and, support interdisciplinary research.	Lead: Provincial Government Collaborators: Educators, Other sectors	Fill knowledge gaps; Increase collaboration	Short-term (0 to 5 years)
68. Monitor and map environmental factors and other events related to public health to identify high-risk areas (e.g., harmful algal bloom outbreaks, fish kills, water temperature, air quality).	Lead: Provincial Government Collaborators: Experts	Fill knowledge gaps	Short-term (0 to 5 years)
69. Reduce non-climatic factors (e.g., prevent chronic disease so Islanders will become more resilient and able to cope with climate change impacts).	Lead: Provincial Government Collaborators: Health care professionals, Educators	Increase resilience; Engage in outreach	Ongoing
70. Create a mechanism at the community-scale to identify and assist vulnerable groups when emergencies arise so first responders can focus on those with the greatest needs.	Leads: Municipal governments, EMO Collaborators: Public	Increase collaboration	Short-term (0 to 5 years)
71. Conduct training exercises involving emergency services and local responders to respond to severe, wide area flooding and improve delivery of service and response time.	Lead: EMO Collaborators: First responders	Fill knowledge gap	Short-term (0 to 5 years)
72. Recommend dual access to properties when possible to assist in the emergency management response should one access route be impassable (e.g., flooded, washed out, surrounded by forest fire).	Lead: EMO Collaborators: Property owners	Increase resilience	Ongoing
73. Create lists of safe spaces within communities and establish a mechanism to communicate the choice before/during/after the event.	Leads: Municipal governments, EMO Collaborators: Public	Increase resilience; Increase collaboration	Short-term (0 to 5 years)

11 TOURISM SECTOR

Warming temperatures could benefit the sector by:

- increasing the number of days suitable for activities such as golfing, biking, hiking and camping;
- boosting summer and shoulder season tourism; and,
- allowing the development of new products.

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events and rising sea levels could challenge the sector by:

- reducing snow cover for skiing and snowmobiling;
- increasing stress and water requirements for turfgrasses on golf courses; and,
- increasing damage of tourism assets and infrastructure from coastal erosion, flooding, or wind events.



PHOTO CREDIT: DON JARDINE

Table 11: List of all adaptation actions recommended adaptation actions for the Tourism sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
74. Forecast future climate for variables that impact tourism (e.g., number of “comfort days” for golf, soft adventure).	Leads: Sector, Provincial Government Collaborators: Experts	Fill knowledge gaps	Short-term (0 to 5 years)
75. Develop more offerings for the shoulder seasons (e.g., festivals, events, experiential products).	Lead: Sector Collaborators: Tourism operators	Increase resilience	Medium-term (6 to 10 years)
76. Promote Prince Edward Island as an escape from urban heat.	Lead: Provincial Government Collaborator: Sector	Increase resilience	Short-term (0 to 5 years)
77. Relocate, retrofit, or protect assets and infrastructure that are vulnerable to the effects of flooding and erosion (e.g., relocate at-risk tourist accommodations, protect scenic routes, site new attractions away from flood and erosion risk zones).	Lead: Provincial Government, Asset and infrastructure owners Collaborator: Sector, Tourism operators, Experts	Increase resilience	Ongoing
78. Consider new methods of meeting water needs (e.g., improving water efficiency, decreasing turf area, harvesting rainwater, etc.) and different turfgrasses that would be suitable under a changing climate.	Lead: Golf course operators Collaborators: Experts	Increase resilience	Medium-term (6 to 10 years)
79. Diversify the product offering (e.g., eco-tourism, cultural heritage, and culinary experiences) to include more all-weather products.	Leads: Tourism operators Collaborator: Sector	Increase resilience	Short-term (0 to 5 years)
80. Determine the viability of storm-watching as an attraction on the North Shore.	Lead: Parks Canada Collaborators: Sector, Tourism operators, Experts	Increase resilience	Short-term (0 to 5 years)



PHOTO CREDIT: DON JARDINE

12 WATER SECTOR

Warming temperatures, changing precipitation patterns, more intense and frequent extreme weather events and rising sea levels could challenge the sector by:

- affecting the timing and rate of stream and aquifer recharge;
- increasing runoff;
- increasing demand on stormwater management infrastructure;
- increasing the risk of wastewater treatment overflows;
- diminishing water quality;
- damaging water infrastructure and equipment; and,
- increasing the risk of saltwater intrusion of drinking wells.

Table 12: List of all adaptation actions recommended adaptation actions for the Water sector.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
81. Identify needs for data, training, knowledge and tools (e.g., install weather stations, improve understanding of groundwater recharge and discharge rates, provide training on watershed monitoring and restoration).	Lead: Provincial Government, Water infrastructure owners Collaborators: Experts	Fill knowledge gaps	Short-term (0 to 5 years)
82. Integrate climate change considerations in financial planning. Water infrastructure owners and managers need to consider the costs and timing of adaptation actions in relation to the costs associated with the increase in liability, increase in maintenance, shorter lifespan, etc.	Leads: Water infrastructure owners Collaborators: Experts	Address financial concerns; Promote climate change mainstreaming	Ongoing
83. Set a future climate scenario to establish design standards and analyze the resilience of existing infrastructure (e.g., should stormwater management systems be built to withstand 1-in-50 year or 1-in-100 year rain events and are the events taking place in 2020, 2050 or 2100?)	Leads: Provincial Government, Water infrastructure owners and managers Collaborators: Experts	Promote climate change mainstreaming	Short-term (0 to 5 years)
84. Put back-up systems in place to limit disruptions to service during extreme weather events (e.g., spare flood pumps, back up electricity source).	Leads: Water infrastructure owners and managers	Increase resilience	Short-term (0 to 5 years)
85. Prompt the development of natural and manmade climate-resilient water infrastructure by incorporating future climate considerations and using land use planning policies and regulations (e.g., limit ditch filling).	Lead: Provincial Government Collaborators: Experts	Leverage regulation; Promote climate change mainstreaming	Short- to medium-term (0 to 10 years)

