A Guide for Ecosystem Based Adaptation Planning in Ontario

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Adaptation Planning – Next Steps for Northern Ontario Conservation Authorities
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Living With Lakes Centre, Sudbury
Ontario Centre for Climate Impacts and Adaptation Resources - OCCCIAR

OCCCIAR is a university-based, resource hub for researchers and stakeholders searching for information on climate change impacts and adaptation.
A Practitioner’s Guide to Climate Change Adaptation in Ontario’s Ecosystems

Version 1.0
CO$_2$ Estimates for 2010 from the IEA

Observed CO2 Emissions vs. IPCC Scenarios

- Observed CO$_2$ emissions from fossil fuels (IEA)
- B2
- A1
- A1T
- A2
- A1FI

Year

CO2 Emissions per year (billions of tonnes)
Historical Climate Data

National Climate Data and Information Archive, Environment Canada

Monthly, daily and hourly observational climate data available
Historical Climate Data – Sudbury - Temperature

- **Average Annual Mean**
- **Average Annual Maximum**
- **Average Annual Minimum**
- **Average Winter Mean**
- **Average Winter Maximum**
- **Average Winter Minimum**

*Increase of 1.5°C*
*Increase of 1.8°C*
*Increase of 1.4°C*
*Increase of 2.3°C*
*Increase of 2.2°C*
*Increase of 2.4°C*
Historical Climate Data – Sudbury - Temperature

Increase of 1.7°C
Increase of 2.2°C
Increase of 1.2°C

Increase of 0.8°C
Increase of 1.0°C
Increase of 0.8°C
Historical Climate Data – Sudbury - Temperature

**Average Fall Mean**

- Year: 1955 to 2010
- Temperature (°C)
- Increase of 0.8°C

**Average Fall Maximum**

- Year: 1955 to 2010
- Temperature (°C)
- Increase of 1.0°C

**Average Fall Minimum**

- Year: 1955 to 2010
- Temperature (°C)
- Increase of 0.5°C
Historical Climate Data – Sudbury - precipitation

- **Total Annual Precipitation**: Increase of 92 mm
- **Total Winter Precipitation**: Increase of 36 mm
- **Total Spring Precipitation**: Increase of 48 mm
- **Total Summer Precipitation**: Increase of 3 mm
- **Total Fall Precipitation**: Increase of 20 mm
Projections for Temperature - Winter

Common Grid - Composite of Models
Mean change from (1961-1990) to (2041-2070 or '2050s')
Winter - Medium - Change in Air Temperature at 2m (°C)

2.8 – 5.4°C
Projections for Precipitation - Annual

Common Grid - Composite of Models
Mean change from (1961-1990) to (2041-2070 or '2050s')
Annual - Medium - Change in Precipitation (%)

5 – 13%
Impacts of Climate Change in Ontario
Mitigation AND Adaptation = “Acting on the causes and consequences of climate change”

- Mitigation: reduction of GHG emissions
- Adaptation: planning ahead to reduce negative and maximize positive impacts
Because impacts are already evident, and will increase, adaptation is needed

What is Adaptation?

- adjusting decisions, activities and thinking because of observed or expected changes in climate
- we adapt to moderate harm or take advantage of new opportunities
- adaptation and mitigation are necessary complements in addressing climate change

“Adaptation means not clinging to fixed methods, but changing appropriately according to events, acting as is suitable”

Zhang Yu (Sung Dynasty 960-1278)
Types of Adaptation

Adaptation can take many forms, anywhere along the spectrums below:

Anticipatory ← Activities that are taken before impacts are observed
Planned Deliberate actions aimed at adaptation

Reactive Activities that are taken after impacts have been felt
Autonomous Activities to spontaneously cope with climate impacts

Anticipatory and planned ecosystem-based adaptation measures that use a range of opportunities for sustainable management, conservation, and restoration are the focus of this guide.

The guide provides tools and examples for identifying and prioritizing adaptation actions to reduce threats, enhance resilience of species and systems, engage people, and improve knowledge.
Examples of Adaptation in Canada

Adaptation is occurring in Canada, both in response to, and in anticipation of, climate change impacts.

- Limiting development in vulnerable areas
  - Policies for coastal regions

- Implementing heat-health alert initiatives
  - Implemented in urban areas in Ontario and Quebec

- Adapting infrastructure design
  - Thermosyphons to induce artificial cooling of permafrost

- Building on pylons to reduce damage from flooding

- Vulnerability maps for permafrost terrain

Don Lemmen, 2012
A Practitioner’s Guide was created

- To help organizations and natural resource practitioners prepare for climate change.
- To demonstrate how a suite of tools (e.g. vulnerability assessments) can be used to inform adaptation efforts.
- To provide a general framework and worksheets that can be used by practitioners from a variety of disciplines.
MNR and MNDMF, in collaboration with other partners, stakeholders and communities, should assess “the climate change vulnerability of the Great Lakes -St. Lawrence, Carolinian, and Boreal Forest and their associated forest-based communities”

MNR will “undertake ecosystem vulnerability assessments and evaluate the risk of climate change impacts to inform adaptation planning of Ontario’s most affected and vulnerable ecosystems and species”

“The Ministry of Natural Resources will explore ecologically-based climate change vulnerability assessments at the species and ecosystem levels as a critical step in an adaptive management approach to natural resource management.”
Key elements of Practitioner’s Guide

- Introduces climate change adaptation, vulnerability and risk
- Describes vulnerability and risk assessment tools and techniques that can be used
- Outlines a framework for action
- Provides examples of projects
Northeast Clay Belt Climate Change Adaptation Project
Examples of vulnerability assessments

Lake Simcoe watershed:
- Vulnerability assessment of wildlife, hydrology, invasive species, species-at-risk, aquatic habitat, tourism
- Development of local adaptation plan with actions to address projected impacts

Northeast Clay Belt
- Vulnerability assessment of forests (composition, fires, blowdown, insects), wildlife, aquatic habitat, soils, tourism
- Scoping adaptation options to cope with projected impacts
An Adaptation Framework

Step 1: Set context for assessment and build team
Step 2: Assess current vulnerability
Step 3: Develop and apply future scenarios
Step 4: Estimate future vulnerability and risks
Step 5: Develop adaptation options
Step 6: Implement and mainstream adaptation
### Step 1: Set context for assessment and build team

**At what level?**

- Local assessments
  - Community
  - First Nation
  - Traditional Territory
  - Watershed
  - Municipality
  - Forest management unit etc.

- Regional-level assessments
  - Eco-district or Eco-region

**Focused on what?**

Ecological and socio-economic themes of interest to resource managers, communities and policy-makers

- Hydrology
- Forests
- Wetlands
- Invasive Species
- Tourism
- Aquatic Habitat etc.

Indicators within each theme may help to focus the analysis
# Vulnerability Assessment Themes

<table>
<thead>
<tr>
<th>Lake Simcoe Assessment Themes</th>
<th>NE Ontario Clay Belt Assessment Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrology</td>
<td>Hydrology</td>
</tr>
<tr>
<td>Aquatic Habitat</td>
<td>Aquatic Habitat</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Wildlife</td>
</tr>
<tr>
<td>Species at Risk</td>
<td>Forest Composition</td>
</tr>
<tr>
<td>Invasive Species</td>
<td>Forest Fire</td>
</tr>
<tr>
<td>Vegetative Cover</td>
<td>Forest Health</td>
</tr>
<tr>
<td>Natural Heritage Areas</td>
<td>Substrate</td>
</tr>
<tr>
<td>Tourism and Recreation</td>
<td>Socioeconomics</td>
</tr>
<tr>
<td>Insects</td>
<td>Communities</td>
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<tr>
<td>Agriculture</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
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</tbody>
</table>
Understanding the **relationship of indicators to climate** is a critical foundation to be able to assess future vulnerability to climate change.

Important to look at **observed climatic trends** in the area to understand changes that have occurred to date

- Using information from local weather stations (e.g. temperature and precipitation trends)
Step 3
Develop and apply future scenarios

Ensemble A2 Scenario
Annual Temperature (°C) Between 2011 and 2100 in Ecodistrict 3E-1

Average Temperature (°C)
- 8 to 10
- 6 to 8
- 4 to 6
- 2 to 4
- 0 to 2
- -2 to 0

Ensemble A2 Scenario
Annual Precipitation (mm) Between 2011 and 2100 in Ecodistrict 3E-1

Average Precipitation (mm)
- 500 - 600
- 600 - 700
- 700 - 800
- 800 - 900
- 900 - 1,000
- 1,000 - 1,100
- 1,100 - 1,200
- 1,200 - 1,300
- 1,300 - 1,400
- 1,400 - 1,500

Notes:
Published July 15th, 2011, © Queen’s Printer for Ontario, 2011. This map is produced from the Climate and Information Branch, Data Management Team, Climate Change and Development Branch, Ontario Ministry of Natural Resources and Forestry. Produced by the Temagami Geomatics Service Centre, TDSG Project ID # 772, Delmar North American Delmar 1983. This map is intended for the purposes of illustration and discussion only. It shows one of a range of possible future projections of Ontario’s climate. Do not rely on this map for legal administrative purposes. This map may contain cartographic errors or omissions.
Developing Projections of Climate

Figure 3. Examples of climate presentation options available to practitioners (Source: Colombo et al., 2007).
Risk assessment used in many fields to think about future issues.