able 12: Continued.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
86. Reduce demand on water infrastructure (e.g., sensitize public to the challenges facing groundwater, provide practical recommendations on how to reduce demand).	Lead: Provincial Government Collaborators: Educators, Public	Increase resilience	Short-term (0 to 5 years)
87. Actively maintain, restore, enhance and create wetlands to increase natural protection of coastal areas and improvements in water quality and quantity.	Lead: Provincial Government Collaborators: Property owners, Sectors, Experts, Watershed groups	Increase resilience; Promote climate change mainstreaming	Medium- to long-term (6+ years)
88. Utilize complementary green infrastructure to manage stormwater (e.g. green roofs, rain gardens, ditches, detention ponds).	Leads: Property owners, Water infrastructure owners and managers Collaborators: Provincial and municipal governments, Experts	Increase resilience	Short- to medium-term (0 to 10 years)
89. Create a pilot project to demonstrate bioretention techniques (see Recommended Adaptation Action #88).	Leads: Provincial Government, Educators	Engage in outreach; Fill knowledge gap	Short-term (0 to 5 years)
90. Develop and supply flood risk maps to municipalities with water infrastructure.	Lead: Provincial Government Collaborators: Municipal governments	Fill knowledge gaps	Short- to medium-term (0 to 10 years)
91. Engage in public outreach. Provide guidance on how to minimize the risk of flooding and improve water security.	Lead: Provincial Government Collaborators: Municipal governments, Educators	Engage in outreach	Ongoing
92. Provide financial incentives to property owners to manage stormwater on site (e.g., ditches, permeable surfaces).	Leads: Provincial Government, Municipal governments, Water infrastructure owners and managers	Address financial concerns	Short-term (0 to 5 years)
93. Coordinate with other sectors and share best practices in maintaining water quality and sustaining water quantity.	Lead: Provincial Government Collaborators: Water infrastructure owners and managers, Other sectors	Increase collaboration	Ongoing
94. Decommission unused wells to prevent risk of contamination.	Leads: Provincial Government	Increase resilience	Ongoing



13 MOVING FORWARD

Throughout discussions with sector representatives, the consensus on climate change and the need to adapt was clear. However, there exist barriers across all groups and sectors that are preventing efficient adaptation from taking place. The common barriers include: uncertainty, lack of funding, insufficient incentive, lack of guidance, requirement for high levels of coordination, and gradual nature of climate change. Potential solutions include collaboration with experts, data gathering, long-term financial planning, demonstrations of successful approaches, and interdisciplinary collaboration. There are also common themes across the 97 recommended adaptation actions: fill knowledge gaps, increase resilience, reduce non-climatic factors, promote climate change mainstreaming, increase collaboration, engage in public outreach, leverage regulation and address financial concerns.

To move forward, it must be recognized that climate change is a shared problem that requires shared responsibility from everyone – individuals, businesses, non-governmental organizations, sectors, different levels of government, etc. Joint action is necessary in cases where different groups and sectors are affected. The provincial government could play a critical role in leading the development of a medium- and long-term strategy in adapting to climate change. They have expertise across all sectors, the authority to compel action, and the ability to coordinate and implement large-scale initiatives.

Table 13: List of all adaptation actions recommended adaptation actions for the moving forward.

Recommended Adaptation Actions	Responsibilities	Themes	Suggested Timelines
95. Educate elected officials and decision-makers on the importance and urgency of climate change adaptation.	Lead: Provincial Government Collaborators: Municipal governments, Experts	Fill knowledge gaps	Ongoing
96. Issue a clear directive to all provincial government departments to incorporate climate change in all decision-making, planning, budgeting, etc. Strong leadership and a clear directive will be vital for meaningful adaptation work to begin.	Lead: Provincial Government	Increase resilience; Promote climate change mainstreaming	Short-term (0 to 5 years)
97. Build a provincial-wide framework for cooperative and coordinated climate change adaptation response across sectors, leads, and collaborators	Lead: Provincial Government Collaborators: Federal Government, Municipal governments, Sectors, Experts, Businesses, Non-governmental organizations, Public	Increase collaboration	Ongoing

Gradual and incremental changes to the status quo alone will be insufficient in the face of future climate. Meaningful and successful climate change adaptation for the Island will require coordinated, collaborative, complementary, and parallel approaches by the different leads and collaborators identified by this report (e.g., sectors, Provincial Government, municipal governments, individuals, etc.). To achieve this, a clear vision of sustainability, the willingness to disrupt the status quo, a commitment to work together, and the urgency to act swiftly are needed from everyone. Planned adaptation takes time and the work must begin immediately. It is insufficient to “prioritize” climate change adaptation; adapting to climate change must be considered a normal way of life.

Anything else you're interested in is not going to happen if you can't breathe the air and drink the water. Don't sit this one out. Do something. You are by accident of fate alive at an absolutely critical moment in the history of our planet.

—Carl Sagan