A complimentary approach called ‘vulnerability assessment’ may provide valuable insights, particularly from an ecosystem perspective.

“Vulnerability to climate change is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.”

A sensitive species example of vulnerability: Eastern Hemlock (*Tsuga canadensis*)

Hemlock, an important tree species found in the Great Lakes – St. Lawrence forest ecosystem, can be used as an example of how the components of vulnerability relate to one another. Brief definitions introduce each component.

**Exposure:** the nature and extent to which the species or system is exposed to significant climate variation. More extreme weather events, including extended droughts and heat waves, are predicted with climate change throughout Ontario, including southern and central Ontario where hemlock grows.

**Sensitivity:** how affected a species or system is by being exposed to a stress. Eastern hemlock requires cool, moist sites to regenerate and thrive. It is quite sensitive to dry and hot conditions and experiences significant stress under these conditions. In addition, hemlock is a preferred browse species of white-tailed deer; since warmer winters result in less snow cover, hemlock seedlings would be exposed to more browsing pressure.

**Adaptive Capacity:** the ability or potential of a system to respond successfully to climate variability and change: Hemlock’s natural ability to adapt to climate change stresses is limited. Its slow growth rate as a seedling makes it less adaptable to heat and drought conditions that would limit its growth, cause significant mortality, and make it less competitive as a seedling than other Great Lakes – St Lawrence tree species. Strategies to keep hemlock in the Great Lake – St Lawrence forest ecosystem include management techniques such as seeding and planting of hemlock on suitable sites around water bodies and assisted migration to appropriate sites further north.
Step 4

**Estimate future vulnerability and risks**

Using results of analysis, identify and describe future vulnerabilities

- Rank each indicator’s future vulnerability High, Medium, or Low using information about sensitivity, exposure and adaptive capacity.

Consider the consequences and likelihood of the vulnerabilities from different risk perspectives (financial, safety, operational etc.)
Climate change adaptation actions help to reduce or eliminate vulnerabilities and risks.

Adaptation options come in all forms, shapes, sizes and can:
- Reduce threats
- Enhance resilience
- Engage people
- Improve knowledge

Recommended to involve partners, stakeholders, public and organizations that will implement the actions in an evaluation of:
- Implementation costs
- Technical and institutional feasibility
- Likely benefits
- Social acceptability
- Ecological suitability, etc
## Evaluation Matrix

### Feasibility Ranking - High (1) to Low (4)

<table>
<thead>
<tr>
<th>Criteria (sample)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>First order priority</td>
<td>Second-order priority</td>
<td>Third-order priority</td>
<td>No priority</td>
</tr>
<tr>
<td>Feasibility/Affordability</td>
<td>Definitely affordable</td>
<td>Some indication adaptation is affordable</td>
<td>Some indication adaptation is unaffordable</td>
<td>Definitely unaffordable</td>
</tr>
<tr>
<td>Feasibility: Legal, political, institutional, and social barriers</td>
<td>No identifiable internal or external</td>
<td>Some identifiable internal or external</td>
<td>Some identifiable internal or external</td>
<td>Obvious and significant internal or external</td>
</tr>
<tr>
<td>Degree of ecological suitability (risk)</td>
<td>No risk</td>
<td>Low risk</td>
<td>Moderate risk</td>
<td>High risk</td>
</tr>
</tbody>
</table>
Sample Adaptation Action #1:
Develop inter-connected terrestrial and aquatic natural areas
Sample Adaptation Action #2:
Support watershed-wide water conservation practices
Sample Adaptation Action #3:

Develop and implement early detection techniques and response strategies for invasive species
Implementation of climate change adaptation plans and strategies will require an adaptive management approach.
Next steps for initiative

- Promoting and disseminating the Guide to practitioners, decision-makers and partners.

- Using the Guide to leverage action on adaptation planning.
  - Practitioners are encouraged to design their own approaches based on the questions being asked and the context and focus of their assessment.

- Making linkages to other emerging guidance and tools in Ontario and beyond.
Thank you